PART III: TOWARD A GENERAL THEORY OF PARTICIPATION

Chapter 7 – Scientific Perspectives on Participation and Mind

1) The Scope of Part III

Let me take a moment to briefly reexamine the developments in this thesis so far, and lay the groundwork for this final Part III. To reiterate my main theme: the path of Western civilization and philosophy over the past 2500 years has been one of a departure and detour from the more ancient worldview of an animated cosmos. This departure has yielded many gains in knowledge and technology, but has been achieved at a cost: estrangement from the natural ground of being. *Homo sapiens*, as a thinking, enminded creature, cannot indefinitely operate as though he were fundamentally unique, alone possessing the qualities of mind. The consequences of this radical separation of humanity from nature are now becoming evident, particularly in the problems arising from within the dominant Mechanistic Worldview.

The imperatives of our time call for a return to an animated, panpsychic vision of the universe. In Part II, I have shown that this panpsychist perspective has never been completed eliminated, and has in fact has been advocated by many of the greatest thinkers in the history of Western civilization. Furthermore, evidence is building that we are approaching the point where we can begin to re-envision a sympathetic, panpsychic worldview, one that is described in the language of participation.

Part II was an attempt to articulate the Partimens, the *mental aspect* of Participatory Reality. Part III focuses on the other, *material aspect*, that which I have called the Partimater. Here I examine the general notion of exchange, first in a social setting and then more broadly. Exchanges of mass and energy in the material realm co-exist with the dynamics of mind in the mental realm.

Not only philosophers, but also noted scientists of the 20th century have seen cause to advocate versions of panpsychism. Evolution, quantum mechanics, and chaos theory have all been employed to argue for panpsychism (hylonoism being an example of the

latter). I begin Part III with a transition from the Partimens to the Partimater, by investigating the evolutionary and quantum mechanical bases for panpsychism. These indicate that the scientific worldview itself is spiraling back to embrace aspects of the original, pre-Western worldview. The evidence from the realm of science constitutes the beginning of this chapter.

A comprehensive theory of participatory panpsychism must look both down and up the hierarchy in the Great Chain of Being. After completing my investigation of the scientific views of mind in nature, and in the particles of nature, I will sketch a larger general theory of participation that encompasses social organizations, eco-systems, and large-scale systems of mind.

2) Panpsychism in 20th Century Science

The objectivism of science offers neither explanation nor accounting for the phenomenon of mind. Mind in humans is an unexplained, and perhaps unexplainable, mystery to science. Mind that may exist elsewhere in nature is scientifically unintelligible and superfluous. Modern analytic philosophy supports both this view of mind and the Mechanistic Worldview generally, and hence sees no credibility in panpsychic theories. The concept of participation likewise lies primarily outside the bounds of conventional science: from Levy-Bruhl's description of it as 'prelogical' and mystic, to Hartshorne's participatory concept of 'organic sympathy, to Berman's and Abram's ideas of animistic participation, to Skolimowski's Participatory Worldview.

And yet there is significant evidence that both panpsychism and participation can be found within the realm of science. As I see it, the pressure of this underlying *Weltanschauung* is causing itself to be revealed even in the hostile environment of a Mechanistic Worldview. I have already shown how Wheeler's vision of participation emerged in the context of quantum mechanics. Numerous other scientists have found grounds for panpsychism, in the fields of physics, chemistry, and biology. Here I will show not only what they believed, but something of how and why they came to their

conclusions. The confluence of panpsychism and participation reaches a peak in the work of David Bohm.

I have already examined the ideas of the scientist-philosophers of the 19th century. Among these, Fechner stands out as the most significant, but the panpsychism of Lotze, von Hartmann, Haeckel, Clifford, and Mach were important predecessors to developments in the 20th century. Apart from Fechner (who lived before Darwin), the critical issue for these thinkers was the theory of evolution. Evolution unified natural phenomena, especially life, and this allowed people to see life emerging in a kind of continuous process from non-life. A natural conclusion then was that consciousness and mind inhered in all matter, and only became visible to us in the structures that we call life. James noted, in an earlier citation, that a panpsychic hylozoism must be "an indispensable part of a thorough-going philosophy of evolution" (op.cit.). Peirce argued from the perspectives of mathematics and physics that "all mind more or less partakes of the nature of matter" (op.cit.), and saw chaotic dynamics as key in this process. Others, like Bergson, argued (somewhat ambiguously) that mind was a creative phenomenon that emerged *de novo* in the course of universal evolution. This leaves the process of emergence as mysterious and perhaps inscrutable, and introduces troublesome instances of 'drawing a line' somewhere in the sequence of structural complexity. Rather, I think that we need to *redefine the concept of emergence*, to more adequately account for the appearance of the new within a connected process of universal evolution[1].

To many scientists of the early 20th century, panpsychism was uncomfortably close to the recently discredited theory of vitalism. As a result they largely avoided discussion of it altogether. The first notable scientist to tentatively put forth panpsychist views was the British astronomer Sir Arthur Eddington. His Space, Time and Gravitation (1920) concludes with the observation that physics only addresses the surface structure of matter and energy, and does not have anything to say about the 'inner content' of reality. Arguing roughly in the manner of Schopenhauer, Eddington claims that the inner content of reality must be like the inner content of the human, i.e. conscious:

> [Physics] is knowledge of structural form, and not knowledge of content. All through the physical world runs that unknown content, which must surely be the stuff of our consciousness. (p. 200)

It is difficult to determine precisely the meaning of this passage; it can be read either as a form of idealism or as panpsychism (though of course Schopenhauer's argument was clearly panpsychic). Eddington again addresses this theme in 1939, leaning more toward idealism. He argues that physics "abolishes all dualism of consciousness and matter" (1939: 150). Dualism, he claims, contains a logical inconsistency: "Dualism depends on the belief that we find in the external world something of a nature incommensurable with what we find in consciousness" (ibid). Since physics shows that all reality is structurally the same, it must all be commensurate with consciousness, i.e. of the nature of a mental sensation. He elaborates:

> Although the statement that the universe is of the nature of 'a thought or sensation in a universal Mind' is open to criticism, it does at least avoid this logical confusion. It is, I think, true in the sense that it is a logical consequence of...our knowledge as a description of the universe. (p. 151)

His reference to a universal Mind sounds very Berkelian -- matter as consciousness only with respect to an observing mind, not as a mind in itself. Eddington's argumentation comes across as a bit confused, but his intention seems clear: that the unified view of physics supports a belief that the content of reality is comparable and even equivalent to the content of mind.

Biologist J.B.S. Haldane speculated on mind in nature in the early 1930's. He addressed the issue of emergence of life and mind from inanimate matter, noting, "it is clear that aggregates of a certain kind do manifest qualities which we cannot observe in their components" (1932: 113). This is an important and subtle observation; Haldane did not say that emergent qualities 'do not exist' in their components, but rather that 'we cannot observe them'. Mind, he suggests, (and 'life' as well) may be found to exist in an unobservable form in all matter.

In fact if consciousness were not present in matter, this would imply a theory of 'strong emergence' that is fundamentally anti-scientific. Such emergence "is radically opposed to the spirit of science, which has always attempted to explain the complex in terms of the simple..." (ibid). Haldane rejects this thesis, and hence is driven to the conclusion that life and mind exist to some degree everywhere:

> We do not find obvious evidence of life or mind in so-called inert matter, and we naturally study them most easily where they are most completely manifested; but if the scientific point of view is correct, we shall ultimately find them, at least in rudimentary form, all through the universe. (ibid)

Two years later he offers thoughts on the philosophical implications of quantum mechanics. In "Quantum mechanics as a basis for philosophy" (1934), Haldane proposes that mind is a "resonance phenomenon" that is associated with the wave-like aspect of atomic particles (recall that particles exhibit both 'particle' and 'wave' behavior, depending on how they are observed). This is a reasonable assertion, he claims, because the characteristics of mind are comparable to those of atomic particles: both arise from dynamical systems, both exhibit a continuity and wholeness, both are at once localized yet spatially diffused. For example, the wave-nature of an electron allows it to penetrate through an insulating barrier (the 'tunneling effect'), and this Haldane interprets as a primitive variety of "purposive behavior". He offers the suggestion that "man also has a 'wave system' which enables him to act with reference to distant or future events, this system being his mind" (p. 89). Anywhere this resonance phenomenon occurs, there we must accept the presence of mind. Haldane speculates that this may happen even in the interior of stars:

> It is not inconceivable that in such [stellar] systems resonance phenomena of the complexity of life and mind might occur. ... [I]t is conceivable that the interior of stars may shelter minds vastly superior to our own, though presumably incapable of communication with us. (p. 97)

Haldane had previously cited Plato, and one cannot help but suspect that he had Plato's 'star-souls' in mind[2].

Physicist and astronomer Sir James Jeans was likewise drawn to philosophical speculations on mind. Like Eddington, he sees evidence for mind throughout nature, and concludes that a form of idealism must be true: "the universe can be best pictured...as consisting of pure thought" (1932: 168). Jeans is clear that this conception undermines the Mechanistic Worldview: "the universe begins to look more like a great thought than like a great machine. Mind no longer appears as an accidental intruder into the realm of matter" (p. 186). In a later work Jeans arrives at a strongly Berkelian idealism (or "mentalism"). He argues that the new physics provides three substantial reasons for seeing reality as "wholly mental": (1) electro-magnetic fields fail to qualify as 'objective', and hence are effectively "not real at all; they are mere mental constructs of our own" (1942: 200); (2) the reality of the theories of physics is essentially mathematical, and therefore essentially mental; (3) as Haldane suggested, the wave-particle duality implies a view in which "the ingredients of the particle-picture are material, those of the wave-picture mental. ... [T]he final picture consists wholly of waves, and its ingredients are wholly mental constructs." (ibid: 202). Like Eddington, Jeans' philosophical naiveté pushes him toward a Berkelian idealism, when in fact panpsychist explanations are equally viable and perhaps more reasonable.

In the early 1940's three notable British biologists ventured theories that had panpsychist dispositions. The physiologist Sir Charles Scott Sherrington is noted for his research on the physiology of the brain, but in Man on His Nature (1941) he delves into mind-brain philosophy. Sherrington argues (not unlike Bruno) for a dual-aspect theory of reality, 'mind' and 'energy': "our world resolves itself into energy and mind. These two concepts…divide, and between them comprise, our world." (p. 348). He is agnostic regarding interaction between these two realms, stating that we are left with

> acceptance of energy and mind as a working biological unity although we cannot describe the how of that unity. … The evolution of one is of necessity the evolution of the other. There is no causal relation between them; they are both inseparably one. Their correlation is unity. (pp. 351-2)

One consequence of this view is that the animate and 'mental' blend seamlessly into the inanimate: "We have difficulty in assigning the lower limit of the mental. It may therefore be that its distribution extends to all organisms, and even further." (p. 354). In other words, "it is as though the elementary mental had never been wanting" (p. 266) – that is, present in all matter throughout the history of evolution.

The second notable voice was W.E. Agar. Agar was a follower of Whitehead's process philosophy, and was intrigued by Whitehead's concept of the 'philosophy of the organism'. He seeks a biological theory of the living organism that corresponds to Whitehead's philosophy. His central thesis is that organisms are both percipient subjects and composed of elements (cells) that are themselves percipient; living cells "must also be regarded as feeling, perceiving, subjects" (1943: 8). The logic continues down the chain of being: "A cell, though a subject, must probably also be considered a nexus of living sub-agents." (p. 11).

Agar is clear that "Whitehead's system essentially involves a form of panpsychism" (p. 66), and his analysis demonstrates a deeper philosophical awareness than the other scientists I have discussed. Agar accepts most aspects of Whitehead's process philosophy, but disagrees with him on the nature of consciousness. Whitehead sees consciousness as a special and limited case of the more general phenomenon of feeling or experiencing; Agar believes that

> the more satisfying hypothesis is that…all experience is in its degree conscious. … [W]e must ascribe consciousness to every living agent, such as a plant cell or bacterium, and even (if the continuity of nature is not to be broken) to an electron. (p. 91)

Agar's panpsychism is thus more thorough-going and explicit than that of Whitehead.

Third is Sir Julian Huxley. Arguing like the others that physics and evolution have demonstrated the underlying unity of reality, Huxley takes a strongly monist perspective. Given that both mind and matter exist, monism requires that these be deeply linked. Adopting a Spinozist ontology, he says that "there exists one world stuff, which reveals

material or mental properties according to the point of view" (1942: 140); the 'material' is reality "from the outside", and the 'mental' is "from within". If we accept the continuity of mind and matter that science imposes,

> then mind or something of the nature as mind must exist throughout the entire universe. This is, I believe, the truth. We may never be able to prove it, but it is the most economical hypothesis: it fits the facts much more simply…than one-sided idealism or one-sided materialism. (p. 141)

This is perhaps the clearest and most unambiguous statement of any of the early-20th century scientists. In fact, the arguments of Huxley and the others above so closely link panpsychism with the scientific worldview that one is inclined to see panpsychism not as a *usurper* of Mechanism, but rather as a mere *logical extension* of it. I explain this as follows: science does in fact reveal some 'truth' about the nature of reality, a reality which has an inherent psychic or noetic quality. Sooner or later science will be required to acknowledge this. Thus science, in spite of its own presumptions about the inanimateness of the world, is driven to recognize the deeper panpsychic reality. As a consequence, the very structure of the scientific worldview is altered – science must ultimately undermine its own presumptions. Then a new worldview will emerge to take its place, one that must necessarily come from outside the bounds of conventional, mechanistic modes of thinking.

It was then a 10-year gap until the publication of zoologist Sewall Wright's article "Gene and organism" (1953). Wright, then-president of the American Society of Naturalists, picked up Agar's (and Whitehead's) argument that the concept of 'organism' should apply to all structures of matter. He defines an organism as any structure in which interrelated parts communicate and cohere in a persistent and self-regulatory manner. He notes that the concept applies not only to plants and animals, but to human society, and even – anticipating Gaia theory – to the Earth's biosystem as a whole:

> [T]he entire array of plants and animals and peripherally the soil and waters of a given region [constitute] an interdependent self-regulatory system, with considerable persistence… Since regions [of the Earth] are connected, the

> entire biota and peripherally the surface of the earth form one great organism. (p. 7)

This is the first recognition since the work of Fechner that the Earth may be considered as a single organic entity. Furthermore, not only the Earth, but the solar system individually and the universe as a whole qualify as organisms. At the other end of the scale, atoms and molecules are to be considered organisms; subatomic particles are questionable (not having parts), but Wright feels that their 'vibratory character' and persistence put them in the same general category.

As to the question of mind, Wright again invokes an argument by continuity, showing that mind must exist in single-celled organisms, and even in their constituent parts: "If we are not at some point to postulate the abrupt origin of mind, mind must be traced to the genes, which presumably means to nucleo-protein molecules." (p. 13). This has implications for humans, because it entails that "our own apparently unified stream of consciousness is somehow a fusion of the minds of the cells" of our bodies. Wright ultimately concurs with Eddington and Jeans, that "the essential nature of all reality is that of mind" (p. 16), though he does acknowledge that his is more of a pluralistic idealism: "reality consists primarily of a multiplicity of minds" – a critical issue from the panpsychist perspective.

Finally, he makes a statement that is fully in agreement with hylonoism; namely, that *mind is correlated with degree of interaction between parts*: "In tightly knit organisms…there is such an incessant interaction among parts as to indicate a high degree of integration of mind." (pp. 14-15). Participatory exchange is thus seen by Wright to correspond to a kind of intensity of mind. Larger-scale systems exhibit the same quality but at a scale beyond ordinary comprehension. The more loosely-knit organizations of societies or planetary ecosystems exist at vastly different scales of space and time, and this fact "may make it…impossible for the human mind to grasp the unity of the whole" (ibid).

Wright elaborated on his panpsychist views over the subsequent 20 years. Writing in the journal The Monist in 1964, he explicitly argues for "dual-aspect or monistic

panpsychism". He presents a 'hierarchy of mind' in which each level in the chain of being is enminded, and participates in higher-order mind: "The very fact of interaction, at any level, implies…that minds are not entirely private. … They [also] exist as components of a more comprehensive mind…" (1964: 284). Then in 1977 he contributes an article to Cobb and Griffin's compilation Mind in Nature. His article, "Panpsychism and science", reiterates the same themes, and places even more emphasis on the problem of emergence: "Emergence of mind from no mind at all is sheer magic." (1977: 82). Dual-aspect panpsychism, Wright says, is the only logically-consistent position.

The 1960's and 70's witnessed a number of new scientists speaking out on behalf of their panpsychist views. Biologist Bernhard Rensch published half a dozen pieces arguing for "panpsychistic identism", beginning with his 1960 book Evolution Above the Species Level. Here he repeats the evolutionist line that "because of [a] lack of any serious evolutionary gap", one cannot limit mental abilities to the higher organisms. Even the gap between living and non-living systems is illusory:

> Here again it is difficult to assume a sudden origin of first psychic elements… It would not be impossible to ascribe 'psychic' components to the realm of inorganic systems also… (p. 352)

This "hylopsychic" view, Rensch claims, finds substantial support from cognition theory and atomic physics. He concludes that "a hylopsychic concept is well in accord with many findings and facts of the natural sciences, and…is possibly the most suitable basis for a universal philosophy." (p. 355). His (1971, 1972, and 1977) all offer further articulation, and present an impressive array of scientific arguments for panpsychism.

C.H. Waddington wrote The Nature of Life in 1961, and he discusses approvingly the ideas of Haldane that I mentioned above. Once again citing evolutionary continuity, Waddington asks:

> Are we not forced to conclude that even in the simplest inanimate things there is something which belongs to the same realm of being as self-awareness? … [S]omething must go on in the simplest inanimate things

> which can be described in the same language as would be used to describe our self-awareness. (p. 121)

In a break from the evolutionary-continuity approach, the physicist A. Cochran (1971) extends Haldane's suggestion and argues that the laws of quantum mechanics in themselves support a panpsychist philosophy[3]. In an ingenious approach, Cochran observes that the atoms of *organic* compounds (carbon, hydrogen, nitrogen, and oxygen) have among the lowest 'atomic heat capacities', which corresponds to a high degree of 'wave predominance' (as opposed to 'particle predominance'), and hence are the most endowed with the qualities of consciousness. He offers that "the quantum mechanical wave properties of matter are actually the conscious properties of matter", and therefore "atoms and fundamental particles have a rudimentary degree of consciousness, volition, or self-activity" (p. 236).

Cochran's article was published just one year before Wheeler's initial articulation of the participatory physics and the "participatory universe", at the 1972 conference in Trieste that I discussed in Chapter 1. As I have noted, Wheeler developed a participatory vision without panpsychism. Other scientists, as I have just shown, came to accept variations of panpsychism without the concept of participation. These two ideas were linked in the thought of two of the most important scientist-philosophers of the 20th century, Gregory Bateson and David Bohm.

3) Bateson and Bohm

Bateson researched and wrote on a wide range of subjects, including biology, anthropology, psychology, cybernetic theory, and natural philosophy. A contrarian to the trend of increasing specialization, Bateson was uniquely qualified to comment on the interconnection between nature and mind. His vision of ecological philosophy and the interrelationship between organic wholes was a predecessor to the more fully developed eco-philosophies of Skolimowski and other environmental philosophers. And his

awareness of the importance of concepts like energy, feedback, and information anticipate elements of chaos theory, and hylonoism[4].

Bateson's inquiry into mind and nature brought him to a qualified version of panpsychism, though he seems to have ultimately abandoned it – for reasons that are not entirely clear. His first inquiries in this area occurred in 1968, in the article "Conscious purpose vs. nature" (1968). Here he expresses his belief, not unlike the other scientist-philosophers of the century, that "the study of evolution might provide an explanation of *mind*" (p. 35). His first point of note is that mind is essentially a natural phenomenon, bound up with the complexity of matter. He cites approvingly Lamarck's view that "mental process must always have a physical representation" (p. 36); and furthermore, "wherever in the Universe we encounter [a certain degree] of complexity, we are dealing with mental phenomena" (ibid). In an attempt to elaborate this matter, Bateson observes that complex dynamic systems involve a process of feedback, such that they are 'self-corrective'. Examples of natural self-corrective systems include the individual organism, a society of organisms, and the surrounding ecosystem. All these levels of organization embody comparable system dynamics, and -- by implication -- should exhibit qualities of mind. To use his example, a forest ecosystem like an 'oak wood' is fundamentally like an individual organism, reflecting mind from within its bodily, material structure. In an intriguing comment, Bateson refers to this kind of embodied mind as 'total mind': "This entity [i.e. the individual organism] is similar to the oak wood and its controls are represented in the *total* mind, which is perhaps only a reflection of the total body." (p. 40). But Bateson leaves it here, and only later follows up on the implications.

His 1972 compilation Steps to an Ecology of Mind includes the above article as well as a number of other important pieces. Preeminent among these is "Form, substance, and difference" (originally published in 1970). Here Bateson first cites his famous but vague definition of *information* as "difference which makes a difference" (1970: 7). He is attempting to relate the phenomenon of mind to feedback systems of energy circulation, and decides that it is 'pure difference' that matters most. In my mind, this difference must necessarily be a difference in *energy*; Bateson seems to disagree, but does not offer a convincing explanation why.

Regardless of whether one views natural feedback systems as consisting of 'differences in energy' or simply 'differences', Bateson is adamant that it is the *circular feedback system itself* that is important -- it is in such a system that we observe what can rightly be called 'mind'. He is quite explicit on this issue:

> The elementary cybernetic system with its messages in circuit is, in fact, the simplest unit of mind; ... More complicated systems are perhaps more worthy to be called mental systems, but essentially this is what we are talking about. (1972: 459)

> We get a picture, then, of mind as synonymous with cybernetic system... (ibid: 460)

This view is very close in spirit to hylonoism, which sees mind in all interactive exchanges of energy. I concluded that, therefore, mind must exist in hierarchic form throughout all levels of being; Bateson reaches the same conclusion: "we know that within Mind in the widest sense there will be a hierarchy of subsystems, any one of which we can call an individual mind" (ibid). It is not just 'universal Mind', but mind at all levels of existence – true pluralistic panpsychism[5].

Bateson's elaboration makes clear that his conception of mind extends not only to small cybernetic systems, but large-scale ones as well:

> It means…that I now localize something which I am calling "Mind" immanent in the large biological system – the ecosystem. Or, if I draw the system boundaries at a different level, then mind is immanent in the total evolution structure. (ibid)

> The individual mind is immanent but not only in the body. It is immanent also in pathways and messages outside the body; and there is a larger Mind of which the individual mind is only a subsystem. This larger Mind…is still immanent in the total interconnected social system and planetary ecology. (ibid: 461).

Still, Bateson does not endorse a full-fledged panpsychism. The only exceptions for him are the fundamental atomic particles ('atomies'). These particles, being without parts, lack the dynamic interrelationships that Bateson sees as necessary for the process of mind. A footnote of his is interesting:

> I do not agree with Samuel Butler, Whitehead, or Teilhard de Chardin that it follows from this mental character of the macroscopic world that the single atomies must have mental character or potentiality. I see the mental as a function only of complex *relationship*. (ibid: 465)[6].

This is perhaps a minor issue, and does not substantially affected his generally panpsychist outlook.

One other important point in this article: Bateson realizes that such a view of mind has not only strictly philosophical implications but significant *ethical* ones as well. If, he says, you adopt the conventional objectivist materialist view of mind, then

> you will logically and naturally see yourself as outside and against the things around you. And as you arrogate all mind to yourself, you will see the world around you as mindless and therefore not entitled to moral or ethical consideration. The environment will seem to be yours to exploit. (ibid: 462)

This strongly suggests, as I have argued, that panpsychism – in conjunction with a participatory philosophy – can serve as the basis for a holistic and compassionate worldview.

In 1979 Bateson came out with his most philosophical book, Mind and Nature: A Necessary Unity. Interestingly, in this work he seems to back away from the panpsychist implications of his earlier writings – though maintaining the same theory of mind, with presumably the same consequences. Mind still exists in the interrelationship and interaction between dynamic parts. But now this is only a necessary, not sufficient condition for mind. He lays out six somewhat-cryptic criteria[7] for complex systems to

possess mind, and notes that *any* system meeting these criteria must be designated as such. The criteria are very general, and would seem to apply to any dynamic system whatsoever. And yet, he excludes not only (as before) subatomic particles, but certain other physical systems as well:

> There are, of course, many systems which are made of many parts, ranging from galaxies to sand dunes to toy locomotives. Far be it from me to suggest that all of these are minds or contain minds or engage in mental process. The…galaxy may become part of the mental system which includes the astronomer and his telescope. But the objects do not become thinking subsystems in those larger minds. The [six] criteria are useful only in combination. (1979: 104)

This statement is quite puzzling, and inconsistent with his own criteria. If his criteria are valid, they should be valid universally. They appear to occur "in combination" everywhere. Something caused Bateson to back away from the logical implications of his own theory, implications that he had seemingly accepted a few years earlier. Bateson had strong intuitions about the nature of energy and feedback and their relation to mind, yet he was ultimately unable to construct a cohesive and consistent theory of mind.

Like Wheeler, David **Bohm** had a long-standing interest in developing the philosophical implications of quantum physics. He wrote numerous pieces on the philosophy of physics, and seems to have been especially interested in the process of mind. More than any other scientist-philosopher, Bohm joins panpsychism and participation into a single view of physical reality.

His interest in panpsychism began as early as 1957, in his book Causality and Chance in Modern Physics. Here he makes only one passing reference to the concept, in the midst of a discussion of his idea of 'strong emergence', i.e. that "new qualities and new laws" can appear because of the "universal process of becoming" (1957: 163) that dominates the universe. Bohm notes that processes of living matter do not fundamentally differ from those of nonliving matter: "when one analyses processes taking place in inanimate matter over long enough periods of time, one finds a similar behaviour [to living

processes]. Only here the process is so much slower…" (ibid). An intriguing comment, if not a ringing endorsement.

Bohm edges closer to both panpsychism and participation in his work Wholeness and the Implicate Order (1980). The participatory dimension comes in his acknowledgement that quantum physics entails a fundamental interconnection between observer and observed:

> [The atom] can best be regarded as a poorly defined cloud, dependent for its particular form on the whole environment, including the observing instrument. Thus, one can no longer maintain the division between the observer and observed… Rather, both observer and observed are merging and interpenetrating aspects of one whole reality, which is indivisible and unanalyzable. (p. 9)

Such a passage recalls the comments of Wheeler, but Bohm does not cite him.

Bohm states that quantum theory presents a fundamental challenge to mechanism because it (A) exhibits radically 'discontinuous' (quantized) behavior, (B) displays simultaneously wave-like and particle-like properties, and (C) demonstrates extreme 'non-locality' – a phenomenon in which coupled particles form an instantaneous relationship over any distance whatsoever (leading to a form of 'communication' that exceeds the speed of light). In fact, he notes that the structure of the universe "is much more reminiscent of how the organs constituting living beings are related, than it is of how parts of a machine interact." (p. 175).

He goes on to argue for a form of neutral monism, wherein "both inanimate matter and life [are comprehended] on the basis of a single ground, common to both" (p. 193). Repeating his earlier observation, he comments that "even inanimate matter maintains itself in a continual process similar to the growth of plants" (p. 194). In the same way that this "common ground" unites living and non-living, so too does it unite mind and 'no-mind'; or as Bohm says, "the implicate order applies both to matter and to consciousness" (p. 196). Both sets of dualities are seen by him as *fundamentally mistaken*. The dualities are false. Consequently, there is a sense in which all matter is

both 'alive' and 'conscious'. In his words, "in a wide range of…important respects, consciousness and matter in general are basically the same order (i.e. the implicate order as a whole)." (p. 208).

Panpsychism is a natural consequence of such a view. Psychic qualities are seen in all things, all systems. Like *memory*, for example. "The recurrence and stability of our own memory…is thus brought about as part of the very same process that sustains the recurrence and stability in the manifest order of matter in general." (ibid). If Bohm seems less than decisive here regarding panpsychism, later works are more explicit.

Interestingly, Bohm also observes a point that I have made with hylonoism, namely, that the *higher-dimensional phase space constitutes a 'true' reality* of the world. He says that "the various [atomic] particles have to be taken literally as projections of a higher-dimensional reality which cannot be accounted for in terms of any force of interaction between them." (pp. 186-7). For example, two atoms that are traditionally seen as moving independently in three-dimensional space are more properly conceived as existing in a single six-dimensional mathematical space: "A system constituted of N 'particles' is then a 3N-dimensional reality, of which each 'particle' is a three-dimensional projection." (p. 188). Just as I argued that physical reality should be conceived in a vastly high-dimensioned phase space, so Bohm makes the same claim; "Quite generally, then, the implicate order has to be extended into a multidimensional reality…which is effectively infinite." (p. 189). *Bohm's implicate order corresponds quite closely to what I have called the Partimens* – a higher-dimensional realm of consciousness and mind.

Bohm explains his theory in less technical terms in a 1982 interview in the journal ReVision. He speaks of the 'deeper ground' that underlies both the explicate and implicate orders. When asked if this ground is self-aware, he replies, "Yes…since it contains both matter and mind, it would have in some sense to be aware." (1982: 37). Repeating again his view that "thought and matter have a great similarity of order", he goes on to state that "in a way, nature is alive, as Whitehead would say, all the way to the depths. And intelligent. Thus it is both mental and material, as we are." (p. 39).

Then in March of 1985, Bohm gave an important speech, titled "A new theory of the relationship of mind and matter", to the American Society for Psychical Research[8]. Its importance lay in his explicit endorsement of panpsychism combined with his first explicit usage of the concept of participation as related to new worldviews. Beginning with the panpsychist element, there are several passages where he makes clear his intention that mind is found in all systems that contain "information content", i.e. all dynamically coherent particles or subsystems. This new emphasis on 'information' recalls Bateson, but Bohm does not specifically cite him.

Recognizing that the term 'information' implies both 'meaning' and a consciousness able to perceive that meaning, Bohm notes first of all that his interpretation of quantum theory grants 'information' to all physical systems. On his view, "the notion of information [is] something that need not belong only to human consciousness, but that may indeed be present, in some sense, even in inanimate systems of atoms and electrons." (1986: 124-5). Because of the "basic similarity between the quantum behavior of a system…and the behavior of mind" (p. 130), he now sees that mind and matter are intimately connected at all levels of being:

> In our view…the mental and the material are two sides of one overall process… [T]here is one energy that is the basis of all reality. … There is never any real division between mental and material sides at any stage of the overall process. (p. 129)

The conclusion is a pluralistic panpsychism that reaches both up and down the hierarchy of structure:

> I would suggest that both [mind and body] are essentially the same. … That which we experience as mind…will in a natural way ultimately reach the level of the wavefunction and of the "dance" of the particles. There is no unbridgeable gap or barrier between any of these levels. … It is implied that, in some sense, a rudimentary consciousness is present even at the level of particle physics. It would also be reasonable to suppose an indefinitely

> greater kind of consciousness that is universal and that pervades the entire process [of the universe]. (p. 131)

This panpsychism fits together for Bohm with a description of the world as *fundamentally participatory* in nature: "the basic notion is participation rather than interaction" (p. 113). In Bohm's vision, matter is participatory because of the quantum nature of atomic particles. These particles, even if assumed to be point-like entities (as Bohm does), are seen to exist probabilistically: an electron in an atom has a high chance of existing in its 'proper orbit', but has a non-zero chance of existing outside that orbit, across the room, or even across the universe. Because of this, every particle is in 'contact' with every other particle. Particles 'dance' together, to a greater or lesser degree. We can clearly see this phenomenon in special cases like superconductivity (wherein "electrons are thus *participating* in a common action based on a common pool of information" – p. 122), or in 'non-local' experiments. But this interconnection is always present. As he says, "the whole of the universe is in some way enfolded in everything and…each thing is enfolded in the whole" (p. 114).

Given this view of reality, the mechanistic sense of an observer dispassionately making an observation is fundamentally inadequate. Interaction becomes participation:

> [S]uch a complex process of participation evidently goes far beyond what is meant by a merely mechanical interaction. It is therefore not really correct to call what happens a measurement… Rather, it is a *mutual transformation* of both systems… (p. 124)

Each system changes the other – an idea reaching back to Hartshorne, Schiller, and even Campanella. Bohm concludes, like Wheeler, that

> The mechanical notion of an interactive universe is seen to be inadequate. It is in need of replacement by the notion of an objectively participative universe that includes our own participation as a special case. (p. 126).

In 1990 Bohm reissued this article with substantial changes (though, confusingly, under the same title). In the new version he clarifies his philosophical terminology without abandoning his central view. He states, for example, that "quantum theory...implies that the particles of physics have certain primitive mind-like qualities...(though of course, they do not have consciousness)." (1990: 272). He is clearly refining his ideas, no longer being satisfied to attribute "rudimentary consciousness" to elementary particles.

As well he strengthens his description of the interconnected, participatory nature of atomic particles. The quantum field, though dropping off exponentially with distance (like an ordinary field), retains in a sense its full efficacy. Associated with the decaying field is a 'quantum potential' that does not vary with distance. As Bohm says,

> The quantum potential depends only on the form, and not the intensity of the quantum field. Therefore even a very weak quantum field can strongly affect the particle. It is as if we had a water wave that could cause a cork to bob up with full energy, even far from the source of the wave. (1990: 276).

It is worth emphasizing: by 'far', Bohm means literally light-years apart, and instantaneously. This is a radically non-mechanistic interpretation -- a physical universe completely and instantaneously interconnected. Such a picture requires a new unifying concept, and Bohm has chosen to express it in terms of participation.

So for Bohm, participation occurs both within the 'material realm' (quantum physically), and also between the qualities of mind that occur at all levels of being. He describes "the essential mode of relationship of all these [levels of mind] as participation" (p. 284), a fact that bears on the human scale of existence as much as the atomic scale: "For the human being, all of this implies a thoroughgoing wholeness, in which mental and physical sides participate very closely in each other." (ibid). Bohm's ontology is thus best described, I claim, as a form of participatory panpsychism.

The last significant work by Bohm (co-written with B.J. Hiley) was the book Undivided Universe (1993). This is primarily a technical work in quantum physics, but it includes a

well-developed philosophical analysis that elaborates on his earlier themes. The concept of participation continues to play an important role, and he often refers to "the irreducibly participatory nature of all quantum processes" (e.g. p. 284). He also refers here for the first time to Wheeler and his conception of the participatory universe. Bohm is in basic agreement, but feels that he has gone further in articulating that vision:

> We have proposed a model of such a reality in which we say, along with Wheeler, that the universe is essentially participatory in nature. However, unlike Wheeler, we have given an account of this participation...in agreement with the actual predictions of quantum theory. (p. 128)

The philosophical conclusions at the end of the book are taken largely verbatim from Bohm's (1990), and so do not add anything substantially new. Regardless, the further articulation of the quantum side of the participatory universe is a substantial accomplishment.

Seen jointly, the work of Bateson and Bohm constitute a culmination of the scientific perspective on participatory panpsychism. Bohm in particular articulated a technical basis for a new worldview, yet his domain was primarily that of quantum physics. With hylonoism I have attempted to flesh out a compatible view from within the domain of classical physics (in that nonlinear dynamics relies primarily on classical principles), and as it pertains to ordinary-scale events and structures. Bateson interprets information, Bohm interprets the quantum potential, and I interpret the point in phase space -- all panpsychistically, all participatorily. Furthermore I add the philosophical and historical dimensions that are lacking in both Bateson and Bohm.

4) Ubiquitous Matter and Zero-Point Energy

If the realm of matter and energy is fundamentally participatory, then it is reasonable to expect that matter is more than isolated and impenetrable lumps of stuff, and that energy is more than the motion of such lumps. A 'Partimater', if it is to be a useful and relevant concept, must demonstrate deep interconnectedness; it must be both holistic in some

sense and yet account for the apparent discreteness of material things. And, such qualities should be evident to some degree in the realm of physics, even as viewed from within the Mechanistic Worldview.

One such quality is that of the literal interconnectedness of matter itself. Material particles, which were radically discrete in the Newtonian system, are seen in the light of quantum theory as being literally connected and 'in touch' with particles at arbitrarily large distances. This fact is important to Bohm, and plays a significant role in the overall vision of a participatory universe. There are at least three senses in which all matter is interconnected: particle fields, quantum potential, and zero-point energy. To situate this discussion, let me quickly examine the historical antecedents.

First, to clarify my terminology: 'ubiquitous matter' does not mean that all regions of the cosmos 'have matter', but more specifically, that any given subatomic particle has a 'presence' both where it is (classically) located, and also *at any point* in the universe; this is the conclusion of conventional quantum theory. If we accept that leptons (i.e. electrons) and quarks are the ultimate quantum particles, then a given particle – say, an electron in a drop of water – literally and physically exists not only in that drop, but in my hand, on the sun, or on the most distant star. We may say that the electron exists *manifestly* in the drop of water, and *subtly* at all other points in space.

The idea that a given piece of matter exists 'everywhere' goes back, like so many ideas, to ancient Greece. Anaxagoras believed that there were infinitely many elements, which existed together as One at the beginning of the cosmos. As Mind began the process of separation, it pulled apart the One into many distinct things, but could not fully isolate one element from another. The primordial intermixture of elements persisted even as the elements were pulled apart and fashioned into material objects: "as it was in the beginning, so now, all things are together" (frag. 6). As a result, each 'element' (i.e. distinct particle) is somehow present in each thing: "[I]n everything there must be everything. … [A]ll things contain a portion of everything." (ibid).

This idea lay dormant for several centuries until taken up by Bruno. In his holistic philosophy he envisioned a fundamental interconnection between each discrete 'part' and

the unity of the cosmos. In his work *De immenso*, Bruno wrote, "the part hideth everywhere in the whole" (cited in Singer, 1950: 79). All parts are intimately interrelated, the web of relationships between parts merges with the whole. Bruno's *minima*, or monad (atom), possessed a soul, as I explained in my discussion of his panpsychism. This spiritual dimension to matter likewise existed throughout the cosmos, and represented the 'presence' of the monad: "Souls, like light or sound, are diffused in all directions through space; they do not impede one another but influence one another." (cited in ibid: 90). Bruno elaborates in *De magia*:

> [E]very soul and spirit hath a certain continuity with the spirit of the universe, so that it must be understood to exist and to be included not only there where it liveth and feeleth, but it is also by its essence and substance diffused throughout immensity… The power of each soul is itself somehow present afar in the universe…(cited in ibid)

Leibniz too accepted this idea, and made it a central feature of his ontology. Already in 1686 he observed that even arbitrarily small bodies influenced, and were influenced by, all parts of the universe. In the early work Primary Truths, Leibniz stated that the atom (he was not yet using the term 'monad'):

> is acted upon by everything else in the whole universe and receives some effect from everything… [N]ot only must there be effects produced in an atom from all the impressions of the universe, but also, in turn, the state of the whole universe must be inferred from the atom… (pp. 33-4).

This idea recurs in Principles of Nature and Grace, where he says that "everything is connected because of the plenitude [i.e. 'fullness'] of the world, [wherein] each body acts on every other body, more or less, in proportion to its distance…" (sec. 3). And we see it again in the Monadology:

> [E]verything is a plenum, which makes all matter interconnected. … From this it follows that communication extends to any distance whatsoever. As a

> result, every body is affected by everything that happens in the universe… (sec. 61)

Like Bruno, the "power" of each monad is felt at any point in space, even if the particle itself is not present.

Not long afterward, Diderot pickup up on this evocative idea and worked it into one of his main themes. This idea first appears in the Interpretation of Nature, where Diderot notes that "we shall come to see that all phenomena, whether of weight, elasticity, attraction, magnetism, or electricity, are all merely aspects of a single state." (1754: 76). This is an intriguing anticipation of what we would today call a Grand Unified Theory of physics. Again this theme is elaborated upon in D'Alembert's Dream. Near the beginning he states that "everything is connected in nature" (1769: 54). Later he literally invents the notion of the 'web of life', by drawing analogy to a spider. The material web is seen as "a sensitive part of [the spider] itself" (ibid: 80); it is virtually an extension of his body. Diderot then makes the connection to the role of humanity in the universe. *Man is like the spider, and the cosmos is his web*. The characters of the dialogue ponder this insight:

> Mlle. de l'Espinasse: Why can I not know what is happening in...the world [i.e. the universe], since I am a group of sensitive points, pressing on everything and subject to impressions from everything?
>
> Bordeu: Because impressions grow weaker in proportion to the distance whence they come.
>
> Mlle. de l'Espinasse: If the lightest blow is struck at the end of a long beam, I hear that blow... If this beam stood touching the Earth with one end and [the star] Sirius with the other, the same effect would be produced. Why, since everything is connected, contiguous, so that *this beam exists in reality*, do I not hear what is happening in the vast space that surrounds me...?

> Bordeu: And who has told you that you don't hear it, more or less? (pp. 81-2; my italics)

To Diderot, the cosmic web is a matter of truth: all things are connected, and we do actually receive subtle sensations from all parts of the universe. Furthermore, the whole of 'sensitive matter' shares in this capability, and logically must also be receptive to actions throughout the universe.

This concept emerged in the realm of science in the mid-1800's, with the work of Michael Faraday. Faraday's experimental work with magnets led to early theories of electromagnetic fields. His field theories aligned him with the dynamism of Boscovich. In an important letter dated 1844[9] he notes that "the atoms of Boscovich appear to me to have a great advantage over the more usual [Newtonian] notion" (1839-55: 290). (Recall that in dynamism, atoms are 'immaterial', consisting of pure force). More importantly, he realized that such an atomic theory necessitates an 'ubiquitous atom'; the atomic force field (whether gravitational or electric) decays exponentially, dropping off rapidly but *never reaching zero*, even at vast distances. Faraday is the first scientist to explicitly acknowledge this fact:

> [T]he constitution of matter would seem to involve necessarily the conclusion that matter fills all space... [M]atter is not merely mutually penetrable, but each atom extends, so to say, throughout the whole of the solar system, yet always retaining its own centre of force. (ibid: 293)

Even in the first days of field theory, it was thus recognized that the influence of matter extends indefinitely. This force, of course, was extremely small, and could be conveniently ignored. Under conditions of crude experimentation and linear approximations, very small forces are seen to have no significance. Chaos theory suggests that we need to reconsider this presumption.

Whitehead absorbed these insights, and incorporated them with the Leibnizian idea of the mind as a "living mirror of the universe". In his Science and the Modern World (1925)

he observes that we are aware of events distant in space and time; this awareness is reflected in our bodily experiences:

> In being aware of this bodily experience, we must thereby be aware of aspects of the whole spatio-temporal world as mirrored within the bodily life. … [M]y theory involves the entire abandonment of the notion that simple location is…primary. … In a certain sense, everything is everywhere at all times. (1925: 133)

Again, this conclusion logically follows from Faraday's idea of fields.

Whitehead wrote the above passage just as De Broglie was formulating the wave-nature of particles, and Schroedinger was developing the concept of the quantum wave equation. The wave equation gave new expression to the idea of ubiquitous matter. Not only were the particle fields ubiquitous, but so too the *particles themselves*. In quantum theory, a particle exists only in a participatory and probabilistic sense. *Participatory*, because the particle has no 'objective' location; its location is determined by the process of measurement. In a sense, the particle is *where you find it*. The act of observation in some way causes the particle to come into being, to become manifest. *Probabilistic*, because a particle has a high likelihood of being found in a particular location (say, in a given atom of hydrogen), but also has a nonzero likelihood of being found at any other point in space. Because of this phenomenon it is reasonable to say that the particle 'exists' everywhere, to a greater or lesser degree. Haldane noted this fact as early as 1934: "the De Broglie waves of any particle are supposed to be omnipresent" (1934: 89)[10].

Lastly, I note that even Teilhard de Chardin found significance in the idea of ubiquitous matter. He reiterates the point that all particles are present everywhere, both in terms of effect (force) and existence. He writes,

> [S]ince the atom is naturally co-extensive with the whole of the space in which it is situated…we are bound to admit that this immensity represents

> the sphere of action common to all atoms. The volume of each of them is the volume of the universe. (1959: 45)

This point is critical for Teilhard in explaining the deep unity of the cosmos.

As I mentioned above, Bohm is one of the few modern physicists to take seriously the idea of ubiquitous matter. He even strengthens the concept with his 'quantum potential' and the idea that the particle is fully efficacious at any distance.

Most recently, we can observe that chaos theory add impetus to both the fields and the quantum effects. Chaos theory informs us that *every action, no matter how small, has an effect*. This effect may be practically imperceptible to humans, but that does not deny its existence. And by the process of nonlinear feedback, the repercussions may be felt far more quickly and significantly than classical science would allow.

And so we are led to accept that all matter is literally interconnected. As Diderot said, "this beam exists in reality". As I move my hand, there is an effect in even the most distant stars. What precisely happens we cannot say; that *something* happens we are certain. And likewise the movements and actions of all parts of the cosmos affect us, in subtle and imperceptible ways. By simply knowing that there is this two-way interrelationship, this 'mutual transformation' of systems, we gain a vivid and sympathetic feel for the realm of the Partimater, and of the participatory cosmos.

* * * * *

There is yet one other important aspect to this picture of reality, one that also comes from within quantum theory. Theory tells us that energy is packaged discretely, in whole number multiples of a base quanta of energy based on Planck's constant (h). Originally this was presumed to mean that energy was either 'zero' (vacuum), or equal to the multiples: $1h\nu$, $2h\nu$, $3h\nu$, … More generally, $E = nh\nu$. As the theory developed, it became clear that 'n' had to be shifted upward by a unit of ½; thus the correct formula became $E = (n+½)h\nu$.

This apparently small change is far from trivial. It implies that the *vacuum state (n=0) actually has an 'energy' associated with it*. This is not the energy of some distant quantum potential, or passing fields; it is the energy of the vacuum itself. This is the so-called 'zero-point energy', or 'quantum vacuum'.

It might be suspected that the zero-point energy is very small. On the contrary – it is exceedingly large. Bohm was the first to recognize this, back in 1957. He observed that

> [I]f one computes the 'zero point' energy due to quantum-mechanical fluctuations in even one cubic centimeter of space, one comes out with something of the order of 10^{38} ergs, which is equal to that which would be liberated by the fission of about 10^{10} tons of uranium. (1957: 163-4)

This unimaginably vast reservoir of energy is present everywhere; it is inherent in the structure of space-time. And yet it is apparently inaccessible to us. Bohm explains, "Of course, this energy provides a constant background that is not available at our level under present conditions." (ibid). He speculates that it fuels the on-going universal 'process of becoming', and notes that in an evolving universe we may someday have more direct access to it.

This zero-point energy plays an important role in Bohm's Wholeness and the Implicate Order, as it forms the material basis for his concept of the 'holomovement'. He notes here that the magnitude of the zero-point energy "turns out to be very far beyond the total energy of all the matter in the known universe." (1980: 191). He proceeds to develop this imagery:

> What is implied by this proposal is that what we call empty space contains an immense background of energy, and that matter as we know it is a small, 'quantized' wavelike excitation on top of the background, rather like a tiny ripple on a vast sea. (ibid)

On this view, the entire cosmos of mass/energy is just the thinnest of veneers, supported by a vast depth of zero-point energy. I see an interesting comparison to the thin layer of

life, the biosphere, that resides on and is supported by the vastly larger mass of the Earth. The Earth does not 'produce' the living sphere, but rather supports it and makes it possible by providing the raw materials and suitable environment. In a similar way it may perhaps be possible to say that the zero-point energy sustains the mass/energy cosmos.

Interestingly, Wheeler also noted the significance of the zero-point energy. For him it is an issue of critical importance: "No point is more central than this, that empty space is not empty. It is the seat of the most violent physics." (1974: 680). He compares this energy to that of the densest form of conventional energy, the nuclear particle (proton or neutron)[11], and notes that the zero-point energy density is about 10^{80} times higher. Unlike Bohm, Wheeler was unable to flesh out the philosophical implications.

Such an idea is almost incomprehensible within the standard Mechanistic Worldview. There is no standard sense of the term 'energy' that can be applied to a pure vacuum. Modern physicists are unsure of the role it plays. Most simply use it as the 'baseline' from which to measure other energies. Others ignore it. Generally speaking, they "simply do not know what to do with it"[12]. I would suggest that this is because it falls outside the bounds of the Mechanistic Worldview as presently conceived. It points toward the need for a new, encompassing worldview, one that is holistic, participatory, and subtle.

In fact it seems to point to an entirely new dimension of unitary reality[13]. If we allow that the realm of mass/energy (the Partimater) and the realm of mind (Partimens) constitute two distinct aspects of a monistic cosmos, then the zero-point energy may be considered as a *third essential aspect*, distinct from the other two. Bohm attempts to articulate something like this in his ideas of the “implicate order”, the “explicate order”, and the “holomovement” of zero-point energy that underlies both. The notion of such a ‘triple-aspect monism’ is radically new (historically speaking), and suggests that there may be more as yet undiscovered aspects to reality, perhaps infinitely many.

Finally, let me note that the zero-point energy has an interesting similarity to the ancient Stoic concept of the *pyr technicon*. Recall my earlier mention of the *pyr technicon* as the

creative fire of the cosmos, the all-pervading force that forms and animates everything. Sandbach calls it "the god that makes the world" and "fire that is an artificer" (1975: 73). In the Epistles, Seneca refers to it as "creative reason" (in Long, 1974: 165). Inwood and Gerson translate it as "craftsmanlike fire" (1997: 138). There is a famous and beautiful passage referring to the *pyr technikon* from Diogenes Laertius, which Long translates as follows: "Nature is an *artistic fire* going on its way to create." (Long, 1974: 147). Cicero cites this same passage, informing us that this in fact was Zeno's definition of nature. It is unclear the extent to which zero-point energy can be said to 'create' material particles, but it certainly seems able to provide basis and support for the on-going existence of matter – and by extension, mind. In any case, we find yet again an instance of the ancient Greeks demonstrating prescient insight into the nature of reality.

For my purposes here, the zero-point energy is important because (A) it provides yet more evidence of a holistic and interconnected cosmos, (B) it may serve as a basis for interaction and exchange, particularly the instantaneous kind that occurs in the nonlocal action of the quantum potential, and (C) it can be seen as a kind of energy source for ordinary material reality, as that which sustains the elementary particles of mass and energy. For the remainder of this thesis I will treat the zero-point energy as a matter of fact, though the arguments do not stand or fall on this point.

NOTES:

[1] Recall my discussion of emergence at the end of Chapter 4.

[2] Coincidentally, scientists have discovered that the sun does in fact have an internal 'resonance phenomena' that is surprisingly complex. The sun exhibits at least two modes of resonance: (1) a 16-month cycle of increasing and decreasing rotation near the solar equator (cf. Howe, et al, 2000), and (2) a series of up and down surface vibrations, some 2000 km in magnitude, centered on a period of 5 minutes (cf. Friedman, 1986, or Lang, 1995). These 'solar heartbeats' point to an internal structure and complexity of a high order; and through the associated sun-spot activity they have a non-trivial effect on the Earth.

The sun has a number of other fascinating mysteries about it, not the least is the sudden and dramatic rise in the temperature of its atmosphere, from around 6,000 deg K at the surface to around 1,000,000 deg K at a height of 100,000 km above the surface; this astonishing increase has no known cause, and in fact appears to violate the 2nd law of thermodynamics. To attribute such complexities to the 'action of mind' is of course highly speculative. I would argue that the sun, like any dynamic system, possesses a noetic unity, and that (anticipating Chapter 8) this unity has an intensity that corresponds to its internal complexity. Furthermore, my theory of hylonoism actually would predict the presence of complex structure in the sun, or for that matter in any system in which an abundance of matter and energy interact dynamically – cf. my discussion in the following chapter.

[3] In fact a similar claim was made a year earlier by Walker (1970). His article primarily argues that quantum processes in the brain (at the synapses) account for a number of characteristics of consciousness, in particular its reality and non-physicality. At the end of the piece he observes that, more generally, "consciousness may be associated with all quantum mechanical processes" (p. 175). In his concluding paragraph, he states that "since everything that occurs is ultimately the result of one of more quantum mechanical events, the universe is 'inhabited' by an almost unlimited number of rather discrete conscious, usually nonthinking entities that are responsible for the detailed working of the universe." (p. 176).

[4] See for example Bateson (1972), pp. 403 ff.

[5] This aspect of Bateson's philosophy seems to have been generally unacknowledged. Recently, Chalmers (1996) has picked up on this Batesonian version of panpsychism (but without acknowledging it), and provided a more thorough philosophical elaboration. See Chalmers (1996: 293-301).

[6] He repeats this view in his Mind and Nature (1979). Here he writes: "I do not believe that single subatomic particles are 'minds' in my sense because I do believe that mental process is always a sequence of interactions *between* parts. The *explanation* of

mental phenomena must always reside in the organization and interaction of multiple parts." (1979: 103).

[7] The six criteria are: "(1) All mind is an aggregate of interacting parts or components. (2) The interaction between parts of mind is triggered by difference. (3) Mental process requires collateral energy. (4) Mental process requires circular chains of determination. (5) In mental process, the effects of difference are to be regarded as transforms of the events which preceded them. (6) The description and classification of these processes of transformation disclose a hierarchy of logical types immanent in the phenomena." (1979: 102)

[8] The talk was published in 1986 – see Bohm (1986).

[9] "A speculation touching Electric Conduction and the Nature of Matter" (Vol. 2) – in Faraday (1839-55).

[10] Since Haldane equates the wave-nature with 'mind', he uses this fact of De Broglie's to argue for the view that mind, too, is omnipresent.

[11] Nuclear energy density is approximately 10^{14} g/cm^3, versus vacuum energy density of 10^{94} g/cm^3 (cited in Wheeler (1962) and in Weaver, 1987: 681).

[12] Larry Sklar, Professor of Philosophy, University of Michigan (USA), Feb. 15 1999 (personal communication).

[13] I wish not to overemphasize the role of the zero-point energy. It is still too unarticulated a concept to play much of a role in any metaphysical system. Some have attempted this (e.g. Zohar and Marshall, 2000), but the results to date are unconvincing.