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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 pre-empted – 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

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. [T]o 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. [T]hese 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 senseless 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 beginning 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 sparsely, 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

Forrester, 1980, chap. 1; Fullinwider, 1983; C. U. M. Smith, 1982a,b; Young, 1970, chaps. 5 and 6).

The point I would like to emphasize here is that there are many different ways to look at the brain, or at anything else. Spencer suggested one of them, on the basis of an analogy with a piano. He used many other analogies as well – his railroad metaphor is perhaps the best known. Other theorists and researchers in his time used battery and dam metaphors, which soon gave way to telephone metaphors and eventually to other telecommunications and information measurement metaphors, a variety of thermostat and feedback metaphors, computer hardware and software metaphors, and now hologram, pattern analysis, and parallel distributed processing metaphors (see Pribram, Chapter 2, this volume). It is important to realize that all these metaphors have had historically significant *directive* functions: They have directed the gaze – not to mention the theoretical and practical activities – of researchers toward different aspects of the nervous system. Indeed, it seems safe to say that, as a general rule, phenomena (such as the brain and its extensions) look somewhat different to – and tend to be conceptualized and treated somewhat differently by – possessors of different metaphorical frameworks.²³

A graphic demonstration of this point could be provided by a historical survey of neurological illustrations, which would show how researchers of different theoretical persuasions produce different “objective” representations of the brain. It may not be so surprising that hand-drawn illustrations (even by well-trained draftsmen) are susceptible to stylization along the lines dictated by theoretical gravity and technical facility, but few people stop to consider that even photographic illustrations are based on “prepared” brains, cut in sections and carefully displayed along lines dictated by current theory. Although we cannot pursue this topic further, it is relevant to observe that different and even opposing theoretical views, grounded on very different sets of analogies, can be illustrated and corroborated at one and the same time, for what counts as “relevant evidence” varies in relation to one’s theoretical vision. A good example is provided by the simultaneous confirmation of both John Hughlings Jackson’s decentralized (British) model of brain functioning and Eduard Hitzig and Gustav Fritsch’s centralized (Prussian) model, both of which were elaborated on the basis of explicitly sociopolitical analogies (Pauly, 1983; C. U. M. Smith, 1982b). (Outside the biological sciences, the contemporaneous confirmation of both Wilhelm Weber’s particle-oriented theory and James Clerk Maxwell’s field theory of electromagnetism provides another good example; see Hiebert, 1980, p. 188.) Obviously the “givenness” of facts is not such that it rules out the possibility of selective perception and alternative interpretation, guided (I would maintain) by differing metaphoric assumptions about reality.

Metaphor in social science

About the metaphors of social science – mechanistic, organic, linguistic, ludic, dramaturgical, and so on – much could be said.²⁴ However, I prefer to focus on a single historical case and an issue that it raises – an issue that will bear further attention when we turn to psychology and its metaphors. As I have already noted, Newton derived his original notion of gravity from the analog of human attraction. I want now to point out the ironical legacy of this concept, which was soon utilized as an analog in theories of social dynamics. As an example, I shall refer to the social theory of Bishop George Berkeley, because it illustrates the point so clearly. It should be understood, however, that Berkeley was only one of many post-Newtonian thinkers and social scientists for whom the metaphor of Newtonian gravity, or some related concept, served as a template for construing human action in the aggregate.

The essence of Berkeley's social theory is expressed in his posthumously titled essay "The Bond of Society" (1713/1955). As set forth in typically succinct Berkeleyan fashion, this theory is based on the simple, straightforward contention that there is a "certain correspondence" or "similitude of operation" between the natural and human worlds. Just as natural philosophers (following Newton) agreed that natural bodies exert a "mutual attraction upon each other," so too, Berkeley asserted, can we observe a "like principle of attraction" in the moral world. In fact, the "social appetite in human souls" – that "greatest spring and source of moral actions" – is the very bond of society, just as gravity is the bond of nature (pp. 225–8).²⁵

So in Berkeley's theory of social interaction, the "social appetite" that binds humans together is likened to the "physical gravity" that draws bits of matter toward one other. Need I explicate the irony? Newton had used the analog of human attraction precisely because he could think of no mechanical or physical force capable of accounting for the natural phenomena he was studying. But even before his death in 1727, his supposedly issue-begging metaphor, backed by the authority he himself had conferred on it, was turned full circle and used as an analog by which human attraction could be understood. And going a step further, the use of this metaphor would soon contribute to the questioning of the very conception of human nature, as nonmechanical and nonmaterialistic, that Newton had found pertinent to his formulation of the concept of gravity in the first place. Although Berkeley himself, as an idealist, sidestepped the physicalist, reductionist connotations of his "Newtonian" way of thinking about social behavior, the same could not be said for many of his contemporaries and successors. Before long, social dynamics (and mental dynamics, for that matter) were being discussed as if humans (or ideas)

were so many billiard balls bumping into one another.²⁶ As we shall remark again later on, this sort of ironical boomerang effect, by which a human metaphor is reflected back on the human condition in a nonhumanist, reductionist form, is not as rare as one might wish in the history of the social and psychological sciences.

Metaphor and the origin of psychological concepts

We come now, at last, to psychology, but only after having devoted the first portions of our brief historical survey to pointing out examples of the way the other physical, biological, and social sciences have developed on the basis of certain root, or founding, metaphors. It is important to remember these examples, lest unwarranted conclusions be drawn about psychology's reliance on metaphorical thought and expression.

We should begin our consideration of metaphors in the psychological domain by focusing on the concepts of the soul, or mind, and its various intellectual and emotional processes – in other words, by focusing on the conceptual foundations of traditional mentalistic psychology. Where do these concepts and terms come from? My answer is quite simple: They come, historically, from the elaboration of metaphorical modes of comprehending human experience.

Like other claims in this chapter, this one is not new. John Locke (1690/1959), who was himself a proponent of many influential metaphors of the mind,²⁷ made the same claim – and presaged the conclusion of numerous linguistic historians, philosophers, and psychologists (e.g., Müller, 1867, and Whitney, 1896, pp. 88–90; Nietzsche, 1873/1979, and Reid, 1785/1969, p. 51; Asch, 1955, 1958, and Skinner, 1989, respectively) – when he noted how “sensible ideas are transferred to more abstruse significations, and made to stand for ideas that come not under the cognizance of our senses” (vol. 2, p. 5). Locke's point was simply that terms referring originally to sensible objects and actions have often come to stand for processes that are not accessible to sensory experience. To illustrate his point, Locke cited such psychological concepts as imagination, apprehension, comprehension, conception, disgust, disturbance, and tranquility, each of which had originally signified physical states and processes.²⁸ Furthermore, Locke went on to say (with considerable foresight) that he was confident that “if we could trace them to their sources, we should find, in all languages, the names for things that fall not under our senses to have had their first rise from sensible ideas” (vol. 2, p. 5).

In other words, Locke recognized that our basic mentalistic concepts are metaphorical – transferred from the physical to the psychological realm in an attempt to express what our inner experience is *like*. But these metaphorical concepts are not simply *descriptive*; they have also been *transformative*: Their use has led to changes in human self-reference and

hence to human self-consciousness. This is a major claim, but one that has the substantial backing of such respected classical scholars as R. B. Onians (1951) and Bruno Snell (1953). The nub of the argument is that it was only over time that such physicalist terms as *pneuma* and *psyche* came to have explicitly psychological meanings and that it was during the same time that humans began to think of themselves as having a distinctive soul or identity – something “solid” and “tangible” at their very core.²⁹ Thus, as Brewster Smith (1985) has argued, explicit self-consciousness seems to be the *result*, not simply the progenitor, of metaphorical thinking. This is apparently true not only on the phylogenetic level – a level on which generic self-consciousness originated when humans began to think about themselves with reference to other things, activities, and persons – but also on the ontogenetic level; As George Herbert Mead (1924–5), Harry Stack Sullivan (1953), Lev Vygotsky (1934/1986), and others have proposed, the origin of individual selves seems to occur in the context of relationships with “others” and with the “outer world.”

I would like to make two other points of more general applicability: (1) Metaphors can have an impact on practical as well as theoretical developments, and (2) metaphorical concepts can undergo progressive, historical development, changing their analogical clothing (as it were) from time to time. Both points can be illustrated with psychological concepts rooted in ancient times. For instance, given the association of “spirit” (or breath) and “life,” which was common in a variety of ancient cultures (see Bremmer, 1983; Rohde, 1894/1925), it was natural for our forebears to think that if the quality of their lives took a turn for the worse it was somehow related to a change in the quality of their spirit. One practical result of such thinking was the institution of trephining – the drilling of a hole in the skull – as a technique for releasing “evil spirits” from patients suffering psychic disturbance.³⁰ It is relevant to emphasize that this practice was reasonable within the conceptual (i.e., metaphorical) context in which it was formulated.³¹ But the major point I wish to make, with the assistance of this example, is that metaphors can have a significant impact in the realm of practical activity. As we shall see later in this chapter and book, this is as true in the twentieth century as it was in ancient times.

To illustrate the historical transformation of metaphorical concepts, I will refer again to the notion of “spirit” or “breath,” with its originally physical referent. Over time, this referent “became” less and less physical, at least in the Western tradition, until it was thoroughly “immaterialized” into the Christian concept of the soul (see Baker, 1947; Knowles, 1962, chap. 17; Tillich, 1972). “Spirit” now meant something different from before, yet, interestingly, many of the psychological practices associated with the earlier concept of the spirit were transformed and maintained in a strikingly parallel manner. For example, the surgical release of

evil spirits was replaced by the “casting out of devils,” which involved spiritual purifications and incantations rather than surgical intervention.³²

Not surprisingly, the historical transformation of metaphorical concepts and practices is not an all-at-once or all-or-none process. Despite the immaterialization of the concept of the soul, for instance, minutely physical “animal spirits” were still part of the basic explanatory framework of psychology in the seventeenth century, when René Descartes assigned them a central role in the tipping of his infamous pineal gland (see the illustrations as well as the text of Descartes, 1662/1972, pp. 91–2). Soon afterward, however, the remaining animal spirits were transmogrified into electrical currents, which in turn were transformed into biochemical solutions, and so on. Thus, the theoretical legacy moves forward – with clinical practice following suit – from ancient times right down to the present.

Descartes and the mechanistic metaphor in psychology

Descartes, to whom I have just referred, is particularly important in the history of psychology for having solidified – for better or worse – the radical distinction between mind and body (see Descartes, 1644/1911c, esp. pp. 221–2; Keeling, 1968, chap. 6). As is well known, Descartes explained all bodily functioning, including emotion and behavior, in mechanistic terms. It is not as well known that Descartes’s postulation of a mechanistic psychology was inspired, like Hobbes’s, by artificial automata, though more by the water-driven figures in the grottoes of the Royal Gardens at Saint-Germain-en-Laye than by clocks (see Jaynes, 1970; Price, 1965; and the illustration opposite the title page of Descartes, 1662/1972). Having seen these remarkable automated statues, Descartes (1662/1972) reasoned that if mere men could make mechanical devices that acted in such lifelike fashion, then surely it was – and had been – a simple thing for God to make living bodies that acted according to the principles of basic mechanics (pp. 1–5).³³

Descartes’s metaphorical reasoning provides another example of someone taking a humanly constructed analog – this time an animated statue made in the image and likeness of human beings – and then using this analog as a means of reflecting on human nature, that is, on the very same aspect of nature that had been the model for the analog in the first place. Of course, Descartes himself (1637/1911b) felt that no merely mechanical creature would have – nor could have – created an external image of itself, and he continued to believe in the autonomy of the human mind (see esp. pp. 115–18). But once the possibility of a mechanistic explanation of mind was proposed, as it was by many in the eighteenth century (see Rosenfield, 1968), the paradoxical import of

Descartes's use of the mechanical metaphor had a deep and lasting effect on the estimation of human nature reached by many scientific and non-scientific thinkers, right up to our own day. Thus, not for the last time in the history of psychology, a caricature of the human mind served as a model for its theoretical portrait. As a result, the mind was not portrayed as being *like* a machine built to mimic human behavior; it was pictured as a machine (e.g., La Mettrie, 1748/1912).

It was a merely logical consequence when David Hartley, among others, began to speculate about the possible physiological basis of Lockean associationism, which became the most popular psychological theory of mental dynamics in the eighteenth century and beyond (see Gay, 1969; Ong, 1951; Randall, 1962; Warren, 1921). After first conceptualizing associationism on an explicitly social model, Hartley (1749/1966) followed a suggestion of Newton's and conjectured that "vibrations" are set off in the brain by the "impact" of sensations and that these physical movements leave "traces" representing the "pathways" that constitute the associative links between ideas (see Walls, 1982). Such metaphorical thinking – about vibrations, impacts, traces, and pathways – stimulated numerous developments in psychoneurological theory and motivated a great deal of empirical research (see, e.g., French, 1969, chaps. 10 and 11; Rather, 1965). Although such research revealed the limitations of these metaphors, there is no denying their important role in the history of physiological psychology.³⁴ Nor, for that matter, should one overlook their role in the history of behavioral psychology, for these metaphors, and the associationist theory by which they were linked to psychology, eventually fed into the development of behaviorism, which was first based on the concept of the physiological reflex (see Watson, 1916) and then developed further on the basis of its critique (e.g., by Skinner, 1931).

Of course, not all post-Cartesian mechanists tried to physiologize psychology or to translate associationism into a behavioristic psychology (see Rachlin, 1970, chap. 1). Some remained steadfast mentalists, even though they were committed to the notion that mental phenomena are products of mechanical processes. One such person was Johann Friedrich Herbart (1816/1891), who referred to these psychomechanical processes as the "statics and dynamics of the mind." I need not remind most readers that "mental mechanics" is now a mainstay of twentieth-century cognitive psychology. Indeed, if there were any utility in attaching such metaphoric labels, I would suggest that Herbart was the "great-grandfather" of contemporary information-processing approaches to the mind.³⁵ Besides this somewhat distant progeny, his "mental mechanics," with its postulated "threshold" between consciousness and unconsciousness, is also related (along unclarified if not paternal lines) to Sigmund Freud's approach to the "statics and dynamics of the mind."

Freud and the metaphors of psychoanalysis

Not too long ago, when positivist strictures were more strongly held, Freud was often charged with serious violations of scientific method (see, e.g., Popper, 1963; Skinner, 1954). Today, however, a somewhat different assessment is coming to the fore, and there is even occasional talk about how advanced his philosophy of science was!³⁶ In any case, whatever criticisms may still be leveled against his work, Freud was unusually astute in his awareness that psychoanalytic theory, like any theory, constitutes what he called a "mythology," in the sense that it inevitably involves speculation. He also realized that there is no way for psychologists to operate without the metaphorical expressions that are, as he said, "peculiar to psychology" (1920/1955e, p. 60). "In psychology," Freud (1926/1959c) wrote, "we can only describe things by the help of analogies. There is nothing peculiar in this; it is the case elsewhere as well. But we have constantly to keep changing these analogies, for none of them lasts us long enough" (p. 195).³⁷

This is a remarkable and by no means isolated statement.³⁸ More explicitly perhaps than any other psychologist, Freud gave analogical thinking center stage in his theoretical ruminations. Beyond that, he let analogies guide his practical work in therapy, where he countered "resistance" with freedom and overcame "repression" with disclosure (see Freud, 1915/1957c, 1926/1959b, esp. pp. 157-64; Laplanche & Pontalis, 1973, pp. 390-7).

It is noteworthy in this context that Freud was a devotee of Plato.³⁹ In effect, he accepted Plato's pragmatic, rather than his idealistic, philosophy of science. If human knowledge at best is a "likely story," Freud strove to make psychoanalysis the most likely story possible. In his continuous struggle to improve this story, he tried out any metaphor that promised to move his thinking forward.

Indeed, a taxonomist would have to work long and hard to classify Freud's many metaphors, which were drawn from social and political life, from the fields of physical dynamics and hydraulics, physiology and natural history, anthropology and mythology, archeology and ancient history, military life and technology, the classics and popular literature, and from other realms as well. As Freud utilized these metaphors - of energy and force, flow and resistance, repression and conversion, defense and aggression, and all the rest - he was clearly following his own advice to change analogies and comparisons as often as necessary.⁴⁰

Freud's use of multiple metaphors was occasioned by his awareness of the insufficiency of any single metaphor. He did not seek multiplicity for its own sake. Instead, as already noted, he constantly strove to find the most appropriate and useful metaphors for his particular concerns and subject matter. For example, in his major treatise, *The Interpretation of*

Dreams (1900/1953a), Freud worked through a series of metaphors in order to arrive at a much more restricted core of basic comparisons (see esp. chap. 7). He did so largely through his explication of the analogy between perception, thought, and writing, which resolved some of the conceptual and empirical problems with which he had been struggling (for an insightful analysis, see Derrida, 1978). Matthew Erdelyi (1985) has argued that our contemporary computer model solves these problems even more economically. This may be so, but we can expect computational theory in its turn to be found wanting, for like all other theories, including Freud's, it is ultimately metaphorical and fallible (see note 35). What is distinctive about Freud is his explicit understanding and acceptance of this metaphoricity and fallibility, and his persistent efforts – however successful – to improve the comparisons that oriented his theory and practice.⁴¹

Perhaps even more important, Freud frequently attempted to specify the limitations of his analogs, often within the very context in which he used them. As much as any other psychiatrist or psychologist, he wanted to be persuasive, but he rarely presented his metaphors and analogies as anything other than imperfect. For instance, in his *Interpretation of Dreams* (1900/1953a), Freud openly admitted that his metaphors needed improvement, but he said that he saw “no necessity to apologize” for that fact since they were only provisional aids, intended to assist his initial descriptions and thoughts about previously unremarked psychic processes (p. 536).⁴² Even granting that this sort of self-disclosure serves a rhetorical purpose of its own, it also invited others to examine, to improve, and sometimes to reject his work in favor of other metaphorical schemes of psychological understanding and practice. That is not a bad way to conduct the business of science.⁴³

James and the metaphorical nature of scientific thought

Even so, until just a decade or two ago, many persons would have been bothered by the suggestion that human thought, including scientific thought, is necessarily perspectival, approximal, and incomplete. But not William James, the most frequently and most justifiably cited “father” of modern American psychology. The expectation that someone might present a theory that would end all theoretical argument was foreign to James's temperament and, as he pointed out, unfaithful to the historical record of science itself. Following in the footsteps of his beloved Ralph Waldo Emerson, James believed that “science is nothing but the finding of an analogy” and that the analogies of science – indeed, the analogies underlying all forms of knowledge – are “fluxional” rather than “frozen” (Emerson, 1837/1983b, p. 55; 1844/1983c, p. 463). In other words, although he was a staunch empiricist – or rather, as he saw it, *because* he

was a staunch empiricist – James insisted that there is always a new way to experience any reality and a new way to categorize any experience. A creative genius in any field, in science as in the arts, is simply someone who has an unusual native talent for perceiving analogies that have not yet occurred to others but that, upon presentation, are seen by them to reveal something salient about experience (James, 1890, vol. 1, pp. 423–4, 529–30; vol. 2, pp. 109–10, 360–5).⁴⁴

Salience, as James knew, is not something that is absolute. It cannot be judged once and for all. Even James's well-known pragmatic criterion of truth is susceptible to variable interpretation: What "works" for one person may not "work" for someone else, given different fundamental concerns. In the end, James felt, humans – scientists included – must humbly accept the fact that the salience of their creative ideas will ultimately be judged by the "consensus" of their social or professional group (James, 1880; 1890, vol. 1, p. 192; 1907/1975).⁴⁵

The achievement of scientific consensus, from this point of view, depends to a significant degree on the rhetorical power of particular analogies or, rather, of the particular stories based on these analogies. This power draws on the experiential sensitivities of the particular scientific community, but it is not reducible in any simple or direct fashion to the "brute facts of the matter." No analogy – which is to say, no *likeness* of reality – is identical with reality. As another of James's admired men put it, "No likeness goes on all fours" (Coleridge, ca. 1823/1981, p. 132). Therefore, no story developed from analogical premises can be definitive or final. This is the same view expressed by Plato long ago: We should expect no more than a likely story from those who construct theories about the natural world (see note 13 and the text associated with it). Consequently, James (1890) concluded, "the best mark of health that a science can show is this unfinished-seeming front," even though it is useful for each science to have as its heuristic goal the attainment of "conceptions so adequate and exact that we shall never need to change them" (vol. 1, p. vii; vol. 2, p. 109). In other words, in James's view as well as my own, we should continue to search for perfectly adequate metaphors or maps of reality, thus continually improving our stock of metaphors, but we should not expect to discover an analog that will provide the "final word" about our experience of reality.⁴⁶

James's belief in the analogical or metaphorical foundation of knowledge is richly illustrated in his own psychological writings. His treatment of thought or consciousness as a "stream" rather than a "chain" or "train" is well known (see James, 1890, chap. 9), and his discussion of other psychological topics is similarly informed by underlying analogies and metaphors.⁴⁷ The ultimate metaphors that founded and framed his psychological thinking, and that came to undergird his pragmatism, pluralism, and radical empiricism, were the Darwinian metaphors of varia-

tion, selection, and function.⁴⁸ All psychological states and actions, according to James, are products of spontaneous variation and/or selection in terms of their consequential utility. This "functionalist" orientation has been shared by many other American psychologists and has structured much of the theoretical argumentation in modern psychology, leading historically from mentalistic functionalism to functionalistic behaviorism and back again. Its rhetorical power is clearly dependent on the authority that Darwinian modes of analysis, because of their success in making sense of a vast array of biological phenomena, have come to enjoy (see, e.g., E. Mayr, 1982). Often taken, despite James's intention, as a definitively true story rather than as a usefully likely story, the functionalist account of mind and action has led to some of the central psychological theories – and myths – of our time.⁴⁹

Conclusion: Psyche's muse in the twentieth century and beyond

Now that we have reviewed Freud and James on the role of metaphorical thinking in science and psychology (as well as in cognition in general), we have reached a point at which we can halt our very selective historical survey with the realization that, around the turn of the century, some psychologists, at least, were keenly aware of the metaphorical nature of psychological knowledge. Although other twentieth-century psychologists have shared this awareness,⁵⁰ psychologists for the most part have tended to flow with the positivist tide. As a result, until recently, data gathering – generally presumed to be an activity that can and should be pursued without any theoretical preconceptions – was frequently considered to be the source of psychological theory and practice (see Toulmin & Leary, 1985). In this regard, the naive empiricist view of James McKeen Cattell, another founder of modern American psychology, is much more emblematic of twentieth-century psychology than the more sophisticated empiricism of James. For Cattell, scientific activity was *work*, pure and simple. Rather than the spontaneous flashes of metaphoric insight that James touted, Cattell (1896) saw "men of science" engaging in the "every-day up-hill work of the laboratory." This work, in his opinion, was "scarcely more stimulating than the routine of the factory or the farm" (p. 139).⁵¹ With such a stoic, antimetaphorical view of science (structured by the metaphor of piecework labor), it is not surprising that the "work" of Cattell and far too many of his contemporaries and successors has provided little more than well-organized catalogs of "facts," largely devoid of long-range theoretical significance.⁵²

Given the positivist mentality of so many twentieth-century psychologists, it was natural enough that awareness of the metaphoricity of psychological concepts and terms receded over the middle portion of this

century, leaving the impression that both scientific and applied psychology, unlike earlier philosophical psychology, rested on an unambiguously rooted conceptual foundation. Perhaps the best example of the solidification of this conceptual foundation is the literalization of “stimulus” and “response,” surely the most used and abused terms in twentieth-century psychology. When John B. Watson (1919) first recommended these terms, he admitted that in introducing them from physiology into psychology “we have to extend somewhat” their usage (p. 10), which is to say (quite properly) that *psychological* “stimuli” and “responses” – as well as the *psychological* “reflexes” (or correlations between stimuli and responses) about which they allow us to speak – are somehow *like* their physiological counterparts, but also *unlike* them. But Watson never defined the exact ways in which psychological stimuli and responses are unlike their originating analogs, thus setting the scene for a simple-minded literalization of these terms,⁵³ and leaving room for subsequent variations or “extensions.” Indeed, as Koch (1959) has persuasively shown, we have not lacked such extensions. In fact, these two reputedly “objective” and “neutral” terms, so basic to behavioral science in this century, have been used over the past half-century in *myriad* ways, and rarely in precisely the same way by any two theorists. The variety is not necessarily bad – let the mutants contend and the fittest variant(s) survive! But when the variation goes unrecognized, a presumption of monolithic unanimity is (and has been) created – a presumption that does not reflect disciplinary reality, however much we might wish that it did.

Fortunately, in more recent years, the variation or pluralism of twentieth-century psychology, which is evident at so many levels of the discipline, has come to be recognized (e.g., see Koch, 1976), and not unrelatedly, awareness of the metaphorical nature of psychological theory, and of the metaphorical framing of psychological practice, has increased significantly. Where this will lead, whether to the dismemberment of psychology (long since predicted by Dunlap, 1938, and others) or to a revivification of psychology, we cannot yet say. (Are neuroscience, cognitive science, and the new health sciences at the “growing edges” or on the “fraying ends” of psychology?) In either case, in the elaboration of these and other developments, we can be confident that Psyche’s Muse – muted and hemmed in, but far from inactive during much of this century – will have her say. Or rather, *we* will have our say, at least a *chance* to have our say; for, as I have tried to show, Psyche’s Muse, the fount of psychological theory and practice, is none other than *we ourselves*, using what the empiricist David Hume called “Analogy, that great principle of Reasoning” and what the rationalist Immanuel Kant, though in an unfortunately transcendentalist mood, called the “Analogies of Experience.”⁵⁴

I have said a number of times that my thesis is hardly new: Many scholars and scientists have recognized that our thoughts, feelings, and

behavior are informed by metaphors. Still, given the stakes in the domain of psychology, it seems more than reasonable that we should pause and reflect on the nature and consequences of these metaphors. That is what this book is all about. Insofar as the quality of life of many individuals and groups, as well as the future of the discipline itself, will be affected by the choices of metaphor that psychologists make, this book has a very serious purpose. By focusing on the role of metaphor in the history of psychology, the following chapters suggest that it is through the judicious choice and use of metaphor that psychologists will deal more or less effectively with the estimable challenges and opportunities that lie ahead.

Acknowledgments

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Notes

- 1 Most of these scholars have taken their lead from Aristotle, especially from his treatises on rhetoric and poetics (Aristotle, ca. 330 B.C./1924a; ca. 330 B.C./1924b). The quotation in the text is from the former work (l. 1410).
- 2 Aristotle (ca. 330 B.C./1924a), for instance, said that metaphor confers "clearness, charm, and distinction [to discourse] as nothing else can" (l. 1405). For a review of the history of scholarship of metaphor, see Johnson (1981a). For a survey of the literature up to 1970, see Shibbes (1971); for that from 1970 into the mid-1980s, see van Noppen, De Knop, and Jongen (1985). Johnson (1981b), Miall (1982), Ortony (1979), and Sacks (1979) provide convenient access into, and examples of, the recent literature on metaphor. Billow (1977), Hoffman (1984a), and Ortony, Reynolds, and Arter (1978) provide overviews of the psychological literature. Vosniadou and Ortony (1988) represent some of the latest developments, and Winner (1988) discusses some of the ontogenetic factors that underpin the use of metaphor in adult life, by scientists as well as others.
- 3 I. A. Richards's chapters on metaphor in *The Philosophy of Rhetoric* (1936) are at the root of much of this recent work, which stems more proximately

from Max Black's *Models and Metaphors* (1962). Richards (1936) argued that "metaphor is the omnipresent principle of language" (p. 92) and, subsequently, that it is also the fundamental principle of thinking: "Thinking is radically metaphoric. Linkage by analogy is its constituent law or principle, its causal nexus, since meaning only arises through the causal contexts by which a sign stands for (takes the place of) an instance of a sort. To think of anything is to take it *as* of a sort (as a such and such) and that 'as' brings in (openly or in disguise) the analogy, the parallel, the metaphoric grapple or ground or grasp or draw by which alone the mind takes hold. It takes no hold if there is nothing for it to haul from, for its thinking is the haul, the attraction of likes" (I. A. Richards, 1938, pp. 48–9).

- 4 Despite the criticisms directed at his (1962) position, Black (1979) has continued to argue that "a metaphorical statement can sometimes generate new knowledge and insight by *changing* relationships between the things designated" and, furthermore, that "some metaphors enable us to see aspects of reality that the metaphor's production helps to constitute" (pp. 37, 39) Someone adopting a less radical position would agree with Black's contention that metaphors can direct our attention to formerly *unnoticed* aspects of reality, and are thus important in the development of new insights into – or visions of – reality, but would eschew the idea that metaphors actually help to constitute reality. Even someone holding this more moderate view, however, would credit metaphor with an essentially epistemological function.

Of the many books and articles stimulated by Black's work, Mary B. Hesse's *Models and Analogies in Science* (1966) deserves mention, not least for its highlighting of relevant issues by means of an insightful rendition of a hypothetical debate between Pierre Duhem and N. R. Campbell regarding the role of models in the construction of theories in physics. Duhem's (1906/1962) and N. R. Campbell's (1920) works provide additional context for the deliberations in this volume. See L. D. Smith's comments (Chapter 7, this volume) on Duhem's metaphorical statements against the use of metaphorical statements in science. Also see Hesse (1955), which shows that Hesse was "on the right track" long before Black's (1962) work appeared.

Finally, Black's work, together with several essays by Saul Kripke and Hilary Putnam, has inspired Thomas Kuhn's recent assignment of preeminence to metaphor in the process of "revolutionary" change in science. As Kuhn said in 1979, reacting to a similarly relevant essay by Richard Boyd (1979), "The view toward which I grope would also be Kantian but without 'things in themselves' and with categories of the mind which could change in time as the accommodation of language and experience proceeded. A view of that sort need not, I think, make the world less real" (pp. 418–19). By 1987, Kuhn would say that, of the three characteristics shared by his illustrative revolutions, the one that "has been the most difficult . . . for me to see, but now seems the most obvious and probably the most consequential," is the common occurrence of a "central change of model, metaphor, or analogy – a change in one's sense of what is similar to what, and of what is different" (p. 20). The crux of Kuhn's analysis is that the groupings or categorizations of phenomena change radically and holistically in the course of a scientific revolution, so that what once were "natural categories" of perception and understanding no longer are such. Aristotle, for instance, found it quite natural to assume that "the falling stone was *like* the growing oak, or *like* the person recovering from illness," and thus that all three were instances of "motion" (p. 20). Newton's alignment of like and unlike, however, was completely different. After his review of other instances of scientific change,

Kuhn (1987) noted that "all these cases display interrelated features familiar to students of metaphor. In each case two objects or situations are juxtaposed and said to be the same or similar. . . . The juxtaposed items are exhibited to a previously uninitiated audience by someone who can already recognize their similarity, and who urges that audience to learn to do the same. . . . Thus, the education of an Aristotelian associates the flight of an arrow with a falling stone and both with the growth of an oak and the return to health. . . . the student learns what categories of things populate the world, what their salient features are, and something about the behavior that is and is not permitted to them. In much of language learning these two sorts of knowledge – knowledge of words and knowledge of nature – are acquired together, not really two sorts of knowledge at all, but two faces of the single coinage that a language provides" (pp. 20–1).

Kuhn's relevant conclusion is simply that "the metaphorlike juxtapositions that change at times of scientific revolution are thus central to the process by which scientific and other language is acquired" (p. 21). As these statements and his examples show, Kuhn's position is now virtually identical to Black's radical position, described at the beginning of this note. Though I stand in close proximity to them, I want to repeat that sharing this position is not a prerequisite for according metaphor an important role in the history of thought and science.

- 5 The necessity of allowing our search for meaning to rest on the achievement of subjective satisfaction, intuition, or belief was suggested long ago by Montaigne (1587–8/1958): "I ask what is 'nature,' 'pleasure,' 'circle,' 'substitution.' The question is one of words, and is answered in the same way. 'A stone is a body.' But if you pressed on: 'And what is a body?' – 'Substance.' – 'And what is substance?' and so on, you would finally drive the respondent to the end of his lexicon" (pp. 818–19). To say that our knowledge rests, ultimately, on a basis secured by satisfaction, intuition, or belief is not to admit that our knowledge is insecure in any devastating sense. I think it was Karl Popper, or perhaps one of his students, who suggested several images that, at least in my rendition, express my own view of the matter: Our knowledge is like a house built on pilings driven into quicksand. No individual piling is absolutely secured, and any given piling may – and probably will – fail and have to be replaced, yet the pilings are sunk into "reality" and manage *as a group and with our ongoing vigilance and repair* to keep us in touch with "reality" without allowing us to sink so far into it that we lose our overarching perspective. An alternative image is quite similar: It is as if we are in a boat whose various planks must be replaced from time to time; though in need of constant repair, our boat manages to keep us afloat. The point in each case is that our knowledge is not supported by any single satisfaction, intuition, or belief, nor by any rock-solid foundation, but by a coordinated system of satisfactions, intuitions, and beliefs, each of which has stood the test of experience, at least up to the present moment. As William James (1897/1979) put it, the "final truth" will not be known "until the last man has had his experience and had his say" (p. 141). In the meantime, the "circle of knowledge" is repeatedly broken and reconnected as we continue to "bootstrap" our understanding of the world and ourselves. Metaphors, I am suggesting, provide one of the major means of this ever-ongoing process.
- 6 The commonality of this view is rarely appreciated, partly because of the difference in vocabulary favored by theorists of different persuasions. As Newell and Simon (1972) have noted, with reference to an earlier article

(Simon & Newell, 1956), there is no set "terminology nor metatheory of science to explicate the roles of metaphors, analogs, models, theories and descriptions, or the passage from one category to another" (p. 5) – hence the cacophony of voices, each trying to express a similar insight. For instance, a justification of the references made in the text would proceed through the explication of the following core statements: *Hume* (1748/1972): "All arguments from experience are founded on the similarity which we discover among natural objects" (p. 36). *Bentham* (1841/1962): "In the use made of language, fiction . . . becomes a necessary resource" (p. 331). *Bain* (1855): "Some discoveries turn upon this [use of the law of similarity] exclusively; and no succession of discoveries can proceed without it" (p. 508). *Peirce* (1932): "Upon finding himself confronted with a phenomenon unlike what he would have expected . . . , he [the reasoner] looks over its features and notices some remarkable character or relation among them, which he at once recognizes as being characteristic of some conception with which his mind is already stored Presumption [or the 'abducting' of similarities] is the only kind of reasoning which supplies new ideas" (pp. 776–7). *Kant* (1781/1965): "We are justified in combining appearances [in order to arrive at concepts] only according to what is no more than an analogy" (p. 212). *Nietzsche* (1873/1979): "The drive toward the formation of metaphors is the fundamental human drive" (p. 88). *Vaihinger* (1911/1924): "All cognition is the apperception of one thing through another. In understanding, we are always dealing with an analogy, and we cannot imagine how otherwise existence can be understood . . . all conception and cognition are based upon analogical apperception" (p. 29). *Cassirer* (1925/1946): "Myth and language [the roots of human cognition] may differ, yet the same form of mental conception is operative in both. It is the form which one may denote as *metaphorical thinking*" (p. 84).

Regarding the thoughts of Peirce, Nietzsche, and Cassirer on metaphor and related topics, which have proved particularly stimulating to many individuals, see Burks (1946), Fann (1970), and Fisch (1986); Blondel (1977), Breazeale (1975), Cantor (1982), Schrift (1985), and Stern (1978); and Langer (1942), respectively. Ogden (1932) offers an interesting overview of Bentham's theory of fictions, including a section titled "Fictions and Metaphors" (pp. 70–4), and McReynolds (1970) discusses the application of this theory to psychological concepts.

Of course, to say that language and thought are ultimately metaphorical leaves unresolved the precise nature of this metaphoricality (see Leatherdale, 1974, pp. 172–3). In this regard I would simply argue, conservatively, that the acquisition of new knowledge is always based on the forward "reach" of metaphorical or analogical perception and thought. This leaves room for the additional claim, which I would also endorse, that such "metaphorical" knowledge can become "literal" knowledge once it is confirmed by continued use and general acceptance: Indeed, it sometimes becomes *all too literal* in the sense discussed later in the text and in note 49.

Again, I would like to point out that my thesis is hardly novel. More than a century ago, the great comparative linguist Max Müller (1867) noted that "no advance was possible in the intellectual life of man without metaphor" (p. 370), and Fritz Mauthner, the writer and philosopher, argued that "without exception every word in its individual usage is metaphorical" and that "we have learnt to understand the metaphor as the term for the phenomenon which others call the growth or the development of language" (quoted in Gerschenkron, 1974, p. 432). Among psychologists, as we shall see, William

James (1890) was among the first to assert that "a native talent for perceiving analogies is . . . the leading fact in genius [creative thinking] of every order" (vol. 1, p. 530, italics deleted).

- 7 I have been unable to relocate the source of this quotation, but it is attributed to Craik somewhere in McCulloch (1965) (see Pribram, 1971, p. 97). In any case, it fits Craik's (1943) general point of view, not to mention his own analogical extrapolations about the brain and its functions (see Craik, 1966, chaps. 4–6).
- 8 A "figure of speech" is any of the various forms of linguistic expression that deviate from the usual arrangement or use of words. The term "trope" is generally treated as a synonym for "figure of speech," and it can be so understood here. Ricoeur (1977) has noted the circular intertwining of "metaphor" and "figure." As he says, "Metaphor is a figure and the word *figure* is metaphorical" (p. 53). The figures of speech that are generally considered closest to, yet distinguishable from metaphor, narrowly defined, are analogy, metonymy, simile, and synecdoche. These and other "metaphorical substitutions and puns" are defined in Lanham (1968).
- 9 As observed years ago by Stanford (1936), the more tolerant use of the term "metaphor" has been favored by most of those who have investigated metaphor from the viewpoint of philology and etymology, whereas the opponents of the equation of metaphor and trope have tended to come (like Stanford himself) from the ranks of literary critics, whose job it is to make finer distinctions about the use of language (p. 100). This is not to say that all literary critics oppose a broad conception of metaphor and its relation to discourse. M. H. Abrams (1953), surely a leading literary critic, has written that metaphor, "whether alive or moribund, is an inseparable element of all discourse, including discourse whose purpose is neither persuasive nor aesthetic, but descriptive and informative. Metaphysical systems in particular are intrinsically metaphorical systems. . . . Even the traditional language of the natural sciences cannot claim to be totally literal, although its key terms often are not recognized to be metaphors until, in the course of time, the general adoption of a new analogy yields perspective into the nature of the old. . . . [Some analogs are] *constitutive* [not simply illustrative]: they yield the ground plan and essential structural element of a . . . theory. . . they select and mold those 'facts' which a theory comprehends. For facts are *facta*, things made as much as things found, and made in part by the analogies through which we look at the world as through a lens" (p. 31).

This statement, especially the latter part, is remarkably prescient of subsequent "postpositivist" philosophy of science (see H. I. Brown, 1977, for a succinct summary; Suppe, 1977, for more details). Even earlier, Kenneth Burke (1935/1965), another leading literary critic, expressed a similar conviction: "As the documents of science pile up, are we not coming to see that whole works of scientific research, even entire *schools*, are hardly more than the patient repetition, in all its ramifications, of a fertile metaphor? Thus we have, at different eras in history, considered man as the son of God, as an animal, as a political or economic brick, as a machine, each such metaphor, and a hundred others, serving as the cue for an unending line of data and generalizations" (p. 95).

Similarly, literary writers, as opposed to literary critics, have shown little hesitation in accepting the wider notion of metaphor. For instance, Robert Frost (1931/1956) found that "in late years" he wanted "to go further and

further in making metaphor the whole of thinking" (p. 37), and Walker Percy (1958) has argued that metaphor "is the true maker of language" and that the mind's "favorite project" is a "casting about for analogies and connections" (pp. 96-7).

- 10 I should reiterate, however, that the broad use of metaphor and its frequent equation with analogy throughout this volume do not mean that any of the volume's other contributors necessarily accept my contention that all language and thought are fundamentally metaphorical.

It is not only metaphor and analogy that can be considered interchangeable for purposes like those pursued in this volume. Howard Gruber, on the basis of his long-term study of creative thinking in science (e.g., Gruber, 1974), has concluded, in harmony with the thrust of my own thought, that "metaphors, analogies, and models are part of a group of comparison processes by which we use some parts of our knowledge to illuminate others. There are many names for such comparison processes, but there is no adequate taxonomy of them. Indeed, since they have almost always been treated singly, we have no adequate overview of the way in which groups of such comparison processes function in intellectual work. Lacking any such systematic treatment, it is idle to fuss over definitions. We need a large and generous term to cover the whole family of comparison processes. . . . I will use *metaphor*, *image*, *figure of thought*, and the abbreviated *figure* interchangeably for such comparison processes" (Gruber, 1980, p. 122).

Gruber's use of "comparison processes" is similar to my own inclination to use "comparative thinking" as a generic term that encompasses and thus avoids the distinction between metaphor, analogy, simile, and so on. In this regard, it is interesting that Kant (1797/1974) used "comparison," as opposed to "distinction," in much the same way (pp. 89-92). However, I only suggest this term here, rather than insist on it, since there is already a long tradition of using "metaphor" to represent the same overarching concept. For a similar blending of "analogies," "models," "hypotheses," and "theories" under the generic concept of "representation," see Wartofsky (1979, esp. pp. 1-11, 24-39). See also Fogelin (1988, chaps. 3-6) and O. Mayr (1986, p. 204, note 1).

- 11 As MacCormac (1985) has said, "Metaphors that were false seem to become true, and metaphors that were ungrammatical seem to become grammatical, both through usage" (p. 27). A related point regarding supposedly literal *thought* has been made by Bloor (1971): "After something has been said by means of a metaphor it is easy to think that it could have been said without it, because one's understanding of the literal concepts undergoes a change under the impact of the metaphor" (p. 441). In other words, since the idea expressed by a metaphor can soon come to seem "natural" and "literal" and can then be expressed (however partially) by different metaphors, it is easy to overlook the creative role of the original metaphor. A recent, effective argument for the thesis that "all language is metaphorical" has been offered by Arbib and Hesse (1986), who admit that this thesis "will appear shocking to those writers who have labored to provide careful distinctions between the literal and metaphoric in traditional grammar and semantics" (p. 150). Their argument hinges on their carefully considered rejection of the literal view of language, a rejection based (among other foundations) on a review of the research on language acquisition. See also Barfield (1960), Benjamin, Cantor, and Christie (1987), and Rumelhart (1979).

- 12 I cannot resist a few parting shots before moving on to the promised historical survey. These shots take the form of corroborative statements by four scholars of rather different orientations – Isaiah Berlin, Nelson Goodman, Robert Nisbet, and Stephen Pepper:

The notion that . . . it is possible to think without such analogies in some direct fashion – “face-to-face” with the facts – will not bear criticism. To think is to generalise, to generalise is to compare. To think of one phenomenon or cluster of phenomena is to think in terms of its resemblances and differences with others. This is by now a hoary platitude. It follows that without parallels and analogies between one sphere and another of thought and action, whether conscious or not, the unity of our experience – our experience itself – would not be possible. All language and thought are, in this sense, necessarily “metaphorical.” (Berlin, 1981, p. 158)

Metaphor permeates all discourse, ordinary and special. . . . This incessant use of metaphor springs not merely from love of literary color but also from urgent need of economy. If we could not readily transfer schemata to make new sortings and orderings, we should have to burden ourselves with unmanageably many different schemata, either by adoption of a vast vocabulary of elementary terms or by prodigious elaboration of composite ones. (Goodman, 1976, p. 80)

Human thought in the large is almost inconceivable apart from the use in some degree of metaphor. Whenever we identify one thing with another – one commonly better known in nature than the other – we are engaging in metaphor. “The mind is a machine.” “Societies are organisms.” “A mighty fortress is our God.” All of these are instances of metaphoric construction. Metaphor is no simple grammatical device, a mere figure of speech; not, that is, in its fullness. Metaphor is a way of knowing – one of the oldest, most deeply embedded, even indispensable ways known in the history of human consciousness. . . . It is easy for the positivist to dismiss metaphor as “unscientific.” . . . But from metaphor proceed some of the dominating themes of Western science and philosophy, as well as art. (Nisbet, 1976, pp. 32–3)

A man desiring to understand the world looks about for a clue to its comprehension. He pitches upon some area of common-sense fact and tries if he cannot understand other areas in terms of this one. This original idea becomes then his basic analogy or root metaphor. He describes as best he can the characteristics of this area, or, if you will, discriminates its structure. A list of its structural characteristics becomes his basic concepts of explanation and description. We call them a set of categories. In terms of these categories he proceeds to study all other areas of fact whether uncriticized or previously criticized. He undertakes to interpret all facts in terms of these categories. (Pepper, 1942, p. 91)

I realize that the mere quotation of these sources, without further explication, constitutes a form of *argumentum ad hominem* (or *ab auctoritatibus*), but I trust that the gentle use of such argumentation is not too offensive when it draws on sources of such proven worth.

- 13 I like Plato's definition of scientific theories as “likely stories,” though I would insist that likely stories are not myths in the derogatory sense. For a use of “likely stories” as an orienting conceptual device, see Leary (1987). With

regard to Plato's ambivalence about metaphor and rhetoric, see Havelock (1963) and Lloyd (1987). The psychological and social context of this ambivalence is described by Dodds (1951) and B. Simon (1978).

- 14 Aristotle's (ca. 330 B.C./1924a) point in saying that "it is from metaphor that we can best get hold of something fresh" (l. 1410) was that "strange words" are "unintelligible" whereas "current words" are "commonplace." It is midway between these two extremes of the bizarre and the rote use of words that metaphor serves both to please and to instruct. Wallace Stevens (1930-55/1982) expressed a similar thought when he wrote that "reality is a cliché from which we escape by metaphor" (p. 179).

The secondary literature on Vico's "metaphoric turn" is so vast and readily available that I shall mention only the recent, excellent book by Mooney (1985). Coleridge's insights and convictions regarding the role of metaphor in the development of human thought and sensibility were further developed in his *Logic* (ca. 1823/1981) and his *Aids to Reflection* (1825/1884), about which Jackson (1983) has written. Coleridge's ideas influenced I. A. Richards as well as many others, including Owen Barfield (1977).

- 15 "Nakedness" was and remains a common metaphor for "plain," "unclothed," and hence supposedly "objective" discourse. A later scientist, Charles Darwin (1876/1887), used a related metaphor when he claimed to have written his autobiography "as if I were a dead man" (p. 27). "Lifelessness" or "passivity" fits the assumptions of positivist rhetoric, which was further exemplified by Darwin's statement that the *Origin of Species* (1859/1964) began to take shape when he was "*struck* with certain facts in the distribution of the inhabitants of South America" (p. 1, italics added). The intended image is clear: He was simply standing there, on Her Majesty's ship the *Beagle*, when nature of its own accord *came to him*. By implication, he did no *looking* or *searching about* for information. "Certain facts" simply spoke for themselves.

Regarding Darwin's rhetoric, see J. A. Campbell (1987), Cannon (1966), and H. White (1978). The fact that this rhetoric ill fitted the historical record of Darwin's own creative activity (as discussed by Leary, 1988b) is another similarity between Darwinian discourse and that of his seventeenth-century forebears. As for the rhetoric of these forebears, Dear (1985) has suggested that, on the basis of their actual practice, the Royal Society's motto should have been *Totius in verba* rather than *Nullius in verba*.

- 16 This ironically metaphorical opposition to the use of metaphor and related modes of thought and language was typical of Reformation figures as well as the "new philosophers" who ushered in the age of modern science. In the sixteenth century, for instance, Martin Luther (ca. 1542/1968) condemned allegory as a "beautiful harlot who fondles men in such a way that it is impossible for her not to be loved" (p. 347). A similar opposition was mounted by persons who might have been expected to use metaphor somewhat more freely - by the Paracelsian-influenced J. B. van Helmont, for instance (see Vickers, 1984, pp. 143-9). Given the widespread concern about potential abuses of figures of speech and thought, it is not surprising that the seventeenth century witnessed the "rationalization of myth" as well as the "end of allegory" as a widely accepted form of extended metaphor (see Allen, 1970, chap. 10).

Other important persons who were ambivalent about the use of metaphor and analogy included Francis Bacon, Galileo, and René Descartes (see Jardine, 1974; Park, Daston, & Galison, 1984). Bacon, for instance, granted

that "there is no proceeding in invention of knowledge but by similitude," but he worried that "all perceptions as well of the sense as of the mind are according to the measure of the individual and not according to the measure of the universe [*ex analogia hominis, et non ex analogia universi*]" (quoted by Park in Park et al., 1984, pp. 294, 295). It was his skepticism about anthropomorphically biased concepts that stimulated his fear of the "idols of the Tribe," not any doubt that the human mind operates through analogy. This was a typical sixteenth- and seventeenth-century fear (see Popkin, 1964). Thus, skepticism should be added to the incipient versions of scientific realism, the positivist theory of knowledge, and the literalist view of language that Arbib and Hesse (1986) have listed as significant correlates of the Scientific Revolution (pp. 148–9).

It is unfortunate that skeptical concerns have not kept pace with the historical elaboration of these other three commitments. If they had been kept in mind – and turned against later versions of realism, positivism, and literalism – modern-day proponents of linguistic purity (such as B. F. Skinner, 1987) might have established a more propitious balance of commitments and concerns, not to mention a greater awareness of the rhetorical devices in their own linguistic behavior. As it is, they tend to see the mote in other people's eyes, but not the metaphor on their own tongues (see Leary, 1988a).

- 17 Newton's thought does not provide the only example of the transfer of a concept from a social to a natural scientific context. Indeed, as a number of scholars have pointed out (Adkins, 1972, esp. chap. 5; Collingwood, 1945, pp. 3–4; Cornford, 1912; Frank, 1945, pp. 116–17; Huizinga, 1944/1955, p. 117; Jaeger, 1934/1945, pp. 158–61; Snell, 1953, chap. 10; Zilsel, 1942), the very notions of "nature," "cause," and "law," which are so central to our conception of natural science, were drawn originally from the social realm. In more recent times, one of the most critical transferences has involved the use of statistics and the attendant notion of probability, originally developed in the study and conceptualization of human thought and social behavior (see Daston, 1988; Hacking, 1975; Porter, 1986; Stigler, 1986). Although the importation of the social-statistical metaphor initially met considerable resistance within the natural scientific community, its eventual acceptance has significantly changed the character of the physical sciences. (For general background and surveys of the impact on individual sciences, see Krüger, Daston, & Heidelber, 1987; Krüger, Gigerenzer, & Morgan, 1987; for an overview, see Gigerenzer et al., 1989; for a specific analysis of "social law and natural science," see Porter, 1986, chap. 5; for a specific example of the use of a social metaphor in the study of physical phenomena, see Gentner & Gentner, 1983.)

Other social metaphors are frequently encountered in the physical sciences. See, e.g., Prigogine and Stengers's (1984) discussion of how order emerges from chaos in the physical world. This Nobel laureate and his colleague propose that the ordered universe is built on the existence of "hypnons" (fundamental "sleepwalking" or "dancing" units).

Human artifacts are also common metaphorical fodder for the physical as well as biological and social sciences. Clocks and various other devices and machines are too obvious to enumerate, but for their historical context, see Beniger (1986), Dijksterhuis (1969), O. Mayr (1986), and Price (1965). Koyré (1950/1968) has shown that, from the very start, the relatively unstructured quality of social life created problems for the assumption that such mechanistic metaphors (and the metaphysical principles based on them) are universal in application (see esp. pp. 22–4).

Finally, social metaphors also play a fundamental role in our understanding of natural scientific activity, which should not be surprising since scientific activity is, of course, social in nature. Think, for example, of all the recent talk of “revolutions” in science (Cohen, 1985; Hacking, 1981; Kuhn, 1970). Whether fortunately or not, the often muted implications of social conflict and aggression that are associated with this political metaphor rest on a much more substantial basis than many might suppose or wish to admit (see D. Hull, 1988). And as Cohen (1985) notes, this political metaphor incorporates an even more fundamental religious metaphor insofar as scientific revolutions have been seen (even by scientists themselves) to depend on the personal “conversions” of individual scientists (pp. 467–72). Berman (1983) discusses the historical relation between revolutions and religious reformation (pp. 18–23).

- 18 As Guerlac (1965) and Schofield (1970) have shown, British philosophers and scientists tended to develop the mechanistic and materialistic implications of Newton’s work.

As is often the case in the history of science, Newton’s ideas were “over-determined” by a variety of overlapping metaphors and modes of thought. Alchemical, biological, and theological metaphors blended with the social metaphor of “attraction” in the development of his understanding of the laws of nature (see Dobbs, 1975; Guerlac, 1983; Westfall, 1987). In all these areas of thought, anthropomorphism was clearly evident. “Sociability,” for instance, was a construct used in alchemy – and in Newton’s own correspondence regarding alchemy (see Dobbs, 1975, pp. 207–9). Although Cohen (1987) reports that “until his death Newton was deeply troubled by the concept [of universal gravity],” and in particular by his inability to give it a (presumably mechanistic or materialistic) explanation (p. 587), Newton’s deep and sustained interest in alchemy seems to have been associated with his *rejection* of materialism and his corresponding *preference* for a “picture of reality in which spirit dominates” (Westfall, 1987, p. 565). This accords with the stance taken in Newton’s stead by Samuel Clarke in the famous Leibniz–Clarke debates, which showed the extent to which theological voluntarism – the belief in the sustaining potency of God’s will – lurked behind, and supported, Newton’s mature vision of the universe (see Alexander, 1956). It is appropriate to add, as Guerlac (1983) has shown, that “God’s active will was understood by Newton through an analogy with human will and animal motion” (p. 228).

This interweaving of alchemical, biological, theological, social, and psychological metaphors with natural scientific concepts suggests the reiterative nature of what soon became the dominant world view in the Western intellectual tradition. Virtually by definition, this world view *qua* world view (or “root metaphor”) became the source of derivative metaphors (see Pepper, 1942). To select but one family of derivative metaphors, the Newtonian concepts of “inertia” and “momentum” have been used in a great deal of subsequent psychological and social theorizing. See e.g., Atkinson and Cartwright (1964), Frijda (1988), Nevin (1988), and Parsons, Bales, and Shils (1953). Of course, with Einstein’s amendments of the Newtonian world view, alternative metaphors, such as those used in Lewin’s (1936, 1951) field-theoretic approach to psychology, became available for behavioral and social scientists.

- 19 The decision to use *this* number system instead of another, *this* statistical procedure instead of another, *this* means of measurement instead of another can make a considerable difference in the results of one’s analysis. Mathematics, whether pure or applied, is no singular, once-and-for-all language that

maps all aspects of the world in a perfect one-to-one relationship. Rather, as recognized since the introduction of noncommutative algebras and non-Euclidean geometries in the nineteenth century, mathematics is (in Poincaré's words) a "free invention of the human mind" whose "truth" is not and cannot be absolute (Wilder, 1981, pp. 78–9). "Gradually," as Morris Kline (1980) has put it, "mathematicians granted that the axioms and theorems of mathematics were not necessary truths about the physical world." Rather, mathematics "offers nothing but theories or models" that can be replaced as demanded by the requirements of given situations (p. 97). The same view is accepted by mathematical physicists. Einstein, for instance, said that "insofar as the propositions of mathematics give an account of reality they are not certain; and insofar as they are certain they do not describe reality" (quoted by Kline, 1980, p. 97). In summary, "the attempt to establish a universally acceptable, logically sound body of mathematics has failed. Mathematics is a human activity and is subject to all the foibles and frailties of humans. Any formal, logical account is a pseudo-mathematics, a fiction, even a legend, despite the element of reason" (Kline, 1980, p. 331). As with any metaphorical system, mathematics becomes a myth (in the derogatory sense) if its metaphoricity is forgotten (see Turbayne, 1970, and note 49). The attempt to counter the myth of mathematics, by the way, started before the nineteenth century with Vico, who recognized that mathematics is an "experimental science" created by humans rather than the gods (see Corsano, 1969).

The nature of mathematics' metaphoricity is suggested by a statement attributed to Bertrand Russell, to the effect that mathematics began "when it was discovered that a brace of pheasants and a couple of days have something in common: the number two" (Koestler, 1964, p. 200). The point is simply that numbers are signs of similarity between things, whether between two objects, between two sets of objects, or between an object and a particular code of reference (one of the many alternate numerical systems). Two ideas, two cars, and two historians of science have at least this in common: Their existence can be "figured" in the same way. (The overlap among our concepts and terms for "number," "figure," and "metaphor" is no mere coincidence.) This numerical figure is the most abstract characteristic that they share (other than existence per se). Such abstraction allows the ultimate degree of precision – and the lowest amount of substantive specificity. "Two" tells you nothing about the nature of the objects compared other than their quantity: *Anything* that can appear in duplicate form, whether "real" or "ideal," can be represented by this figure. Although history testifies to the theoretical and practical benefits that can be gained by utilizing this kind of abstraction, that does not make number any less metaphorical.

Even those who might balk at considering number itself to be metaphorical would probably agree that the process of *applying* numbers is metaphorical (see McCloskey, 1985, pp. 79–83). Beyond that, the application of numbers is inherently *rhetorical* – i.e., meant to be persuasive – even though it cannot lead to totally definitive accounts of reality (see Davis & Hersh, 1986, 1987). Relatedly, the development of new forms of mathematics – e.g., the mathematics of probability – can be shown to have changed the ways in which we think about ourselves, the world around us, and everyday life (see Daston, 1988; Gigerenzer et al., 1989). For discussions of the role of analogical thinking in mathematics, see Mach (1905/1976) and Polya (1954); for a discussion of mathematics as a cognitive activity, see Lakoff (1987, chap. 20); for a discussion of the locus of mathematical reality by a nonmathematician, see L. A. White (1949); for an offbeat, but interesting discussion of number as

metaphor, see R. S. Jones (1982); for a relevant discussion of the aesthetics, as opposed to the logic, of mathematics, see Papert (1978); and for discussions of the quantification of psychology, see Danziger (1987), Gigerenzer (1987), Hornstein (1988), and Leary (1980a). Regarding the “unreasonable effectiveness of mathematics in the natural sciences,” see Wigner (1960); for a somewhat converse argument, see Sharma (1982); and for a cultural explanation of the symbiosis of mathematics and physics, see Wilder (1981, pp. 45–6). The main thrust of Wilder’s analysis of mathematics as a cultural system is seconded by the work of MacKenzie (1981). Perhaps, since “proof” is considered such a hallmark of absolute truth, I should end this note by quoting Wilder’s (1981) comment that “it seems to be a commonly held belief, chiefly outside the mathematical community, that in the realm of mathematics can be found absolute truth. . . . [But as we have seen] ‘proof’ in mathematics is a culturally determined, relative matter. What constitutes proof for one generation, fails to meet the standards of the next or some later generation” (pp. 39–40). For more on this topic, see Davis and Hersh (1986) and the final paragraph of note 44.

- 20 Regarding Darwin’s sometimes positivist rhetoric, see note 15. But also note that, despite this rhetoric, Darwin believed that “without the making of theories I am convinced there would be no observation” (letter to C. Lyell, 1 June 1860, in F. Darwin, 1887b, vol. 2, p. 315). Indeed, his son recalled that Darwin often said that “no one could be a good observer unless he was an active theoriser. . . . it was as though he were charged with theorising power ready to flow into any channel on the slightest disturbance, so that no fact, however small, could avoid releasing a stream of theory, and thus the fact became magnified into importance” (F. Darwin, 1887a, p. 149). That it was not simply theory but theoretically pregnant metaphors that were so readily set loose in Darwin by the process of observation can be seen from Darwin’s own comments and notebook annotations: “There is an extraordinary pleasure in pure observation; not but what I suspect the pleasure in this case is rather derived from comparisons forming in one’s mind with allied structures” (letter to J. D. Hooker, ca. 1847, in F. Darwin, 1887b, vol. 1, p. 349). But despite his son’s recollection of the facility of Darwin’s theorizing power, Darwin himself reported that making original conjectures was by no means easy: “Perhaps one cause of the intense labour of *original inventive* thought is that none of the ideas are habitual, nor recalled by obvious associations” (notebook entry, 16 August 1838, in Barrett, 1974, p. 282); that is, Darwin had to make his novel comparisons in the face of habitual associations, which work by their nature toward nonoriginal ends. Still, the effort did not squelch his pleasure: “I remember my pleasure in Kensington Gardens has often been greatly excited by looking at trees at [i.e., as] great compound animals united by wonderful & mysterious manner” (notebook entry, 15 July 1838, in Barrett, 1974, p. 273). All in all, Darwin would probably have agreed with T. H. Huxley, who wrote that “the great danger which besets all men of large speculative faculty, is the temptation to deal with the accepted statements of facts in natural science, as if they were not only correct, but exhaustive. . . . In reality, every such statement, however true it may be, is true only relatively to the means of observation and the point of view of those who have enunciated it” (quoted by F. Darwin, 1887b, vol. 1, p. 347).

Darwin’s sensitivity to rhetorical style is revealed in his reply to a young naturalist who had sent him a manuscript for review: “Shall you think me impertinent . . . if I hazard a remark on the style, which is of more importance than some think? In my opinion (whether or no worth much) your paper

would have been much better if written more simply and less elaborated" (letter to J. Scott, 11 December 1862, in F. Darwin & A. C. Seward, 1903, vol. 1, p. 219–20). Later he wrote: "I never study style; all that I do is to try to get the subject as clear as I can in my own head, and express it in the commonest language which occurs to me. But I generally have to think a good deal before the simplest arrangement and words occur to me. . . . writing is slow work; it is a great evil, but there is no help for it. . . . I would suggest to you the advantage, at present, of being very sparing in introducing theory in your papers. . . . *let theory guide your observations*, but till your reputation is well established be sparing in publishing theory. It makes persons doubt your observations" (letter to J. Scott, 6 June 1863, in F. Darwin & A. C. Seward, 1903, vol. 2, pp. 322–3).

- 21 Regarding the evolutionary epistemology on which this comment draws, an epistemology developed on an explicitly Darwinian model, see D. Campbell (1960, 1974), Popper (1979), R. J. Richards (1977), and Toulmin (1972). Also see Simontin (1988) for a psychology of science based on this epistemology and Cohen (1985) for a discussion of the earlier "Darwinian" philosophies of science of Ludwig Boltzmann and Ernst Mach (pp. 534–40). For other impacts of Darwinism on diverse fields of thought, often mediated by the metaphorical extension of Darwinian concepts, see Appleman (1970), Beer (1983), G. M. Edelman (1987), Leatherdale (1983), Oldroyd (1980), R. J. Richards (1987), Seward (1909), and Wiener (1949). Twentieth-century American psychology in particular is based on Darwinian premises. Two of the most self-conscious of these extensions are those of William James, discussed below in the text, and B. F. Skinner, discussed in note 49.
- 22 Darwin had previously tried to "fit" or "map" his data on a more or less linear time-line. With the image of the tree, he was able to *imagine* a much more complex set of relationships among his data. Although he realized early on that coral, with which he was quite familiar, provided a better image than did a tree (since the branches at the base of coral die off, obscuring the earlier connections between subsequent branches, as occurs analogously in evolutionary history), and although he realized later that seaweed provides an even better image than coral (in that seaweed is "endlessly branching" in every possible direction), Darwin seems to have liked and used the "tree of life" image because of its biblical connotations (see Beer, 1983, p. 37; Gruber, 1978). This suggests a more general rule: that the choice of any given metaphor can depend on more than simply its structural characteristics. Aesthetic and other characteristics can – and probably often do – play a role, as they did in this case. For further discussion of the role of visualization in science (often in the form of visual metaphors), see Arnheim (1969), Koestler (1964, bk. 1, chap. 21), Langley, Simon, Bradshaw, and Zytkow (1987, chap. 10), A. I. Miller (1984), Randhawa and Coffman (1978), Roe (1951), Root-Bernstein (1985), and Shepard (1978). Regarding the role of visual representation in the history of psychology and psychiatry, see Gilman's (1976, 1982, 1988) pathbreaking works.
- 23 This is not to say that phenomena can look any way we want them to look. Except for those who are psychotic or similarly impaired, there are limits to the extent to which "reality" can be assimilated to subjective suppositions, fears, and desires. At the same time, however, the "resistance" of phenomena to being "taken" in a variety of ways, whether perceptually or cognitively, is far from absolute. See Barnes and Shapin (1979, pt. 1), Cooter (1984), and Shapin (1979).

- 24 The literature on social scientific metaphors (other than those used in psychology) includes Barrows (1981), R. H. Brown (1976, 1977, 1987), Deutsch (1951), Felstiner (1983), Gerschenkron (1974), Goldstein (1984), Harré and Secord (1972), H. Jones (1906), Kahn (1965), Martin Landau (1961), Misia Landau (1984), Lasky (1976), Leiber (1978), McCloskey (1985), E. F. Miller (1979), Nisbet (1976), Olson (1971), Saccaro-Battisti (1983), and Stepan (1986). Buck (1956), Chapman and Jones (1980), and Gergen (Chapter 8, this volume) are also very relevant. The literature on premodern and a-modern social metaphors includes Agnew (1986), Alford (1982), Bambrough (1956), Curtius (1953, esp. pp. 138–44), Douglas (1982), Jaynes (1976), Kantorowicz (1957), and Tillyard (1944). Medical metaphors that verge on and overlap with social metaphors are discussed in Figlio (1976), Harrington (1987), Rather (1982), Sontag (1978, 1988), and Temkin (1977). The role of metaphors in social policy making is the special province of Schön (1963, 1979), but Gusfield (1976) has also made a significant contribution. The metaphors of day-to-day political discourse – so redolent of “battles,” “races,” “trading,” and other forms of contest and compromise – await someone’s sustained attention. To date, Burke (1945) has pointed toward, and Lakoff and Johnson (1980) have provided examples of, the sort of metaphors that would result from such an analysis.
- 25 For further discussion of Berkeley’s social theory and its historical context, see Leary (1977) and Macklem (1958). On Berkeley’s use of other metaphors, see Brykman (1982) and Turbayne (1970), and on the metaphors underlying various modern philosophies of the social sciences, see Shapiro (1985–6).
- 26 David Hume is the best known representative of the many individuals who wished to be the Newton of the social (or moral) sciences. Not only does the subtitle of Hume’s major treatise (1739–40/1978) identify the work as an “attempt to introduce the experimental method of reasoning into moral subjects,” but Hume explicitly indicates that his hypothesized “principle of association” is meant to be the principle of gravity of the mental world. The sequence of Hume’s metaphorical thoughts is quite revealing. He begins by talking about the principle of association as a “gentle force” that unites ideas in the mind (p. 10); suggests that association represents “a kind of ATTRACTION, which in the mental world will be found to have as extraordinary effects as [does gravity] in the natural, and to shew itself in as many and as various forms” (pp. 12–13); then says that he “cannot compare the soul more properly to any thing than to a republic or commonwealth, in which the several members are united by the reciprocal ties of government and subordination” (p. 261); and ends by claiming that the principles of association “are the only links that bind the parts of the universe together, or connect us with any person or object exterior to ourselves,” which is to say that these principles of association “are really *to us* the cement of the universe” (“Abstract,” p. 662). In a very real sense, Hume brings the attraction metaphor full circle – back from the natural philosophy of Newton to the social and mental realms in which Newton’s universe inheres. Along the way, he characterizes ideas and perceptions, and distinguishes beliefs and fantasies, by their various degrees of “force,” “vitality,” “solidity,” and “firmness.” We shall have occasion to reflect on such physicalist metaphors for mental phenomena in the next section of this chapter.

I should also note that an entirely *social* metaphor guides Hume’s understanding of reason and its relations to other human faculties: “Reason is, and

ought only to be the slave of the passions, and can never pretend to any other office than to serve and obey them" (p. 415). Although many others, from Plato to Freud, have expressed the relation of reason to other dynamic factors through the use of similar social metaphors, Hume was distinctive in regarding the "enslavement" of reason to be appropriate and acceptable.

Finally, another reaction to the clockwork universe, wittily expressed by Thomas Reid (1785/1969), points toward the inverse social metaphor at the foundation of the mechanistic world view:

Shall we believe with Leibnitz, that the mind was originally formed like a watch wound up; and that all its thoughts, purposes, passions and actions, are effected by the gradual evolution of the original spring of the machine, and succeed each other in order, as necessarily as the motions and pulsations of a watch?

If a child of three or four years, were put to account for the phenomena of a watch, he would conceive that there is a little man within the watch, or some other little animal that beats continually, and produces the motion. Whether the hypothesis of this young philosopher in turning the watch spring into a man, or that of the German philosopher in turning a man into a watch spring, be the most rational, seems hard to determine. (p. 444)

Reid granted that "it is natural to men to judge of things less known by some similitude they observe, or think they observe, between them and things more familiar or better known," and he acknowledged that "where the things compared have really a great similitude in their nature, when there is reason to think that they are subject to the same laws, there may be a considerable degree of probability in conclusions drawn from analogy" (p. 48); but he also noted that "men are naturally disposed to conceive a greater similitude in things than there really is" (p. 49), and he insisted that "all arguments, drawn from analogy, are still the weaker, the greater the disparity there is between the things compared" (p. 50). Amen.

- 27 Locke is perhaps best known for his metaphor of the mind as a *tabula rasa*, or blank tablet (or more precisely, "white paper, void of all characters"; see Locke, 1690/1959, vol. 1, p. 121), but he used many other metaphors as well, including a metaphorical comparison of the mind, or understanding, to a "*dark room*" or "closet wholly shut from light, with only some little openings [i.e., sensory channels] left, to let in visible resemblances, or ideas of things without" (p. 212). Reid (1785/1969) recognized that this metaphor was no mere rhetoric device, but embodied a central assumption underlying Locke's theory of perception (p. 124). By popularizing this and other assumptions, Locke helped to establish the representationalist tradition of perceptual theory, with its metaphorical treatment of ideas as "resemblances," "pictures," "copies," and "likenesses" of reality (see Hamlyn, 1961, chaps. 6 and 8). The larger question of psychology's borrowing of such metaphors from the realm of the arts, especially in the pivotal eighteenth century, when the boundaries between aesthetics and psychology were so fluid, deserves study. The full story promises to be quite fascinating, reaching back to the original Greek concept of *idola* and forward to the latest "picture theory" of semantics.

Besides our notions of "copies," "likenesses," and such, we have derived our sense of "perspective" – so fundamental to modern consciousness – from the history of drawing and painting (see Guillén, 1968). Drawing and painting,

of course, are not the only sources of these art-related metaphors. Architecture has also long been a favorite source of psychological (as well as epistemological) metaphors, according to which we "construct" our mental life from the "ground up" – or "top down" – following "plans," "blueprints," and so on (see, e.g., Anderson, 1983). Less well known, but historically important metaphors have been drawn from music, covering the range from "harmony" to "rhythm." When brain researchers recently "scored" brain-wave harmonies (see, e.g., the "cerebral symphony" in Pribram, 1971, p. 75), it is likely that few people realized the rich tradition they had joined (see, e.g., Heelan, 1979; Kassler, 1984; Levarie, 1980).

Beyond the *tabula rasa*, "dark room," and representational metaphors of the mind, Locke helped to establish the "atomistic" or "corpuscular" approach to the mind, according to which the mind is analyzed into its presumably elemental ideas (Locke, 1690/1959, vol. 1, pp. 121–9; see Buchdahl, 1969, chap. 4). He was also responsible for the influential view that the mind is characterized and motivated by its fundamental "uneasiness" (Locke, 1690/1959, vol. 1, pp. 332–9; see Hazard, 1935/1963, chap. 5). These basic metaphorical assumptions informed many of the psychologies that came after Locke's.

28 Locke could have added moral concepts, such as dependability, reliability, and forthrightness, to this list of psychological concepts. As Whitney (1896) wrote, "A conspicuous branch of the department of figurative transfer, and one of indispensable importance in the history of language, is the application of terms having a physical, sensible meaning, to the designation of intellectual and moral conceptions and their relations. . . . In fact, our whole mental and moral vocabulary has been gained precisely in this way. . . . there is a movement in the whole vocabulary of language from the designation of what is coarser, grosser, more material, to the designation of what is finer, more abstract and conceptual, more formal. . . . there is no grander phenomenon than this in all language-history" (pp. 88–90). Whitney provided examples to support his contention.

On the use of "botanomorph" metaphors in the description of traits and types, see Sommer (1988).

29 For some interesting conjectures on the development of the ancient Greek mind, coupled with a very sensitive awareness of the role of metaphor in self-understanding, see Jaynes (1976).

30 See Fletcher (1882) and Majno (1975), both of whom include illustrations in their discussions of trephining or trepanation (as Majno calls it).

31 Should trephining seem unreasonable, or even inconceivably primitive, see Valenstein (1986) on twentieth-century psychosurgery. (The illustrations on p. 210, regarding the use of electroconvulsive shock as an anaesthetic and the use of transorbital lobotomy as a cure for schizophrenia, are particularly emblematic.) It is also humbling to compare other twentieth-century practices with earlier ones that seem *prima facie* rather "backward." It is not clear, for instance, that the rationale behind the nineteenth-century practices of douching and rotating (see Howells & Osborn, 1984, vol. 1, pp. 260–1; vol. 2, pp. 799–801, for brief descriptions and illustrations) is significantly different in kind or quality from the rationale behind many of the therapeutic practices that are common in the late twentieth century. Although Gross (1978) is admittedly critical in orientation, his description of our "psychological society," with its "new therapies" and "new messiahs," can hardly be ignored as

completely off the mark. At the same time, however, it is unlikely that all of the parallels between current and past practices should be seen as an indictment of twentieth-century practice. Almost certainly, some of them should be regarded as a complement to earlier therapeutic interventions that had a more solid basis than we generally recognize.

- 32 On the various forms of possession and exorcism, in other cultures as well as in the history of the Western world, see Ellenberger (1970, pp. 13–22).
- 33 Descartes's reliance on metaphorical thinking may seem to clash with his self-proclaimed image as a thoroughly skeptical, cautious, and hence conservative thinker. But like Francis Bacon, who has also been misunderstood in this regard (see note 16), Descartes (1628/1911a) was quite aware that "all knowledge whatsoever, other than that which consists in the simple and naked intuition of single independent objects, is a matter of the comparison of two things or more, with each other. In fact practically the whole of the task set the human reason consists in preparing for this operation" (p. 55). For a discussion of Descartes's use of other metaphors, see N. Edelman (1950). On the use of human artifacts, especially machines, as analogs of physical, biological, social, bahavioral, and mental phenomena, see Boring (1946), Chapanis (1961), and note 17. One of the strong advocates of the metaphorical use of such artifacts in psychology, Clark Hull (1943), sought to combine both "objectivity" and "modelling" by considering "the behaving organism as a completely self-maintaining robot." This, he thought, would serve as an effective "prophylaxis against anthropomorphic subjectivism" (p. 27). The next question, I suppose, regards who and what will provide a safeguard against the excesses of "mechanomorphic objectivism." (For a similar comment on the uncritical physicomorphism of psychological language, see Asch, 1958, p. 87.)
- 34 The discovery of the limitations of these and other correlates of the mechanistic metaphor in eighteenth-century physiology and psychology contributed to the emergence of a very different root metaphor – that of "sensitivity" or "sensitivity" (see Moravia, 1978, 1979; Rousseau, 1976). Of course, no matter how delimited, the mechanistic metaphor was far from dead: It was transmogrified in the nineteenth century to fit the new demands and possibilities suggested by the laws of thermodynamics. In unwitting anticipation of the metaphor's further transformation into Freudian *psychodynamics*, Helmholtz (1861/1971) even argued that "the human body is . . . a *better* machine than the steam engine" (p. 119, italics added). Note that it was now the steam engine, not the clock or the hydraulic statue, that was the preferred analog. As this updated comparison implies, the mechanistic metaphor has proved to be immensely protean, changing shape whenever there is an advance in physical science or engineering technology (see Wiener, 1961, chap. 1).
- 35 For an overview of the recent cognitive revolution and some of the variant forms of contemporary cognitive psychology and cognitive science, see Baars (1986) and Gardner (1987). For a general discussion and more details regarding cognitive metaphors, see Bruner and Feldman (Chapter 6, this volume) and Hoffman, Cochran, and Nead (Chapter 5, this volume), respectively. Cognitive metaphors are also usefully and interestingly tabulated and discussed by Estes (1978), Gentner and Grudin (1985), Lakoff and Johnson (1981), and Roediger (1980). The current dominance of cognitivism in psychology is reflected in the fact that cognitive metaphors are frequently assumed to be literal descriptors of mental entities and processes (see, e.g., Newell & Simon, 1972; Pylyshyn, 1984). Although the literalization (in the sense

described earlier in this chapter) of the new cognitive metaphors of input, storage, retrieval, output, and all the other argot of computation and instrumentation is perhaps to be expected, given the frequent usage of these metaphors, I cannot help but join H. Jones (1906) and Berggren (1962) in worrying about the potential *misuse* and *abuse* of metaphors. Nor can I resist joining Turbayne (1970) in fearing the danger of creating a *myth* out of metaphors when such literalization occurs. A myth in this instance would be the result of assuming that a set of "likenesses" between (say) computation and mentation provide adequate grounds for an inference of complete, or at least essential, *identity*. For a further discussion of "myth," used in a negative rather than positive sense, see note 49.

Once again, as in the discussion of Berkeley's gravitational theory of human attraction, I feel compelled to point out the paradox that a machine made to mimic *some* of the human mind's activities has come to serve as the standard *against which* the human mind's activities – and *potential* – are measured. Despite all the marvelous advances in information-processing theory and technology – no, *because* of them – it would seem wise to avoid the temptation to think that we have finally reached the end of the road in understanding our mental life. To anyone with historical awareness and sensitivity, it should seem premature, as William James would put it, to assume that the final word has been spoken on this matter (see note 5).

I do not wish to be misunderstood. Even granting that its fruitfulness could be recognized only in a technologically advanced – and obsessed – culture, the information-processing metaphor (in its computationist and other guises) has been extraordinarily fruitful. It has even found its way into the study of personality (Powell, Royce, & Voorhees, 1982), the psychology of induction and creativity (Holland et al., 1986; Langley et al., 1987), and the philosophy of science (Thagard, 1988). My concern is focused not on what this metaphor and its derivatives offer, but on what alternative metaphors may be *cut off* if they are taken to be definitive. This is a basic motivating concern behind my own research on the use – and abuse – of metaphor in science. The *use* of metaphor is necessary and wonderful to behold; but the *abuse* of metaphor – its use as a tool of presumptuous prescription rather than tentative description – concerns me a great deal. At worst, the metaphors bandied about today with such confidence by psychologists and cognitive scientists may infiltrate public consciousness (and personal self-consciousness) and remain lodged there, long after these same psychologists and cognitive scientists have adopted a new set of metaphors. Do we really want our children and fellow citizens to think of themselves as more or less adequately networked information systems and computational devices? There are surely worse metaphors to live by, but *any* prescriptive metaphor is, I believe, one too many.

It should be obvious that I am very sympathetic when Lakoff and Johnson (1981) state that they

are not suggesting that there is anything wrong with using such [cognitive] metaphors. . . . [But] the metaphors of a science, like any other metaphors, typically hide indefinitely many aspects of reality.

The way ordinary people deal implicitly with the limitations of any one metaphor is by having many metaphors for comprehending different aspects of the same concept. . . . These clusters of metaphors serve the purpose of understanding better than any *single* metaphor could. . . . the insistence on maintaining a consistent extension of one metaphor may blind us to aspects of reality that are ignored or hidden by that

metaphor. . . . The moral: Cognitive Science needs to be aware of its metaphors, to be concerned with what they hide, and to be open to alternative metaphors – even if they are inconsistent with the current favorites. (p. 206)

Theirs is not the only such cautionary comment (see, e.g., Crosson, 1985; Weizenbaum, 1976; on the “high cost of information,” see Haraway, 1981–2; and for a critique of the “mind-as-machine paradigm,” see Lakoff, 1987, chap. 19). It should be added that history suggests that *no* metaphor, however mythologized, is likely to stifle all dissent and creative thinking. Thus, we can always expect that new metaphors will be found. Just how fair a hearing new metaphors will receive, however, will vary according to the degree of “true believing” that stands in their way.

Finally, having asserted this caveat, I must give credit where credit is due: Much of the recent revival of interest in analogy and metaphor has been spurred by those committed to the information-processing, computational-calculus, artificial-intelligence approaches to mental dynamics (see, e.g., Arbib, 1972; Boden, 1977, chap. 11; 1988, chap. 6; Russell, 1986; Sternberg & Rifkin, 1979).

- 36 Certainly, in comparison with the naive empiricism of some of his well-known scientific contemporaries, Freud fares well in this regard. Else Frenkel-Brunswik (1954), trained in the philosophy of science as well as in psychology at the University of Vienna in the late 1920s, was one of the first to note that “Freud, in contrast to some of his followers, was keenly aware of logical and epistemological problems,” including those pertaining to the conventionality of scientific definitions (p. 294). Relatedly, in a critique of Skinner’s (1954) criticism of Freud’s scientific method, Scriven (1956) argued that “the language of psychoanalysis . . . is very open-textured; it is a first approach. Being so, it runs the risk of becoming empirically meaningless, a ritual form of mental alchemy. But the *approach* is fully justifiable; and it is as wrong to suggest that Freud should have pinned his terms down to infant neurology or, by the ‘simple expedient of an operational definition,’ to physical and biological science, as it would be to insist that the founders of radio astronomy should have early said whether a radio star was a solid body or a region of space” (p. 128). More recently, MacIntyre (1967), among others, has pointed out the blindness of commentators who seem not to have noticed that, after all, “Freud brought to light and described a huge variety of hitherto unrecognized types of behavior,” thus giving psychology “a new subject matter to explain” (p. 252). He also noted that the ritualistic criticism regarding the untestability of Freud’s theory is simply false – much of Freud’s theory *has* been rejected and/or modified as a result of such testing. Other philosophers who have shown an increased interest in Freud’s work include Wollheim (1971) and the contributors to Wollheim (1974). Among the latter, Glymour (1974) explicitly defends Freud’s bootstrapping verification procedure, if not all of his logical arguments.

Meanwhile, Ricoeur (1970) and Spence (1982, 1987) represent a school of philosophers and psychologists who are taking a new hermeneutic approach to psychoanalysis, trying to elucidate the ways in which psychoanalysis represents an *interpretive* enterprise par excellence. Although some are critical of this new approach (see esp. Grünbaum, 1984, who presents an updated version of the old empiricist critique) and although others present a very different view of Freud’s work (see esp. Sulloway, 1979, who places Freud squarely *and only*

in the biological tradition), the hermeneutic understanding of Freud's work as essentially interpretive in orientation is more in line with Freud's intentions and background than these critics recognize or allow. As early as 1895 Freud realized that he was groping toward an approach that resulted in case histories that were more novelistic than scientific in format (Freud, 1895/1955a, pp. 160–1), and by 1896 he had already clarified that psychological processes involve "rearrangement" and "retranscription" of memory traces – that is, a "revision" of sensations, images, ideas, and words (see his letter to Wilhelm Fliess, 6 December 1896, in Masson, 1985, p. 207). When Freud subsequently remarked that psychoanalysis was concerned with *reconstructing* these same displaced "traces" into coherent stories in which the missing elements had been reinserted into their proper places (as he did in the famous case of Dora, 1905/1953b, e.g., pp. 16, 116, in which he used the concepts of "censors," "new editions," and "facsimiles" as well as "revised editions"), he was simply closing the circle of a long-standing position. That Freud himself studied the science of language and drew on relevant aspects of the philological tradition is clear (see Forrester, 1980), and that he was conversant with the philosophical literature – and was confident in his own epistemological position – is shown by his comment that he did not have to refer to Vaihinger's (1911/1924) work in order to legitimate his own use of "fictions." All sciences, Freud argued (1926/1959c, p. 194), depend on such "fictions." Most recent philosophers of science would agree, even if they would use different terms.

To review briefly three salient points in Freud's philosophy of science: (1) He did not feel that precise definitions should be the *sine qua non* of scientific work. In fact, he felt just the opposite – that premature definition serves only to retard open and unfettered research (see, e.g., Freud, 1914/1957a, p. 77; 1915/1957b, p. 117; 1917/1963, p. 304; 1925/1959a, pp. 57–8). (2) He did not feel that certainty is a necessary characteristic of science. In fact, he doubted that it could be reached. Instead, he proposed that science should aim for highly probable knowledge – for better and better analogies that provide ever closer "resemblances" and "approximations" of reality (see, e.g., Freud, 1895/1955b, p. 291; 1917/1963, pp. 51, 296). (3) He took a completely pragmatic approach to science. He freely admitted that his metaphorical concepts were "nothing but constructions," but he insisted that psychoanalytic practice showed them to be "necessary and useful constructions," at least for the time being (1917/1963, p. 326). He presumed that one must make many assumptions in order to get on with scientific work and that the way to justify any given assumption (or metaphorical conception) was simply "to see what comes of it. The outcome of our work will decide whether we are to hold to this assumption and whether we may then go on to treat it in turn as a proved finding. But what is it actually that we want to arrive at? What is our work aiming at? We want something that is sought for in all scientific work – to understand the phenomena, to establish a correlation between them and, in the latter end, if it is possible, to enlarge our power over them" (p. 100). Freud's criterion of psychological health was similarly pragmatic: It is "a practical question and is decided by the outcome – by whether the subject is left with a sufficient amount of capacity for enjoyment and of efficiency" (p. 457). Of course, he related this outcome to a metaphorical premise regarding the "relative sizes of the quota of energy that remains free" (p. 457).

- 37 Bettelheim's (1983) translation of this passage is less awkward and more apt: "In psychology we can describe only with the help of comparisons. This is nothing special, it is the same elsewhere. But we are forced to change these

comparisons over and over again, for none of them can serve us for any length of time" (p. 37).

That there was nothing unusual, so far as Freud was concerned, about psychology's reliance on metaphorical comparisons is made clear by these two passages:

I know you will say that these ideas [about "resistance" and "repression"] are both crude and fantastic. . . . more than that, I know that they are incorrect, and, if I am not very much mistaken, I already have something better to take their place. Whether it will seem to you equally fantastic I cannot tell. They are preliminary working hypotheses, like Ampère's manikin swimming in the electric current [in one of the founding studies in the science of electromagnetism], and they are not to be despised in so far as they are of service in making our observations intelligible. (Freud, 1917/1963, p. 296)

We need not feel greatly disturbed . . . by the fact that so many bewildering and obscure processes occur [in our scientific speculations]. . . . This is merely due to our being obliged to operate with the scientific terms, that is to say with the figurative language, peculiar to psychology (or, more precisely, to depth psychology). We could not otherwise describe the processes in question at all, and indeed we could not have become aware of them. The deficiencies in our description would probably vanish if we were already in a position to replace the psychological terms by physiological or chemical ones. It is true that they too are only part of a figurative language; but it is one with which we have long been familiar and which is perhaps a simpler one as well. (Freud, 1920/1955e, p. 60)

The critical "mechanism" of scientific creativity for Freud was, as he wrote to Sándor Ferenczi on 8 April 1915, the "succession of daringly playful fantasy and relentlessly realistic criticism" (quoted by Grubrich-Simitis, 1987, p. 83).

- 38 As he said elsewhere, "What is psychical is something so unique and peculiar to itself that no one comparison can reflect its nature" (Freud, 1919/1955d, p. 161). Freud was keenly sensitive to the need for multiple comparisons – and to the insufficiency of the ones he had so far located – from very early in his career. As he said, "I am making use here of a number of similes, all of which have only a very limited resemblance to my subject and which, moreover, are incompatible with one another. I am aware that this is so, and I am in no danger of over-estimating their value. But my purpose in using them is to throw light from different directions on a highly complicated topic which has never yet been represented. I shall therefore venture to continue in the following pages to introduce similes in the same manner, though I know this is not free from objection (1895/1955b, p. 291). He made such statements throughout his career, as he struggled for more and more adequate analogs of the psychological processes he studied and dealt with. This was a never-ending struggle for him, not confined to his early works. In just three of the final pages of *The Ego and the Id* (1923/1961a), for instance, Freud compared the ego to a constitutional monarch, a servant of three masters, a psychoanalyst, a politician, and protozoans (pp. 55–7)!
- 39 Freud's love of antiquity and of Greek history and literature is well conveyed by Gay's (1976) text and the accompanying pictures of the ancient statues and other antiquities in Freud's Viennese home and offices. Indeed, it is for good

reason that Freud's thought has been studied in relation to Greek mythology, philosophy, and rhetoric (see, e.g., Mahoney, 1974; Tournay, 1965). Freud's relation to the classical humanist tradition – a tradition that is overlooked in Sulloway's (1979) attempt to reduce Freudian thought to its biological roots – is discussed by Bettelheim (1983) and by the contributors to Gedo and Pollock (1976). It is also elucidated in Rieff's (1979) masterful analysis. Among the various passages in which Freud indicated his debt to Plato, and specifically to Platonic myths, the following is particularly telling: "What psycho-analysis called sexuality was by no means identical with the impulsion towards a union of the two sexes or towards producing a pleasurable sensation in the genitals; it had far more resemblance to the all-inclusive and all-preserving Eros of Plato's *Symposium*" (Freud, 1925/1961b, p. 218).

- 40 To get a quick sense of the role of metaphors and analogies in Freud's work, see A. Richards's (1974) compilation of "some of the more striking of Freud's analogies and extended similes" (p. 179). On Freud's metaphors, see, e.g., Badalamenti (1979), Bloom (1982), Browning (1987), Derrida (1978), Edelson (1983), Erdelyi (1985), Mahoney (1982, chap. 5), Nash (1962, 1963), Pederson-Krag (1956), Shengold (1979), Spence (1987), and Wilden (1980). On the psychoanalytic approach to metaphor, see Rogers (1978).

One of Freud's fundamental metaphors – "translation" or "transcription," used in reference to the revision of one's life story that takes place in the course of psychoanalysis – was mentioned in note 36. Another fundamental metaphor, or rather family of metaphors, comes from archeology (see note 41). Another has to do with the analogies between the ontogenetic development of the individual and the phylogenetic history of the human race (see, e.g., the subtitle and analysis of Freud, 1913/1955c, and the title and analysis of Freud, 1915/1987). And, of course, Freud's metaphorical transformation of thermodynamics into psychodynamics is signaled throughout his work in such passages as "The prime factor is unquestionably the process of getting rid of one's own emotions by 'blowing off steam'" (Freud, 1905/1953c, p. 305).

- 41 Despite (or perhaps because of) Freud's frequent changes in what might be called his "surface metaphors," we can see a smaller set of "deep metaphors" that persist, with amendments, throughout the development of his thought. This suggests a difference between metaphors that are relatively more expository or elaborative and those that are more basic, though I would not want to reduce expository metaphors to nonconsequential status. One example is Freud's reliance on the archaeological metaphor – or family of metaphors – according to which the mind is like an archaeological dig, with various layers or historical sediments being buried at different levels (though because of occasional upheavals they are sometimes displaced in relation to the original line of sediment) and being "unearthed" and "reconstructed" in the course of psychoanalysis. This basic metaphorical scheme, which clearly oriented Freud's aptly designated "depth psychology," was obvious as early as 1897 (see Freud's comments and drawing in Masson, 1985, pp. 246–8), and it was still critical at the end of his career (see, e.g., Freud, 1930/1961c, pp. 69–71). Regarding Freud's abiding interest in archaeology, including Heinrich Schliemann's highly suggestive discovery of the many-layered city of Troy, see Bernfeld (1951) and Gay (1976).

The fact that Freud readily changed *his own* metaphors does not mean, of course, that he always welcomed changes made or suggested by others. Although he certainly had the right to argue for his own preferred concepts

and theories, his tendency to be dogmatic toward others in this regard is not easily justified. However, though Freud sometimes fell below the mark that many of us would endorse at our point in time, the personal, interpersonal, and historical contexts of Freud's dogmatism – not to mention the character of this dogmatism itself – have not yet been adequately assessed. Meanwhile, Gay's (1988) recent work compensates for earlier treatments of this matter.

- 42 This is not to deny that many of his followers – and many commentators on psychoanalysis – have been less careful, nor that Freud himself was occasionally less careful, nor that Freud's rhetoric at times invited misunderstanding. For example, Freud's frequent and graphic use of synecdoche (e.g., labeling developmental stages, which he had already shown to be much more complicated, as simply "oral," "anal," "phallic," and "genital") both aided the popularization and encouraged the trivialization of his ideas (see Rieff, 1979, pp. 44–5). But a distinctive aspect of Freud's rhetoric is his almost obsessive criticism and qualification of his own metaphors (see, e.g., Freud, 1900/1953a, p. 536; 1913/1955c, pp. 160–1; 1917/1963, pp. 295–6; 1919/1955d, p. 159; 1926/1959c, pp. 194–5, 254; 1930/1961c, pp. 70–1, 144; and Freud's appreciative footnote quotation from Sir James G. Frazer in 1913/1955c, p. 108). Freud continually pointed out the *disanalogous* dimensions of his metaphors – where and to what extent they fell short of the mark. Unfortunately, as Mahoney (1982) has noted, "All too often, commentators paraphrasing Freud leave out the figure of speech, the *what if*, the *possible* or *probable*, by which his own statements are qualified, thus obscuring the suppositional character of the original" (p. 117).
- 43 Perhaps I should clarify that I am neither for nor against psychoanalysis *per se*, but I am appreciative of Freud's broadening and deepening of psychological understanding and of his insight and courage regarding metaphorical and analogical thinking. I hardly presume that Freud's metaphors are definitive, but I have no doubt that he pursued and shed light on topics of great significance and relevance.
- 44 James (1878/1983a) reached the conviction that analogical thinking is fundamental to human knowledge, including science, very early in his career: "Every phenomenon or so-called 'fact' has an infinity of aspects. . . . What does the scientific man do who searches for the reason or law embedded in a phenomenon? He deliberately accumulates all the instances he can find which have any analogy to that phenomenon, and, by simultaneously filling his mind with them all, he frequently succeeds in detaching from the collection the peculiarity which he was unable to formulate in one alone. . . . our only instrument for dissecting out the special characters of phenomena, which . . . are [then] used as reasons, is this association by similarity. . . . the mind in which this mode of association most prevails will . . . be one most prone to reasoned thinking" (pp. 12, 21–2, italics deleted).

A mind *less* prone to analogical thinking is more prone, according to James, to "association by contiguity," which is to say, to a mental life constituted by sequences of thought that are automatically, or irrationally, determined by the past order of experience. James (1880) described this latter, "non-thinking" type of mind as "dry, prosaic, and matter of fact" – in a word, "very literal." Human intelligences of such a "simple order" are, he said, "slaves of habit" who "take the world for granted" (p. 456). "But turn to the highest order of mind, and what a change!" (p. 456). Here, "instead of thoughts of concrete things patiently following one another in a beaten track of habitual sugges-

tion," there are "the most abrupt cross-cuts and transitions from one idea to another, the most rarefied abstractions and discriminations, the most unheard-of combinations of elements, the subtlest associations of analogy; in a word, we seem suddenly introduced into a seething caldron of ideas, where... partnerships can be joined or loosened in an instant, treadmill routine is unknown, and the unexpected seems the only law" (p. 456).

Interestingly, James (1883-4/1988) noticed that, although "the world may be a place in which the same thing never did & never will come twice," the human mind nonetheless constantly tries to find similarities among these ever-novel phenomena. Indeed, instead of the "psychological principle of sameness," James suggested that it would be more precise to speak of the "law of constancy in our meanings," which he took to be "one of the most remarkable features, indeed one might well say the very backbone, of our subjective life" (p. 285). It is only through the operation of this "law," James argued, that generalization, abstraction, reasoning, and other forms of higher cognition can take place.

This emphasis on the centrality of association by similarity - or analogical thinking - continued throughout James's works, including his philosophical works. Regarding metaphysical knowledge, for example, he agreed with Harald Höffding (1905a,b) - and foreshadowed Stephen Pepper (1928, 1942) - when he argued that "all our attempted definitions of the Whole of things, are made by conceiving it as analogous in constitution to some one of its parts which we treat as a type-phenomenon" (James, 1905, p. xi).

In corroboration of points made elsewhere in this chapter, it is relevant to note that James agreed that (1) mathematics, as well as classification and logic, is fundamentally metaphorical, that is, based on comparison or analogical thinking (see James, 1890, vol. 2, pp. 641-69); (2) our terms and concepts for mental phenomena are derived from physical analogs (see James, 1883-4/1988, p. 256; for a possibly influential precedent, besides Locke, see Emerson, 1836/1983a, p. 20); (3) alternative theoretical frameworks can be simultaneously verified (see James, 1890, vol. 2, p. 312; 1907/1975, p. 104); (4) human understanding, or knowledge, can be usefully considered to be a "translation" of "sensible experiences into other forms" (see James, 1890, vol. 2, pp. 640, 669); and (5) the disanalogous dimensions of metaphorical comparisons must be clarified along with the analogous dimensions (see, e.g., James, 1890, vol. 1, pp. 6-7, and note 49).

- 45 Early on, James (ca. 1879/1978) recognized that "universal acceptance" is the "only mark of truth which we possess" (p. 360). Pointing toward a sociology of knowledge, he came to realize how complex and interdependent the matter of acceptance is: "You accept my verification of one thing. I yours of another. We trade on each other's truth. . . . All human thinking gets discursified; we exchange ideas; we lend and borrow verifications, get them from one another by means of social intercourse. All truth thus gets verbally built out, stored up, and made available for everyone" (1907/1975, pp. 100, 102).

Simplistic interpretations of what James meant when he spoke about an idea "working" or "paying off" have led to some grotesque distortions of the thought of one of the greatest intellects in American history - in philosophy as well as psychology. (Alfred North Whitehead, 1938, pp. 3-4, even argued that James was one of the four great intellects of the Western tradition, along with Plato, Aristotle, and Leibniz.) The social dimension of James's thought, as exemplified above by the notion of verification by social intercourse, has often been underestimated. Even though James emphasized the individual over the

- group, this does not excuse some of the simple-minded claims that have been made about James's disregard of the social nature of psychological phenomena, including knowledge. He was a leader, for instance, in arguing for the social dimension of the self (1890, vol. 1, pp. 293–6).
- 46 Although “the ideal of every science is that of a closed and completed system of truth” (James, 1890/1983c, p. 247), experience is ever open-ended, ever promising and yielding new phenomena and new aspects of phenomena (see James, 1890, vol. 1, p. 233; 1897/1979, p. 141). Thus, the quest for “‘absolutely’ true” concepts is an “ideal vanishing-point towards which we imagine that all our temporary truths will some day converge” (James, 1907/1975, pp. 106–7). We must remember that absolute truth is a goal, not an achievement, so that when we “lay hold of” reality from a particular “angle,” we will not unduly persist in treating reality “as if . . . it were nothing but that aspect” (James, 1890, vol. 2, p. 648; 1907/1975, p. 103). How far can and will nature be “remodelled” by human understanding? That is “a question which only the whole future history of Science and Philosophy can answer” (James, 1890, vol. 2, p. 671).
- 47 See, e.g., James (1878/1983a, pp. 35–6; 1884/1983b, pp. 152–3; 1890, vol. 1, pp. 26–7, 234–5, 288–9, vol. 2, pp. 450, 481; 1902/1985, pp. 380–1; 1907/1982; 1909/1986, pp. 374–5) and the metaphors highlighted in E. Taylor (1982, e.g., on p. 18). On the evolution of various “ensembles and families of metaphors” in James's work, see Osowski (1986). On the influence of James's “fluid symbols” (e.g., his famous analysis of and emphasis on the “stream of consciousness”), see Ruddick (1981).
- 48 On the Darwinian background of James's thought, see Hofstadter (1955), Perry (1935, vol. 1, chap. 27), R. J. Richards (1987, chap. 9), Russett (1976), Wiener (1949), and Woodward (1983). The classic exposition of James's thought is provided by Perry (1935), but for a more recent, lengthy explication and analysis, see Myers (1986); and for a much briefer summary of James's philosophical principles, see Suckiel (1982). Bjork's (1988) treatment is relevant insofar as it focuses on the centrality of James's cognitive theory to his overall intellectual position. In all of these works, it is rarely, if ever, noted that James was one of the first to see and to accept the larger significance of Darwinian natural selectionism. Darwin (1859/1964) convinced many, rather quickly, of evolutionism, but natural selection – Darwin's own theory of evolution – was not so quickly accepted (see D. Hull, 1973). Long before selectionism was accepted by the majority of biological scientists as one of the primary mechanisms of biological evolution, James (1880) had accepted it and was drawing out its implications for the theory of social evolution. One would hope that R. J. Richards's (1987, chap. 9) recent work will inaugurate a revival of interest in this aspect of James's work.
- 49 I mean “myth” here not simply in the more positive sense intended earlier in this chapter, but also in a more derogatory sense, according to which myth is the taking of an analogy or metaphor as an identity – and, by extension, the taking of its elaboration as a completely true story. Another way of saying this is that myths (in the negative sense) arise when people forget to say “like” or “as if” when proposing a metaphorical comparison and when they neglect to define the ways in which analogous things or processes are also *disanalogous* or *dissimilar*, as they are by definition as well as experience. For related discussions, see Burke (1935/1965, p. 97) and Turbayne (1970, esp. pt. 1). Royce's (1964) discussion of “encapsulation” – the taking of “one approach to reality

as if it were *the* approach" (p. 164) – is also relevant. You might also recall Thomas Carlyle's (1829/1971) comment on all the early-nineteenth-century talk about the "Machine of Society": "Considered merely as a metaphor, all this is well enough; but here, as in so many other cases, the 'foam hardens itself into a shell,' and the shadow we have wantonly evoked stands terrible before us and will not depart at our bidding. Government includes much also that is not mechanical, and cannot be treated mechanically; of which latter truth, as appears to us, the political speculations and exertions of our time are taking less and less cognisance" (p. 70). The modern preference for representing reality in terms of "differences and identities" rather than "comparisons and similarities" (a preference analyzed by Foucault, 1970, chap. 3) accounts, somewhat tautologically, for the contemporary tendency toward literalization, which is the modern version of mythical thinking. This preference for what Kant (1797/1974) called "distinctions" (the noting of differences and identities rather than comparisons and similarities) does not eliminate the actual process of comparison that underlies cognition, but it does tend to obscure it. With regard to the dangers of not discriminating between similarities and identities, it is interesting that Descartes (1628/1911a) began his first philosophical work with a warning against taking similarities as identities (p. 1).

James frequently pointed out the dangers of literalization – of taking metaphors as definitive, literal statements of truth. For example, regarding two of the major psychological theories of the nineteenth century, he wrote: "I do not mean to say that the 'Associationist' manner of representing the life of the mind as an agglutination in various shapes of separate entities called ideas, and the Herbartian way of representing it as resulting from the mutual repugnancies of separate entities called *Vorstellungen*, are not convenient formulas for roughly symbolizing the facts. So are the fluid-theories of electricity, the emission-theory of light, the archetype-theory of the skeleton, and the theory that curves are composed of small straight lines. But, if taken as literal truth, I say that any one of these theories is just as false as any other, and leads to as pernicious results. . . . Associationism and Herbartianism [like other scientific theories] are only schematisms which, the moment they are taken literally, become mythologies, and had much better be dropped than retained" (1884/1983b, pp. 147, 153).

James's caveat did not foreclose the tendency toward literalization. To give but one example, B. F. Skinner's (1938, 1981) radical behaviorism is founded – as is James's psychology, though with very different results – on the central Darwinian metaphors of variation, selection, and utility. Skinner supposes that there are spontaneous, blind variations in behavior, some of which are selected (i.e., reinforced) because of their utility. But despite the fact that he transfers Darwin's concepts from the context of phylogenetic history to that of ontogenetic development, and despite the fact that he applies these concepts to the arena of behavioral learning rather than that of biological speciation, Skinner makes no qualification in his literalist appeal to Darwinian authority. He is, he claims, simply drawing out the ineluctable consequences of Darwin's evolutionary theory. I would say that he is making an interesting and potentially informative extrapolation from Darwin's theory, but that he is mistakenly equating the evolution of species over millennia with the evolution of an individual's behavior over a single lifetime; and I would suppose that the conceptual framework adequate for the one will not be identically adequate for the other. It is precisely the specification of some of the major *differences* – that is, the specification of the extent to which variation, selection, and utility

are *not* preemptive concepts for the understanding of organic behavior – that would help fill in and round out Skinner's psychology.

What adds a bit of pathos to all this is the fact that Skinner uses Darwinian theory in support of a completely determinist view of human nature, a view that allows for no freedom or self-control, as traditionally understood. Once again we see an ironical conceptual boomerang. Darwin, you will remember, reached his theory by looking specifically at how human breeders control nature by *intentionally* selecting the characteristics they want to enhance in future generations. Now Darwin's metaphor of natural selection, which is based on the notion of human control over nature in the breeding of domestic animals, is used to support the argument that nature controls humans, and thus to discredit the very conception of conscious intentionality that grounded Darwin's theory.

James (1890), by the way, was more faithful than Skinner – or Darwin – to Darwin's originating insight. He explicitly used selection *by means of conscious attention* (or intention) to explain what he regarded to be the relatively small, *but very significant* amount of human freedom (chap. 26).

Regarding Skinner's attitude toward metaphor and Skinner's own metaphorical language, see Leary (1988a) and L. D. Smith (Chapter 7, note 4, this volume). Staddon and Simmelhag (1971), in their attempt to account for behavioral *variation* as well as behavioral *selection*, provide one of many examples of the amplification of the Darwinian metaphor that lies at the heart of Skinnerian psychology.

- 50 For instance, G. Stanley Hall, one of the founders of scientific psychology in America, felt as strongly as Freud and James about the analogical or metaphorical basis of all knowledge. In a manner reminiscent of both James and Emerson, Hall (1904) claimed that metaphors are among the mind's "first spontaneous creations" and that they provide the basis for the development of language, which is therefore essentially "fossil poetry." With reference to psychological knowledge in particular, Hall noted that through the "widening circle of objects and events" linked by metaphorical thinking, "scores of objects are no longer mere things of sense, but are words in the dictionary of psychic states and moral qualities" (vol. 2, p. 145). In saying this in his typically obscure manner, Hall had in mind the same fact noted by Locke, James, and others (see note 28 and the last paragraph of note 44): that psychological concepts such as "imagination," "apprehension," and "emotion," and moral concepts such as "dependability," "reliability," and "forthrightness," were drawn originally from physical analogs.

Whatever their similarity, Hall's approach was also markedly different from those of Freud and James. Rather than assume that there is always more than one salient metaphorical view of reality, Hall supposed that one particular metaphorical approach could be the definitively correct one. A monist rather than a Jamesian pluralist in this regard, he proposed his own recapitulation theory of psychological development as the ultimate scientific theory of human personality and character (1897, 1904, 1922). Transforming a metaphor into a principle, he extrapolated theories of childhood, adolescence, and aging from the premise that the phylogenetic history of the species provides a literal, completely accurate analog of the developmental stages in the life of the individual. Similar recapitulationist theories have been proposed by others in the history of psychology and have been much more influential than usually recognized. See Gould (1977a) for general background on recapitulationist

theory; see Sulloway (1979) on Freud's recapitulationism; and see Jung (1917/1966) and Piaget (1967/1971, chap. 4, esp. pp. 158-64; 1969) for other theories with recapitulationist elements that continue to attract attention. As for Hall's developmental theory, both its largely speculative nature and its spare empirical backing help account for its downfall.

- 51 Elsewhere, Cattell (1898) noted that the experimental psychologist's "regard for the body of nature becomes that of the anatomist rather than that of the lover" (p. 152). Though perfectly understandable, Cattell's choice of metaphors is emblematic of the professionalization of psychology (more hoped for than actual when Cattell wrote these words). No longer an "amateur" (or lover) of human nature, Cattell wanted to move beyond even T. H. Huxley (1898), "Darwin's bulldog," who for all his fierce commitment to science still felt that "living nature is not a mechanism but a poem; not merely a rough engine-house for the due keeping of pleasure and pain machines, but a palace whose foundations, indeed, are laid on the strictest and safest mechanical principles, but whose superstructure is a manifestation of the highest and subtlest art" (p. 311).

The loss of aesthetic feeling for one's subject matter – the dulling of the eye, as William Wordsworth (1814/1977) put it with special reference to materialistic science (p. 155) – is a loss of significant import, as both Darwin and James would have agreed (Leary, 1988c). Such aesthetic loss is frequently tied to the "overt" rejection of metaphoric language – and the "covert" or unrecognized use of empiricist metaphors, such as those associated with "taking nature apart" and "reconstructing it" with the "bare essentials," generally "from the bottom up." It is worth considering the nature of the supposed "nonessentials" that are omitted by and from classic scientific study and the actual and potential damage done to psychology – not to mention our scientific and technological culture – by their omission, especially since many of these "nonessentials" (e.g., emotional, aesthetic, and moral reactions and interests) are related to the so-called secondary qualities of experience that were banished from the realm of scientific theory and research at the time of Galileo, Descartes, and Newton (see Burtt, 1925/1954, esp. pp. 180-4, 231-9, 303-25; Koyré, 1950/1968, 1957). Although strides are being made toward returning these "qualities" to their rightful place in the realm, and study, of reality, we seem not to have tapped the full dimensions of the "human metaphor" (Sewell, 1964). With William James and others, I doubt we ever will, but we ought not close the door to the attempt: We ought instead to strive, through the metaphors we create and use, to enrich and empower rather than to restrict and desiccate human potential, experience, and action. Such enrichment and empowering would pay double dividends insofar as richness of experience and emotion are among the most important factors that enable and motivate metaphoric, or creative, expression (see MacCormac, 1986).

- 52 In fact, Cattell's near decade of "mental testing" left little more than a warehouse of meaningless data (see Sokal, 1987). In contrast, the works of Freud and James continue to be sources of theoretical ideas fifty and eighty years after the respective deaths of these two thinkers. It is also relevant that even an antimetaphorist leaves metaphorical traces, and in Cattell's case these traces have dug deeply into psychological practice. The empiricist rhetoric of scientific inquiry – like the methodological practices it corroborates – is age-old, but the rhetoric of modern psychological diagnosis and treatment is much more recent. Though this is a huge topic, what is most pertinent – and will

serve as an illustration – is the rhetoric (and myths) that grew up around Cattell's concept of "mental testing." From its original metaphorical basis in the "anthropometric" work of Francis Galton, the "psychometry" of the "mental testing" movement begun in America by Cattell was soon enveloped in a rhetoric of social doctoring and human engineering. Drawing attention and power from its numerous linguistic and conceptual references to the two most conspicuous fields in which modern science has proved its worth (medicine and engineering), an entire rhetoric of abnormal and clinical psychology was elaborated. As doctors tested for disease and engineers for stress, so psychologists came to think of themselves, and presented themselves, as being capable of testing for intelligence or insanity or any number of psychological properties. They were not simply *like* doctors and engineers; they *were* doctors and engineers, testing "patients" for "mental disease" and designing "solutions" for their "mental stress." More significantly, a whole set of practical routines has been tied to this conceptual framework – routines that still direct the professional activities of many psychologists, even though the conceptual framework itself (at least the portion drawing on medical analogs) has received some well-publicized criticism (particularly after Szasz, 1961). On the rhetoric of mental testing and of professionalization in general, see J. Brown (1985, 1986); on applied psychology earlier in this century, see O'Donnell (1985), Napoli (1981), and Samelson (1979); and on the development of psychology's (or more particularly, psychiatry's) professional jurisdiction over "personal problems," see Abbott (1988, chap. 10).

- 53 Such subtle movement from metaphorical to supposedly literal conceptualization of psychological phenomena is typical of the historical development of twentieth-century psychological rhetoric. The apparently pure, neutral psychological language mandated earlier in the century by the dominant positivist philosophy of science was always, deeper down, informed by comparative thinking (see note 10); and many of the theoretical arguments and developments over the past century have been the result of what might be called *analogical redescription* of psychological phenomena. For example, much of the turn-of-the-century awareness of, and framework for understanding, the phenomena of nonnormal psychology (e.g., regarding different levels of consciousness and dual personality) was "translated" into the new scientific language of psychology, with little acknowledgment, from psychic research (Leary, 1980b). Another example is provided by a truncated argument made by John B. Watson (1916) in his presidential address to the American Psychological Association. "It seems to me," he said, "that hysterical motor manifestations may be looked upon as conditioned reflexes" (p. 99). This is not an unreasonable analogy, and pursuing it might have enlightened our understanding of hysteria, but Watson slid without further justification from this suggestive analogy to a matter-of-fact declaration that "the conditioned reflex can be used as an explanatory principle in the psychopathology of hysteria" (p. 99).

This sort of linguistic sleight of hand, by which an analogical redescription is taken to be a new theoretical explanation, was noted in 1934 by a perceptive observer who complained that "psychology, for all its theories, has performed no miracles. It has renamed our emotions 'complexes' and our habits 'conditioned reflexes,' but it has neither changed our habits nor rid us of our emotions. We are the same blundering folk that we were twelve years ago, and far less sure of ourselves" (Adams, 1934, p. 92). Even those who would be more generous in their assessment of modern psychology and its effects will probably sympathize with this critique. Still, it is a measure of the success of

modern psychology's rhetoric that so many people now turn to psychology both in health and in distress. Indeed, many Americans now approach psychology as their predecessors approached religion. Not coincidentally, a great deal of religious rhetoric – for example, about the means of personal enlightenment and salvation – has found its way into psychological treatises.

The persuasiveness of twentieth-century psychology, like that of any other discipline, is clearly related to its choice of metaphors. By drawing on culturally salient and popular metaphors, psychologists have created a salient and popular discipline. I shall give three examples based on the fact that our culture places a high value on *efficiency*, that our society is *capitalistic*, and that we are obsessed with *technology* (facts that are admittedly interrelated): (1) In our efficiency-conscious culture, psychologists have used metaphors of efficiency at the very core of their thinking and rhetoric. Nurtured by the Puritan ethic as well as by the capitalist marketplace, the cult of efficiency has influenced both applied psychology (e.g., industrial and educational psychology) and more theoretical psychology (e.g., abnormal and personality psychology). As correlates of the metaphor of efficiency, with its criteria of economy of effort and directedness of purpose, “mental deficiency” became the effective synonym for subnormal mental functioning, while the leading of an “integrated” and “productive” life became the major criterion of psychological normality. (2) In this capitalist society, psychologists have given metaphors of productivity and exchange a prominent place in their analyses of social behavior. Although theories of social exchange (in social psychology) and theories of optimization (in behavioral psychology) have been given their mature form only in recent decades, the implicit assumptions of cost–benefit analysis have guided theoretical work in psychology for much longer. (3) In this technological society, psychologists have turned to cybernetic, computational, and other such analogs of neurological, cognitive, emotional, and behavioral functioning. (The computer is but one of many technical devices that have provided critical analogs for the theoretical ruminations of twentieth-century psychologists.) Clearly, no one would or could have thought of our senses, for example, as “signal detection devices” without the prior invention of radar, nor would the methodological and quantitative techniques necessary to study the senses as signal detectors have been available without the previous development of radar and similar technology.

On psychological efficiency and deficiency, see Goddard (1920), Hollingworth (1912, 1914), Judd (1918, chaps. 4 and 5), Witmer (1915, 1919), and Woodworth (1901). Dewey's (1896/1972a) description of “good character” as having as its first attribute “1. Efficiency, force. To be good for something, not simply to mean well” (p. 326), and his subsequent (1897/1972b) remark that “force, efficiency in execution, or overt action, is the necessary constituent of character” (p. 78), provide a context for his later (1900) concern about such things as “waste in education” (chap. 3). The “progressivist” cultural context of this “cult of efficiency” (as Callahan, 1962, has called it) is reflected in works such as that of E. H. Richards (1910), in Frederick W. Taylor's “Scientific Management Movement” (see May, 1959, pp. 132–6; Schwartz, 1986, chap. 8; F. W. Taylor, 1911), and in various educational concerns and reforms (see Callahan, 1962; Tyack & Hansot, 1982). The long-term legacy of this cult was still visible in the 1950s (see Wallin, 1956). Indeed, it is visible today, transmogrified into ergonomics, cost–benefit analyses, optimization theories, and so on, which continue to influence theories of individual and social behavior, both inside and outside psychology proper (see, e.g., Haraway, 1981–2; Wilson, 1968, 1971, 1975, 1978).

As I have indicated, optimization theories are related to earlier concerns about efficiency and come primarily from economic theory. The exchange metaphor is also rooted in economic (capitalist) theory and was introduced formally into psychology in works such as that of Thibaut and Kelley (1959). Regarding later developments, see Gergen, Greenberg, and Willis (1980). With regard to technological metaphors, see Pribram (Chapter 2, this volume) and N. Wiener (1961). The complete and fascinating story of the dialectic between ideas and devices in psychology – how ideas lead to the invention of devices and how devices lead to the modification and extension of ideas – has not yet been adequately told, though the interaction of thoughts and things (including in some cases political theory, daily patterns of behavior, and everyday technical devices) is beginning to be the focus of historical scholarship in other realms (e.g., Beniger, 1986; Gimbel, 1976; Landes, 1983; O. Mayr, 1986). The overlap between the American cult of efficiency and the American obsession with machines was well expressed in Santayana's classic analysis, "The Intellectual Temper of Our Times" (1913/1940), in which Santayana noted that in America (as opposed to Europe) "the mind is recommended rather as an unpatented device for oiling the engine of the body and making it do double work" (p. 17).

There is no *necessary* problem involved in drawing on culturally popular metaphors, but the dangers associated with it, especially the danger of literalization, are quite real: When metaphors seem "obvious," they can easily be "taken for granted" and can be very persuasive to a great many people. Furthermore, when a culturally prominent metaphor is literalized, this tends to legitimate as well as draw on cultural values and arrangements. To this extent, culturally based metaphors have ideological dimensions and political ramifications no less than do metaphors that purposely cut against the grain of standard cultural assumptions. In this situation it seems all the more important that theoretical metaphors be clearly seen and identified for what they are, namely, historically contingent modes of perception, cognition, and (so far as they are implemented) action. That well-socialized Americans tend to engage in social interactions in "capitalistic" ways, expecting a profitable – and perhaps a more than equitable – exchange of goods and services, should not be surprising. But to "prove" the validity of exchange theory by observation of *American* social-behavior patterns, and then to propose exchange theory *on this basis* as a *universal* explanation of human behavior, is to prescribe uncritically one particular cultural pattern as the "normal" mode of human behavior. This not only canonizes one particular cultural arrangement, it shields it from criticism and by implication damns alternative social arrangements as "unnatural," deviant, or less than optimal. The case is similar regarding other sorts of metaphors. For example, our culture favors novelty ("signals" or "messages") over constancy ("background noise"), and we learn to focus, to think about, and to study our senses accordingly. But "signal detection" hardly exhausts the range and possibility of sensory experience.

Still, have signal detection theory and social exchange theory helped us understand, control, and even extend certain dimensions of our experience? Absolutely. And provided that they are not seen as definitive, they even provide the grounds for a *critique* of our sensory and social experience. But insofar as they become prescriptive, they narrow rather than expand our options, and there, I believe, is the rub: metaphor, yes; prescription, no.

A historiographical postscript: The intimate connection between culture and psychology that is so obvious *in* metaphor – and instrumentally accomplished, in part, *through* metaphor (see MacCormac, 1985, p. 2) – makes metaphor an

extremely useful tool for the historian who wishes to study the impact of culture upon psychological theory and practice and the converse impact of psychology upon culture. The latter influence results from the energizing and popularizing that can begin within the domain of psychology, as, for instance, when Freud helped make awareness – or the supposition – of sexual motives, dream symbols, and various sorts of symptoms and defenses part of our cultural heritage. Although more strictly academic and scientific psychology has had less obvious influence on culture at large, it has contributed to our culture's sensitivity to the ways in which our lives are "shaped" by the environmental "reinforcements" that we receive. Indeed, the entire Head Start Program and much of the Peace Corps movement have been energized by hopes and techniques derived at least in part from academic psychology. The historical charting of this mutual influence of psychology and culture, which is surely dialectic, constitutes one of the major challenges for historians of psychology. As this history is charted, the old distinctions between intellectual, social, and cultural history will become less and less useful, and metaphor will be seen as one of the sinews that bind this history together.

The degree of intimacy between cognition and culture is reflected in the title of a recent book that focuses on cultural models *in* rather than *of* language and thought (Holland & Quinn, 1987), and it is clearly implicated in Geertz's (1983) call for an "ethnography of modern thought."

- 54 Or what we can call, more simply, the human imagination. The modern ambivalence toward the "imagination" as a presumptive human faculty has been well documented (see, e.g., Costa-Lima, 1988; Engell, 1981; Gay, 1969, pp. 208–15; Johnson, 1987; Kearney, 1988; Schulte-Sasse, 1986–7, 1988). Even though science contributed in some ways to a rediscovery of the imagination (see Rousseau, 1969), it is nonetheless true that the imagination has generally been considered to lack the methodological rigor and reliability demanded by science and, consequentially, that the imagination is a "faculty seldom encountered in modern treatments of analogy in science" (Park et al., 1984, p. 287). However, the imagination's fortunes seem to be changing. (In this regard, see all the works previously cited in this note as well as Boulding, 1956, chap. 11; Hesse, 1955; Holton, 1978; Koestler, 1964; Ricoeur, 1979.) I hope this trend continues. An unembarrassed admission of the reality and role of the human imagination seems to me to be perfectly in tune with the discussions of "fact, fiction, and forecast" (Goodman, 1954), "personal knowledge" (Polanyi, 1958), "plans" (Miller, Galanter, & Pribram, 1960), "foresight and understanding" (Toulmin, 1961), "the logic of scientific discovery" (Hanson, 1961), "conjectures and refutations" (Popper, 1963), "posit and reality" (Quine, 1966), "paradigms" (Kuhn, 1970), "the thematic imagination in science" (Holton, 1973), "ways of worldmaking" (Goodman, 1978), "the construction of reality" (Arbib & Hesse, 1986), "science as creative perception-communication" (Bohm & Peat, 1987, chap. 2), "constructive realism" (Giere, 1988), and "imagistic and analogical reasoning" (Nersessian, *in press*) that, from my perspective, express the central thrusts and trajectories of recent and current musings about the nature of knowledge and science. It is not only the "poet's pen" that gives "shapes" to "things unknown." The scientist too has an imagination that "bodies forth the forms of things unknown" and gives to them a "local habitation and a name" (Shakespeare, 1598/1936, p. 406). The scientist too is a "maker." Indeed, the modern scientist has demonstrated the awesome truth of Wallace Stevens's (1930–55/1982) contention that "the imagination is man's power over nature" (p. 179).

That I turn to poetry to express the heart of the matter is no accident. As Sewell (1985) has argued, the sooner the "uneven dance" between psychology and poetry is choreographed, the better; and as Asch (1958) noted years ago, the study of metaphor could contribute not only to "our knowledge of cognitive functions" but also to a "lessening of a gap that has, too long, continued between psychology and the humanities" (p. 94). Indeed, psychology, like science more generally, is one of the humanities – one of the major products of the human imagination. We should remember, ponder, and act according to this fact. John Dewey (1891/1969), in arguing that "we must bridge this gap of poetry from science" and thus "heal this unnatural wound," said much the same thing: "This division of life into prose and poetry [or science and the humanities], is an unnatural divorce of the spirit" (p. 123).

In this context, it is symbolically apt that Marx Wartofsky concludes his too neglected (1979) collection of papers on representation and the scientific understanding with an essay titled "Art as Humanizing Process" (pp. 357–69). If we can understand more fully how art humanizes us, we can begin to fathom some of the less commonly recognized ways in which science can contribute to the expansion of human awareness, understanding, discrimination, choice, and action.

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