

TOWARD A NEW SCIENCE OF HUMANITY

by Solomon H. Katz

We live in a time of rapid change the rate of which is unprecedented in human history. Our times are characterized by astronomical growth in world population and the rising need for vast new resources for humanity. Accompanying this growth is a rapidly changing technology which has provided not only much of the basis for modern survival but also much of the basis for continued worldwide growth of human population and the continued use of dwindling resources. Yet, in the midst of these literally exponential technological changes, there sits the human species, whose evolution prepared it for a much simpler life, uncomplicated by the vast complexities now surrounding it. In the most elementary terms, it is obvious that the human species is being stretched to the limits of its ability to adjust to these rates of change. This picture is further complicated by our not knowing which elements of our current technology are helping us to survive and which are helping to destroy us. This is largely because we do not know enough about the impact of more technology upon

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ourselves and our environment. Example after example of problems of pollution, politics, and population brings us closer toward a realization that a balanced human ecosystem must be attained within a very short period of time, and yet the paradox is that more technology is probably the only avenue open to attain this goal.

As these problems close in on our whole way of life, we begin to recognize that most of our social institutions are threatened, and the fabric of our society seems unable to bear any more stress. We are caught once again. It seems that technology cannot by itself, that is, by its traditional methods, extricate us from our problems. Yet, at the same time, our previously reliable social institutions are so beleaguered that they cannot extricate us either. This leaves our society in a quandary. Do we sink back into a mire of indecision, abandon our current technologies and institutions, and let come what may?

It is not that we *could* not abandon our current technology and institutions or even to some extent that we *are* not abandoning them; the essential point is that, if we do, we run the risk of losing any hope of future solutions. The world balance has already been shifted so far in favor of complex technology that we need to discover new ways to balance it with the real needs of our ecosystem. In general, we can accomplish this balance in at least two ways. The first approach is to continue as we have in the past to extend the boundaries of what we know of our world and apply this knowledge through new technology to solve our problems. The second alternative is to develop a new framework which stems from a continuation of the first approach but also purposefully¹ seeks to delve into areas not previously thought to be the realm of science—in other words, a new science of the human species, a science not limited by previous definitions and whose function is to serve our understanding of the entire universe and to integrate this knowledge in the context of the full gamut of human potential and experience. This means that ultimately what is now considered religion and even those irrational elements not now a part of either science or religion all become a part of a new context in which we seek a more complete balance between the new pressures created by rapid technological change and the evolved constraints of our species.

THE HUMAN BRAIN AND MODERN TECHNOLOGY

Perhaps the chief organ of adaptation underlying both the evolutionary potential of the human species and the current technological dilemma is the human brain. It is this organ that allowed for the emergence over the last ten thousand years of a biocultural evolution which is not just biological or social but is a combination of both

operating in reciprocal interaction over time. This biocultural evolution consisting of adaptive interactions in a particular ecosystem between the genetic information, shared by reproduction, and the cultural information, shared by simple speech communication, became more complicated when information was shared in "written" codes that could be accurately transmitted over distances and time. This dimension facilitated other parallel developments that made a whole new set of adaptations possible. With the use of accurate records, trade could become more complex; the movements of the heavenly bodies could be accurately charted and ultimately predicted; social regulations could be extended for large populations; and, more generally, much of what was thought to be culturally valuable could be transmitted more accurately to the next generation. However, all of these advantages brought the chief disadvantage of having to stretch the flexibility and adaptability of the human brain to carry out new modes of operation which, while advantageous to the population as a whole, did apparently demand the dependence upon some cognitive thought processes more than others. Of course, this is not to say that all previous thought processes had to shift to adapt to these new constraints, nor is it to say that there were now new cognitive thought processes not previously present. Rather, the shift was probably one of degree more than kind, since it is possible that the differential complex behavior already present from extended use of tools was a necessary precursor to this new behavior.² It was necessarily a shift toward the kinds of cognitive styles that are required to interact successfully with new kinds of symbolic information codes concerned with a whole series of more complex social and technological concepts and activities.

At the base of our newly emerging framework which seeks a more holistic and synthetic view of our species lies a better understanding of the qualities of the human brain which make possible the kind of shift in cognitive style that has occurred over this period. As the process of biocultural evolution continued within the last ten thousand years, there has been an increasing dependence on the cultural-technological modes of adaptation. Such phenomena have recently allowed the complex societies dependent on high technology to evolve to the point where in modern industrial societies many of the earlier, traditional adaptations to physical environmental features have disappeared. Among other things, for example, we artificially (nonbiologically) regulate environmental temperatures, synthesize foods, communicate over wires and "on the air" in the form of radio waves, supplement our disease resistance, and control our fertility. One could say that the sociocultural dimension has replaced our phys-

ical environment by a whole new network of selective factors all of which are directly and indirectly influencing our evolution. However, how this is occurring and whether this evolution has any significant pattern are intriguing but as yet unanswered questions. What is clear is that as long as it continues there has to be strong selection favoring the special abilities needed to participate in this process. Once again, we are directed to the obvious and critical roles the human brain plays in evolving the necessary adaptations to this even larger sociocultural dimension of our environment. It is entirely possible that what we have recently gained by utilizing these cognitive styles that underly our modern technological evolution may also have had some significant costs in terms of basic brain activities and cognitive needs which are no longer satisfied to the degree to which they were before such cognitive styles became adaptive.³ The purpose of this paper is to explore one of the important aspects of brain function and cognition in an attempt to demonstrate how we might build this understanding into our emerging framework of a new, more adaptive science of humanity.

HEMISPHERICAL ASYMMETRIES AND BRAIN FUNCTION

In general, there are two major modes of cerebral cortical function.⁴ One element functions from the right cerebral hemisphere and the other from the left. They are interconnected by a large bundle of communicating fibers called the corpus callosum. Because the neural pathways controlling motor abilities decussate (or cross over) in the lower portions of the brain stem, the right side of our body is controlled principally by the left hemisphere and the left side principally by the right hemisphere. Scientists have demonstrated over the last hundred years or so, beginning with the early neurological work, such as Paul Broca's, with language disabilities following accidents and strokes, that language per se, speech, and writing are almost universally controlled by the left side of the brain.⁵ Hence, any accident involving the left hemisphere impairs speech and/or produces other kinds of specific disabilities called aphasias. Conversely, any single neural damage exclusively to the right hemisphere does not usually appear to impair linguistic abilities but does lower performance in spatial tasks, simple musical abilities, recognition of familiar objects and faces, and bodily self-awareness.⁶

Sperry, Gazzaniga, and Bogen, among others, have reported that the left hemisphere of the brain is involved generally in logical, analytical, linear, and sequential (especially time-bound) thought processes and specifically in mathematical and linguistic abilities.⁷ The right hemisphere is involved in spatial relations, musical (tonal qual-

ities), artistic, simultaneous (not constrained by time), and holistic thought processes. Until the brilliant work by Roger W. Sperry and his associates at the California Institute of Technology, it was not known how the two halves communicated with each other. Their work demonstrated the significance of the corpus callosum or the large bundle of fibers that neuroanatomically connect the right and left hemispheres. Basically, in working with patients in whom the corpus callosum was severed to isolate the occurrence of severe seizures to one side of the brain, they found that the "split-brain" patients functioned exactly as would be predicted on the basis of the brain damage reports. If presented with visual stimuli that were projected to either the right or left hemisphere, patients could not verbally identify objects presented to the left hand unless the objects were felt by the right hand or seen by the right field of vision. Conversely, the right hand could write but no longer draw. From this body of evidence, it has been concluded that the corpus callosum is the source of the transfer of information between the two hemispheres.

Several important experiments with these split-brain patients indicate that a number of emotionally laden stimuli are processed by the right hemisphere and that the behavior emanating from this hemisphere is not directly interpreted by the left hemisphere. In one instance of this phenomenon a woman was shown a photograph of a nude that was projected to the left part of her visual field, which would be interpreted in the right hemisphere. Her nonverbal communications (via her face, body posture, and so forth) indicated very clearly that an emotional response was occurring but she gave no "conscious" verbal response indicating that she had any idea of what was producing this emotional turmoil in her affect. There is another reported instance where a split-brain patient attempted to swing an ax at someone with his left hand and immediately his right hand went to restrain it, as if the two hemispheres were in conflict, one wanting to be violent (right hemisphere) and the other (left hemisphere) restraining the act.⁸

Other work points to a variety of subtle differences in right-left sensory and motor behavior indicating the differential functioning of the hemispheres. While it is known that the hemispheres communicate in a coordinated fashion, it is not known precisely how this coordination is effected. It seems likely that during various states of consciousness one or the other hemisphere seems to be dominating.⁹ It is likely that, depending on the activity, normally the brain selectively uses one or the other hemisphere more or less during the performance of various motor activities. In a sense, while we are carrying

out one activity, we may be selectively screening out another—perhaps as a child who when spoken to in the midst of daydreaming hears the words but does not know what has been said. Perhaps only in unusual circumstances do we break through to use both hemispherical modes in focused, coordinated fashion, as in a flash of insight, as when Archimedes said “Eureka!” When this occurs, there is certainly a great deal of exhilaration, a new kind of high point—an “epiphany,” as James Joyce once called it.¹⁰

At another level we shall see from the following letter and quotation an unusual insight into these processes in which a creative individual seizes on both linear and nonlinear elements in his work:

Baden, Sept. 10, 1821

To Tobias von Haslinger

My very dear friend,

On my way to Vienna yesterday, sleep overtook me in my carriage. . . . While thus slumbering I dreamt that I had gone on a far journey, to no less a place than Syria, on to Judea and back, and then all the way to Arabia, when at length I actually arrived back at Jerusalem. The Holy City gave rise to thought of the Holy Books. No wonder then if the man Tobias occurred to me, which led me to think of our own little Tobias and our great Tobias. Now during my dream journey, the following canon came into my head. . . .

But scarcely did I awake when away flew the canon, and I could not recall any part of it. On returning here however, next day, in the same carriage. . . . I resumed my dream-journey, being on this occasion wide awake, when lo and behold! in accordance with the laws of association of ideas [The use of this phrase is indeed striking.—H.S.], the same canon flashed across me; so being now awake I held it as fast as Menelaus did Proteus, only permitting it to be changed into three parts. . . .

LUDWIG VAN BEETHOVEN

If the modern composer, in the effort to understand better his creative mind, attempts to re-examine the elements of musical syntax, he must immediately find himself occupied with the nature of melody, for it is the melodic phrase, exactly equivalent to the sentence in the syntax of language, which serves as the primary element in almost any musical structure. By investigating the possibilities of phrase construction and discovering for himself what can be done within a small formal frame the composer not only disciplines his creative unconscious so that the melodic fragments which it offers up possess increased sharpness of contour, but develops at the same time the architectural faculty which will enable him to calculate correctly the time-spaces involved in the manipulation of larger musical forms. Haydn, Mozart and Beethoven possessed the greatest mastery of musical phraseology, and it was at that historical period that such a mastery was stylistically most welcome, for the composers who followed soon became interested in subjectifying the tonal material, with the result that continuity established by means of small connected phrase groups broke down and was replaced by the concept of organic form.¹¹

However, Beethoven was not alone in his insight concerning the way

the human mind functions. More recently, Robert Assagioli rearticulates this argument into a discussion of intellect and intuition. For him, intellect is the world of words, the analytical mind, whereas intuition performs a synthetic function by apprehending a totality. Ideally, the two work in consort, the intellectual interpreting, verbalizing, and translating the intuitive, then further intuitive insight followed by interpretation, and then onward. Of course, he also indicates that not all individuals finely balance this behavior—instead, some repress one or the other and use either intellect or intuition.¹²

Returning to a prime question before us, we must begin to ask if we can use this developing knowledge on brain function to evolve a new synthetic method which deals more effectively with all of the problems created by our current levels of science and technology. More specifically, how does a broader understanding of brain phenomena, such as what goes on in each cerebral hemisphere as well as the integrative capabilities of the two sides, help us toward this goal? As early as 1909 Robert Hertz stated this in the last sentence of his classic sociological article, "Preeminence of the Right Hand." He said: "If the constraint of a mystical ideal has for centuries been able to make man into a unilateral being, physiologically mutilated, a liberated and foresighted society will strive to develop the energies dormant in our left side and in our right cerebral hemisphere, and to assure by an appropriate training a more harmonious development of the organism."¹³ Elsewhere, Jerome Bruner discusses this whole question in a highly perceptive essay:

Since childhood, I have been enchanted by the fact and the symbolism of the right hand and the left—the one the doer, the other the dreamer. The right is order and lawfulness, *le droit*. Its beauties are those of geometry and taut implication. Reaching for knowledge with the right hand is science. Yet to say only that much of science is to overlook one of its excitements, for the great hypotheses of science are gifts carried in the left.

Of the left hand we say that it is awkward and, while it has been proposed that art students can seduce their proper hand to more expressiveness by drawing first with the left, we nonetheless suspect this function. The French speak of the illegitimate descendant as being *à main gauche*, and, though the heart is virtually at the center of the thoracic cavity, we listen for it on the left. Sentiment, intuition, bastardy. And should we say that reaching for knowledge with the left hand is art? Again it is not enough, for as surely as the recital of a daydream differs from the well-wrought tale, there is a barrier between undisciplined fantasy and art. To climb the barrier requires a right hand adept at technique and artifice. . . .

One thing has become increasingly clear in pursuing the nature of knowing. It is that the conventional apparatus . . . leaves one approach unexplored. It is an approach whose medium of exchange seems to be the metaphor paid out by the left hand. It is a way that grows happy hunches and "lucky"

guesses, that is stirred into connective activity by the poet and the necromancer looking sidewise rather than directly. Their hunches and intuitions generate a grammar of their own—searching out connections, suggesting similarities, weaving ideas loosely in a trial web. . . .¹⁴

Yet for all that science is, it is certainly rooted in a process involving these same lucky guesses, intuitions, and hunches. But if these are the roots of this tree of science, the branches are surely quite different. They are concerned only with the product of this process aseptically cleaned by a rational and linear mode of thought that fits perfectly with our technology but not our humanity. It is this emphasis on the analytic and reductionistic approaches to human understanding almost to the point of the denial of right hemispheric kinds of intuitive nonlinear thinking that we must begin to ponder. Does this cognitive style underly the lack of a well-developed synthetic methodology in modern science, as well as the rejection of traditional religious ritual and the loss of our sense of purpose in much of the world? If it does, then what we need is an understanding of how to develop the effective interplay between these modes of thought. Although our scientific method of experimentation and logical analysis could be useful in fulfilling this critical need for understanding, I believe that the problem is so significant and the need for its solution so great that we should make use of all our resources in seeking a solution.

ANTHROPOLOGICAL PERSPECTIVES ON RIGHT AND LEFT

Perhaps the most important resources available to the anthropologist are the natural experiments which have occurred in the various human populations around the world over both time and space. By making use of the data collected for hundreds of different human societies over the last hundred years or so, we can begin to put together pictures of the patterns of human cognition as they have evolved through trial and error. Frequently, these pictures help us understand something about a particular adaptation, whether it be biological, psychological, or social.¹⁵ Hence, it may be possible to carry out cross-cultural studies of practices which reflect upon the theme of asymmetries in cerebral cortical function.

It is possible that the requisite knowledge of these differences in cortical function is significant enough for the successful adaptation of a human population so that any population which incorporated this knowledge into their cognitive structure would have added survival value. This would accrue as a result of more fully and effectively utilizing the full gamut of cognitive capacities. Although this is a very difficult hypothesis to evaluate, in this case we have two significant

advantages. First, there is a significant motor association between hemispheres and handedness or even sidedness. The right side is controlled principally by the left hemisphere and the left side by the right hemisphere. Since the psychoneural evidence is sufficient to associate left- or right-handedness or left- or right-sidedness with different kinds of behavior, all we have to do is to determine if various societies have information in their belief systems about the kinds of behavior expected to be associated with left and right hemispheric functions or, in other words, knowledge which coincides with the scientific evidence of right and left, as expressed by left- and right-handedness or sidedness.

The second advantage comes as a result of the historic recognition by Robert Hertz of the earlier neurological work of Broca and others.¹⁶ In this regard, Hertz was one of the first to recognize the importance and complexity of the relationship among the functional, anatomical, and cross-cultural attitudinal aspects of cerebral asymmetry and handedness. As Hertz pointed out, Paul Broca's statement that we are right-handed because we are left-brained could be reversed. Hertz suggested that we may be left-brained because we are right-handed, citing the cross-cultural attitudes toward "the dexterous" right and "the sinister" left. He reasoned that it was entirely possible for children to be socialized for right-handedness, whether predisposed in this direction or not, and therefore to develop left hemispheric "dominance" for speech. Of course, we now realize that the relationship is more complex than Hertz suggested and that Broca was essentially correct. The evidence strongly favors a biological predisposition toward the right hand and the left brain.¹⁷

In a historical sense, it is interesting to note that the work of Hertz would be much less known today were it not for Rodney Needham's excellent translation and careful investigations over the last twenty years. More recently, Needham, who has been influential in French and British structuralist schools of anthropology, has assembled a book based on a collection of essays by various anthropologists on folklore beliefs concerning left and right. What is particularly interesting from the point of view of this paper is that Needham's book *Right and Left* implicitly and explicitly denies the presence of any neurogenic basis underlying the reported dual classification systems.¹⁸ Perhaps this attitude is best stated explicitly in J. Chelhod's article on the preeminence of the right based upon Arabic evidence, when he says:

The hypothesis of organic asymmetry however updated cannot therefore withstand a critical examination of the facts. If right handedness were

physiologically controlled, there would have been no need to impose on it by training and coercion. At birth, a human being should be more or less disposed to make equal use of both his hands. . . . Hertz has done no more than describe the facts without however explaining them. The whole problem is indeed to know why a favored position is invariably attributed to the right side. But it is surprising after having rightly discarded an anatomical thesis, Hertz finds nothing else to propose but a baffling return to organic asymmetry.¹⁹

Hence Needham's book provides us with a unique set of data on the subject which is certainly not biased toward any pattern reflecting a neural basis for its explanation.²⁰

DUALITIES AND COGNITIVE STYLES

Having briefly reviewed the neuropsychological literature on this important element of cerebral function and introduced the anthropological dimension, we are now in a position to become more specific. What emerges from the neuropsychological literature that is pertinent for us is a list of dualities which reflect asymmetric function (see table 1). Although, as is the case in any developing field, such a list is only intuitive and not yet complete, it does, nevertheless, represent one of the most useful ways of compiling the results of many of the experiments and insights already gained. In addition, a listing of these antinomic dualities (see table 2) has the advantage of being juxtaposed with the cross-cultural anthropological reports indicating how various societies throughout the world categorize human experience and endeavors with right and left.

We should realize that such a list of dualities from a scientific perspective is only intuitive because the scientific picture is far from complete with regard to right and left hemispheric functional asymmetries. In fact, what may occur as a result of our anthropological study of the natural variation of this phenomenon is a further clarification of hypotheses for testing by neuropsychologists. For example, I have been able to develop a parallel list from the anthropological literature associating concepts with handedness and/or sides of the body. Associated with the left (the right cerebral hemisphere) are the symbolic, ritualistic, mystical, mythical, omnipotent, transcendental, supernatural, evil, profane, not subject to direct verbalization, that is, not easy to describe and linguistically variable, and foreign or alien. The right hand and side of the body are associated with the social order, politics, organization, social system, morality, goodness, sacred, explicitly verbal mathematical, and ordered.

With this verbal picture in our minds—I hope in *both* the right and left hemispheres—I would like to take the next step into some an-

TABLE 1
FUNCTIONAL ASYMMETRIES IN THE CEREBRAL HEMISPHERES
A. SPECIFIC FUNCTIONS ASCRIBED TO EACH HEMISPHERE

	Left Hemisphere	Right Hemisphere
Clinical evidence	Speech Writing and reading Various activities composed of complex motor sequences	Spatial orientation Facial recognition Recognition of complex figures
Experimental evidence	Naming Perception of significant order	Perception of abstract pattern Facial recognition

B. BIMODAL PERCEPTUAL AND COGNITIVE FUNCTIONS INFERRED FROM
CLINICAL AND EXPERIMENTAL EVIDENCE

Left Hemisphere	Right Hemisphere
Analytic	Synthetic
Perception of order (lineal)	"Gestalt" perception (nonlinear)
Sequential ordering (time)	Simultaneous comprehension (timeless)
Propositional	Appositional
Verbal	Spatial
Intellectual	Intuitive
Active	Receptive

NOTE.—This table is designed to indicate some of the principal evidence regarding the functions of the right and left hemispheres. For a more intensive review of the evidence, see J. Levy, "Psychobiological Implications of Bilateral Asymmetry," in *Hemisphere Function in the Human Brain*, ed. S. Diamond and J. G. Beaumont (London: Paul Elek, Ltd., 1974), pp. 121–83. Part B is a representative list of general scientific abstractions ascribed to each hemisphere.

TABLE 2
SELECTED ITEMS ASSOCIATED WITH RIGHT AND LEFT IN DUAL
CLASSIFICATION SYSTEMS

Right	Left	Societies
Strong	Weak	Kaguru, etc.
Social order	Disorder	Nyoro
Genealogy	Myth	Lugbara
Senior	Junior	Meru, etc.
Eating	Eliminating	Arabs
Worldly	Spiritual	Amboyna, etc.
Esteemed	Hated	Nyoro
Auspicious	Inauspicious	Maori, etc.
Life	Death	Toradja, etc.

NOTE.—This table, from Solomon H. Katz and D. Armstrong, "Neural Bases of Right-Left Dual Classification Systems" (paper presented at the Symposium on Biogenetic Structuralism at the annual meetings of the American Anthropological Association, Mexico City, November 20, 1974), is adapted from data on various societies presented primarily in *Right and Left*, ed. and trans. Rodney Needham (Chicago: University of Chicago Press, 1973). Right or left in the context of this table indicates handedness or sidedness. These dual classifications are also referred to as antinomies or opposites in the text of the paper. Recently, Charles Laughlin, Jr., and Eugene G. d'Aquili (*Biogenetic Structuralism* [New York: Columbia University Press, 1974]) have suggested that thinking in terms of polar opposites is a direct function of cross-modal association occurring in the inferior parietal lobule in the brain (see also Solomon H. Katz, "Evolutionary Perspectives on Purpose and Man," *Zygon* 8 [1973]: 325–40).

thropological literature to build further bridges between the ways in which people of various societies interpret and explain their world and the way we would predict in general, known scientific terms how these hemispheres function. These examples have been explicitly chosen here purely for the richness of the dualities rather than for how well they do or do not fit a particular pattern. In this regard, I would like to cite a few quotations that give us an intuitive sense of what these lists mean, which are, after all, English translations. Since English comes from an Indo-European tradition, it is important to note that this tradition seems to associate everything in positive, dexterous, right, and correct terms with the right hand and everything in sinister, inauspicious, and evasive terms with the left hand. For example, this is reflected in a statement Hertz quotes from Meillet: "It seems that when speaking of the left side one avoided pronouncing the proper word and tended to replace it by different ones which were constantly renewed."²¹ Hertz goes on to say:

The multiplicity and instability of terms for the left, and their evasive and arbitrary character, may be explained by the sentiments of disquiet and aversion felt by the community with respect to the left side. Since the thing itself could not be changed, the name for it was, in the hope of abolishing or reducing the evil. But in vain; for even words with happy meanings, when applied by antiphrasis to the left, are quickly contaminated by what they express and acquire a "sinister" quality which soon forbids their use. . . .²²

However, in other traditions such as the Maori:

Among the Maori the right is the sacred side, the seat of good and creative powers; the left is the profane side, possessing no virtue other than, as we shall see, certain disturbing and suspect powers. The same contrast reappears in the course of the evolution of religion, in more precise and less impersonal forms: the right is the side of the gods, where hovers the white figure of a good guardian angel; the left side is dedicated to demons, or to the devil, and a black and wicked angel holds it in dominion. . . . It is not by chance that in pictures of the Last Judgment it is the Lord's raised right hand that indicates to the elect their sublime abode, while his lowered left hand shows the damned the gaping jaws of Hell ready to swallow them. The relation uniting the right to the east or south and the left to the north or west is even more direct and constant, to the extent that in many languages the same words denote the sides of the body and the cardinal points. The axis which divides the world into two halves, the one radiant and the other dark, also cuts through the human body and divides it between the empire of light and that of darkness. Right and left transcend the limits of our body to embrace the universe.

According to a very widespread idea, at least in the Indo-European area, the community forms a closed circle at the center of which is the altar, the Ark of the Covenant, where the gods descend and from which place divine aid radiates. Within the enclosure reign order and harmony, while outside it

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extends a vast night, limitless and lawless, full of impure germs and traversed by chaotic forces. On the periphery of the sacred space the worshippers make a ritual circuit round the divine center, their right shoulders turned towards it. They have everything to hope for from one side, everything to fear from the other. The right is the inside, the finite, assured well being, and certain peace; the left is the outside, the infinite, hostile, and the perpetual menace of evil.²³

Elsewhere, Weischoff says:

Of the Pangwe in Cameroon Tesson records that the bodies of prominent sorcerers are placed so as to lie on the left side in burial, which means, as the author himself emphasizes, with the right side uppermost. *Evil* magicians, those who practice *witchcraft*, are buried on the right side, or with the left above.

The Bakitara of the Victoria Nyanza hate left-handed people and so no one is allowed to give anything to another person with the left hand. . . . Exactly the same is reported . . . for the Waseguyu who consider it bad manners to eat with the left, as this is used for all kinds of impure actions. The Ovambo in Southwest Africa avoid passing an object to a person with the left hand, and regard a greeting made with the left hand as an offense. . . . The Herero, the southern neighbors of the Ovambo, belongs to this group of concepts. When, during a fight, the leader has a cramp in the left cheek below the eye, it indicates that the fight will be lost and that important persons will be killed. In contrast to this belief, it may be added here, itching in the right foot denotes an approaching death in the family. Among the Ovimbundo of Southern Angola a very insulting sign is made in this way. The left arm is held up with the fist closed. The left wrist is grasped with the right hand. The left fist is then shaken while the right hand is still grasping the left wrist. . . . apparently what we have here is an indication that left is equivalent to bad.²⁴

While in most cases these antinomies do not directly coincide with the list of abstracted neural functions of the left and right hemispheres, it is clear there is a strong relationship. These antinomies or opposites reflect a concern with the opposing nature of their experiences with explaining their world. We see the vagaries associated with the nonverbal left and the high degree of order and linear organization with the right. However, it is also evident that some elements of the dualities are more a part of their particular ecosystem than they are a part of the expression of the cognitive functioning of the hemispheres. It could be that these ecosystemic antinomies are highly adaptive and hence become attached to the side which is most appropriate to optimize their adaptive significance in a particular ecosystem.

This dual opposition of classes of phenomena which are closely associated with the functions of the left and right hemispheres applies not only to the small, remote societies reviewed above but also to the much larger traditions including the Arabic-Islamic, Chinese-Taoist,

Indian-Hindu and Buddhist, and Judeo-Christian concepts of religion. However, it is important to indicate that some of the Eastern religions teach the synthetic and integrated quality of the two opposites so that they form a higher unity. This may have something to do with the recognition that integration of these two modes of thought leads to the most effective use of the mind. This may be related to the kind of integration that occurs during the creative process mentioned earlier in the discussion of Archimedes' eureka and Joyce's epiphany.

I find it most interesting that in a recent paper Karl E. Peters mentions examples of this duality in another context dealing with the pervasive presence of these opposites for male and female, for which there is some emerging evidence²⁵ indicating that males in our society seem to function better in right hemispheric tasks than females. Peters says:

Perhaps a still better way to resolve this question [of the unity between good and evil] . . . would be to inquire how those characteristics symbolized by the masculine and those symbolized by the feminine may be either good or evil, depending on the context in which they occur. There may be times when activity and critical orderliness are good and times when they are evil; the same might hold true for the passivity and generative disorderliness symbolized by the feminine. . . . the Chinese association of good with the active, masculine principle and of evil with the passive, feminine principle does make an important point. . . . in the context of the unity of yin and yang, it implies that both good and evil are a part of the creative whole . . . that randomness and disorder are just as much a necessary part of creation as selection and order. In both the scientific and religious pictures, good and evil, insofar as they are identified with order and disorder or the masculine and the feminine, transcend common understandings of morality reflected in cultural taste to the point where both are seen as important elements in the divine process of creation.²⁶

Peters elaborates with a quotation from the modern Hindu philosopher Sri Aurobindo, who refers to the absolute or ultimate reality as beyond "stability and movement" (order and disorder): "But as we cannot describe or think out the Absolute in itself, beyond stability and movement, beyond unity and multitude—nor is that at all our business—we must accept the double fact, admit both Shiva and Kali and seek to know what is *this measureless Movement in Time and Space with regard to that timeless and spaceless pure Existence.*"²⁷

FURTHER DEVELOPMENT AND IMPLICATIONS

In general, this verbal picture reflects what appears, on preliminary analysis of many other societies, to be an overwhelmingly significant relationship between the dualities seeming to align perfectly with

right and left hemispheric functions to the point even of associating correctly the contralateral or opposite hand with the appropriate thought pattern. Although it is only peripherally discussed here, the problem that Benjamin Whorf has developed with regard to the limitations of language may play an important role in limiting the extent to which this problem can be adequately translated and then discussed in English.²⁸ It is clear that cross-cultural "understanding" of this phenomenon of right-left, like the one about cooking corn in the appropriate manner (cited in n. 15 below) or treating illness effectively with primitive technologies and practices,²⁹ probably serves important adaptive functions. However, before such issues can be fully explored, some important questions require answers. We need to understand, first, whether left-right dualities occur in various degrees in all societies, and, second, if the degree of emphasis in a society is related to the level of hemispheric differentiation required by the particular human ecosystem to which the population is adapted. A third question, of course, relates to training. Even Hertz in 1909 recognized this when he turned around Broca's statement that we are right-handed because we are left-brained and alternatively asked if we are left-brained because we are right-handed.

A modern reappraisal of this question would emphasize the degree to which one or the other hemisphere can be trained either through motor patterning (as interested Hertz)³⁰ or through a broader concern with emphasizing a style of cognition. This must be followed by asking about the degree to which this training can influence our perception and explanation of the world.³¹

In other words, do we have a cultural style that teaches children to attend only to certain aspects of brain function? In our society it would seem that we pay more attention to verbal analytic, linear, time-oriented training than to the rhythmical and mystical, nonverbal, non-time-oriented dimensions of our right hemisphere. However, this is not to say that this is always the case in our society, and, in fact, the subcultural differences in early child rearing to emphasize one style of thinking over another could account for some of the reported racial differences in IQ and school achievement scores.

This question of cultural style and training relates to another theme which is important cross-culturally. We all know how it is possible to train verbal analytical abilities associated with the left hemisphere and even some special artistic and musical abilities more commonly associated with the right hemisphere, but what about the training of continuous high dependence on right hemispheric functions? Ornstein has hypothesized that there are many indications that a variety of stories, rituals, and exercises reflect precisely this concern for using

both the verbal and special functions of the two hemispheres. For example, Ornstein related the Sufi story, "Never Know When It Might Come in Useful":

Nasrudin sometimes took people for trips in his boat. One day a pedagogue hired him to ferry him across a very wide river. As soon as they were afloat, the scholar asked whether it was going to be rough. "Don't ask me nothing about it," said Nasrudin. "Have you never studied grammar?" "No," said the Mulla. "In that case, half your life has been wasted." The Mulla said nothing. Soon a terrible storm blew up. The Mulla's crazy cockleshell was filling with water. He leaned over toward his companion. "Have you ever learned to swim?" "No," said the pedant. "In that case, schoolmaster, all your life is lost for we are sinking."³²

Ornstein also suggests that a number of ritualistic exercises such as staring at objects or symbols, continuous repetition of incantations, and a variety of other practices all attempt to bring on a meditation state which specifically relates to right hemispheric functions. Additionally, it is possible that the attempts by other societies to induce religious trance states by self-hypnosis, various drugs, and/or ritualized dance also relate to this same phenomenon. It is but a short step to ask if alcohol and drug abuse are also adaptive responses to the same need in our apparently "left-dominant cultural style." Similarly, we can also ask if this right-left hemisphere asymmetry is related to the function of dreams and even in the sense in which Jung wrote when he mentioned the collective unconscious. Finally, we must be concerned with the connection between both hemispheric modes and the development of new means of optimizing the effective use of their integration.

IMPLICATIONS TOWARD A NEW SCIENCE OF HUMANITY

With these and other new questions and answers that these kinds of discussion of human brain function spark, we may be closer to understanding the ingredients for a truly synthetic science of humanity that even takes into account our religious needs as well. In this sense this paper represents an attempt, as some readers have already realized, to generate and begin to open up in an intuitive and almost, if you please, right-sided approach whole new areas of crossover among human cognition, religion, philosophy, and science. Such ideas have significant and obvious implications even for our understanding of poetry, music, and the visual arts.

Earlier I indicated we are losing our sense of purpose mainly because of our increasing dependence on the scientific method, which is highly reductionistic, empiric, and analytical.³³ I also suggested that

the social consequences of our rapid rates of technological change and loss of identity are leading us toward the brink of potentially catastrophic revolution and decay.³⁴ Science has the opportunity to play a positive role in overcoming this problem. To do so, science must become more holistic and synthetic by incorporating into its fabric a new level of understanding of the human and sociocultural qualities of its inventors. Such a new science, for example, will deal not only with the rational thought processes traditionally labeled legitimate but also with those religious and humanistic aspects of our existence which have previously been considered peripheral to its goals. It is in this context that the approach used in this paper was conceived to point toward the full significance of this new side of our thought processes. Of course, these thought processes are “new” only inasmuch as we have finally been able to begin to use our scientific methods to verify their presence. Certainly, the absolutely abundant anthropological evidence that supports their manifestations from the intuitive perspective indicates that our implicit knowledge of these phenomena may be as old as humanity itself. But what is different and truly exciting this time is that we can now begin to use the knowledge as a regular part of our *scientific* understanding of the human mind in order to extend further our means of adapting to the world we live in. For the first time we can begin to remove the wraps from the right hemispherical meaning of mystical and transcendental experience if our rational scientific method proves, transmits, and makes real the existence of such phenomena for our society. Then, once again, we can feel more comfortable with accepting the unusual powers that all of us possess and yet so few in our culture are willing, trusting, or even confident enough to use. At last, our newly developing science of humanity can potentially set us free to recognize that there is more to humanity than all of our linear thinking can give us and to realize that human life viewed predominately from left hemispheric functions is almost as flat as viewing the world through one eye.

In conclusion, we *are* moving toward a new science of humanity, one which does understand and accept our rational and irrational, the brain’s left and right. This will be a science of humanity which will help us more fully satisfy our needs and more completely develop our real abilities and potentials. And with a new science of humanity we *can* have a new kind of technology—a technology we control and not one that controls us. This means a science and technology that allow for the development of a new level of spiritual and intellectual unity within ourselves and among one another and toward our environment.

NOTES

1. See my "Evolutionary Perspectives on Purpose and Man," *Zygon* 8 (1973): 325-40, for a further discussion of purpose.

2. S. Washburn and S. C. Strum, "Concluding Comments," in *Perspective on Human Evolution*, ed. S. Washburn and P. J. Dolhinow (New York: Holt, Rinehart & Winston, 1972), 2:469-70.

3. Of course, one could question whether the same science that stands behind modern technology could ever hope to recognize those nontechnical qualities of human thinking which do not conform to these cognitive styles demanded by science and technology. However, to do so in one sense would be to deny that people who use and practice science are human, since in general all humans, including scientists, are likely to have these abilities. In fact, given the high probability of variation in cognitive styles in any human population, there is every reason to believe that this variation could be explained scientifically. To have variation, we would only have to assume that one population would have more practitioners of one style of thought than another but that most human populations have some who can think in terms compatible with the symbolic information codes used for complex technology.

4. This brief review attempts to avoid all but the essential information on the problem of hemispherical asymmetries. Much more extensive reviews of the evidence can be found in the works of J. E. Bogen ("The Other Side of the Brain: An Appositional Mind," in *The Nature of Human Consciousness*, ed. R. Ornstein [New York: Viking Press, 1973], pp. 101-25; J. E. Bogen and G. M. Bogen, "The Other Side of the Brain III: The Corpus Callosum and Creativity," *Bulletin of the Los Angeles Neurological Societies* 34 [1969]: 191-220; and n. 7 below).

5. This universality of speech and the left hemisphere is not complete. Numerous studies, including those of J. Levy ("Psychobiological Implications of Bilateral Asymmetry," in *Hemisphere Function in the Human Brain*, ed. S. Dimond and J. G. Beaumont [London: Paul Elek, Ltd., 1974], pp. 121-83), indicate that there are individuals with right-hemisphere speech in a small but significant portion, approximately 40 percent of left-handed individuals, of any population. However, this is further complicated by the fact that H. Hecaen and J. de Ajuriaguerra (*Left Handedness: Manual Superiority and Cerebral Dominance*, trans. Eric Ponder [New York: Grove & Stratton, 1964]) have reported that, as a population, left-handed individuals have a higher incidence of early hemispherical brain damage (presumably at birth) which causes an early switching over of speech to the other hemisphere. In addition, such switching over can occur with some decrease in efficiency any time from birth to pubescence but usually not after this period, although it is important to mention that left-handed individuals have at any age a better prognosis for recovery from brain injuries influencing speech than the right-handed. A. Gessell and L. B. Ames ("The Development of Handedness," *Journal of Genetic Psychology* 70 [1947]: 155-75) have reported a significant correlation between right tonic neck reflex in premature babies (seven months) and handedness at ten years. Elsewhere, N. Geschwind ("Cerebral Dominance and Anatomic Asymmetries," *New England Journal of Medicine* 287 [1972]: 194-97) has reported clear neuroanatomic differences in brain symmetry favoring the left hemisphere for speech at birth. In general, Levy concludes from this kind of evidence that the capacity for speech asymmetries has a strong genetic component favoring right-handed motor control and left-hemisphere speech control. This leaves a small population of individuals with a recessive genetic predisposition toward left-handedness and right-hemispheric speech. Finally, it is also important to mention that this crossover between left-hemisphere speech and right-handedness, and vice versa, does not always occur, since crossed aphasias are reported (see Levy) where an individual can be right-handed and have the right hemisphere for speech.

6. N. Geschwind, "Disconnection Syndromes in Animals and Man," *Brain* 88 (1965): 237-94, and n. 5 above.

7. R. W. Sperry, M. S. Gazzaniga, and J. E. Bogen, "Interhemispheric Relationships: The Neocortical Commissures; Syndromes of Hemisphere Disconnection," in *Handbook*

of *Clinical Neurology*, ed. P. J. Vinken and G. W. Bruyn (New York: American Elsevier Publishing Co. 1969), 4:273-90.

8. Preliminary experimental results by an investigator at the University of Pennsylvania indicate that alcohol selectively affects the left hemisphere functions more than the right, allowing right hemisphere functions to predominate. As an interesting experiment, it is hypothesized that motor control of writing is mirror-imaged through the corpus callosum on the right hemisphere. Hence, under the appropriate conditions most of us are capable, without any previous training, of picking up two pencils and simultaneously writing simple words and sentences forward with the right hand and backwards with the left. This may be especially true after having a few cocktails—alcohol apparently disinhibits our right hemisphere (J. Levy, personal communication, 1974)!

9. More specifically, the next time you are involved in analyzing a problem and are writing, observe what you are doing with your left hand! Alternatively, watch an artist use his or her left hand in the carrying out of his or her work.

10. See Eugene G. d'Aquili and Charles Laughlin, Jr., "The Biopsychological Determinants of Religious Ritual Behavior," this issue; Laughlin and d'Aquili, *Biogenetic Structuralism* (New York: Columbia University Press, 1974).

11. H. Shapero, "The Musical Mind," in *The Creative Process*, ed. Brewster Ghiselin (New York: Mentor Books, 1952), pp. 51-52; see also T. G. Beuer and R. J. Chiarello, "Cerebral Dominance in Musicians and Nonmusicians," *Science* 185 (1974): 537-39.

12. Robert Assagioli, *Psychosynthesis: A Manual of Principles and Techniques* (New York: Viking Press, 1971).

13. Robert Hertz, "The Preeminence of the Right Hand: A Study in Religious Polarity," in *Right and Left*, ed. and trans. Rodney Needham (Chicago: University of Chicago Press, 1973), p. 31.

14. Jerome Bruner, *On Knowing: Essays for the Left Hand* (Cambridge, Mass.: Harvard University Press, 1962), pp. 2-4.

15. Recently, for example, two graduate students and I (Solomon H. Katz, M. Hediger, and L. Valleroy, "Maize Processing Techniques in the New World," *Science* 184 [1974]: 765-73) had occasion to analyze the nutritional significance of a particular cooking practice used in the preparation of maize. There was biochemical evidence that such a practice would significantly enhance the nutritional value of a maize diet to the point where it could support most of a population's nutritional needs. Of course, we also knew that maize was the key dietary constituent behind the rise of the great Mesoamerican civilizations; this meant there was sufficient time for some kind of optimum adaptation to be made for this diet. While it was obviously clear that such scientific evidence as that stemming from biochemistry could not have existed, we hypothesized that this knowledge had important survival value and was probably gained by a process of trial and error and that, once gained, was so successful that it became a permanent part of a culture. Furthermore, by relating the level of consumption and production to the presence or absence of this technique, we were able to demonstrate a nearly perfect relationship between heavy dependence on maize and the practice of this particular cooking technique. It was so significant that we suggested that this technique was a critical limit for the full development of maize agriculture.

16. Hertz (n. 13 above).

17. See n. 5 above.

18. Needham (n. 13 above).

19. J. Chelod, "A Contribution to the Problem of the Preeminence of the Right, Based upon Arabic Evidence in Right and Left," in *Right and Left*, ed. Needham, p. 244.

20. These data and other information I have been able to collect provide us with a sample. Although small, and selected only on the basis of the recorded information on the problem, it is nevertheless an adequate enough sample to determine if there are important associations and patterns between the natural interpretation of right and left and what we have already learned from the experimental neurological studies. This is especially true if there is no reason to suspect in advance that the collection of these samples was biased to reflect a particular pattern. In addition, by taking all recorded

examples, we are using a total ascertainment-like approach that should also serve to help eliminate any bias in the sample. Of course, there is always the likelihood that they were all part of a few, broad cultural traditions (see R. Naroll, "Galton's Problem," in *A Handbook of Method in Cultural Anthropology* [Garden City, N.Y.: Natural History Press, 1970], pp. 974-89). However, even this finding would be interesting because it would reflect the strong resistance of these traditions to any kind of change, even under the different ecological circumstances to which these populations reflecting the broad traditions were ultimately subjected. Even with these words of caution about sampling, we should caution further that at this very preliminary stage of investigation into the problem, the concepts which follow should not be construed as the products of statistically tested hypotheses—rather, the results here should be viewed as a possible basis for further, more formal inquiry (Solomon H. Katz and D. Armstrong, "Neural Bases of Right-Left Dual Classification Systems" [paper presented at the Symposium on Biogenetic Structuralism at the annual meetings of the American Anthropological Association, Mexico City, November 20, 1974]).

21. Hertz, p. 11.

22. *Ibid.*

23. *Ibid.*, pp. 11-14.

24. Heinz A. Weischoff, "Concepts of Right and Left in African Cultures," in *Right and Left*, ed. Needham, p. 63; my italics.

25. Levy (n. 5 above).

26. Karl E. Peters, "The Image of God as a Model for Humanization," *Zygon* 9 (1974): 116.

27. *Ibid.*, p. 117; my italics.

28. J. B. Carroll, ed., *Language, Thought and Reality: Selected Readings of Benjamin Lee Whorf* (Cambridge, Mass.: M.I.T. Press, 1951).

29. Katz et al. (n. 15 above); Solomon H. Katz and Anthony F. C. Wallace, "Anthropological Perspectives of Behavior and Disease," *American Journal of Public Health* (November 1974), pp. 1050-53.

30. Hertz (n. 13 above).

31. In this regard it is interesting to note that, ordinarily, questions regarding heritability and environment can be answered by comparing identical and fraternal twins. Under the vast majority of circumstances identical twins who share the same genes are more alike than fraternal twins who share, like brothers and/or sisters, the same parents. However, in the case of handedness, identical twins are more often opposite handed than fraternal twins, making it impossible to calculate heritability. In a large twin study just carried out at our Growth Center we found by examining data only from identical twins, i.e., those who share identical genes and whose co-twin wrote with the same hand in cases of either left-left or right-right, that they always demonstrated a very high degree of similarity in a variety of psychological tests of perception and achievement. However, when the identical co-twin was opposite handed right-left or vice versa, there was a very significant difference between their psychological profiles. While these results require further analysis before their full meaning can be extensively interpreted, they nevertheless suggest the important effects of *in utero* environment upon the development of handedness, since there was no reason to suspect that these twins were purposefully trained after birth to assume these unusual differences.

32. R. E. Ornstein, *The Psychology of Consciousness* (San Francisco: W. H. Freeman & Co., 1972), p. 49.

33. Katz (n. 1 above).

34. Solomon H. Katz, "The Dehumanization and Rehumanization of Science and Society," *Zygon* 9 (1974): 126-38.