Metaphors in the history of psychology

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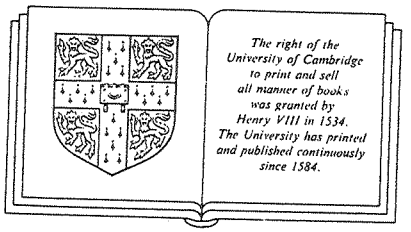

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Motives and metaphors: a study in scientific creativity

PAUL McREYNOLDS

My purpose in this chapter is to examine the role that metaphorical thought has played in the historical development of motivational psychology. The relation between motives and metaphors constitutes a particularly apt topic, since recently there has been growing interest in the significance of metaphors and analogies in scientific thought (e.g., Boyd, 1979; Gruber, 1980; Hesse, 1966; Kuhn, 1979; Leatherdale, 1974; MacCormac, 1985; McReynolds, 1980; Turbayne, 1962) and since the field of motivation is one of the most basic and venerable areas of psychology.

Rather than beginning with a predetermined conception of the utility of metaphors in motivational theorizing and then looking for historical instances that fit that conception, I will present a historical survey of different approaches to motivation, paying special attention to the use of metaphors and analogies, and I shall then draw such conclusions from the data as seem warranted. Though my survey is necessarily limited and selective, it covers a representative sample of motivational perspectives. Before beginning this survey, it will be useful to discuss briefly the concepts of motive and metaphor.

The concept of motive

Though a rigorous and completely defensible definition of motivation is not easily articulated, the general area demarcated by the term is clear enough, and theorists throughout history have found the notion of motive, or something like it, necessary for an explanation of behavior. If we think of behavior as being determined by factors of two kinds, those in

the organism and those in the situation, then motivation falls in the former category. Thus, motivational influences are those behavioral determinants that an organism carries around within itself into different environments.

A key term here is the word "behavior." Generally speaking, this term is taken to refer to actions that are in some sense optional for the organism. Thus, an animal may or may not eat in a given situation, a person may or may not go to a given social function, and so on. To say that a behavior is optional is not to assert that it is necessarily, or even probably, consciously intended; rather, it is simply to imply that within the range of realistic possibilities, including relevant species-specific tendencies, the occurrence of the behavior is problematic and is significantly determined by variable factors within the organism. In contrast, such "automatic" functions as digestion, respiration, and cardiovascular processes are not ordinarily thought of as "behavior," though they may be, at least under certain circumstances and to a certain extent. Broadly conceived, behavior consists of actions, movements, motions, whatever the animal as a *whole* animal (as contrasted with a particular organ of the animal) *does*, whether overtly or covertly.

Essential, then, to the notion of motivation is the idea of organisms *doing* things, and doing them in large part under their own steam, to put it metaphorically. Thus, we can think of organisms as being constituted so as to have the capacity to perform certain behaviors; yet without some internal impetus, some inner push or pull, some tendency toward actualizing its potential actions, an organism would merely exist, inert and inactive. To be sure, it could still respond, in reflex fashion, to the world about it, but it would lack the characteristic capacity of animate beings to adjust their behavior to internal needs and deficits. What we think of as motivational tendencies do not exist in the abstract, independent of their context. Rather, they come into play only under certain conditions. For example, the motive to drink arises in response to a water deficit, the motive to flee in response to a perception of danger, and so on.

These inner impetuses to behavior – individually, in toto, and in the context of the overall state of an organism – constitute the essence of the concept of motivation. The base paradigm or metaphor for the notion of motive, then, is that of a force within an organism that leads to certain movements – hence the term "motive," something that produces motion, or movement.

The durability and tenacity of motivational concepts derive from the fact that motivational interpretations, in one form or another, have proved to be essential to the explication of behavior. Yet the precise nature and source of most motives are highly obscure and, of course, were even more so in earlier times. This obscurity should not be surprising given that motives are internal factors largely hidden from direct inspection. As a result, the variety of motivational formulations that have been proposed through the ages is enormous, and many of these conceptions have involved complex metaphors. This suggests that metaphors are most likely to occur in areas of science in which important questions are combined with limited knowledge.

Another reason for the prominence of metaphorical patterns of thought in motivational psychology lies in the kind of problems that are dealt with in the study of motivation. The area encompasses (but is not limited to) the topics of intentional (purposive) behavior, choice behavior, perceptions of personal control, and intrapsychic conflicts, and such topics inevitably raise difficult conceptual issues, including the problems of free will and determinism. In coping with these and related problems, motivation theorists have sometimes turned to anthropomorphism (e.g., referring to the ego as if it were animate) and reification (e.g., treating the unconscious as if it were a thing). Such patterns of thought are frequently expressed in figurative language.

The relation between motives and emotions deserves a brief introductory comment. The distinction – and overlap – between these two concepts have always posed something of a puzzle, and some authors have treated them as essentially interchangeable. In the seventeenth century the notion of a "passion" included both conative and affective aspects, and in the contemporary period motivation and emotion are sometimes brought together in the same text and in the same journal.[1] The problem is not so much that motivation and emotion are in principle indistinguishable, but rather that they frequently occur conjointly. Certain strong emotions (e.g., love or anger) have obvious impellent functions, and, conversely, certain motivational processes (e.g., success and failure) may have conspicuous emotional concomitants. The answer to this apparent problem is to recognize that the same phenomenon may from one perspective be motivational and from another be affective. Thus, to the extent that a given emotional state has motivational qualities it is also a motive, and vice versa.

The concept of metaphor

A metaphor is a particular type of cognitive construction. Ordinarily manifested verbally, it relates two items, not typically conceptualized as similar, in a relatively surprising and sometimes dramatic fashion.[2] Metaphorical thinking is prominent in ordinary human discourse, in literature, and in the arts, as well as in the sciences. For example, such figurative expressions as "My job is a rat race" and "He's a chip off the old block" are part of the standard repertoire of contemporary American speech. In literature the use of metaphor – as when Carl Sandburg (1916)

refers to Chicago as "Hog Butcher for the World" (p. 3) and tells us that "The fog comes/on little cat feet" (p. 3) – is particularly striking and perhaps essential. Metaphor also plays a role in the arts. In painting, for instance, cubists saw the world as composed of cylinders, cones, and spheres, and in music a well-known composition is commonly referred to as the "Pastoral Symphony."

Though the utilization of metaphors was once considered relatively rare and somewhat inappropriate in the sciences, recent scholarship – as already noted – has strongly emphasized the prominent role that metaphors and analogies have played in scientific creativity. Instances are not hard to find. In the physical sciences one thinks, for instance, of August Kekulé's discovery of the structure of benzene on the basis of a dreamlike image of a snake gripping its own tail or of Lord Rutherford's hypothetical construction of the atom – as composed of electrons whirling around a nucleus – in terms of the structure of the solar system. An early and well-known metaphor in psychology, dating back to Plato and Aristotle, represents memory in terms of the impression of a seal on a wax tablet. A favorite contemporary psychological metaphor, in some quarters at least, is that of the brain or mind as a "black box."

The technical literature on metaphors, most of it concerned with logical and linguistic analyses and involving a number of conflicting interpretations and emphases, is enormous.[3] Fortunately, it is unnecessary for us to review this literature in detail here. Indeed, it is probably best to approach our historical survey without too many preconceived notions as to the nature of metaphors, lest those ideas inappropriately bias our search.[4] There are, however, several important introductory points to be made.

First, some comments on the usage of several words – in particular *simile, metaphor, analogy,* and *model* (as this term is used in science) – will be helpful. Each of these words refers to the comparison of two terms on the basis of similarity. In a simile the similarity is specifically stated, as in the expression "The brain is *like* a computer." If we change this slightly to suggest an identity, as in "The brain *is* a computer," we have a metaphor. And if we propose that the computer is in certain respects a representation of how the brain functions, we have made the computer a model of the brain. The term "analogy" is often employed when one wishes to draw attention to a relevant similarity between two things, while at the same time recognizing their differences. Note that all these uses are figurative. The brain is *not really* a computer; it does not have transistors, disk drives, and so on.

In practice the distinctions among similes, metaphors, models, and analogies are not always clear-cut. There is a growing tendency to employ the word "metaphor" as a generic term for all of the above dyadic expressions.[5] I will generally follow this convention in this chapter,

though my main emphasis will be on the identification of what are technically analogies, similes, and metaphors. The term "model," it seems to me, should be (and typically is) restricted to the more complex, deliberative attempts to construct predictive replicas (physical, conceptual, or mathematical) of given natural domains.

How do metaphors exercise their influence on thought? In what manner can metaphors be productive, as contrasted with merely clever? Some insight into these questions is afforded by the view of Burke (1945/1969) that a metaphor "is a device for seeing something *in terms of* something else" (p. 503). Thus, to say that "the brain is a computer" is to lead one to think of the brain *from the perspective of* what computers are like: It causes one to conceptualize the brain in a new way. Similarly, the metaphorical expression "Sue has a warm personality" yields a quite different picture of Sue than the expression "Sue has a cold personality."

The essence of a metaphorical construction, in action, is that a person is interested, for one reason or another, in a given idea or topic, X, and elaborates this idea or topic by combining it with or relating it to another idea or topic, Y, thus extending or modifying the meaning of X. For this combination to qualify as a metaphor, it is further required that X and Y be from content areas that are not normally linked, so that at first their conjunction may seem paradoxical, or even absurd. The reason they *can* be linked, in spite of this disparity, is that they can be conceived as having *something* in common, and it is when one perceives what this commonality could be that he or she "gets" the metaphor. It is through this commonality that the meaning of X is modified by seeing it from the perspective of Y. Thus, in the utterance "John is a dormant volcano," it is clear that the person John (X) is not actually a dormant volcano (Y); but if it is perceived that the function of the expression is to imply that while normally John is placid he has the capacity to react violently, then this metaphorical characterization has successfully led to an elaborated and enhanced understanding of John. Writers on metaphor have employed a variety of terms to designate what I have referred to simply as X and Y. I find the labels proposed by Leatherdale (1974, p. 16), "topic analogue" and "imported analogue," to be particularly helpful, and I will employ these terms from time to time.

Metaphors sometimes undergo stages of development. In some instances this means that over time a metaphor comes to be taken literally.[6] For example, the expression "Man is a machine" was originally intended metaphorically, but is now believed by some persons to be a literal truth. Another similar, but subtly different type of change occurs when a "live" metaphor becomes a "dead" one, as exemplified by the short history of the term "skyscraper," which once had a certain shock value but which soon came to be used in reference to any tall building.[7] All languages are well stocked with such dead metaphors. Indeed, Jeremy Bentham insisted

early in the nineteenth century that all strictly psychological terms in the common language were once figurative expressions based on corporeal analogies (McReynolds, 1970; Ogden, 1959).

It is useful to classify metaphors according to the extent of their coverage or application. In this regard two types have been distinguished. Pepper, in his *World Hypotheses* (1942), delineated the concept of "basic analogy or root metaphor" (p. 91), which can be contrasted with other, more specific metaphors. A root metaphor is a conception of broad theoretical generality that suggests, by analogy, other similarly broad conceptions. Although Pepper did not give a name to the more frequent, less encompassing metaphors, MacCormac (1985), following Pepper, has proposed that the broader class be termed "basic metaphors" and that the other, less encompassing class be called "conveyance metaphors" (p. 19). A basic metaphor, in MacCormac's dichotomy, serves "as a basic presuppositional insight or intuition that undergirds an entire theory." A conveyance metaphor, in contrast, is "employed to express a particular feeling or to suggest an individual possibility" (p. 19). As an example of a root or basic metaphor, MacCormac cites the computational metaphor, which has recently led to a variety of formulations regarding cognitive processing.[8]

What are the functions of metaphors in science? Park, Daston, and Galison (1984), in their stimulating discussion of the employment of analogies by Bacon, Galileo, and Descartes, distinguish between the use of analogies as vehicles for scientific explanation and their use as vehicles for scientific exposition. Thus, Galileo, though a master of expository analogies, tried to avoid their use in explanation, whereas Descartes emphasized their explanatory role. Of the two types, explanatory analogies are the more exciting to the historian because of their role in scientific discovery. What frequently appears to happen is something like this: A scientist trying to make sense of an inadequately charted domain finds that the conventional way of conceptualizing it leaves important issues unresolved, and then comes up with a way of seeing a particular problem as analogous to something from an entirely different domain, thus putting the whole matter into a new perspective. Sometimes this is helpful; sometimes it is not.

Metaphors in motivational psychology

Having examined the concepts of motives and metaphors, we are now ready to bring the two together in a primarily historical perspective. My approach will be to focus on certain key instances of metaphorical thought in the history of motivational psychology, since it would be impossible to trace this history comprehensively in a chapter-length study – and since, in any case, this would not necessarily be the best way to proceed, even if space permitted. In other words, I shall identify and describe what I conceive to be the major root or basic metaphors that have historically been involved in human motivation theory, and I shall organize my subsequent discussion in terms of these.

I discern five such underlying metaphors, though I do not insist that my list is absolutely comprehensive. Motivation is a very intricate affair, and efforts to fathom its mysteries have resulted in innumerable currents and cross-currents of thought. As a result, no reasonably finite set of categories can guarantee a definitive taxonomy of this highly complex and confused area. Certainly there is no single theme, except perhaps something that would be so broad as to be ineffectual, under which all motivational conceptions can be ordered. Even with my fivefold conceptualization there will be instances in which it is unclear whether a given conception fits into one category or another, as well as cases in which a particular motivational conception has some of the characteristics of two or more metaphoric themes.

The five basic metaphors of motivation that I propose are the following:

1. Controlling powers: persons as pawns[9]
2. Personal control: persons as agents
3. Inherent tendencies: persons as natural entities
4. Bodily processes: persons as organisms
5. Inner forces: persons as machines

These five basic metaphors can be thought of as the guiding themes in terms of which motivation theorists have tended to develop their conceptualizations.[10] In the following sections of this chapter, I will examine each of these themes, focusing on the use of metaphors in various motivation theories rather than on the theories themselves. Within each section, I will also include, as appropriate, instances of less encompassing (conveyance) metaphors.

Controlling powers: persons as pawns

It seems probable that human interest in the determinants of behavior reaches far back into prehistory, virtually to the dawn of the species. Our knowledge of the earliest conceptions of what we now term motivation is, of course, extremely sparse, but we can draw certain plausible inferences. It seems certain, on the basis of anthropological and linguistic analyses, that the present naturalistic era, which began in the first millennium B.C., was preceded by a long period during which the occurrence of important events, including significant human actions, tended to be attributed to the influences of "higher," supernatural powers.[11] Though it is not clear how widespread this pattern of thought was, it is evident, as I will document presently, that it was once very prominent. When applied to human

behaviors, it amounts to a theory of motivation in which the basic paradigm is that the decisions an individual makes, when faced with important choices, are determined by the influences on his or her mental processes of certain controlling deities.

This conception of action, though present in a wide variety of early peoples, including the Norse, Slavs, Anglo-Saxons, Celts, ancient Persians, and Aryan invaders of early India, has been most definitively revealed in the works of Homer. As the classical scholar R. B. Onians (1951) put it:

> In Homer, one is struck by the fact that his heroes with all their magnificent vitality and activity feel themselves at every turn not free agents but passive instruments or victims of other powers.... A man felt that he could not help his own actions. An idea, an emotion, an impulse came to him; he acted and presently rejoiced or lamented. Some god had inspired or blinded him. (p. 303)

The same theme has been articulated by other authorities on the history of ideas, including E. R. Dodds (1951), who employed the term "psychic intervention" to refer to the conception of higher powers interfering with the course of behavior, and by Bruno Snell (1953), who concluded:

> In Homer a man is unaware of the fact that he may act spontaneously, of his own volition and spirit. Whatever "strikes" him, whatever "thought comes" to him, is given from without, and if no visible external stimulus has affected him he thinks that a god has stood by his side and given him counsel. (p. 123)

There are many examples of this folk motivation notion in Homer, but I will indicate only one here. Early in the *Iliad,* the hero Achilles, angry at Agamemnon for having taken from him the fair-cheeked Briseis, is torn "whether to draw from beside his thigh the sharp sword, driving/ away all those who stood between and kill the son of Atreus [Agamemnon],/or else to check the spleen within and keep down his anger" (bk. 1, 190–2; Lattimore, 1962, p. 64). In this situation of uncertainty, the goddess Athene appears to Achilles and directs him to stay his ire.

The extent to which the actions of the characters in the *Iliad* are conceived to be determined or at least influenced by divinities was first systematically explored by Nilsson (1925/1967) and was developed further by Dodds (1951), Onians (1951), and Snell (1953). Barbu (1960) as well as Simon and Weiner (1966) have related the conception more directly to psychology. Barbu, for instance, observed that "the people described by Homer did not feel that the 'motives' of their behavior lay in themselves; on the contrary, they believed that their behavior was determined from outside, by the gods" (p. 75). More recently, I have utilized this metaphor in tracing the history of the concept of anxiety (McReynolds, 1975). It was Julian Jaynes (1976), however, who carried the psychological implications of the *Iliad* to their extreme. In his stimulating but speculative theory of the historical origins of consciousness, he has proposed that people of the Homeric age lacked consciousness and that their voluntary behaviors were exclusively a function of felt directives from a god.

This interpretation, however, seems quite implausible. Certainly, Homer's characters manifest an abundance of very human motives and drives. Indeed, if this were not the case, readers today would hardly find the poems so compelling. The episode referred to above – in which Agamemnon has claimed Briseis simply because he desires her and is powerful enough to take her and in which Achilles reacts ambivalently, revealing conflicting motives – provides two cases in point. In my view, the evidence, interpreted conservatively, strongly supports the view that an early conception of what we now call motivation presupposed that many human inclinations to act arise from the intervention of divinities, but it does not support the further interpretation, proposed by Jaynes and implied to some degree by the other scholars quoted above, that *all* human actions were conceived in this manner.

In summary, there seems little doubt that in the early period *many* human motives for action were conceptualized in terms of what I have labeled the controlling-powers metaphor. Answers to questions concerning when, where, and how this mode of understanding motivation originated are lost in the mists of prehistory, but the paradigm appears to have been utilized in a considerable variety of early cultures.[12] As a basic metaphor for motivation, the theme is, of course, fundamentally flawed in that it does not lead to precise and accountable theories. With the advent of the materialistic era in ancient Ionia and Greece, the approach tended to disappear, and it never attained the status of a systematically delineated conception of human behavior.[13]

Personal control: persons as agents

The motivational conception of people being in charge, so to speak, of their own behavior has a long past. However, the person-as-agent paradigm was not systematized until the classical Greek period. Since then, in its various representations and reincarnations, it has continued to be a viable approach. Though different aspects of this theme have been emphasized by different authors, the essential core conception is that an individual's behavior is a function of his or her having and exercising the capacity to make voluntary choices and decisions and to act purposively on them.

The early development of the person-as-agent motivational paradigm

occurred in what has been referred to by Jaspers (1953) as the "axial period" of human history, specifically in the era between 800 and 200 B.C. (see Parkes, 1959, p. 76). It was in this period that the earlier "preindividualistic" world view was succeeded, notably in the intellectual culture of the Greek world, by a conception of the individuality of human beings (Barbu, 1960, p. 71). This historical stage is thus to be strongly contrasted with the stage described earlier as underlying the higher-powers theme. With regard to human motivation, what we see in this transition is a shift from the assumption that important human decisions are made by the gods to the view that they are made by human beings themselves. Thus, the agency for important action was consciously and explicitly transferred from without to within.

According to the best classical authorities, the rise of individualism was stimulated and manifested by such lyric poets as Sappho and Pindar and by the great tragedies of Aeschylus, Sophocles, and Euripides. Snell, in his *Discovery of the Mind* (1953), and Barbu, in his chapter titled "The Emergence of Personality in the Greek World" (1960, chap. 4), have brilliantly described the dawning emphasis on internal human directives in classical Greek thought. This was the era of Socrates' concern with self-knowledge and of the admonition "Know thyself" over the entrance to the temple at Delphi. It was also the era of the first systematic psychological theories. Plato's was among the first.

Plato divided the soul into three parts or aspects: reason, high spirits (passions), and appetites. All of these have motivational significance, but it is the first – reason, or the rational mind – that corresponds ancestrally to the concept of personal agency. Plato was particularly interested in the relation of reason to the other aspects of mental life and motivation, and he portrayed this relationship with several striking metaphors. Perhaps the best known of these is the simile of the charioteer and two steeds (*Phaedrus*, 253–5; Hamilton & Cairns, 1961, pp. 499–500). In this simile, one of the horses is portrayed as highly spirited but manageable (passion), and the other as difficult and unruly (appetites). The charioteer, of course, represents reason. The point of the metaphor is that the charioteer (human agency), perhaps with some support from one of the horses (passion), controls the movement of the chariot. In other analogies, Plato compared the three motivational aspects to counselors (reason), helpers (passions), and money makers (appetites) in a city (*Republic*, 441; Hamilton & Cairns, 1961, p. 683) and to lovers of wisdom, lovers of honor, and lovers of gain (*Republic*, 581; Hamilton & Cairns, 1961, p. 808). One cannot know, of course, whether these metaphors were instrumental in the development of Plato's tripartite theory or whether their role was solely that of communicating his conception through vivid imagery. At minimum they performed the latter function.

Whereas the concept of human agency was only loosely delineated by Plato, it was spelled out explicitly and in considerable detail by Aristotle. In Aristotle's analyses the notion of agency entails the ideas of choice, end-oriented behaviors, and purpose. The following statements of Aristotle (ca. 335 B.C./1975) are illustrative: "It appears therefore . . . that a man is the origin of his actions . . . and all our actions aim at ends" (p. 139) and "The origin of the movement of the parts of the body instrumental to the act lies in the agent; and when the origin of an action is in oneself, it is in one's own power to do it or not" (p. 119).

Aristotle was more technical and less poetic in his writings than Plato. These facts, as well as the fact that Aristotle, coming after Plato, found knowledge more well ordered, may account for his less dramatic and apparently less frequent utilization of figurative language. Aristotle did, of course, employ metaphors.[14] With respect to the concept of agent, for example, Aristotle (ca. 335 B.C./1975) suggested that the process of deliberating about ends is analogous to the analysis of a figure in geometry (pp. 137–9). He also compared the process of an individual making a choice by and for himself to the procedure by which Homeric kings proclaimed decisions to the people (p. 141).

Since the time of St. Augustine, the notion of self-agency, in the sense of voluntarily choosing and intending, has often been discussed in terms of "the will."[15] Though this term is difficult to define in a rigorous manner and though it has been employed in a variety of ways by different authors, it typically carries the connotation of a distinct volitional power or faculty, as implied by "*the* will." In addition to Augustine, other prominent analysts of the will have been St. Thomas Aquinas, René Descartes, David Hume, Immanuel Kant, and William James. Perhaps in part because of its somewhat ambiguous and abstract nature, the history of the idea of the will is replete with metaphors, of which two may be noted here.

Pierre Charron, in his influential treatise *Of Wisdom* (1601/1707), contrasted the will with the nature of understanding and wrote with respect to the former, "Here the Soul goes as it were out of it self, it stretches and moves forward toward the Object; it seeks and runs after it with open Arms, and is eager to take up its Residence, and dwell with the Thing desir'd and belov'd" (p. 165). Edward Reynolds (1640/1971), writing a little later, conveyed his idea of will in the following way:

> the Will hath both an *Oeconomical* Government in respect of the Body, and the Moving Organs thereof, as over *Servants*: and it hath a *Politique* or Civill Government towards the *Understanding*, *Affections*, and *Sensitive Appetite*, as *Subjects*, with which by reason of their often Rebellions, it hapneth to have sundry conflicts and troubles: as Princes from their seditious and rebellious subjects. (pp. 541–2)

Though currently out of vogue as a topic of psychological inquiry, the term "will" remains a stable part of our language, as in such metaphorical expressions as willpower, weak willed,[16] and goodwill, and it continues to be a focal point in the ongoing discussion of free will.[17] Further, whereas concern with the faculty of will has faded in contemporary psychology, emphasis on the personal-control metaphor, in its broader sense, remains strong and indeed appears to be increasing.

Richard de Charms (1968), taking an individual-differences approach to personal causation, has employed the metaphors of Origins and Pawns to designate, respectively, individuals who feel that their behaviors are determined by their own choices and those who feel that their actions tend to be controlled by other persons or the environment. Julian Rotter (1966) utilized a spatial metaphor – locus of control – to differentiate similarly between feelings of internal (person-as-agent) and external (person-as-pawn) control. Another major contemporary metaphorical term that apppears to have at least some of the characteristics of self-agency is the concept of a Plan as introduced by Miller, Galanter, and Pribram (1960).[18]

The major current interest in the person-as-agent paradigm, however, has been in the form of philosophical examinations of the concept of agency (e.g., Harré, 1984; Harré & Secord, 1972; Taylor, 1977). Harré (1984) conceives of personal agency as a kind of release for potential action, and he has employed the following conveyance metaphor to elaborate his meaning: "In preparing to set off a race the starter creates a state of readiness in the runners with his 'Get Set.' The subsequent 'Go' can be thought of as a releaser" (p. 189).

Inherent tendencies: persons as natural entities

One of the oldest and still prevalent motivational conceptions is that people behave the way they do because it is *natural* for them to do so. Systems based on this root metaphor have difficulty explicating individual differences in behavior, but they do so to some extent by positing different natural behavior repertoires for men, women, and children. Conceptions of human nature – and hence of natural behavior – date back at least to ancient Sumer (Kramer, 1963), and there are numerous implicit allusions to the nature of man in Homer, in early biblical writings, and in the literature of early China and India.

It is important to emphasize that the term "natural" is not being employed here in the limited sense of "instinctive," "inherited," or "genetic." These concepts, reflective of more modern approaches to the continuity of human nature, were not involved in the formative stages of the inherent-tendencies metaphor, nor are they part of its essence. The reference of "natural," as applied to human beings, is simply to the way

people intrinsically are, as represented in Aristotle's (ca. 330 B.C./1947) statement that "all men naturally desire knowledge" (p. 3). That is, people seek to learn new things because it is natural for them to do so. In discussing human nature, which has always been taken to refer primarily to the motivational makeup of human beings, some authors, like Aristotle, have described certain posited natural motives, whereas others have simply asserted that certain desires or tendencies were implanted by God or by an anthropomorphized Nature.

Systematic discussions of natural motives were inaugurated in the classical Greek period. The Greek word that we translate as "nature" is *phusis*. The etymology of this term suggests that its original meaning, later metaphorically extended, was "manner of growth" (Adkins, 1970, p. 79). Aristotle developed a large catalog of natural desires and behavioral tendencies (Griffin, 1931), including desires for food, warmth, sexual relations, care of the young, and many others. The early Stoic philosophers were primarily responsible for developing a speculative taxonomy of the human passions. Their general model, concerned with supposedly natural motivational affects, lasted – with numerous additions and variations – for two millennia. History, then, has witnessed the postulation of a wide assortment of motives held to be inherent in human nature. I will spotlight several of these to illustrate the role of metaphors in the historical development of the inherent-tendencies theme.

First, consider the passion of love, a broadly construed human inclination of tremendous interest to Renaissance philosopher-psychologists. The following selection, which I give at some length in order to convey its overall context, is from *A Table of Humane Passions* (1620/1621), by the French philosopher Nicolas Coeffeteau:

> As it is the custome of men to refer the noblest effects to the most excellent causes; many considering the dignity of *love*, have imagined that this *Passion* came from a particular impression, which God makes in our *Soules*, inspiring into them with the *nature*, the affections which transport them, and which makes them seeke the objects which are pleasing unto them. The which they strive to prove by the example of the naturall inclinations which he hath given to other Creatures. Wee see, say they, that God as the Author of *nature,* hath ingrafted into light things an inclination to rise upward, to seeke the place of their rest, by reason whereof the fire doth always send his flame towards *heaven*. And in like manner hee hath imprinted in heavy things a naturall inclination which makes them tend to the *center*: so as stones, marbles, and such like, do always bend downeward, & do not hang in the aire, but with violence and contrary to their inclination. In the same manner, say they, God hath ingrafted in man a certain inclination to those things

> which have some beames of beauty or bounty, so as when these objects come to incounter his eyes or minde, he is ravished, and then presently there is framed in his heart an ardent desire to seek and pursue them. (pp. 83–5)

What is Coeffeteau's purpose in using this metaphor of "ingrafting"? It is not to introduce a new explanatory concept, or simply to clarify his exposition. I suggest that it is primarily *persuasive*, that is, to convince the reader of the plausibility of the view that the inclination to love is implanted by God. Coeffeteau tries to do so by showing that this proposition is analogous to something the reader (in that period) already took for granted, namely, the Aristotelean conception of upward and downward motion.

As a second example of metaphors used in the service of the inherent-tendencies theme, I refer to Coeffeteau's treatment of pleasure and pain. The passage, in the same book, reads as follows:

> As this great *Fabricke* of the heavens [19] makes his motion upon the two Poles of the world, which are as it were the two points where it beginnes and ends: So it seemes that all the Passions of our soules depend upon *Pleasure* and *Paine*, which grow from the contentment or distaste which we receive from the diverse objects which present themselves to us in the course of this life. (pp. 244–5)

The contention that pleasure and pain are the natural arbiters of behavior is an old one. Perhaps its best-known formulation is Jeremy Bentham's (1789/1948) metaphorical expression that "Nature has placed mankind under the governance of two sovereign masters, pain and pleasure. It is for them alone to point out what we ought to do, as well as to determine what we shall do" (p. 1).[20]

For my next illustration I am indebted to David Leary (1977), who has called attention to an interesting employment of analogy in George Berkeley's social theory. (The very fact that Berkeley, famous for his idealism, had a social theory will perhaps surprise many.) The essence of Berkeley's (1713/1955) position was an emphasis on the inherent nature of human sociability. To portray his conception, Berkeley drew a parallel between social tendencies and gravitational concepts as then recently codified in Newtonian theory. The following, somewhat truncated selection expresses the analogy:

> Philosophers are now agreed that there is a mutual attraction between the most distant parts at least of this solar system.... Now, if we carry our thoughts from the corporeal to the moral world, we may observe in the Spirits or Minds of men a like principle of attraction, whereby they are drawn together in communities, clubs, families, friendships, and all the various species of society. As in bodies, where the quantity is the same, the attraction is strongest between those which are placed nearest to each other, so is it likewise in the minds of men, *caeteris paribus*, between those which are most nearly related. (pp. 225–6)[21]

An important contemporary of Berkeley was Francis Hutcheson. Hutcheson, in company with a number of other philosophers of his period, in particular Shaftesbury, espoused a natural human tendency toward benevolence, or what today is termed altruism. Like Berkeley and practically all other savants in the early eighteenth century, Hutcheson was influenced by Newton. It is therefore not surprising to find Hutcheson (1725) framing the following comparison:

> This *universal Benevolence* toward all Men, we may compare to that Principle of *Gravitation*, which perhaps extends to all Bodys in the *Universe*; but, like the *Love* of *Benevolence, increases* as the Distance is diminished, and is *strongest* when Bodys come to *touch* each other.... This *increase* of *Love* towards the *Benevolent* according to their *nearer Approaches to our selves* by their *Benefits*, is observable in the high degree of *Love*, which *Heroes* and *Law-givers* universally obtain in their own Countrys, above what they find abroad. (pp. 198–9)

It is instructive that both Berkeley and Hutcheson employed gravitational metaphors to state their cases. Although it would be difficult to prove, it seems that it was through the creative use of analogies from Newton's conception of gravitation (its postulated universality and its inverse square law) that Hutcheson, like Berkeley, came up with the ideas he proposed concerning sociability and benevolence. In any case, it is interesting to note how Berkeley and Hutcheson utilized the then very recent Newtonian theory of gravitation and how, at an earlier time, Coeffeteau used the then prevailing Aristotelean conception of forces. Clearly, the specific comparisons made by these theorists reflected the historical contexts in which they lived.

My final illustration of a productive analogy in the naturalistic mode is less clear-cut, but very interesting. In the year 1692, Christian Thomasius, a leading figure in the German Enlightenment, proposed a model of personality that postulated four inherent human inclinations: sensuousness, acquisitiveness, social ambition, and rational love. The strikingly innovative aspect of Thomasius's conceptualization is that it was proposed along with a method of systematically applying numerical rating scales in the assessment of these four motivational variables (McReynolds & Ludwig, 1984). In addition, Thomasius reported quantitative information derived from five persons, including what amounts to reliability data concerning one case. This work appears to constitute the first documented systematic collection and analysis of quantitative data on actual subjects in the entire history of psychology.

Thomasius's approach to reliability – having the same person rated independently by two judges – was suggested to him by the following analogy, as expressed in his own words (translated and quoted in McReynolds & Ludwig, 1984):

> Just as in mathematics, where there is no better way to check to see if one has calculated correctly than to repeat the process two or three times in order to find out if the sum is the same, I have thought that in the discovery of other truths, regardless of what discipline it may be, this method might be the best way of checking [the accuracy of this science]. (p. 551)

An intriguing question is, Where did Thomasius get the idea of rating psychological dimensions? In addition, why did he utilize a sixty-point scale rather than a scale of ten, twenty or some other number of points? Although we can only conjecture, there is no harm in exploring possible clues. Most likely Thomasius got his basic idea from an analogy based on temperature scales. Though accurate and standardized thermometers had not been developed by 1692, the idea of linear temperature scales was well established and presumably well known to Thomasius.[22] The subsequent choice of a sixty-point scale may have been based on an analogy with time measurement as carried out by mechanical clocks. The number 60 has, of course, been significant in Western culture since it served as the base for the number system of the ancient Sumerians, but it was in the latter part of the seventeenth century that clocks began to have minute hands that marked off hours in sixty equal units.

In the modern era the inherent-tendency approach to motivation was afforded strong support by the writings of Charles Darwin (1859, 1871) and William James (1890), both of whom emphasized instinctive factors in behavior. Though instinct theories are now out of style, they have been succeeded by analogous ethological conceptions (see Eibl-Eibesfeldt, 1970; Klopfer & Hailman, 1967). Though ethologists have concentrated on animal behavior, their work has definite implications for human motivation. Other inherent-tendency approaches (e.g., Cattell & Child, 1975; Eysenck, 1967) have been largely assimilated into genetic conceptualizations, though only in a very preliminary way. At the level of folk theories of motivation, interpretations of behavior in terms of conceptions of basic human nature are commonplace.

Bodily processes: persons as organisms

The essence of the bodily-processes metaphor for motivation – that humans are animate, organic beings – does not preclude the simultaneous application of the person-as-agent, person-as-natural-entity, and person-as-machine guiding metaphors. Conceptions of the nature of animate beings have changed over the centuries, but this fact need not trouble us here, since our goal is not an ultimate specification of what life is, but a clarification of the role that conceptions of the living organism have played historically in motivational theory.

In this context it is important to note that an animate world view, in which all reality is interpreted as being alive and as possessing feeling and wishes, has been prevalent throughout much of human history. This view was not limited to primitive peoples or to early civilizations. On the contrary, as we will see shortly, it persisted in some degree until the eighteenth century. Such a perspective obviously facilitated attempts to interpret behaviors in terms of organic processes, as these were understood at different times and in different places.

An early, though limited, organismic conception of motives was offered by Plato in his *Philebus* (31d–32d; Hamilton & Cairns, 1961, pp. 1109–10). In this dialogue Socrates proposes that a state of distress in a living creature follows a disturbance of harmony and that the distress caused by such a state (e.g., hunger or thirst) leads to restorative efforts. This formulation is clearly an adumbration of modern physiological-deficit models of motivation.

Aristotle, primarily a biological theorist, was strongly oriented toward an organismic motivational perspective. In his *Movement of Animals* (ca. 340 B.C./1968), he employs a number of metaphors to elaborate the nature of motivated behavior:

> The movement of animals resembles that of marionettes which move as the result of a small movement, when the strings are released and strike one another; or a toy-carriage which the child that is riding upon it himself sets in motion in a straight direction, and which afterwards moves in a circle because its wheels are unequal.... Animals have similar parts in their organs, namely the growth of their sinews and bones, the latter corresponding to the pegs in the marionettes and iron [presumably a reference to a part of the carriage], while the sinews correspond to the strings, the setting free and loosening of which causes the movement. (pp. 463–4)[23]

A contemporary reader coming upon these words for the first time is likely to see in them an early instance of the person-as-machine metaphor. This, however, would be incorrect. The machine paradigm was still some two millennia in the future (about two thousand years separate Aristotle from Hobbes and Descartes), and Aristotle's purpose in employing a mechanical metaphor was not to insist that animals are actually machines, but rather, as a biologist, to portray the nature of animal movement by relating it to something familiar to his audience. The fact that passages similar to the one just quoted were put forward in the

seventeenth and eighteenth centuries to argue for a machine model illustrates how similar metaphors can be employed for quite different purposes and how the message intended by a metaphor is very much a function of its context.

The major organismic conceptualization developed in the ancient world was the theory of the humors. Originally systematized by Hippocrates as an explanation of diseases, it was later elaborated and extended by Galen and others to comprise a theory of temperament. The general notion of the latter theory, as is well known, was that certain temperamental orientations, such as cheerfulness and irritability, are determined by bodily constituents of the kind that we nowadays would label biochemical. Though primarily an affective theory, humorology also had obvious motivational implications. For instance, humoral theorists supposed that the amount of phlegm affected the vigor of actions. So far as humorology provided a motivational psychology, it is appropriate to note that Galen's original development of the fourfold-temperament conception in the second century A.D. appears to have been stimulated, at least in large part, by an analogy with Hippocrates' disease model – and that the latter was itself derived from the Greek conception of four primary organismic qualities (hot, cold, dry, and wet). These four qualities were transferred by Galen to the psychological realm when, for example, he attributed a quickly changing mind to an excess of bodily heat, emotional stability to coolness, and so on (Siegel, 1970, p. 210). These metaphors are still embedded in our common language, as when we say that a person is hot-tempered or is cool in the presence of danger.

As noted earlier, the concept of motivation encompasses the phenomenon of movement, and early writers who took the organismic perspective were especially interested in how animal motion could be explained. It was recognized very early – by the Hellenistic period and possibly before – that animal motion in some manner involves directives sent out from the brain by means of the nerves to the musculature, which in turn actually effect movement. A central problem in this analysis was the means by which the messages travel along the nerves. The question was not resolved, of course, until the modern era, with the understanding of bioelectric processes, but the intervening centuries brought forth a variety of speculations.

Galen conceived that some unspecified alteration in quality moves along the nerve, and he likened this to the manner in which light and heat are transmitted from the sun (Siegel, 1970, p. 194). The most general approach until the modern period, however, was to picture the nerves as tubes through which "animal spirits" pass from the ventricles of the brain to the muscles. As the muscles supposedly fill with animal spirits they expand, thus bringing about movement through an essentially hydraulic process (Esper, 1964, p. 100; Jaynes, 1970). As an example of this notion

of neural transmission, I quote briefly from an anatomy lecture given in 1620: "Nerves have no perceptible cavity internally . . . but their internal substance is continuous and porous, whereby it gives a passage to the animal spirit, which is exceedingly rapid in motion and is carried through this substance with an irradiant rapidity, just as we see light moving through air" (quoted by French, 1975, p. 15).[24]

Before closing this section, I wish to comment briefly on the origins of hydraulic analogies, which have played so great a role in motivation theory. Empedocles (fifth century B.C.), so far as written evidence indicates, was the first philosopher to apply the hydraulic notion to organisms. In his *On Nature* (Esper, 1964, p. 96; Leonard, 1908, p. 47, fragment 100; Worthen, 1970), he compared the functions of passages (tubes) within the body to the phenomenon of a girl holding a container ("a water-clock of gleaming bronze") under water with her hand over an opening so that the air within prevents water from entering. Empedocles' somewhat ambiguous simile, and the fact that he is traditionally associated with the development of the pneumatic school of medicine, suggest that his thoughts may have been instrumental in the eventual development of systematic hydraulic theories. We may more safely presume that the actual hydraulic and pneumatic apparatuses, as described by Hero of Alexandria (ca. A.D. 62/1971), were of suggestive value to early motivation theorists.

Hydraulic analogies, it would seem, have proved almost essential to motivational psychologists, and their day in the sun has hardly ended. Without elaboration and without specifying whether they support the person-as-organism or the person-as-machine root metaphor, I shall simply list a number of quasi-hydraulic analogies recently or currently employed in motivational theory: Freud's (1940/1964) conception of cathexes, in which libidinal energies, in order to be invested in one object, must be withdrawn from another object; Jung's (1928/1960) principle of equivalence, according to which psychic energy can be attached to one interest only if released from another attachment; Hull's (1943) motivation theory, which assumes that the forces from several motives sum up to yield an overall drive (D); Lorenz's action-specific energy model, in which different energy sources, conceptualized as figuratively filling a reservoir, build up pressure to bring about release (see Klopfer & Hailman, 1967, pp. 42–3); and my own theory of anxiety, which attributes the intensity of that affect to the level of unassimilated experiences (McReynolds, 1976). The most common example of a hydraulic motivational metaphor lies in the popular notion that people need to "let off steam" from time to time as the pressure from accumulated irritations increases.[25]

Clearly, the organismic approach to human motivation is highly prominent in contemporary psychology. This biological emphasis underlies

work on such topics as the role of hormonal factors, brain functions, and other physiological factors in behavior (for a review, see Mook, 1987). I should note too that there has been a concerted tendency to incorporate the organismic paradigm within the mechanistic paradigm.

Inner forces: persons as machines

The predominant contemporary motivational paradigm is based on the machine metaphor. People are conceived as machines, and the expression and interaction of motives are interpreted in terms of the operations and effects that characterize mechanisms. It is, to be sure, not easy to know precisely what constitutes a mechanism. There was a time when the word "machine" conjured up images of gear tracks, pulleys, levers, and the like, and perhaps it still does. Such a picture, however, is hardly adequate in a period in which the most sophisticated apparatuses include transistors, X-rays, and laser beams. Fortunately, it is not necessary for our present purposes that we have a rigorous definition of machines, since our concern is not primarily with machines per se, but rather with people's conceptions of machines.[26]

In this context let us briefly examine the history of the machine metaphor as applied to motivation and consider in particular how it came to be differentiated from the animate-being metaphor. For several millennia, probably since the beginnings of systematic human thought, there was a tendency (as we noted earlier) for people to attribute life, at least in some lower sense, to objects that we now consider inanimate. This perspective had remarkable staying power. For example, it was commonly assumed – and not just by the alchemists – that metals were in some sense alive. As late as the latter part of the seventeenth century, John Locke (ca. 1720/1877) wrote, "All stones, metals, and minerals are real vegetables; that is, grow organically from proper seeds, as well as plants" (p. 486). The animate paradigm began to be systematically supplanted by the mechanical paradigm in the seventeenth century, and by the nineteenth century the dominant world view, at least in the West, revolved around the machine analog. This transition, though somewhat abrupt in historical terms, did not occur overnight and is fascinating to study.

Today, with the dominance of the machine metaphor, we are likely to say that the human brain is like a computer, but in the transitional period, when the animate perspective was still powerful, one was just as likely to understand a physicalistic phenomenon by comparing it to something animate. For example, Arabian alchemists "compared the transmutation of diseased metals into gold to the medical cure of sickness. They thought of the furnace for the metal as if it were a hospital cot for the invalid" (J. C. Gregory, 1927, p. 301). Francis Bacon, though a strong harbinger of the developing mechanistic perspective, still thought,

as Gregory puts it, in terms of an "*inanimate equivalent* of animate behavior" (p. 304). Thus, Bacon conceived that "inanimate bodies had a 'kind of appetite' to choose the pleasing or avoid the unacceptable.... Water would hang in droplets to avoid discontinuance... gold leaves preferred the point of a finger to the neighbourhood of the atmosphere" (p. 304), and so on.

Perhaps the most intriguing instance of a physicalism-to-animism analogy is that believed to have been utilized by Newton (1687/1974) in the formative stages of his theory of gravitation. Though explicit documentary evidence is lacking, there is reason to believe that Newton's revolutionary insight grew out of analogies from the animate realm (see Dobbs, 1975; Guerlac, 1983; Manuel, 1968, pp. 73–4, 84–5; Westfall, 1980; see also Leary, Chapter 1, this volume). Before the *Principia*, the developing mechanistic philosophy of nature was framed in terms of particles in motion, acting directly on one another. Newton's epochal move was to posit that bodies attract each other at a distance, without necessary intermediary bridges. Though his notion was considered occult by many and had implications bothersome to Newton himself, its far-reaching influence cannot be doubted. How did Newton come upon such an idea? What was its germinal origin in his mind? Apparently, Newton reached this conception through analogical reasoning based on his intensive studies of alchemy, a field populated by such concepts such as "active principles," "attraction," "repulsion," and the "sociability"[27] of substances (Dobbs, 1975; Westfall, 1980). Ultimately, once his theory was further developed, Newton attributed the physical forces in the universe to God's will (Guerlac, 1983).

What factors led to the rise of the mechanistic world view and thus to a mechanistic conception of motivation in the seventeenth and eighteenth centuries? A partial answer seems to lie in the popularity during that period of lifelike, mechanically animated figures, or automata, which were sometimes found in public places. Such moving replicas of humans and animals, with their complex contrivances of wheels, cams, and levers, could well have suggested that humans and animals actually are machines, though somewhat more complex than the existent automata. Indeed, we know from Descartes's own testimony that analogies based on the automata found in the grottoes of Paris were instrumental in his conceptualization of animals as machines (Descartes, 1662/1972; Jaynes, 1970). This is particularly relevant testimony since Descartes's theories are usually accepted as seminal in the eventual development of the machine model.[28]

Nevertheless, and without depreciating the influence of automata, I am not inclined to assign them a singular role in the eventual triumph of the mechanistic world view. For one thing, seventeenth-century automata, though possibly more complex than those of previous eras, were hardly

novel. It is now well documented that complex machines, including intricate automata (Bedini, 1964; Brumbaugh, 1966; Chapuis & Droz, 1958; Hero, ca. A.D. 62/1971; McReynolds, 1971; Price, 1964) and even an early computer-like device (Price, 1959), existed in ancient Greco-Roman culture. Thus, it is clear that factors other than the mere existence of automata are necessary to explain the emergence of the machine paradigm.

It is fairly obvious what these crucial factors were. Specifically, they were (1) the development of a new conception of motion and (2) the spread of mechanical clocks, many of which involved automata, including human figures constructed to strike the hours. Since both of these factors were intimately involved in the development of the mechanical metaphor for motivation, I will discuss each of them separately.

First, the concept of motion. Aristotle had proposed a theory of motion that dominated thought up to and in some respects beyond the time of Galileo. This conceptualization emphasized the inherent capacity of animals to engage in self-initiated movement, in contrast to inanimate objects, which move only when pushed or pulled or when seeking their natural position. This last point is important: It was assumed that heavy objects such as stones naturally move downward toward the center of the universe (conceived as the center of the earth) and that light objects, such as smoke, naturally move upward. An important exception to these generalities was the movement of the heavenly bodies, which were thought to be animate. For them the natural movement was supposed to be circular. Further, the natural state of all terrestrial bodies was considered to be rest, so that for an object to be kept in motion it was presumed that continuous force had to be applied. (For a psychological analogy based on Aristotle's conception, see the quotation from Coeffeteau that is given earlier.)

This complex, but highly influential model ran into certain problems even in Aristotle's day, and it came under increasing attack in the late medieval and Renaissance periods. The new paradigm of motion, represented most definitively in the work of Galileo and Newton, emphasized rectilinear motion and the tendency of bodies to stay at rest or to continue in motion, as the case might be, and erased any underlying difference between the movements of terrestrial and heavenly bodies. The long-term effects of this revolution in the conception of motion were extremely far reaching. Butterfield (1957) even concluded that "of all the intellectual hurdles which the human mind has confronted and overcome in the last fifteen hundred years, the one most stupendous in the scope of its consequences is the one relating to the problem of motion" (p. 15).

This paradigm shift in the conception of motion had important implications for psychology, and especially for motivation theory. This is not surprising given that the term "motive," in its psychological sense, originally referred to the nature and sources of animal and human movement. The influence of the new conception of motion was particularly apparent in the seventeenth-century writings of Thomas Hobbes, who was strongly influenced by Galileo. Hobbes, working from an analogy with the role of motion in physics, developed a materialistic theory in which mental activity was equated with infinitely small motions, or "endeavors," in the nerves and the brain. The concept of "endeavor," as we noted earlier, was subsequently used by Newton (see note 27). As employed by Hobbes, it had a distinctly motivational cast, being used, for instance, to explain appetitive and aversive tendencies. As Peters (1967) has observed, "The postulation of these minute movements in the bodies of animals and men made the suggestion plausible that human action as well as the movement of projectiles can be explained mechanically. After all men move forwards and away from objects and each other" (p. 87).[29]

The second important factor in the rise of the mechanistic world view, and more particularly of the mechanistic conception of motives, was the spread of mechanical clocks. Though horological devices of various sorts, some of them quite complex, can be traced well back into the medieval and ancient periods, it was in the fourteenth century and thereafter that large, mechanical, weight-driven clocks began to appear throughout Europe. For some time the more prominent of the clocks included complex automata, thus reflecting the persistence of the animistic world view. During the sixteenth century, or perhaps even before, a new form of motive force – the use of metal springs that could be tightened – was developed. This made it possible to construct much smaller as well as portable clocks.

As clocks improved in accuracy and portability, and became more widely disseminated, they came to be viewed as amazing, miraculous, even lifelike devices. This attitude was vividly expressed in a rhetorical question asked by the philosopher John Amos Comenius (1657/1910): "Is it not a truly marvelous thing that a machine, a soulless thing, can move in such a life-like, continuous, and regular manner?" (p. 96). It is not clear, this long after the event, who first had the creative inspiration that the human mind, or at least the animal mind, might be thought of as analogous to a clock, but eventually the clock metaphor became very prominent in psychological thought. Among the many seventeenth- and eighteenth-century authors who utilized the clock metaphor in explicating human behavior were Hobbes, Descartes, and La Mettrie.

It is important to emphasize the special relevance of the clock analogy to motivation theory. This relationship derives primarily from the significance of metaphors that focused on the analogy between the sources of power in clocks and the motive forces in animals and persons. Thus, we find Comenius stating, with respect to early clocks, that "the weights are the desires and affections which incline the will this way or that" (p. 48).

Later, as clocks became more sophisticated, it was the spring (specifically the mainspring) that constituted the imported analog for conceptualizing motivation in mechanical terms. Thus, Julien de La Mettrie, in his influential *Man a Machine* (1748/1912), referred to the human brain as the "mainspring of the whole machine" (p. 135), and William Paley (1825) noted that "when we see the watch *going*, we see proof . . . that there is a power somewhere . . . that there is a secret spring . . . in a word, that there is force, and energy, as well as mechanism" (p. 525).

As I have proposed elsewhere (McReynolds, 1980), the clock metaphor, including the provision of an internal power source that keeps the mechanism functioning, was instrumental in delineating the conception of inner forces, or motives, in humans and animals.[30] Though the general notion of motivation is an old one, and medieval and Renaissance philosophers posited a motivational faculty ("motiva") to carry out the directives of the soul, the idea of motives as inner forces or impetuses had to await not only the elucidation of the concept of force by Galileo, Newton, and others, but also the specific analog of the spring-driven clock. By the end of the eighteenth century the term "motive," in its modern psychological sense, had come into general use (e.g., Bentham, 1789/1948, 1815/1969; Hutcheson, 1725; Locke, 1690/1959). It is interesting that the term "motive power" also came to be employed in physics (e.g., Carnot, 1824/1960).

As the dominant world view shifted from that of an animate perspective to that of mechanism (Dijksterhuis, 1969), it began to seem natural to conceptualize different aspects of reality in mechanical terms. Thus, even after the use of the clock metaphor declined in the eighteenth and nineteenth centuries, other machine-like analogs were used to sustain and advance the mechanistic model of motivation.[31] The essence of this paradigm, as it developed, was the assumption of internal conditions or states that automatically drive or impel an animal or person into given behavioral channels. These inner motive forces were conceived as arising mechanically and necessarily within the individual. The grand success of Newton's (1687/1974) gravitational theory suggested to various philosophers that concepts and approaches analogous to those employed by Newton might be productive in the human sciences. Earlier quotations in this chapter, from the works of Berkeley and Hutcheson, reflect this view. More systematic attempts to borrow creatively from Newton were made by Locke, Hume, Hartley, Kant, and Herbert (see Lowry, 1971).

The nineteenth century saw the rapid development of thermodynamic theory in physics, which fostered the further delineation of the concepts of energy and entropy. These concepts were adapted analogically by certain theorists. Both Freud (see Holt, 1968) and Jung (1928/1960) utilized the notion of psychic energy, and McDougall (1933) posited the existence of mental energy. The principle of entropy and the conservation

of energy contributed by suggestive example to a number of hydraulic motivational models, as discussed earlier in this chapter.

Coming to the present period we find that motivation theory in the twentieth century has been dominated by two broad conceptualizations: psychoanalytic theory and drive theory. Both of these approaches have involved the significant use of conveyance metaphors. Psychoanalytic motivation theory, developed by Freud (1917/1963, 1933/1964, 1940/1964) from the end of the last century into the 1930s, can be seen as an incongruous but productive marriage of the person-as-agent and person-as-machine metaphors. The concept of the ego is reflective of personal control, but the greater part of psychoanalytic motivation theory, with its emphasis on the interplay of inner forces, is clearly mechanistic. Freud himself was a prolific inventor and user of metaphors (Nash, 1962; Thomä & Kächele, 1987; see also Leary, Chapter 1, this volume). In this connection, one thinks not only of Freud's extensive hydraulic analogies, to which I alluded earlier, but also of his postulation of a "censor" guarding against the entry of "repressed" material into consciousness; his proposal of dramatic interrelations among the anthropomorphic ego, id, and superego; and so forth. As Leary has observed, Freud's use of metaphors was deliberate and nonapologetic. Further, as Nash has pointed out, "Freud not only illustrated by metaphor, he also conceived in metaphor" (p. 25).

Probably the most widely employed technical term in motivational psychology in this century has been "drive." This term was introduced by Woodworth in 1918, along with the companion term "mechanism." (The term "mechanism" failed to catch on in motivation theory.) It is interesting that Woodworth employed metaphors in order to delineate the meaning of these concepts. Using the example of a baseball pitcher, he described mechanism as the problem of aiming, gauging the distance, and coordinating movements, and drive as the answer to the questions why the man is pitching at all, why he pitches better on one day than another, and so on (pp. 36–7). "The distinction between drive and mechanism may become clearer," Woodworth (1918) wrote, "if we consider it in the case of a machine. The drive here is the power applied to make the mechanism go; the mechanism is made to go, and is relatively passive" (p. 37).[32] Following Woodworth, other psychologists developed drive theory. Most important among them was Clark Hull (1943, 1952), who revealed his early commitment to a mechanistic approach in the following diary entry for 1 March 1926: "It has struck me many times of late that the human organism is one of the most extraordinary machines – and yet a machine" (Hull, 1962, p. 820).

Though both psychoanalytic theory and drive theory are now less central to motivational psychology than before, they are still influential, and a number of newer mechanistic motivational conceptions have gained recognition. These include optimal-level theory and opponent-process

theory. Optimal-level theory (summarized in Arkes & Garske, 1977, pp. 144–65) holds that individuals seek to maintain optimal levels (not too much and not too little) of certain psychological variables, such as the amount of novelty that one is experiencing or the extent that one is aroused. Though this theory has many roots, it was stimulated in part by an analogy with Cannon's (1932) conception of homeostasis (Mook, 1987; Stagner, 1977), which held that organisms are so constituted as to maintain a proper balance within physiological systems. Opponent-process theory, developed by Solomon and Corbit (1974), is concerned with the fact that certain experiences that are either pleasant or unpleasant tend, when terminated, to be followed by an opposite affect (see Mook, 1987). For example, certain drugs yield positive affects, but the withdrawal feelings are distinctly unpleasant. The essential theme of this theory was borrowed by analogy from sensory psychology (Hurvich & Jameson, 1957).

In conclusion, the person-as-machine metaphor has tended to dominate motivational theorizing in recent decades, and it has tended to incorporate both the person-as-natural-entity and the person-as-organism themes. Further, both contemporary behaviorism and current cognitive psychology are essentially mechanistic in style. The only serious rival to the machine analogy on the current scene is the person-as-agent metaphor, which (as noted earlier) has shown a striking resurgence in recent years.

Theoretical implications

Having completed our historical survey, we are now in a position to see what lessons and suggestions may be gleaned from the record of the past. Perhaps the most clear-cut and not unexpected conclusion is that analogical thinking has been widely employed throughout the two and a half millennia of formal thought about motivation. The specific examples that I have given constitute only a small fraction, though I think a representative fraction, of the metaphors that motivation theorists have devised. The general pattern has been that a particular way of conceptualizing motivation has been developed or modified by importing analogs from other content domains.

My primary purpose in taking a longitudinal approach in this survey has been to enable us to get an overall picture of the topic under review, to see – to put it figuratively – the forest rather than the trees. In this context, we may ask where the imported analogs for motivation metaphors have come from. Our review clearly indicates that they have come from all over – from wherever thinkers and scientists have found what seemed to be relevant instances. For example, motivation theorists have borrowed analogs from music (e.g., dissonance motivation), from politics

(e.g., censoring motives), and even from other fields of psychology (e.g., the opponent-process motivational model). More generally, it appears that analogs have most frequently been drawn either from the fund of general wisdom and experience familiar to everyone or from nonpsychological areas that enjoy high prestige. Instances of the first sort include, for example, different versions of the clock analogy as well as most of the motivational metaphors employed by Plato, Descartes, and Freud. In contrast, metaphors of the second class include those adapted from the physical sciences, such as those relying on concepts from Newtonian theory. This reference to physical science analogs as examples of the second sort presumes, of course, that the prevailing world view accords higher prestige to the physical sciences than to psychology and the other life sciences. It is worth noting in this regard that in an earlier age, when the animistic perspective was dominant, physical scientists commonly imported analogies from the animate world in order to afford their concepts an aura of greater reality. The physical notion of force, for instance, was often explicated by analogy to human physical strength.

Thus, the typical *direction* of a scientific metaphor or analogy is from a *more* prestigious and credible domain to a *less* prestigious and credible domain. Consider, for instance, the expression "human benevolence is like gravity." One of the implications of this statement is that benevolence is universal, and one of the aims of its reliance on a scientific metaphor is to make this theoretical position seem more plausible, more convincing, by associating it with a proposition or phenomenon that the audience already takes for granted. Of course, what is taken for granted differs from one era and from one audience to another, so it should not be surprising that there has been a continual change over time in the choice of specific (conveyance) motivational analogies. Thus, whereas Newtonian mechanics once spawned a number of inertia analogies, more recently it has been physical field theories in the tradition of Einstein's relativity theory that have suggested newer motivational conceptions like those of Kurt Lewin (1939).[33] Currently, as noted earlier, a major development in motivational psychology is optimal-level theory. This approach utilizes analogs from both technology (e.g., the thermostat) and biology (Cannon's concept of homeostasis).

Taken together, these observations suggest that the metaphors employed in motivational psychology tend to be *topical*, to draw on relevant *new* sources as these become available. But though this is so, it is also true that certain metaphorical themes in the area of motivation are amazingly persistent. I am thinking, for example, of the innumerable restatements and reincarnations of the hydraulic analogy. Another enduring theme is the concept of various bodily or psychological deficits or needs. Further, the same theme may appear in similar metaphors at widely separated times. For example, in a dramatic description reminis-

cent of Plato's image of the two steeds, Freud (1933/1964) compared the ego's relation to the id to that of a rider on his horse. Similarly, the clock metaphor is still used, at least in common speech ("I wonder what makes him tick?"). However, fundamentally different underlying metaphors may be supported by essentially similar topical analogs. For example, the automata that Descartes and others used to support the machine paradigm were not radically different from the marionettes with which Aristotle illustrated the organismic paradigm.

Frequently, scientific metaphors appear to flow rather directly from prevailing world views – often, I suspect, without the theorist being aware of this fact. That the universe and all its parts, including persons, are basically mechanisms is the implicit assumption underlying most current motivational theorizing, but the majority of contemporary theorists probably do not realize that the mechanistic paradigm is itself a metaphor on the grand scale. This observation leads me to propose that metaphors can in principle be conceptualized hierarchically, from the most all-encompassing instances, such as the animistic paradigm and the machine paradigm, to the most particularistic and trivial ones, as when one might construct a metaphor that has meaning only for a very limited audience. It is, I suggest, the higher, broader analogies, which I have referred to as basic or root metaphors, that serve as guides, often implicitly, to theory construction. The lower-level, more particularistic metaphors are more likely to serve an expository role.[34]

An interesting question is, When do metaphors come into play? What occasions their construction? Metaphors are devised, of course, by persons acting under individual needs and whims. Consequently their advent cannot be predicted in any rigorous way. Yet certain generalities are suggested by our survey. One is that metaphors appear to arise in times and areas of ignorance and uncertainty and to persist as live metaphors for as long as the questions at issue remain clouded or undecided, and as long as the imported analog retains its credibility.[35] In other words, theorists are likely to reach for a metaphor when they are faced by a problem. Examples of this are provided by the great variety of metaphorical descriptions of neural transmission that were devised over the years until the problematic nature of bioelectrical transmission was finally resolved. A second kind of situation in which metaphors are likely to be generated is brought about by the introduction and development of a new high-order (or basic) metaphor. Thus, the person-as-machine conception stimulated, or was associated with, a great variety of mechanistic analogs – clocks, automata, mills, telephone switchboards, and other devices.

Further, on the basis of our foregoing survey, I believe that metaphors are less likely to appear in areas of immediate personal significance and/or experience than in domains that are more personally remote. That is, metaphors appear not to be as necessary for the elaboration of phenomena that are already personally meaningful. In support of this interpretation I refer to the fact that concepts of the soul and human agency, both of which refer to personal, inner experiencing and both of which have motivational significance, have generated relatively few metaphors. Similarly, directly experienced motivational tendencies, such as hunger, thirst, pain, and pleasure, have not frequently been described metaphorically.[36] In contrast, extensive use of figurative language has been employed for the person-as-machine paradigm, which seems a less "natural" and less immediately understandable way of construing human behavior.

What are the uses or functions of metaphors in science? The foregoing historical survey suggests that analogical thinking serves three distinct functions: descriptive, persuasive, and creative. The first and last of these correspond to what Park et al. (1984) refer to as the expository and explanatory roles of analogy.[37]

Descriptive uses of analogy are important didactically in *delineating* and *communicating* motivational conceptions. Descriptive metaphors tend to involve generally familiar analogs – analogs familiar, that is, to the theorist's intended audience. For example, consider Plato's metaphor of the chariot and Freud's comparison of the tie-up of psychic energy (in fixation) to the analog of a portion of an army staying behind the general advance in order to maintain control over a conquered territory. These metaphors were surely familiar to Plato's and Freud's diverse audiences and would have helped their audiences understand the phenomena they were trying to describe.

Persuasive analogies are intended to *convince* an audience. In the case of science the audience is typically the relevant scientific community, though it may (especially initially) be restricted to the theorist. Persuasive metaphors are argumentative and frequently syllogistic. They tend to take the following form: A is obviously true; B is like A; therefore B is probably true. Theories cannot be validated in analogistic arguments, but they can be made to seem plausible, aesthetically appealing, and worthy of further consideration. An example, presented earlier, would be Coeffeteau's analogical comparison between human love and the then highly credible Aristotelian conception of natural forces.

Of special interest is the third, explanatory function of metaphor, which suggests a truly *creative* use of analogy. The primary audience here is the scientist, and the aim is to *solve* a theoretical problem by coming to see the relevant phenomenon in a new way. Sometimes, of course, the theorist may have no specific aim – no explicit question to answer. On such occasions the new analog may appear adventitiously, as did the clock analog and more recently the computer analog, but in any case it opens up new and unexpected vistas for theoretical exploration. The virtue of the creative metaphor is that it permits the theorist to conceptualize data in a different way, to reexamine previously accepted verities. Some of the

new directions opened up may lead to permanent advances; others may lead into blind alleys. Thus, if we think of creativity as being composed of two basic stages – first, the production of new ideas and, second, the critical examination and development of these ideas – then it is obvious that analogical thinking makes its major contribution in the first phase.

Have analogies led to any major creative advances or "breakthroughs" in motivation theory?[38] I think so, and as examples I cite the development of the concept of motivational force or strength and the distinction between force and direction in motivation, the first engendered by the clock metaphor and the second by Woodworth's drive versus mechanism analogy. For a recent example, I refer to the development of optimal-level motivation theory, a substantial theoretical advance. Though adumbrations of optimal-level conceptions can be found as far back as classical Greece,[39] the general notion did not become significant until the relevant biological and physical analog had been created.

Final comments

This chapter has examined the role of metaphors in motivation theory from a historical perspective. The material was organized in terms of five basic metaphors of motivation that have been influential during the course of history. On the basis of this survey, I have concluded that metaphors have served – and presumably will continue to serve – three different functions in motivation theory: descriptive, persuasive, and creative.

Though I have focused on metaphors in motivational psychology, I believe that most of the tentative generalizations I have put forward are relevant to other fields of psychology, and probably to the entire scientific enterprise.

Notes

1 For example, they are treated together in P. T. Young's *Motivation and Emotion* (1961) and in the journal *Motivation and Emotion*.

2 Many writers on metaphor (e.g., MacCormac, 1985; Sarbin, 1982) have commented on the fact that the paired referents in a metaphor, particularly when it is new, have a striking, unusual quality that contributes to an attention-getting tension or strain in the hearer. As a metaphor becomes "older" and more familiar, this novel quality weakens.

3 Among the general sources that I have found particularly informative and stimulating are Black (1962), Burke (1945/1969), Leatherdale (1974), MacCormac (1985), Mair (1977), Ortony (1979), Paprotte and Dirven (1985), Sarbin (1982), and Turbayne (1962). Important special-area sources, in addition to those already cited, include Hester (1967), Rogers (1978), and Sapir and Crocker (1977). Among those presenting psychological theories of metaphors are MacCormac (1985), Miller (1979), and Sarbin (1982).

4 Though exceptions exist (e.g., Gentner & Grudin, 1985; Park, Daston, & Galison, 1984), most analyses of metaphors and analogies have been based on instances selected to illustrate certain preconceived theoretical ideas rather than on surveys of metaphors as they actually occur. Gentner and Grudin's recent study presents an interesting analysis of changing trends in the use of metaphors in scientific psychology over the past ninety years.

5 Of the four concepts (simile, metaphor, model, and analogy), analogy is usually considered the most basic. As Leatherdale (1974) states, "Both the concept of metaphor and the concept of model include within their sense the concept of analogy. As far back as Aristotle one form of metaphor is described as 'giving the thing a name that belongs to something else . . . on the grounds of analogy'" (p. 1). The dependence of metaphor on analogy is also noted by MacCormac (1985, pp. 21–2), who suggests that the difference between the two terms of a metaphor is more marked than between the terms of simple analogies, which accounts for the more discernible shock provided by metaphor. The tendency of writers to consider simile, metaphor, model, and/or analogy as aspects of the same domain is reflected in several recent titles, including *Models and Metaphors* (Black, 1962), *Models and Analogies in Science* (Hesse, 1966), and *The Role of Analogy, Model and Metaphor in Science* (Leatherdale, 1974).

6 Sarbin (1968, 1977, 1982) refers to the process whereby metaphors are transformed into literal equations as the reification of metaphors. The frequent reification of psychoanalytic metaphors is discussed by Thomä and Kächele (1987). This problem was hardly unknown to Freud. As Thomä and Kächele observe (p. 33), Breuer, in his portion of the seminal work on psychoanalysis (Breuer & Freud, 1895/1955), cautioned against the danger of treating metaphorical concepts as if they were real (p. 169).

7 Transformation of a literal statement into a figurative one may also occur. For example, in pre-Copernican days the sentence "The sun is setting" was intended as a literal statement, whereas now it is generally understood to be metaphorical.

8 In further distinguishing basic and conveyance metaphors, MacCormac (1985) writes: "Conveyance metaphors usually propose a metaphoric insight limited in scope, whereas basic metaphors underlie an entire theory or discipline devoted to description of widespread phenomena." For example, "the scientist may adopt consciously or unconsciously the basic metaphor, 'The world is mathematical'" (p. 48). For a further discussion of Pepper's root-metaphor approach, see Sarbin (1977). Basic or root metaphors are, of course, not limited to science. They exist in all broad areas of human thought.

9 I am employing the term "pawn" in essentially the same metaphorical sense as de Charms (1968), except that my usage is set in a historical context.

10 My listing is different from the classification of root metaphors proposed by Pepper (formism, mechanism, contextualism, and organicism), though there are certain similarities, especially with respect to the mechanistic orientation. It should be noted that whereas Pepper's aim was to conceptualize and delineate all root metaphors that have logical and scientific merit and which can be defended in a fundamental sense, my aim here is to identify and describe particular root metaphors that motivation theorists have actually employed, regardless of their adequacy, during the course of history. My purpose is thus significantly different from that which guided Pepper.

11 "Supernatural" is, of course, *our* term. The distinction between natural and supernatural was not made in the prenaturalistic period.

12 There is no way of knowing with certainty how prominent was the tendency to attribute the origin of human motives to higher powers. Most scholars believe that the tendency existed to a significant degree, and this is my conclusion. Smith (1974) disagrees to some extent, concluding that "Homeric man was not a puppet of the gods as has been charged. But there are a number of ways in which the gods did exert influence" (p. 315). Dodds (1951) has convincingly argued that the instances of supernatural control recounted in the *Iliad* are not mere literary devices, but instead reflect the cultural views of that period. One may ask, What was the psychological basis of the attribution of personal decisions to the gods? The most plausible answer is that they were projections in the psychoanalytic sense. According to H. B. Parkes (1959), "Man's first answer to the social and political problems involved in the rise of civilization was to strip himself of all responsibility for his destiny and project all authority upon the gods" (p. 53). And B. Simon and H. Weiner (1966) state: "One can then view the gods as projections, not merely of unacceptable impulses or wishes, but more as projections of self-representations" (p. 308). The projection hypothesis is supported by the fact that the values attributed to the gods paralleled those of mortals.

13 Though all or most vestiges of the early controlling-powers conceptions have disappeared, instances of the underlying theme are by no means rare in modern society. Thus, it is not unusual for ordinary individuals to feel that a decision of theirs has been guided by a higher power. Further, paranoid delusions often take the form of a conviction that one's mind is being controlled by alien forces. In addition, modern empirical research has highlighted the extent to which individuals in contemporary society attribute control over themselves to such metaphorical entities as fate and destiny.

14 Indeed, Aristotle, as is often pointed out, was the first person to identify and discuss metaphors formally (in his *Poetics* and *Rhetoric*), and his conceptions are still of substantive value.

15 St. Augustine is generally credited with being the first to develop a systematic concept of will. This concept was necessary "in order to clarify which part of the human personality is concerned with freedom, sin, and divine grace" (Dihle, 1982, pp. 194–5). Whether Aristotle had previously formulated a theory of will is debatable and appears to depend on how one defines the will. Certainly Aristotle's discussion of agency laid the groundwork for an understanding of voluntary behavior, but it did not posit a separate faculty or part of the mind to serve this function. For general historical sources on the concept of will, see Bourke (1964) and Dihle (1982).

16 Nietzsche, in his *Will to Power* (1901/1968), refers to "weakness of the will" as a "metaphor that can prove misleading. For there is no will, and consequently neither a strong nor a weak will" (p. 28). But elsewhere (p. 52) he appears to accept weakness of will as a meaningful attribution.

17 John Locke (1690/1959), employing a metaphorical approach to emphasize his view that the question of freedom of will is meaningless, wrote that "it is as insignificant to ask whether man's *will* be free, as to ask whether his sleep will be swift, or his virtue square" (vol. 1, p. 319).

18 It is interesting that some authors, when they wish to make a metaphorical term appear more substantial, begin it with a capital letter. Note, for example, Origin, Pawn, Plan. It may be observed that the term "origin" was also used to refer to human agency in the quotation from Aristotle given earlier in the text.

19 This phrase, "fabric of the heavens," later appeared in John Milton's *Paradise Lost* (1667/1968, bk. 7, l. 710; in later eds., bk. 8, l. 76) and is the title of a work by Toulmin and Goodfield (1961).

20 A later work by Bentham, *A Table of the Springs of Action* (1815/1969), was, I believe, the first volume devoted exclusively to the subject of motivation. The beautiful metaphor in its title, derived from the mainsprings of clocks, is still widely used as a dramatic synonym for motivation. As noted earlier, Bentham contributed significantly to the understanding of figurative language, and not surprisingly, we find a number of descriptive metaphors in his *Springs of Action*. These include references to motives as performing the "office" of a "spur" and, alternatively, the "office" of a "bridle" (p. 7). In another instance, Bentham posited that on some occasions certain motives may be substituted for others as "covering motives" (p. 30), employed as "fig leaves" (p. 32).

21 Berkeley (1713/1955) attributes the social impulse to divine implantation: "It is a principle originally engrafted in the very first formation of the soul by the Author of our nature" (p. 227). Further, he supposes that the impulse has a variety of manifestations: "As the attractive power in bodies is the most universal principle which produceth innumerable effects, and is a key to explain the various phenomena of nature; so the corresponding social appetite in human souls is the great spring and source of moral actions" (p. 227).

22 Though Thomasius employed the word *Grad* (degree) to indicate the units in his rating scales, this fact cannot be interpreted as strong evidence for a thermometer analog since *Grad* was used generically to express differences in intensity. It is interesting that Thomasius's younger colleague, Christian Wolff, was involved in the development of the thermometer (Bolton, 1900), though apparently only well after Thomasius completed his work on rating scales.

23 The translator (E. S. Forster) notes that "the marionettes seem to have been worked by means of cylinders round which weighted strings were wound, the cylinders being set in motion by the removal of pegs" (p. 463).

24 The fact that the word "neuron" derives from the Greek word for "string," as in the strings that operated the marionettes (Gregory, 1981, p. 69), neatly illustrates the role that metaphors play in the development of technical terms. It is interesting that Vesalius, the famous Renaissance anatomist, used the metaphor of "cords" in referring to nerves (Dampier, 1958, p. 122).

25 For a further discussion of hydraulic analogies in motivation, including additional examples, see Esper (1964, pp. 99–102). Some knowledge of hydraulics probably dates back to the ancient Mesopotamians since agricultural irrigation was central to their culture. It can also be conjectured that pneumatic principles may have become obvious through the observation of children playing with the bladders of butchered animals.

26 For stimulating discussions of the concepts of machines and mechanisms, see R. L. Gregory (1981) and Harré (1970). For general sources on the influence of the mechanistic world view on psychology, see Leahey (1980), especially "The Mechanization of the World Picture, 1600–1700" (chap. 3), and Lowry (1971).

27 Leary (Chapter 1, this volume) has called our attention to the interesting fact that whereas Newton evidently developed the concept of gravitation at least in part through analogy with the concept of sociability, Berkeley later argued for inherent human sociability by analogy with Newton's gravitation! This certainly illustrates both the ubiquity and adaptability of metaphors in scientific thought. Newton, it should be noted, lived in a transitional period and can be said to have had one foot in the mechanistic camp and the other still in the animistic camp (through alchemy). Though he attempted to eliminate all animistic notions from the *Principia*, the transitional nature of his period is reflected in his use of the psychological term "endeavor" (Latin, *conatus*) in the scholium following the definitions (Newton, 1687/1974, vol. 1, pp. 6–12; see Cohen, 1983, p. 82). It seems clear that the concept of "sociability" was meaningful to Newton through his studies of alchemy, which was heavily anthropomorphic. I am inclined to doubt Manuel's cautious suggestion that Newton's own personal isolation played a significant role in the development of his thought. For in-depth treatments of Newton's work in alchemy, see Dobbs (1975) and Westfall (1980, esp. chaps. 8 and 9).

28 The possible influence of the Parisian automata on Descartes's creative development is dramatically described by Jaynes (1970). For a 1615 pictorial sketch of these automata, see the frontispiece in Descartes (1662/1972). Tuchman (1978) provides a vivid picture of a fourteenth-century spectacle involving automata (p. 311).

29 Hobbes's theoretical emphasis on motion led Brandt (1928, p. 379) to suggest that he might better be termed a "motionalist" than a materialist. For further comments on the role of motion in Hobbes's conception of *conatus*, see Bernstein (1980).

30 For other sources on the role of the mechanical clock in the development of science, see the recent excellent treatments in part I of Mayr (1986), part II of Macey (1980), the first three chapters of Maurice and Mayr (1980), and the more popular but highly informative treatment by Landes (1983).

31 For example, the analog of the mill (as in a mill for grinding grain). Recall, for instance, these lines of Pope (1751/1942): "This subtle Thief of Life, this paltry Time,/What will it leave me, if it snatch my Rhime?/If ev'ry Wheel of that unweary'd Mill/That turn'd ten thousand Verses, now stands still" (p. 171).

32 Woodworth was not the first person to distinguish between the force and mechanism aspects of motivation. See the quotation from Paley in the text above.

33 See also Lundin (1972, pp. 220–33). The essential idea of Lewinian field theory was to relate behavior systematically to the overall environmental field in which the behavior occurs.

34 I have organized this chapter in terms of two levels of coverage of metaphors (MacCormac, 1985), and I consider this dichotomy valid and useful. In principle, however, one can conceptualize a continuum along which any metaphor could be assigned a place as a function of its range of application.

35 As a science progresses, metaphors that were formerly meaningful may become obsolete. For example, the telephone switchboard metaphor is no longer considered an adequate representation of brain functioning.

36 Bentham's reference to pain and pleasure as sovereign masters, noted early in this chapter, is an exception to this generalization.

37 The same metaphor may serve more than one of these functions.

38 The question can be raised as to whether *all* creative advances depend, in the final analysis, on analogical thought. An affirmative answer would presuppose that all new ideas are combinations of existent elements. Such a hypothesis is attractive, but it begs the issue of the *origin* of the elements. Further, it should be remembered that not all scientific advances are the result of new ideas. Many advances, in contrast, reflect new empirical discoveries. For example, our knowledge of the functions of the hypothalamus is based primarily on careful empirical examination, not on analogies.

39 I have in mind here the emphasis in ancient Greek culture on moderation and avoidance of excess.

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5

Cognitive metaphors in experimental psychology

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In his classic article on reaction time research, Saul Sternberg (1969) began with the assumption that information is stored, retrieved, and operated on in a series of stages or mental operations between the stimulus and response. In his experiments, Sternberg had people learn lists of letters or digits and then indicate whether a given test letter or digit was in the learned list. The task is called "memory scanning" for a good reason: The metaphor relates to the phenomenal experience of remembering the list in the form of a mental image. The basic metaphor, a comparison of imaging to a beam scanner (Sternberg, 1969, p. 440), fits many participants' postexperimental reports of their experience at the task.

The scanner presupposes a mechanism that can look through the beam in order to carry out acts of recognition. Sternberg postulated a single homunculus that could either operate the scanner or examine the contents of memory but that could not do both at once. Furthermore, he assumed that it takes a fixed amount of time for the homunculus to switch from one operation to another. Each step of encoding and matching takes some amount of time for each item in the list. If the scanning were to go over the items one at a time, then one pattern in the reaction time data would be expected. If the scanning were to go over all the items at once, another pattern would be expected. Each assumption from the metaphor yielded further testable hypotheses.

This introductory example illustrates what we will do in this chapter: We will show how metaphors for various aspects of cognition relate to refined psychological theorizing and to ideas for experiments. The com-