

## MEDITATION RESEARCH: AN INTRODUCTION AND REVIEW

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Although the field of meditation research began only some twenty years ago, the current research literature is voluminous, generally technical, and rapidly expanding. A full technical review now requires book length treatment and two such volumes are in press (Shapiro, 1980; Shapiro & Walsh, 1980).

However as yet there is nothing available for the nonspecialist reader which provides a general overview of the evolution and state of the art of empirical research on meditation. The present paper thus aims at filling this gap by providing a brief introductory and relatively nontechnical review. This review therefore emphasizes the extraction of general principles of the evolution and state of the research art rather than exhaustive, critical analysis of individual studies. Readers wanting such an analysis are referred to the critical reviews of Shapiro & Giber (1978), Shapiro (1980), or Shapiro & Walsh (1980).

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Empirical research began in the early sixties with sporadic investigations of claims by some yogis that they could demonstrate abnormal degrees of physiological control such as the slowing of heart rate (*e.g.*, Anand & Chhina, 1961; Anand *et al.*, 1961).

Initial skepticism was high, and Charles Tart (1969) claimed that the two articles in his book on altered states comprised two-thirds of the English-language literature on meditation. However, the development of fields such as biofeedback and altered states research plus the popular interest in non-West-

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ern cultures and disciplines led in turn to greater scientific interest, and by the early seventies widespread systematic research had begun.

Transpersonal psychologists have been interested in meditation research because of their hope that they could forge a link between the practices of the Eastern consciousness disciplines and Western empirical research. However, the current research tools of science are primarily aimed at measuring objective physiological, chemical, and behavioral variables, and especially initially, the meditation variables examined have tended to be relatively gross, *e.g.*, heart and respiration rate, by comparison with the subtle experiential shifts which are the goal of meditation. There is thus some question of the relevance of much research, but recent trends are towards more sensitive and refined measures.

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Research in areas such as meditation tends to evolve through several stages, beginning with examining the responses which occur and their time course, then looking at the interaction of meditation with other factors such as the age, background, and personality of the practitioner, and finally looking for the mechanisms which might be involved in producing the observed effects. As might be expected of a young field, most research on meditation has focused on the earlier stages, such as its effects. Each of these stages will now be examined in detail.

#### RESPONSES

Psychological, physiological, and chemical responses to meditation have all been observed, and these provide useful divisions for discussion.

#### *Psychological Variables*

*Objective Measures.* The general picture which is emerging suggests that meditation may enhance psychological well-being and perceptual sensitivity (for extensive reviews, see Shapiro & Giber, 1978; Shapiro, 1980; Shapiro & Walsh, 1980). Many studies have reported that meditation reduces anxiety, either for non-specific anxiety and anxiety neurosis (Girodo, 1974; Shapiro, 1976), or for specific phobias such as of enclosed spaces, examinations, being alone (Boudreau, 1972), or of heart attack (French & Tupin, 1974). Clinical research has indicated that drug and alcohol use may be reduced (Benson, 1969; Shafii *et al.*, 1975; Shapiro & Zifferblatt, 1976). Hospitalized psychiatric patients with a variety of disorders

may benefit from daily Transcendental Meditation (Glueck & Stroebel, 1978).

There have also been reports of psychosomatic benefits. Meditation has been employed successfully for rehabilitation after myocardial infarct (Tulpule, 1971), to treat bronchial asthma (Honsberger, 1973) and insomnia (Woolfolk, 1975), and to reduce high blood pressure (Datey *et al.*, 1969; Benson & Wallace, 1972; Patel, 1975; Stone & DeLeo, 1976).

Positive effects have also been noted in healthy nonclinical populations. A number of studies have suggested that meditators change more than controls in the direction of enhanced confidence, self-esteem, sense of self-control, empathy and self-actualization (Lesh, 1970; Nidich *et al.*, 1973; Hjelle, 1974).

In summary then, experimental evidence clearly indicates that meditation may have considerable therapeutic potential. However few definitive claims can be made and many points remain unclear. For example, many studies have been flawed by methodological problems such as the lack of adequate control groups, uncertain expectation and placebo effects, and dubious measurement procedures.

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Furthermore, several recent studies have suggested that meditation may not necessarily be more effective for clinical disorders than are other self-regulation strategies such as relaxation training and self-hypnosis, at least over short time periods such as two weeks and using objective measures (Kirsch & Henry, 1979; Boswell & Murray, 1979; Goldman *et al.*, 1979; Zuroff & Schwartz, 1978; Marlatt *et al.*, 1980). On the other hand, in several comparative studies meditators reported that their subjective experiences were deeper, more meaningful, and/or more enjoyable than those of subjects using other self-regulation strategies, even though objective tests did not reveal significant differences (Curtis & Wessberg, 1975; Cauthen & Prymak, 1977; Morse *et al.*, 1977).

### *Phenomenological Studies*

Relatively few phenomenological studies have been performed and most have been confined to beginning meditators. Some of the more commonly reported experiences include intense and labile emotions, episodes of high arousal and deep relaxation, enhanced perceptual clarity and sensitivity to psychological processes and a range of psychological insights, increased change and fluidity in perception of objects includ-

ing the body (reduced object constancy), awareness of the difficulty of controlling the mind and especially in not losing concentration or becoming lost in fantasy, altered time sense, altered states of consciousness, experience of self-transcendence and unity with others, reduced defensiveness, and greater openness to experience (Maupin, 1965; Deikman, 1966; Lesh, 1970; VanNuys, 1973; Banquet, 1973; Kubose, 1976; Osis *et al.*, 1973; Kohr, 1977; Walsh, 1977, 1978; Kornfield, 1979; Shapiro, 1980; Walsh & Shapiro, 1980; Walsh & Vaughan, 1980).

The range is large and suggests that almost any experience may occur in meditation as a result of greater openness and sensitivity. Indeed more experienced meditators note that, what tends to emerge as one continues to have more and deeper experiences is an underlying calm and nonreactive equanimity so that this greater range of experiences can be observed and allowed without disturbance, defensiveness, or interference. More and more the individual identifies him or herself with the calm observer or witness of these experiences rather than with the experiences *per se* (Goldstein, 1976; Goleman, 1977; Ram Dass, 1978).

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Many meditators, including behavioral scientists, have reported that as they continued to meditate, they noticed a deepening of their intellectual understanding of the statements of more advanced practitioners (Walsh, 1977, 1978; Ram Dass, 1978). It thus appears that intellectual understanding in this area demands an experiential basis and that what was incomprehensible at one stage may subsequently become understandable once an individual has experienced some of the meditative process.

Occasionally some of the experiences which occur may be disturbing, *e.g.*, anxiety, tension, anger, perceptual changes in sense of self and reality (French *et al.*, 1975; Lazarus, 1976; Kennedy, 1976; Walsh & Roche, 1979; Otis, 1980). These may sometimes be quite intense but generally are short-lived and remit spontaneously. In many cases they seem to represent a greater sensitivity to, and the emergence and release of, previously repressed psychological memories and conflicts. Thus the initial discomfort of experiencing them may be a necessary price for processing and discharging them.

Experimental measures also indicate greater perceptual sensitivity. Sensory thresholds, the lowest levels at which a stimulus can be detected, are lowered (Davidson *et al.*, 1976), while the capacity for empathy (Lesh, 1970; Leung, 1973) and field independence (Linden, 1973; Pelletier, 1974) are increased. Thus



both phenomenological and objective studies agree with the classical literature that meditation enhances perceptual sensitivity. A recent exception is a study which failed to detect effects of Zen practice on either field independence or the Holtzman Inkblot test, but the practice period was extremely short, only 5 days (Goldman *et al.*, 1979). In contrast a study of experienced subjects who had undertaken at least three months of intensive practice of Buddhist meditation showed highly significant shifts in Rorschach effects (Brown and Engler, 1980). These effects showed some consistency with those described in classical meditation texts and recently reinterpreted in the light of modern cognitive and perceptual theory (Brown, 1977).

### *Physiological Variables*

The evolution of research on the physiology of meditation began with sporadic investigations of some of the more spectacular feats allegedly performed by certain yogis, such as the ability to alter heart rate. When some of these claims proved valid, more systematic investigation was begun. The introduction of better controls led to the appearance of the next phase in which it was found that many of the physiological effects initially assumed to be unique to meditation could actually be induced by a number of other self-control strategies such as relaxation or self-hypnosis. This has led some researchers to assume prematurely that there is little that is unique to meditation or its effects.

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### *Metabolism*

For example, in the field of metabolism, the initial reports of Wallace (1970; Wallace *et al.*, 1971) were met with a combination of enthusiasm and skepticism. Wallace reported marked reductions in metabolic rate as shown by reduced oxygen consumption, carbon dioxide production, and blood lactate levels and suggested that transcendental meditation led to a unique hypometabolic state. Subsequent studies did in fact confirm a reduced metabolic rate, but better controls suggested that the effects were not unique to meditation (Fenwick *et al.*, 1977).

### *Autonomic Nervous System*

Similarly, initial studies revealed a reduction in the galvanic skin response (GSR) following Transcendental Meditation

(Orme-Johnson, 1973). The GSR provides a measure of autonomic nervous system reactivity and hence also of stress reactivity. Goleman and Schwartz (1976) noticed an interesting GSR pattern in which meditators displayed a greater anticipatory response to an expected stressor but then recovered more rapidly than controls. Goleman and Schwartz suggested that this might represent a more adaptive pattern of stress response.

However, recent studies have not demonstrated greater effects of short-term (weeks) meditation than of equivalent amounts of other self-regulation strategies such as self-hypnosis and relaxation (Curtis & Wessberg, 1975; Cauthen & Prymak, 1977; Morse *et al.*, 1977; Parker *et al.*, 1978).

At this stage some researchers felt that the uniqueness of meditation as a metabolic state had been disproved. However meditation aims at very subtle shifts in awareness and perception and the most commonly used physiological measures are probably insufficiently sensitive to detect them. With rare exceptions most studies have examined novice meditators who may well show less marked effects. In addition, recent studies of Transcendental Meditation have found unique patterns of blood hormone levels and blood flow to a number of organs including the brain (Jevning & O'Halloran, 1980). Thus in summary, it is apparent that meditation elicits significant metabolic effects, but to what extent these are unique to meditation remains unclear.

#### *Brain Physiology*

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Studies of brain physiology during meditation have most frequently employed the EEG (electroencephalograph) for the measurement of brain wave electrical activity and have tentatively identified a number of patterns. With most meditative practices the EEG patterns have slowed and displayed greater synchronization, with alpha waves (8-13 cycles per second) predominating. With more advanced practitioners even greater slowing may be evident, and theta (4-7 cycles) patterns may occur (Wallace, 1970; Wallace *et al.*, 1971; Corby *et al.*, 1978). These patterns are consistent with deep relaxation and some meditators may show episodes of drowsiness or sleep, though these appear to be less common than in untrained controls. Some degree of slowing may also be evident between meditation periods.

More discrete analyses are beginning to suggest the existence of specific patterns of synchronization both between corresponding areas of the two cerebral hemispheres and within

individual hemispheres (Glueck & Stroebel, 1978). These patterns appear to be different from those which occur with relaxation or biofeedback, but their significance is not yet clear. Preliminary tests indicate that meditators may exhibit enhanced ability in skills localized in the right hemisphere, e.g., ability to remember and discriminate musical tones (Pagano & Frumkin, 1977), and that EEG activation may display greater flexibility in shifting from one side to the other in response to the demands of specific tasks (Bennet & Trinder, 1977).

Most studies have employed Transcendental Meditation because of its popularity and simplicity. However it should not be assumed that all practices have the same effects. Zen monks, whose practice involves a continuous open receptivity to all stimuli, displayed a continued EEG responsiveness to a repeated sound, instead of habituating to it as non-meditators would (Kasamatsu & Hirai, 1966). However, Raj yogis, whose practice involved an internal focusing which reduced responsiveness to environmental stimuli, failed to show any EEG responses to repeated noises (Anand *et al.*, 1961).

In summary then, both metabolic and neural responses have been clearly demonstrated to occur in meditation. Certain features of the EEG patterns appear to be unique to meditation, but whether the metabolic responses are also unique remains unclear.

#### TIME COURSE

Meditators vary widely in their subjective reports of how rapidly they experience effects of the practice, though almost all report that the experiences deepen with continued practice (Kornfield, 1979). However, as yet we have very little experimental data. Greater practice seems to produce more marked effects (Shapiro, 1980), but the nature of the learning curve is quite unclear, and with few exceptions subjects have had amounts of experience which would be considered only beginning level by most meditation systems. On the other hand, a study by Goleman and Schwartz (1976) suggested that even first-timers might show detectable effects.

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#### THE INTERACTION OF MEDITATION WITH OTHER VARIABLES

This level of research looks at the ways in which the effects of meditation are modified by other variables. Important variables here include the personality and background of the

meditator, the combination of meditation and psychotherapy, and the identification of factors which enhance meditation effectiveness.

As might be predicted there has as yet been little work done at this level. However, individuals who persist with the practice of transcendental meditation and appear to have a successful outcome, as compared to those who give it up, have been found to display certain features in common. These include being less likely to be seriously psychologically disturbed, to have little indication of psychotic tendencies, and to be more open to recognizing and acknowledging unfavorable personal characteristics. They appear to be more interested in internal subjective experiences and more open to unusual and "unrealistic" experiences. They may be less emotionally labile, perceive themselves as having a high degree of control over their own lives, and possess high baseline levels of concentration and alpha wave activity (Anand *et al.*, 1961; Maupin, 1965; Lesh, 1970; Smith, 1978). On the other hand, some people with a past history of schizophrenia may suffer psychotic breaks if they engage in very intensive meditation practice (Walsh & Roche, 1979). Future research in this area may identify those subjects who will respond optimally, those who risk negative effects, and the means of enhancing favorable responses. Although there is little firm experimental data, subjective reports from both therapists and clients suggest that meditation by either the therapist or client or both may facilitate psychotherapy.

#### MECHANISMS BY WHICH THE EFFECTS OF MEDITATION ARE PRODUCED

Most effects of meditation represent the end product of a chain of reactions or mechanisms which extend from the first brain response through chemical, physiological, and behavioral links. Knowledge of these mechanisms would be extremely helpful in understanding how effects of meditation are produced and how they may be influenced.

At the present time the mechanisms most frequently suggested to mediate or produce meditative effects are psychological, *e.g.*, relaxation, desensitization to formerly stressful stimuli, heightened awareness, habituation, attention, expectation, deautomatization, cognitive factors, counterconditioning, insight, disidentification from mental content, regression in the service of the ego, and behavioral self-control skills (Maupin, 1965; Deikman, 1966; Goleman, 1971; Shapiro & Zifferblatt, 1976; Walsh, 1977, 1978). At the physiological level, suggested

mechanisms include reduced metabolism and arousal, hemispheric-lateralization (a shift in the relative activity of the two cerebral hemispheres), brain wave resonance and coherence, a shift in the balance between the activating and quieting components of the autonomic nervous system, and altered brain blood flow (Davidson, 1976; Bennett & Trinder, 1977; Glueck & Stroebel, 1978). To date, few chemical mechanisms seem to have been advanced, although a number of relevant responses have been identified, *e.g.*, reduced blood levels of lactate and of the hormones cortisol and epinephrine which are involved in the response to stress.

One possible mechanism which has received surprisingly little consideration is dehypnosis (Walsh, 1978). Anyone who has undertaken intensive meditation practice soon realizes that the untrained mind is filled with a continuous flux of largely unrecognized thoughts, images, and fantasies which constrict and distort awareness to a significant degree (Tart, 1975; Goldstein, 1976; Walsh, 1977, 1978; Walsh and Vaughan, 1980b). This recognition is available to anyone willing to undertake sufficient practice and has been a widely held tenet of meditation disciplines across cultures and centuries. In the words of the Buddha (Byrom, 1976),

We are what we think.  
All that we are arises with our thoughts.  
With our thoughts we make the world.

Such a process in which the state of consciousness is altered and perception is distorted by thoughts without the individual's recognition of these effects is essentially one of hypnosis. From this perspective our usual state of consciousness can be seen as a hypnotized state and advanced meditation can be seen as a process of dehypnosis. This is most apparent in practices such as Buddhist insight meditation where refinement of perception results in a progressive disidentification from increasingly subtle layers of thought (Goldstein, 1976; Walsh and Vaughan, 1980b).

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Precisely how any or all of these mechanisms might be involved in producing the final pattern of responses is as yet unclear (Shapiro, 1980; Shapiro & Walsh, 1980). Most commonly a single factor or process has been suggested to be *the* mediating mechanism. However the complexity of biological systems is so great that it is probably more accurate to think in terms of multilevel, multidimensional interactive patterns. Indeed ultimately it may even be inappropriate to think of cause and effect relationships in light of the emerging evidence—at levels from quantum physics to neurosciences and the con-

sciousness disciplines—of the inseparability and interdependence of all components of any system in particular and of the universe in general (Capra, 1975; Walsh, 1979; Walsh & Vaughan, 1980).

#### SUMMARY

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While much has been learned experimentally about meditation and its effects, this research field is still in an early stage of development. Many conclusions are tentative, and as yet relatively little can be said about the relationships between the shifts in consciousness and perception which are the goals of meditation and the variables which readily lend themselves to Western empirical measures. The dream of a bridge between Eastern practice and Western research thus remains largely unattained, but also remains worth seeking.

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## EMERGING CROSS-DISCIPLINARY PARALLELS: SUGGESTIONS FROM THE NEUROSCIENCES

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### 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*

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*possible  
parallels  
between  
science  
and  
consciousness  
disciplines*

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, indivisible, 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; Bynam, 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.

#### 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.

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.

*and  
brain  
and the  
universe  
as a  
coherent  
whole*

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.

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).

*microworld  
and  
macroworld  
are  
very  
different*

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  
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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.

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