Walsh, R.N. Emerging cross-disciplinary parallels: Suggestions from the neurosciences. Journal of Transpersonal Psychology, 11, 175-184, 1979

EMERGING CROSS-DISCIPLINARY PARALLELS: SUGGESTIONS FROM THE NEUROSCIENCES

Roger N. Walsh
Irvine, California

HYPOTHESIS

The basic hypothesis of this paper is that, as human perceptual sensitivity increases beyond a certain threshold, we penetrate beyond the realm of our ordinary experience of the world and its concomitant "reality" and obtain a fundamentally different view of nature. This view may be obtained through any of the epistemological modes of acquiring knowledge: sensory perception, intellectual conceptual analysis, or contemplation. Heightened sensitivity may be obtained either through direct training of awareness as in meditation or other consciousness disciplines, through refinement of conceptual analysis, or by augmentation and systematization of sensory perception through instrumentation and experiment as in advanced science. But no matter how it is obtained, enhancement of sufficient degree may reveal a different order of reality from that to which we are accustomed. Furthermore, the properties so revealed will be essentially more fundamental and veridical than the usual, and will display a greater degree of commonality across disciplines. Thus as empirical disciplines evolve and become more sensitive, they might be expected to uncover phenomena and properties which point toward underlying commonalities and parallels between disciplines and across levels.

empirical disciplines and underlying commonality

The author wishes to acknowledge the invaluable stimulation and feedback given by Ken Wilber, Gordon Globus, and Duane Elgin.

This article will appear in a forthcoming book, Walsh, R. & Vaughan, F. *Beyond ego: Transpersonal dimensions in psychology*. Los Angeles: J.P. Tarcher, 1980 (In press).

Thus what this paper suggests is that we may be witnessing a paradigm transition in which one of our most fundamental paradigms, the bedrock of Western science, the classical Greek concept of the universe as essentially atomistic, divisible, isolable, static, nonrelativistic, and comprehensible by reductionism, is in the process of replacement, not just for physics where evidence for such a shift was first obtained, but for all sciences. In physics this image of the universe is increasingly, though far from unanimously, recognized (*e.g.*, Capra, 1975, 1976; Wilber, 1977; Beynam, 1978; Bohm, 1978; Zukav, 1979). What is being suggested here is that much of this new paradigm may also be applicable to the neurosciences in particular and ultimately to all science, and that as the individual branches of science evolve we may witness increasing degrees of cross-disciplinary parallels, not only between sciences, but between science and the consciousness disciplines as each discovers the same fundamental underlying properties of nature.

possible parallels between science and consciousness disciplines

EPISTEMOLOGICAL LIMITATIONS

Both modern science and the consciousness disciplines point out that our usual perception is limited and distorted to an unrecognized degree. For millennia the meditative and yogic disciplines have devoted themselves specifically to this problem and have stated that it is only when we begin to increase our perceptual sensitivity and accuracy that we begin to appreciate the existence and magnitude of the problem (*e.g.*, Goldstein, 1976; Goleman, 1977; Shapiro, 1980; Shapiro & Walsh, 1980; Walsh & Vaughan, 1980).

The aim of modern science is similar, namely to transcend our usual perceptual limitations in order to obtain more accurate and sensitive knowledge of the universe. Western psychology has long recognized and explored perceptual limitations, but in recent years certain data derived from physics has begun to confirm certain aspects of the picture of underlying reality described by the consciousness disciplines and the limitations of perception. They suggest that our usual perceptual limitations tend to produce consistent yet unrecognized distortions no matter where we look. These distortions include tendencies to solidify, dichotomize, separate, oversimplify, concretize, and to underappreciate the extent of continuous flux, impermanence, interconnectedness, and holistic consistency of the universe. Both the consciousness disciplines and modern physics, and now perhaps also the neurosciences, suggest that these distortions are so pervasive and unrecognized that our usual picture of the universe, *i.e.*, reality, is fundamentally erroneous

or illusory. The word illusory has often been misunderstood to imply that the world does not really exist. Rather it simply implies that our perception of it is colored and distorted to an unrecognized degree.

THE EVOLUTION OF SCIENTIFIC INVESTIGATION

The preceding sections have suggested that the evolution of science along lines of increasing perceptual sensitivity may reveal increasing cross-disciplinary parallels and that the neurosciences may be at the threshold of such a stage. Let us now examine the general evolution of scientific research within a field in order to suggest how the nature and evolution of research designs may interact with and determine scientific models of nature, and ultimately result in the holistic model described above.

Scientific investigation in any field usually begins with the study of simplified isolated systems. Usually the effects of one or a small number of selected independent variables are tested and all others are excluded or ignored, as are interactions with other systems and dynamic processes. These few selected variables are usually those which account for the greatest portion of the variance.

With increasing experimental sophistication and sensitivity, the effects of formerly excluded variables intrude more and more and must eventually be taken into consideration. Yesterday's confounding variable becomes today's independent variable. The total amount of variance accounted for continues to increase, though usually at asymptotic rates since independent variables tend to be investigated in decreasing order of potency. With increasing numbers of variables, interactions and interdependencies become increasingly apparent until eventually it is recognized that all variables, including the state of the observer, exert multiple effects (Walsh & Cummins, 1976). A complete understanding requires no less than a consideration of all variables, *i.e.* of the entire universe.

all variables exert multiple effects

At this stage the original model of an isolatable limited system breaks down and is recognized as an illusory artifact. The scientific model has led to its own annihilating edge and the inherently holistic, indivisible, interconnected, interdependent, infinitely overdetermined and dynamic nature of the world is recognized. Such a perspective as this obviously transcends traditional models of causality resulting in an omnideterminism in which all components are seen to mutually determine all others. The state of any part reflects the state of

the whole. However, it should be noted that this does not necessarily point to a holographic model in which the whole is contained *in* each part, as certain models of physics and the consciousness disciplines propose.

Having examined the general principles of the hypothesis presented in this paper and of the evolution of scientific investigation, let us now turn to the specific evidence from the neurosciences which appears to lend support to these general principles and to certain claims of the consciousness disciplines and modern physics.

THE ECOLOGICAL BRAIN

the brain as a plastic organ

Despite centuries of philosophical speculation, it is only within recent decades that the neurosciences have been able to provide an answer to one of their oldest questions. "Does sensory stimulation and use of the brain result in detectable changes in it?" Contrary to most previous opinion, the answer is clearly "yes." A growing body of research demonstrates that the brain is actually a plastic organ which responds to its sensory environment at all levels, from gross brain size down to the smallest subcellular constituents.

Moreover this responsiveness appears to represent an exquisitely sensitive adaptation to the functional demands of the environment. Relatively minor environmental changes are now known to be capable of eliciting chemical, physiological, and anatomical responses in brain structure and function. Greater input from a more demanding complex environment, for example, results in increases in neuronal size and physiological and chemical activity. These responses are specific in magnitude, location, duration, and nature, to the specific magnitude, duration, location, and nature of the stimulus (for reviews, *see* Diamond, 1976; Greenough, 1976; Walsh & Greenough, 1976; Rosenzweig & Bennett, 1977, 1978; Walsh, 1980).

To summarize a long and complex neuroscientific story, it is now apparent that the brain is a plastic organ whose structure and function mirror its ecology. Moreover this structure and function are largely dynamic, continuously adapting to changing functional demands (Beck *et al.*, 1969; Sotelo & Palay, 1971). Neural components show complex interconnections and interdependence; changes in any one part of the brain are likely to affect many if not all other parts. For the most part, environmentally induced changes cannot be predicted with absolute certainty but rather tend to be probabi-

listic, *i.e.* predictable only within certain limits. Furthermore, no one single mechanism can account for observed changes. No one chemical reaction, physiological principle, or psychological property is sufficient to precisely circumscribe neural events (Walsh & Cummins, 1975).

Rather, any one change reflects the totality of responses of all parts, dimensions, and levels of the brain. There is thus no one fundamental mechanism to which neural responses can be reduced and by which they can be explained. At the more fundamental levels, all effects reflect and are consistent with the state of the whole brain. Neural causality is thus not fully describable by reductionism but rather must be sought in the state of the whole brain—and ultimately, at a level which transcends traditional concepts of causality, in the state of the brain within its environment.

and brain and the universe as a coherent whole

On the other hand, the environment can only be known through the brain. The brain and the remainder of the universe thus constitute a coherent whole; they cannot be separated and studied independently without constituting an artificial and distorting duality which hides their underlying unity and interconnectedness. The structure and function of the brain are a function of the whole and of the brain-nonbrain (environment) interaction. The record of their interaction is dynamically engraved in chemical and anatomical script in the neural pathways. The universe comes to know itself through the brain and, within its limits, the brain appears to modify and adapt itself so as to better know the universe.

The failure to appreciate the interconnectedness of brain and environment has resulted in numerous experimental errors and some whole fields of research now require reassessment. For example, some of the effects long attributed to "malnutrition" may actually reflect direct effects of the environments in which malnutrition occurred (Levine & Wiener, 1976; Richardson, 1976; Levitsky, 1979).

The evolution of the study of brain ecology thus begins to suggest a number of features of holism, interconnection and interdependence, dynamism, probabalism, complexity, and acausal self-determinism, which are reminiscent of parallels in both modern physics and the consciousness disciplines.

CROSS-DISCIPLINARY PARALLELS

When perceptual limitations are overcome, the reality which is revealed appears strikingly different from the everyday one.

In general the following characteristics are descriptive of the reality described by the consciousness disciplines, certain models of physics, and suggestions from some areas of the neurosciences. The universe appears to be:

nondualistic as opposed to dichotomous.
a *unitive whole* as opposed to unrelated parts.
interconnected as opposed to comprised of separate and isolated components.
dynamic and in continuous motion or flux as opposed to static.
impermanent and ephemeral as opposed to lasting and permanent.
empty (largely constituted by non-solid empty space), rather than solid.
acausal (but not anticausal), *i.e.* transcendent to traditional models of causality, since every component enters into the determination of every event (omnideterminism).
foundationless and self-consistent in that, since all components and mechanisms are interconnected and interdependent, none are ultimately more fundamental than any other—hence the universe is inexplicable in terms of a limited number of fundamental mechanisms.
statistical and probabilistic instead of certain.
paradoxical rather than ultimately intellectually comprehensible, codifiable, and communicable.
inextricably linked with the observer.

observation as a function of consciousness

What can be known is the interaction between observer and observed and never the independent properties of the observed alone. All observation is a function of the consciousness of the observer, and thus the known universe is inextricably linked with consciousness rather than being separable into consciousness and objects of consciousness: "The world may be called physical or mental or both or neither as we please: in fact the words serve no purpose" (Bertrand Russell, cited by Wilber, 1977, p. 38).

Thus the fundamental ontology which is being revealed is largely dynamic, fluid, impermanent, holistic, interconnected, interdependent, foundationless, self-consistent, empty, paradoxical, probabilistic, infinitely over-determined, and inextricably linked to the consciousness of the observer.

It might be hypothesized that since the above-mentioned description refers to fundamental properties common to all phenomena, then perception of sufficient sensitivity and veridicality will begin to recognize these properties no matter what the perceptual mode and no matter what the object of

perception. Thus any object, if examined by any perceptual mode with a sensitivity enhanced to sufficient degree either by direct training or scientific instrumentation, might be expected to present a picture of its inherent nature as described above.

But at this level of greater sensitivity another factor enters, namely the consciousness of the observer. Since ultimately we can know only the properties of the interaction between observer and observed, any discipline will begin to detect fundamental properties of both the objects under investigation as described above, plus the observational system, including the consciousness of the observer. The picture of the universe which emerges therefore turns out to be a function of consciousness. Thus the common properties of all objects plus the involvement of consciousness in all observations may both provide a basis for cross-disciplinary parallels.

LIMITATIONS TO THESE PARALLELS

In pointing to these parallels, I do *not* wish to suggest that physics, the consciousness disciplines, and the neurosciences are converging on a common level of reality. There has been much overly-simplistic and wishful thinking about this as Ken Wilber (1979a, b) has clearly described, and the following discussion owes much to him.

microworld and macroworld are very different

For example, the microworld of quantum physics is very different from the macroworld which we observe with our unaided physical senses—so different in fact that it is not fully communicable in language, but only in mathematics. Indeed, it is not even fully imaginable within our physical senses and macroworld-oriented imagination (Capek, 1961). In addition, while the neurosciences may be beginning to suggest a holistic model, the perennial philosophies and certain schools of quantum physics propose models which are both holistic and holographic (each part not only influences every other part but actually contains it).

Just as physics describes limits on the equivalence of properties across size scales, the perennial philosophies describe limits to the equivalence of properties across an ontological scale which they range from consciousness at one end to inanimate physical matter at the other. Levels are held to be interdependent and interpenetrating, but it is also held that the properties of consciousness cannot be reduced to those of physical matter and must be known by a different epistemological mode, *i.e.* contemplation as opposed to sensory perception and conceptual reasoning (Wilber, 1979a, b; 1980 a, b).

Note that the size levels of the physicist and neuroscientist are encompassed within the physical matter level and sensory perception-conceptual modes of the perennial philosophy. The physicist is thus describing holism and perhaps holography within one size level, the findings of neurosciences reflect parallels across size levels, while the perennial philosophy is describing holism *and holography* within *and across* all size and ontological levels and epistemological modes.

Popularized extrapolations from holographic interpretations of quantum physics have recently become easily accepted, except among some physicists who are by no means unanimous on some of these interpretations (Gardner, 1979). It is also frequently claimed that quantum physics is finding proof of the claims of the perennial philosophy. The above argument suggests, however, that this is not so. Although one interpretation of quantum physics suggests a holographic reality at this ontological and size level, it can say little about other size levels and nothing about other ontological levels. At the present time we can only point to parallels.

CONCLUSION

the same principles at many levels

In general we might hypothesize that the more mature a discipline or branch of science, the more it will begin to unearth and point towards underlying phenomena and properties which parallel those found by other disciplines. This will not be instead of, but in addition to, the unique properties of the specific objects which it studies. Perhaps the same principles will be re-discoverable at many levels, with many degrees of subtlety and pervasiveness. The more sensitive the discipline, the more these underlying principles may be recognized. Beneath the initial appearance of infinite diversity may perhaps be found a complementary underlying essential commonality pervading all of nature, transcending traditional disciplinary boundaries, and ultimately representing a function of our own consciousness.

REFERENCES

BECK, E.C., DUSTMAN, R., & SAKAI, M. Electrophysiological correlates of selective attention. In C. Evans & T. Mulholland (Eds.), *Attention in neurophysiology*. London: Butterworths, 1969.

BEYNAM, L.M. The emergent paradigm in science. *ReVision*, 1978, *1*, 56-72.

BOHM. D. The enfolding-unfolding universe. *ReVision*. 1978. *1*. 24-51.

CAPEK. M. *Philosophical impact of contemporary physics*. Princeton: Van Nostrand. 1961.

CAPRA. F. *The Tao of physics*. Boulder. Co.: Shambhala. 1975.

CAPRA. F. Modern physics and eastern mysticism. *J. Transpersonal Psychol.*. 1976. *8*. 1. 20-40.

DIAMOND. M.C. Anatomical brain changes induced by environment. In L. Petrinovich & J. McGaugh (Eds.). *Knowing, thinking and believing*. New York: Plenum Press. 1976. 215-39.

GARDNER. M. Quantum theory and quack theory. *New York Review of Books*. May 17. 1979.

GOLDSTEIN. J. *The experience of insight*. Santa Cruz. Ca.: Unity Press. 1976.

GOLEMAN. D. *The varieties of the meditative experience*. New York: Dutton. 1977.

GREENOUGH. W.T. Enduring brain effects of differential experience and training. In M. Rosenzweig & E. Bennett (Eds.). *Neural mechanisms of memory and learning*. Cambridge. Ma.: MIT Press. 1976. 255-78.

LEVINE. S. & WIENER. S. Malnutrition and early environmental experience: Possible interactive effects on later behavior. In R. Walsh & W. Greenough (Eds.). *Environments as therapy for brain dysfunction*. New York: Plenum Press. 1976. 51-70.

LEVITSKY. D.A. (Ed.). *Malnutrition. environment. and behavior*. Cornell. N.Y.: Cornell Univ. Press. 1979.

RICHARDSON. S. The influence of severe malnutrition in infancy on the intelligence of children at school age: An ecological perspective. In R. Walsh and W. Greenough (Eds.). *Environments as Therapy for Brain Dysfunction*. New York: Plenum Press. 1976. 256-75.

ROSENZWEIG. M.R.. & BENNETT. E.L. Effects of environmental enrichment or impoverishment on learning. and on brain values in rodents. In A. Oliverio (Ed.). *Genetics. Environment. and Intelligence*. Holland: Elsevier. 1977. 163-96.

ROSENZWEIG. M. & BENNETT. E. Experiential influences on brain anatomy and brain chemistry in rodents. In G. Gottleib (Ed.). *Studies on the Development of Behavior and the Nervous System. Vol. 4. Early Influences*. New York: Academic Press. 1978.

SHAPIRO. D. *Meditation: Self-regulation strategy and altered states of consciousness*. New York: Aldine. 1980 (In press).

SHAPIRO. D. & WALSH. R.N. (Eds.). *The science of meditation: Research. theory. and practice*. New York: Aldine. 1980 (In press).

SOTELO. C. & PALAY. S.L. Altered axons and axon terminals in

the lateral vestibular nucleus of the rat. *Lab. Invest.*, 1971, *25*, 653–71.

WALSH, R. *Towards an ecology of brain*. Jamaica, N.Y.: Plenum Press, 1980 (In press).

WALSH, R.N. & CUMMINS, R.A. Mechanisms mediating the production of environmentally induced brain changes. *Psychological Bulletin*, 1975, *82*, 986–1000.

WALSH, R.N. & CUMMINS, R.A. The open field test: A critical review. *Psychological Bulletin*, 1976, *83*, 482–504.

WALSH, R.N. & GREENOUGH, W.T. (Eds.). *Environments as therapy for brain dysfunction*. New York: Plenum Press, 1976.

WALSH, R.N. & VAUGHAN, F. (Eds.). *Beyond ego: Transpersonal dimensions in psychology*. Los Angeles, Ca.: J. Tarcher Press, 1980 (In press).

WILBER, K. *The spectrum of consciousness*. Wheaton, Ill.: Theosophical Publishing House, 1977.

WILBER, K. Eye to eye. *ReVision*, 1979a, *2*, 3–25.

WILBER, K. Physics, mysticism, and the new holographic paradigm: A new appraisal. *ReVision*, 1979b (In press).

WILBER, K. *The atman project*. Wheaton, Ill.: Theosophical Publishing House, 1980a (In press).

WILBER, K. Eye to eye: Transpersonal psychology and science. In R. Walsh & F. Vaughan (Eds.), *Beyond ego: Transpersonal dimensions in psychology*. Los Angeles: J. Tarcher Press, 1980b (In press).

ZUKAV, G. *The dancing Wu Li masters: An overview of the new physics*. New York: William Morrow, 1979.

Communications with the author and requests for reprints may be addressed to Department of Psychiatry and Human Behavior, California College of Medicine, U. C., Irvine, California 92717