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ESSAY

A Holistic Aesthetic for Science

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Abstract — All scientific work takes place within a community of specialists who define what types of studies, evidence and modes of presentation are accepted as valid. A number of factors influence these decisions. Among them are tacit assumptions hidden in the language and practice of science. In recent years, philosophers, historians, linguists and feminist critics of science have elucidated some of these assumptions. The result has been a recognition that at least some scientific decisions are made simply because they "feel right." In other words, science possesses an aesthetic. After reviewing the evidence for the role of a scientific aesthetic, I suggest the conscious adoption of a new aesthetic based on love. Adoption of this aesthetic can lead us to change our relationship to the phenomena we study. Where Western science has mainly been concerned with the control of nature, an aesthetic of love can lead to an appreciation of the wisdom of nature. Instead of searching for causes, a science based on love can lead to a study of the patterns of phenomena. Within these patterns no single element is determinative. Rather, the pattern as a whole determines the role of the individual elements. Traditional Chinese Medicine serves as a powerful example of the capabilities of this pattern thinking approach.

Introduction

Ten years ago it seemed inconceivable that within a decade it would be possible to suggest that scientific judgments are, and should be, based on aesthetic as well as on objective criteria. Yet this is the conclusion that results from the work of historians (e.g., Kuhn, 1962), philosophers (Longino, 1990), linguists (e.g., Whorf, 1956), and feminist scholars (e.g., Keller, 1985, 1992) who are exploring the relationships between language, society and science. This paper discusses the work of some of these scholars as it relates to the development of alternate approaches to science. In the process, I will illustrate the role of aesthetic criteria in Western science. Science has inherited an aesthetic of domination over nature from at least the time of Francis Bacon (1561-1626) (Keller, 1985). The existence of this aesthetic removes scientific knowledge from the realm of the objectively true and places it in the framework of the community in which it occurs (Longino, 1990). The recognition of the aesthetic basis of science opens the door to other approaches to scientif-

ic knowledge, approaches that are based on different assumptions about our relation to the world.

My second purpose is to suggest a new aesthetic for science. This is an aesthetic based on love. I believe that by consciously seeking a loving relationship to phenomena we can transform the way we do science. An aesthetic based on love can be the basis for a methodology that respects the integrity of nature, i.e. a methodology that sees the context of a phenomenon as being as important as the phenomenon itself. Respect for the context has important consequences for how science is done.

Epistemology

I will begin with a brief synopsis of an epistemology I have found helpful in understanding the concept of objectivity (Steiner, 1886/1968). I have chosen this starting point because Steiner takes a radical approach to knowledge: an approach that can explain both how knowledge of the world is possible and how different scientific communities can productively view the world in different ways. For instance, Steiner's epistemology can help explain how both Western and Traditional Chinese Medicine (TCM) are effective, even though the philosophies that underlay them are fundamentally different.

Steiner's epistemology is monistic. It conceives of the totality of the world as a unity, but a unity that is apprehended by human beings in a dualistic way. From one side we approach the world through our percepts: pure sensations devoid of meaning. From the other our thinking produces (or perhaps more correctly apprehends) concepts that give meaning to the sensations. Sensation and concept belong together in a unity that is prior to our perception of it.

According to Steiner, our nature as thinking beings *both* gives meaning to and separates us from the world. Through thinking we generate the meanings we attach to the events of our experience. Meaning springs from our activity as thinking beings. I return to this point below. But thinking has another function. Through thinking we become aware of our ego, our nature as beings who are distinct from the rest of the world. Through thinking we experience ourselves as distinct from the other phenomena of our experience. In this process we differentiate ourselves from the rest of the world and create the conditions under which the world appears to us as a duality. If we could apprehend sensations and concepts together, so that we immediately and intuitively knew the concept(s) to associate with a given sensation, we would experience the world as a unity. When we were presented with the sensorial attributes of some object we would also immediately know the concept(s) that corresponds to that object. We would not have to exert our thinking activity in order to unite concept and percept. We would always immediately know the concept(s) to apply to an object. Many of the difficulties I discuss below have their roots in this dualistic way the world appears to us (Steiner 1886/1968).

An excellent example of the sensorial side of reality, devoid of meaning, is given by Dillard (1974) who cites von Senden's (1960) work on the restoration

of sight to people born blind. Von Senden (1960) collected accounts of operations to restore sight to people blind since birth with cataracts.

> For the newly sighted, vision is pure sensation unencumbered by meaning: "The girl went through the experience that we all go through and forget, the moment we are born. She saw, but it did not mean anything but a lot of different kinds of brightness." Again, "I asked the patient what he could see; he answered that he saw an extensive field of light, in which everything appeared dull, confused, and in motion. He could not distinguish objects." Another patient saw "nothing but a confusion of forms and colors." When a newly sighted girl saw photographs and paintings, she asked, "'Why do they put those dark marks all over them.' 'Those aren't marks,' her mother explained, 'those are shadows. That is one of the ways the eye knows that things have shape. If it were not for shadows many things would look flat.' 'Well, that's how things do look,' Joan answered. 'Everything looks flat with dark patches.'" (Dillard 1974, p. 26)

There is no meaning in pure sensation. Where then does meaning arise? It cannot be from the sensations themselves. They are devoid of significance, as the above example shows. Meaning exists in the concepts we unite with the sensations via thinking. Through thinking we reunite concept and sensation into the whole that was shattered by our organization. The concept/sensation whole is the primary reality according to Steiner. It exists prior to our grasp of it. In sensation we are exposed to one side of this whole. Thinking gives us the other side. We reunite concept and sensation through thinking.

Difficulties often arise because of this two-fold way in which we apprehend the whole. Because we must exert ourselves to grasp the whole it is easy to believe that we create it, to believe that the world of our experience is merely a product of our creation. According to Steiner, this is a mistake. The world is a preexisting whole that appears to us in a dualistic way because of our organization as thinking beings. The world is a whole that we perceive from two directions. We should not be fooled into thinking that the concept/sensation whole does not exist just because we approach it from two directions instead of apprehending it directly. According to Steiner (1886/1968) the concepts we form of the world are as much a part of the world as are our sensations. Both are intimate parts of a preexisting whole.

Linguistic and Cultural Influences on Knowledge

From these considerations it would be easy to conclude that there is a specific concept that belongs to a given sensation. Truth would then consist in uniting the correct concept with the correct sensation. According to this view it would be possible to know the world "as it is" unencumbered by any personal element (Klocek, 1993). This view maintains that I learn nothing about myself when I connect a particular concept with a sensation. Instead, I learn about the "true nature" of the world. I do not believe that this view can be supported. I do indeed learn something about myself by knowing what concepts I connect with a particular percept. Even in identifying an object as a rose I learn about

myself. At the very least I learn what language I speak and language plays an important role in shaping our relationship to the world. Linguistic critiques of knowledge turn on precisely this point. Philosophers, linguists and feminist scholars have asked the very meaningful question, "How is my relationship to the world influenced by language and culture?" Here I will leave philosophy and turn to the question of how my concepts of the world are shaped by the language I speak and the culture I inhabit.

The linguist Benjamin Lee Whorf (1956, p. 135) gives examples of how our perceptions and behavior are shaped by language. For some years before studying linguistics Whorf worked as an analyst for a fire insurance company. He compiled statistics on the physical conditions that surrounded the outbreak of fires. He discovered that fires are caused not only by physical factors but also by the meaning that people attach to certain potentially dangerous situations. For instance, people exercise great care around stored gasoline drums as these are perceived to present a high danger of fire. However, around stored *empty* gasoline drums people are much more careless. By labeling the drums *empty*, their conception of the drums changes. The visual sensation of the drum remains the same, but what the observer *makes* of the percept changes. It changes so much that the observer's behavior changes when he is around *empty* drums. This is despite the fact that the *empty* drums present a greater danger of fire because of the explosive vapor they contain.

Whorf cites similar examples of the influence of language from his work on the Hopi language (Whorf, 1956). In this research he dealt with a larger framework than in the previous example. He was concerned with how the totality of a person's conceptual world is shaped by the language they speak, not just how the perception of one event is shaped by language. He illuminates the Hopi Indian's conception of the world through a study of their language. After completing an extensive morphological description of the Hopi language, Whorf undertook a comparison between Hopi and Western European languages in order to address the questions "(1) Are our own concepts of 'time,' 'space,' and 'matter' given in substantially the same form by experience to all men, or are they in part conditioned by the structure of particular languages? (2) Are there traceable affinities between (a) cultural and behavioral norms and (b) large-scale linguistic patterns?" (Whorf, 1956, p. 138). Whorf does not suggest that there is anything as strong as a correlation between language and culture, but he does conclude that language is an important influence on culture. In order to keep this discussion short, I will restrict myself to two of Whorf's examples dealing with the perception of time.

In Western European languages we speak of time as if it had two types of properties: order and quantity (see Jones 1982 for a fuller discussion of these properties). We use these two properties of number to characterize the corresponding aspects of time. The ordering properties of number refer to the characteristics that allow them to be placed in sequential order (32 comes before 33 comes before 34, etc.). These properties are used to describe serial arrange-

ments, not quantity. The quantitative properties of number refer to amount. They deal with how many items there are, not the order in which they occur. We use the quantitative properties of number when we say five apples, twelve trees, etc. In Western European languages we use the quantitative properties of number even when the "things" we are referring to are not "things" at all, but are of a qualitatively different nature. For instance, we refer to five days, two seasons, three years, etc., even though none of these "quantities of time" can be experienced as can five apples. Days, seasons, and years are not physical entities. We do not experience them in groups, yet we use the same linguistic form to express the number of days as we do to express the number of apples. By doing this we give time a spatial aspect. We treat days as if they were spatial entities that can be aggregated into groups.

Whorf calls the process of using language to assign spatial properties to aspects of the world that are non-spatial, objectification. Western European languages make time into an object by speaking of it as if it had spatial properties. Time, can thus be manipulated like other spatial objects. In giving time spatial characteristics we mask our direct experience of time, which Whorf describes as an experience of "becoming later."

The Hopi language does not allow objectification. In Hopi, the quantitative properties of numbers are only used to describe objects, not time. In fact, plurals in general are only used to refer to physical objects. Plurals are never used to refer to units of time. In Hopi, there is no expression equivalent to our "they stayed ten days." The equivalent phrase emphasizes the sequential occurrence of the days: "they left after the tenth day." In Hopi the emphasis is placed on the sequence of the days rather than on the quantity of days. Hopi has nothing that corresponds to our "length of time." In its place the Hopi use a linguistic form that allows specification of which of two events occurs before the other.

My second example concerns verb tenses. Whorf claims that the three-tense verb system of Western European languages contributes to our tendency to objectify our experience of time, a tendency that is reinforced by other parts of our language. Three tenses allow us to conceive of an objective past, present and future, rather than to pay attention to our more direct experience of time.

In Hopi, verbs have no tenses. Rather they have what Whorf refers to as validity-forms, modes and aspects. Validity-forms are used when the speaker reports some situation (this corresponds to our past and present tenses) or when he reports that he expects something to happen (our future tense). Thus a report is always personalized. An individual's experience is reported as his experience, not as an objective fact. Modes, the second of Whorf's categories, express the relationship between clauses in a sentence to indicate which of the events occurs later, earlier or if the events are simultaneous. Aspects, the last of the categories, deal with both degrees of duration and different types of tendency during duration. In Western European languages we usually express aspects by using metaphors to spatial qualities. We express degrees of duration

by words such as "long," "short," "much," "great," etc., and temporal tendencies by words like "increase," "grow," "come," "fall," etc. Although we do use some non-metaphorical terms to express these aspects, there are few terms available for this purpose ("early," "soon," "very," etc.). Whorf gives an example of how we use spatial terms to express non-spatial situations.

> I "grasp" the "thread" of another's argument, but if its "level" is "over my head" my attention may "wander" and "loose touch" with the "drift" of it, so that when he "comes" to his "point" we differ "widely," our "views" being indeed so "far apart" that the "things" he says "appear" "much" too arbitrary, or even "a lot" of nonsense! (Whorf, 1956, p. 146)

In Hopi, spatial qualities are never used in a metaphorical way to refer to non-spatial events. The exact forms that aspects take in Hopi are hard to describe. Suffice it to say that they are never spatial. Because of this quality, Hopi does not allow objectification. Events are expressed in their relation to the speaker, not to an objective external past or present.

To demonstrate how these linguistic patterns help shape the "thought world" of the Hopi, Whorf points to the importance of preparation in Hopi culture.

> A characteristic of Hopi behavior is the emphasis on preparation. This includes announcing and getting ready for events well beforehand, elaborate precautions to insure persistence of desired conditions, and stress on good will as the preparer of right results. Consider the analogies of the day-counting pattern alone. ... The count is by *ordinals*. This is not the pattern of counting a number of different men or things, even though they appear successively, for even then, they *could* gather into an assemblage. It is the pattern of counting successive reappearances of the *same man* or thing, incapable of forming an assemblage. The analogy is not to behave about day-cyclicity as to several men ("several days"), which is what we tend to do, but to behave as to the successive visits of the same man. One does not alter several men by working upon just one, but one can prepare and so alter the later visits of the same man by working to affect the visit he is making now. This is the way the Hopi deal with the future — by working within a present situation which is expected to carry impresses, both obvious and occult, forward into the future event of interest. (Whorf, 1965, p. 148)

This example illustrates the relationship between language and culture that shapes a human being's perceptions of the world. Our use, in Western European languages, of both the ordering and quantitative properties of number to describe time makes it easy for us to conceive of time as countable, quantitative and objective. We can easily conceive of units of time that are divorced from our direct experience and can use these units to quantify duration. It is this process that allows us to calculate the trajectory of a thrown stone, artillery shell, or missile. These types of calculations are more difficult in Hopi. The time units that can be easily expressed in Hopi are more related to direct experience. They can be enumerated, but not easily quantified.

These examples demonstrate how language and the concepts that underlie

language, shape our conception of the world. Although a Hopi and English speaker may experience the same sensation and may describe the sensation in words that can be translated into one another, the contextual meaning of the words is often quite different. Consequentially, the speaker's experience of the object in its full (contextual) richness will also be different. Whorf's example of the importance of preparation in Hopi society is an example of the contextual richness that is expressed in language.

Aesthetics of Western Science

Feminist critics of science have made points about the language of science that are similar to Whorf's points. Language influences our scientific world view just as it influences the Hopi conception of the world. Feminist criticisms turn on this fact and on the observation that all interpretations presuppose an activity on the part of the interpreter. Interpretations are not neutral — merely reporting the "facts" or "data," which can more or less speak for themselves — but are colored by interpretation (Longino, 1990). The shade of this coloring is influenced by the language of science.

Like natural language, scientific language only has meaning within a specific community. Within this community language shapes the questions that are asked and the answers that are accepted as valid (Keller, 1985).

> Sharing language means more that knowing the "right" names by which to call things; it means knowing the "right" syntax in which to pose claims and questions, and even more importantly it means sharing a more or less agreed-upon understanding of what constitute legitimate questions and meaningful answers. (Keller, 1985, p. 130)

An example of how language shapes scientific research will make this clear. Much of plant molecular biology is currently involved with the description of genes that play a role in various developmental processes (see Wessler, Meyerowitz and Freeling, 1993 for examples). Although much of this work is descriptive in that it identifies and describes DNA sequences and does not test hypotheses, the rhetoric that surrounds it is the rhetoric of experimental science. Many of the same molecular biologists who are active in sequencing genes (a descriptive activity) are critical of descriptive studies. Some even go so far as to restrict science to those aspects of the world that can be subjected to experimental test. Granting agencies (some divisions of the United States National Science Foundation, for instance) that will not fund descriptive studies, eagerly fund descriptions of new genes if the rhetoric of the proposal emphasizes the experimental nature of the project. This is a case where language plays an important role in determining what scientific studies are considered legitimate.

For at least some feminists, linguistic considerations are also important in issues of scientific methodology. For instance, in one essay Keller (1985) deals with the opposition between love and knowledge that has been expressed

in scientific language since the time of Francis Bacon (1561-1626), the author of *The New Organon* (Bacon, 1620) and one of the founding fathers of modern science. In her essay, Keller (1985, pp. 115-126) focuses on the relationship between emotional and cognitive experience and suggests that the opposition between love and knowledge leads to a contamination of objectivity with domination. Since she does not believe that this contamination is inevitable, she is quick to distinguish between dynamic objectivity and static objectivity.

> I define [dynamic] objectivity as the pursuit of a maximally authentic, and hence maximally reliable, understanding of the world around oneself. Such a pursuit is dynamic to the extent that it actively draws on the commonality between mind and nature as a resource for understanding. Dynamic objectivity aims at a form of knowledge that grants to the world around us its independent integrity but does so in a way that remains cognizant of, indeed relies on, our connectivity with that world. ... I call static objectivity the pursuit of knowledge that begins with the severance of subject from object rather than aiming at the disentanglement of one from the other. (Keller, 1985, p. 116-117)

Thus, Keller redefines the emotionally laden term "objectivity" to allow scientists to take a loving interest in the world and yet remain objective. Like others before her (Schachtel, 1959; Zajonc, 1983) she recognizes that dynamic objectivity demands at least a temporary suspension of one's own egocentric desires.

Keller's consideration of the opposition between love and knowledge goes beyond the role of language in shaping our conception of the world. It deals with how scientific ideology (the Baconian opposition between love and knowledge, for example) is expressed in language.

> Ideology makes itself felt principally in the process by which particular styles, methodologies, and theories come to be legitimated as "good" science. Certain theories and methods are selected as "best" by a process in which scientists collectively choose among competing methodological and theoretical candidates. The criteria for such choices are complex. Inevitably, the question is not simply which theory offers the fullest explanation, the best prediction, but also which theory best satisfies that host of unspecifiable "aesthetic" criteria (see, for example, Kuhn, 1962; Hanson, 1958) — including which theory is most consonant with one's implicit ideological and emotional expectations. (Keller, 1985, p. 126)

If we accept that Western science depends on aesthetic criteria, the question becomes which criteria to choose, not whether or not science should have an aesthetic. I believe that the choice of an aesthetic will be fundamental to the future course of science. Keller (1985, 1992) and other feminists critics of science (Bordo, 1986; Harding, 1986; Shepherd, 1993; among others) have shown the limitations of the aesthetic of domination that has characterized science since the time of Bacon. This aesthetic, with its opposition between love

and knowledge, has served us well, but I believe that it is time to consider alternatives.

Modern Western science has provided many ways to improve our lives. There are few areas that have not been touched by these advances. We have benefited from improved communications, health care, transportation and more recently by the advent of computers, but these advances have come at a cost. The aesthetic of domination equates progress with the destruction of nature. It values economic advancement over community and industrialization over love for the land. Within limits, this aesthetic is very powerful. I believe that we have reached these limits. We must now search for new aesthetics that can supplement the one we have inherited from our predecessors.

A New Aesthetic for Science

In the remainder of this paper I suggest a new aesthetic for science and explore some of its characteristics and consequences. I suggest that love can serve as this new aesthetic.

When we adopt an aesthetic as a guiding principle we make a statement about our relationship to the world. This relationship finds expression in the research that we undertake and in the instruments and technology we develop (Shepherd, 1993). Accepting a new aesthetic will change not only the questions we ask, but also the way in which we ask them. Our current domination based aesthetic impels us to create technologies that control nature. Because Western science intends a relationship of power over nature, we adopt methods and tools that allow us to express this intent. These tools may be as explicit as a mechanical tree harvester or as subtle as computer modeling, but they all express the fundamental desire to dominate nature that is expressed through modern science.

Accepting an aesthetic based on love allows a different relationship to phenomena than is found in contemporary Western science. In place of models and mathematical descriptions, an aesthetic based on love can lead us to see the phenomena in their full richness and complexity, to pay attention to the patterns that arise in the phenomena as a whole. Instead of isolating certain features and building a model, a methodology based on love can guide us to focus on the full range of phenomena presented to our awareness. Within these phenomena we can learn to perceive the pattern that unites the individual elements. A loving approach can help us to dwell duly and lovingly on the phenomena themselves until we find the whole that is expressed in and through the phenomena. At the beginning the phenomena may appear undifferentiated and unintelligible, much like the visual world appears to a blind person whose sight has been restored (von Senden, 1960). At the end, the phenomena are ordered into a higher whole. A pattern is perceived in the phenomena. Thoughtful, loving observation makes possible the emergence of a higher perception from the undifferentiated chaos of phenomena.

A metaphor for the emergence of higher order patterns from undifferentiat-

ed phenomena is the emergence of an image out of the seemly unpatterned pictures of random-dot stereograms (Baccei, 1993). At first glance, these images appear to consist of unpatterned splotches of color. But as the observer adjusts his focus from the surface of the picture to infinity, a stereographic image usually appears (Julesz, 1971). Similarly, as a scientist changes his intent from gaining power over nature to developing a loving understanding, he may experience patterns that previously remained hidden.

In order for love to become a guiding principle of science we must be willing to accept changes in the way we know. The perception of the pattern of phenomena that is facilitated by our loving interest involves a change in consciousness. As scientists we are conditioned to experience the world in an analytic, exterior mode (Keller, 1985). Bortoft (1986) describes this mode of consciousness as sequential and linear, as proceeding piecemeal from one element to the next. In contrast, a holistic mode of consciousness is simultaneous, intuitive, non-linear, and enhances our ability to perceive pattern. It is concerned more with relationship than with discrete objects. In this mode of consciousness we are able to see the whole as unitary and primary, not merely as something constructed out of parts. The parts are not merely building blocks for the whole, but bear the impress of the whole throughout their nature. The whole is both created out of and gives meaning to the parts. It is to this holistic type of perception that I refer when I say that a loving approach to nature will necessitate a change in our consciousness.

In moving from an analytic to a holistic mode of consciousness we do not need to renounce effective action in the world. That a holistic pattern thinking approach can be productive is illustrated by Traditional Chinese Medicine (TCM). The Taoist philosophy that underlies TCM is non-causal. Instead of searching behind the symptoms for the cause of a disease, a traditional Chinese physician searches for patterns within the symptoms themselves (Kaptchuk, 1983; Maciocia, 1989). The pattern of disharmony is both created by and gives meaning to the symptoms. Thus, the symptoms take their meaning from their context not out of themselves. For instance, the symptom of a red tongue can indicate a pattern of excess "activity" (excess Yang) if it occurs with one set of symptoms, or a pattern of deficient "rest" (deficient Yin) if it occurs in another combination. These two patterns have very different therapeutic consequences. In TCM, the pattern of disharmony is the disease. There is no causative agent behind the pattern.

TCM is an example of a holistic approach that unites the phenomenon (symptom) and the whole (pattern). In this process the physician adopts a different relationship to the phenomena than we do in Western science. This relationship involves a closer connection to the phenomena, and implies a more intimate relation between the physician's own perception and thinking than is normally found in contemporary Western science. Developing the ability to adopt this relationship requires training, just as does proficiency in any field. Without training we should not expect to be able to apply a holistic pattern

thinking approach, or to act out of the loving aesthetic upon which this approach is based. As scientists, we have received many years of analytical training. Similar training is needed to cultivate a holistic approach based on love. I believe that artistic training has much to offer in this regard.

Uniting Part and Whole through Artistic Training

Works of art are typified by a relationship between part and whole where the whole is created out of and yet gives meaning to the parts. A work of art is an integrated whole. In it we do not find a dichotomy between part and whole, but an integration of the parts into the larger whole that is the work of art. In this integration the parts participate in creating the whole and at the same time take their meaning from, are defined by, the whole. For instance, in a Romanesque icon, the strong vertical elements that emphasize the preeminent position of Christ are often strengthened by and reflected in the forms of the saints that surround Christ's throne. The forms of the saints thus help create a major dynamic of the picture. At the same time, their forms reflect the central vertical of the icon. In this way the saints are linked to the central figure of Christ from whom they take their meaning (both artistically and spiritually). If they were isolated from the icon they would loose a portion of their meaning. Their forms would no longer be related to Christ.

Or, to take another example, in a turn of the century cityscape the curve of a river may be echoed by a curving street. These sinuous movements are then set off against the cubical forms of the buildings to create a dynamic tension. The interaction of these forms both creates a major dynamic of the picture and provides the context out of which the forms take their meanings. The forms of the river, street and buildings are all related to each other in the composition.

In these examples the individual elements both contribute to the construction of the composition and bear its impress. The composition is built up through the individual elements, but the elements are not independent of the whole. They contain the meaning that is the context in which they occur. They are not building blocks that can be taken from one context and placed seamlessly in another. The verticals of the saints both reinforce Christ's vertical form and take their meaning from this vertical. They would not have the same meaning in a different context. The cubical forms of the cityscape, uncontrasted with sinuous movement, would not produce the same dynamic tension as when these elements are juxtaposed.

Art, like TCM, can provide a way of looking and understanding that unites the particular phenomena (the elements of the composition) with the whole (the work of art). Thus, artistic training can teach us to use our aesthetic sense to perceive the part/whole unity/duality. Through this training, we form the sense organs to perceive the whole as it is created out of, and defines, the parts. This ability forms the basis for a holistic pattern thinking that is rooted in love.

In order to engage in this type of thinking we must learn to take the pattern (the whole) as seriously as the phenomena (the parts). It is easy to dismiss the

pattern because we have been trained to ignore it. Our first reaction will almost certainly be that the pattern (the whole) is irrelevant. Instead of looking for pattern, a scientists' first tendency will most likely be to break the whole into parts and search for the piece that is the cause of the phenomena. Identifying causes is a major goal of modern Western science, based as it is on an analytic mode of thought. This is why training is necessary. Only training will allow us to switch modes of consciousness and credit the relationship between part and whole, between phenomena and pattern.

The unification of part and whole in art makes artistic training well suited for the development of the ability to think in patterns. Once obtained, this ability can be applied to scientific work. For the scientifically inclined, the goal is not to become an artist, but to use artistic training as a means of self-development. To accomplish this goal, I suggest a course of study that includes some practical artistic training combined with an aesthetic study of great works of art. Lowry (1963) provides this type of introduction to art, an introduction that focuses on training our aesthetic sense. I do not believe that artistic education that is directed solely at intellectual understanding or solely at acquiring technical proficiency will provide the necessary basis for perceiving pattern. Like the state of consciousness it seeks to engender, the training should focus on seeing (or creating) the whole as expressed through its parts.

An additional method of training was suggested by the German poet and scientist Wolfgang von Goethe (Lehrs, 1985). Goethe recommends training our aesthetic sense through a process he calls "exact sensorial imagination." In this process you first visualize a natural object as exactly as possible. After you examine the object closely you turn away and recreate the sensory qualities of the object in your imagination. At first, it may take many glances at the object to create an image, but your faculty of visualization will increase with practice. At the second stage, you visualize a number of related forms such as sequential leaves from a single plant stem, then mentally transform them into one another. In this way the static forms are brought into movement and related to each another. As in more formal artistic training, it is important to pay attention to the whole form of the object, not just the details. Attention to your feelings while doing the exercise can assist in this process. These feelings are an expression of the object as an aesthetic phenomenon. They help us see the object as a whole.

Objectivity

In closing, I want to turn briefly to a central concern in developing an alternative approach to science: objectivity. We need not fear that by taking a pattern thinking approach we will loose our scientific objectivity (Longino, 1990). As Keller (1985) points out, there can be more than one meaning of objectivity. While Keller (1985) stresses how an individual's relationship with the world can create different types of objectivity, Longino (1990) emphasizes the role of scientific communities in creating objective knowledge. She ex-

plores the transformative role of criticism in removing an individual's subjective preferences from the scientific canon.

Steiner's (1886/1968) epistemology allows an even more fundamental analysis of how different kinds of objectivity are possible. According to Steiner, the nature of thinking provides us the means to discover reality in connection with phenomena. His work implies that this process of discovery can take many different forms. Modern Western science is one form. Finding the pattern within phenomena is another. The preexisting unity of sensation and concept assures that our thoughts are a part of reality. It does not guarantee that all of our thoughts will be in accord with reality, but it does provide the security of knowing that our thoughts are part of reality. We do not have to look behind the phenomena or to build models to contact the objectively real. We can find reality when we find the pattern that is inherent in the phenomena themselves. This pattern is discovered through our activity of thinking just as contemporary scientific models are discovered by the use of thought. The ability of our thinking to apprehend the conceptual side of the concept/sensation unity is the basis both for building models and for perceiving pattern in phenomena. When done carefully both methods can be objective. When done sloppily, neither method is objective.

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