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Organism and Psyche in a Participatory Universe*

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Abstract

The Jungian ideal of the whole person is one whose cell and psyche, body and mind, inner and outer, are fully integrated, and hence completely in tune with nature. Jung's ideas on psychical development show many parallels to those relating to the organism. Similarly, Laszlo's theory of the quantum holographic universe views the universe effectively as a kind of superorganism, constantly becoming, being created through the activities of its constituent organisms at every level. The organism is thus the most universal archetype. I describe a theory of the organism, based on quantum coherence, which is, in some respects, a microcosm of Laszlo's universe. It involves key notions of the maximization of local autonomy and global cohesion, of universal participation, of sensitivity and responsiveness, which have profound implications for our global future.

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Organism - the universal archetype

In the Summer of 1991, I saw something in Mexico City which haunted me for months afterwards. It was a thick round slab of sculpted rock, about 3.25m in diameter. The official guide book says it depicts the Aztec moon goddess, embodying the powers of night, who was killed and gruesomely dismembered by her brother the sungod - an act so terrible that the world itself is torn asunder. Yet, the beautifully executed symmetries of the form evokes a sense of the dismembered parts drawing together again to make a whole, counteracting the violent severence of head and limbs. Mazatl Galindo, who teaches indigenous American cultures and is himself of Aztec Indian descent, has since explained to me that this sculpted disc, which has the same dimensions as the much better known, and widely reproduced calender stone, is actually also a calender: the thirteen main joints of her dismembered body representing the thirteen divisions of the year. The alternating disintegration and re-integration it evokes signifies the cycles of death and rebirth that mark the passage of time.

I came upon the sculpture while accompanying a group of university under-graduates travelling around the world on an intensive, year-long education programme on Global Ecology - Integrating Nature and Culture (of which I was a founding faculty member). In the course of the year and throughout the Third World, we had experienced the same distressing disintegration of the environment and indigenous communities brought on by industrial developments. And yet there remains, everywhere, an indestructible, irrepressible spirit to make things whole again. It was not just a survival instinct, but a genuine lust for life - the psychic energy that created the calender stone is at work, initiating the healing process even as disintegration is continuing apace. The meaning of that year's journey and the journey of my life as symbolic of life itself came to me like an avalanche. I have died several deaths since my encounter with that symbol. I found myself standing at the gates of the underworld, as Orpheus must have done, torn between the fear of impending hell and the over-riding need to recover a lost love. Eventually, it transformed my life, in much the way that Jung (1964) has envisaged the transforming power of symbols.

Love rules our lives on many planes. Scottish psychologist Ian Suttie (1924), a critic of Freud, proposed that love, as distinct from sex, is the primary drive for all social organisms. Love comes from the nurturing ministrations of the mother or caretaker during infancy. From this arises a feeling of tenderness that regards all people to be possible companions, to be enjoyed and loved, and from whom approval is sought. On another plane, the successful separation of child from mother creates a field of attraction, a "virtual space" of love which we fill with our social and creative activities (Winnicott, 1974).

Love is a desire for wholeness. It is a desire for resonance, for intimacy, a longing to embrace and complete a larger whole. And it is that which motivates our social and creative acts and our knowledge of nature on the most universal plane (Ho, 1994a). At its most personal, love is our affection for specific human beings, it is also one's own process of individuation - of remaking one's "self" out of the fabric of experiences, transcending the well-worn archetypes to become a unique whole person. The whole person is one whose sense of uniqueness is premissed on her relationship with all of nature. Thus, the personal and universal are inextricably intertwined. The most intimate knowledge of oneself is at the same time, the most profound knowledge of nature.

The true love of self is also inextricably the love of humanity and of all nature. That is why we feel obliged to serve, to help, to alleviate suffering and pain just as they were our own. Scientists like David Bohm, Ervin Laszlo and others are indeed trying to recover that lost love, the universal wholeness and entanglement that enables us to emphathize and to be compassionate.

The whole is never static, it is constantly dying and reborning, decaying and renewing, breaking down to build up again. The same cycles of disintegration and re-integration occur whether one is looking at the energy metabolism of our body or the stream of consciousness out of which we individuate our psyche. During the normal 'steady state' of our existence, the multitudes of infinitesimal deaths and rebirths are intricately balanced so that the old changes imperceptibly into the new. However, whenever the attracting centre of the new is radically different from the old, a larger, and at times, complete disintegration may be needed before the new can individuate. It is like the caterpillar which must completely dissolve so that the beautiful butterfly can emerge. That is our hope for the approaching millennium.

The psyche has so much in common with the organism that many of the most perceptive biologists and psychologists have proposed a complete continuity and identity between the two. They were impressed with the 'directiveness' of all vital processes, whether developmental, physiological or psychical. In development, the fertilized egg goes through a series of morphogenetic changes directed towards producing the adult organism, and is remarkably resistant to disturbing influences. Similarly, the organism is able to maintain its internal physiology in a constant state despite large changes in the external environment. So it is with the purposiveness of all living things. One has only to try to stop a cat from doing what it wants to do. The mark of a living being is that it always has its own way of doing things, its own directed purpose in life that resists what is imposed on it. It is not at the mercy of its surroundings. It is so even for the simplest unicellular organism. The biologist Jennings (1933) took a lifetime to study the ciliate protozoa *Paramecium*, and became convinced of its purposiveness, it autonomy at the very least. For example, it will swim

towards the light, or not, according as to whether it is hungry or fully fed.

Geneticist Sinnott (1950) argues in his book, *Cell and Psyche*, that biological organization, concerned with development and physiology, and psychical activity, concerned with behaviour and leading to mind, are fundamentally the same thing. "In some unexplained fashion, there seems to reside in every living thing,...an inner subjective relation to its bodily organization. This has finally evolved into what is called consciousness...through this same inner relationship, the mechanisms which guides and controls vital activities towards specific ends, the pattern or tension set up in protoplasm, which so sensitively regulates its growth and behaviour, can also be experienced, and this is the genesis of desire, purpose, and all other mental activities." (p.48)

To me, the Jungian ideal of the whole person is also one whose cell and psyche, body and mind, inner and outer, are fully integrated, and hence completely in tune with nature. That may be the secret of the golden flower (see Fordham, 1966), the immortal spirit-body created out of the resolution of opposites, the intertwining of darkness and light (moon goddess and sungod) that is the essence of life itself. The encounter with the Aztec calender stone is the immediate prelude to my work towards a theory of the organism, much of which is in *The Rainbow and The Worm* written almost a year later (Ho, 1993). A recent summary of the main thesis with additional work done since is presented elsewhere (Ho, 1997a)

Jung's ideas on psychical development show many parallels to those relating to living organization, and have since been borrowed back into biology. 'Individuation', for example, has been used by the embryologist/ geneticist Waddington (1956) to describe the process of forming a whole, or a whole organ, such as a limb from the global morphogenetic field. Jung himself was not unaware of these parallels when he presented the psyche as a dynamic, self-regulating system, motivated by psychic energy or *libido*, a general sense of desire or longing, an urge that flows between opposite poles, so that the stronger the opposition the greater the tension (Fordham, 1966). The allusion to the living system and energy flow is unmistakable. Jung's theory of the psyche, drawn largely from his own experiences and imagination, is also a theory of the organism. The organism is the most universal archetype.

Similarly, Laszlo's (1995, 1996) theory of the quantum holographic universe views the universe effectively as a kind of superorganism, constantly becoming, being created through the activities of its constituent organisms at every level. These activities leave traces (quantum interferences) in the universal vacuum field which feed back on the future evolution of the organisms themselves. The universal quantum holographic field is the collective consciousness (including the unconscious) of *all* organisms. My theory of the organism is in some respects, a microcosm of Laszlo's universe.

The irrepressible tendency towards the whole

What is it to be an organism? It is, at bottom, the irrepressible tendency towards being whole. It is that which underlies both the directiveness of vital activities, and the love we express on many planes. In biological development, the most characteristic feature of the embryo is not so much its directiveness towards producing an adult organism or any archetype, rather it is its tendency to maintain and develop into an organized whole, however

it is disturbed. Sometimes, this organized whole is so altered that it is no longer recognizable as the same organism, but it is nonetheless an organism in the sense of being an organized whole.

More significantly, there is a special relationship between part and whole in the organism.The egg starts to develop by cell division. At a sufficiently early stage, the cells in the embryo are typically *totipotent*, in that they have the potential to develop into any part of the whole. When they are separated, each cell can develop into a whole organism, albeit a much smaller one than the original. Similarly, if a part of the early embryo is removed, that part can be regenerated from the remaining so that the whole is again recovered. Regeneration can also occur in adult organisms of some species such as the salamander. It is part and parcel of the healing process that enables all organisms to recover from illnesses and injuries. Whole and part are therefore mutually implicated in the organism. This quality of organic wholeness has eluded mechanistic science right from the beginning, and has been the main sticking point of the debate between the mechanists and their opponents, the vitalists.

Organic space-time versus mechanical space and time

The mechanistic framework broke down at the turn of the present century, giving way to quantum theory at the very small scale of elementary particles and to general relativity at the large scales of planetary motion. In place of the static, eternal universe of absolute space and time, there is a multitude of contingent, observer-dependent space-time frames. Instead of solid objects with simple locations in space and time, one finds delocalized, mutually entangled quantum entities evolving like organisms. The opposition between the mechanistic and the organic worldview hinges on the fundamental nature of space and time.

Mechanical space and time are both linear, homogeneous, separate and local. In other words, both are infinitely divisible, and every bit of space or of time is the same as every other bit. A billiard ball *here* cannot affect another one *there*, unless someone pushes the one here to collide with the one there. Mechanical space-time also happens to be the space and time of the commonest "common-sensible" world in our mundane, everyday existence. It is the space-time of frozen instantaneity abstracted from the fullness of real process, rather like a still frame taken from a bad movie-film, which is itself a flat simulation of life. The passage of time is an accident, having no connection with the change in the configuration of solid matter located in space. Thus, space and time are merely coordinates for locating objects. One can go forwards or backwards in time to locate the precise objects at those particular points. In reality, we know that we can as much retrace our space-time to locate the person that was 30 or 50 years younger as we can undo the wrongs we have committed then. There is no simple location in space and time (Whitehead, 1925).

Psychoanalyst-artist Marion Milner (1957) describes her experience of "not being able to paint" as the fear of losing control, of no longer seeing the mechanical common-sensible separateness of things. It is really a fear of being alive, of entanglement and process in the organic reality that ever eludes mechanistic descripion. And yet, it is in overcoming the imposed illusion of the separateness of things that the artist/scientist enters into the realm of creativity and real understanding - which is the realm of organic space-time. Mechanical

physics has banished organic space-time from our collective public consciousness, though it never ceases to flourish in the subterranean orphic universe of our collective unconscious and our subjective aesthetic experience. In a way, all developments in western science since Descartes and Newton may be seen as a struggle to reclaim our intuitive, indigenous notions of organic space-time, which, deep within our soul, we feel to be more consonant with authentic experience.

Organism versus mechanism

The mechanistic worldview indeed officially ended at the beginning of this century. But the profound implications of this decisive break with the intellectual tradition of previous centuries were recognized by a mere handful of visionaries, especially by the French philosopher Henri Bergson (1916), and the English mathematician-philosopher Alfred North Whitehead (1925). Between them, they articulated an organicist philosophy in place of the mechanistic. Let me summarize some of what I see to be the major contrasts between the mechanical universe and the universe of organisms.

Mechanical Universe	Organic Universe
Static, deterministic	Dynamic, evolving
Separate, absolute space and absolute time for all observers	space-time inseperable, contingent observer(process)-dependent space-time frames
Inert objects with simple locations in space and time	Delocalized organisms with mutually entangled space-times
Linear, homogeneous space and time	Nonlinear, heterogeneous, multi- dimensional space-times
Local causation	Non-local causation
Given, nonparticipatory and hence, impotent observer	Creative, participatory; entanglement of observer and observed

The contrasts are brought into sharper relief by considering the differences between mechanism and organism, or, more accurately, the opposition between a mechanical system and an organic system. First of all, a mechanical system is an object *in* space and time, whereas an organism is, in essence, *of* space-time. An organism creates its own space-times by its activities, so it has control over its space-time, which is not the same as external clock time. Secondly, a mechanical system has a stability that belongs to a *closed* equilibrium, depending on controllers, buffers and buttresses to return the system to set, or fixed points. It works like a non-democratic institution, by a hierarchy of control: a boss who sits in his office doing nothing (bosses are still predominantly male) except giving out orders to line managers, who in turn coerce the workers to do whatever needs to be done. An organism, by

contrast, has a dynamic stability, which is attained in open systems far away from equilibrium. It has no bosses, no controllers and no set points. It is radically democratic, everyone participates in making decisions and in working by intercommunication and mutual responsiveness. Finally, a mechanical system is built of isolatable parts, each external and independent of all the others. An organism, however, is an irreducible whole, where part and whole, global and local are mutually implicated.

An even more significant change in worldview is the dissolution of the Cartesian barrier separating the observer from the observed. In the quantum universe, observer and observed are mutually entangled, each act of observation determining the evolution of *both* . Knowledge, therefore, involves the full participation of the knower in the known. As the knower is an organism, she is also an actor who participates in constructing and shaping the universe, and*she does so knowingly*. There is, thus, no escaping from the responsibility of a participatory universe and the moral imperative of one's mutual entanglement, ultimately with all of nature. But let us begin with the central percept of being an organism.

A theory of the organism

There are 75 trillion cells in our body, made up of astronomical numbers of molecules of many different kinds. How can this huge conglomerate of disparate cells and molecules function so perfectly as a coherent whole? How can we summon energy at will to do whatever we want? And most of all, how is it possible for there to be a singular "I" that we all feel ourselves to be amid this diverse multiplicity?

To give an idea of the coordination of activities involved, imagine an immensely huge superorchestra playing with instruments spanning an incredible spectrum of sizes from a piccolo of 10^{-9} metre up to a bassoon or a bass viol of a metre or more, and a musical range of *seventy-two octaves*. The amazing thing about this superorchestra is that it never ceases to play out our individual songlines, with a certain recurring rhythm and beat, but in endless variations that never repeat exactly. Always, there is something new, something made up as it goes along. It can change key, change tempo, change tune perfectly, as it feels like it, or as the situation demands, spontaneously and without hesitation. Furthermore, each and every player, however small, can enjoy maximum freedom of expression, improvising from moment to moment, while maintaining in step and in tune with the whole.

I have just described a theory of the *quantum coherence* that underlies the radical wholeness of the organism, which involves total participation, maximizing *both* local freedom and global cohesion. It involves the mutual implication of global and local, of part and whole, from moment to moment. It is on that basis that we can have a sense of ourselves as a singular being, despite the diverse multiplicity of parts. That is also how we can perceive the unity of the here and now, in an act of "prehensive unification"(Whitehead, 1925). Artists like scientists, depend on the same exquisite sense of prehensive unification, to see patterns that connect apparently disparate phenomena.

In order to add corroborative details to the theory, however, I shall give a more scientific narrative beginning with energy relationships.

The thermodynamics of organized complexity

Textbooks tell us that living systems are open systems dependent on energy flow. Energy flows in together with materials, and waste products are exported as well as the *spent* energy that goes to make up *entropy*. And that is how living systems can, in principle, escape from the second law of thermodynamics. The second law, as you may know, encapsulates the fact that all physical systems run down, ultimately decaying to homogeneous disorganization when all useful energy is spent, or converted into entropy. But how do living systems manage their antientropic existence?

I have suggested (Ho, 1996a,b; 1997a) that the key to understanding how the organism overcomes the immediate constraints of thermodynamics is in its capacity to store the incoming energy, and in somehow closing the energy loop within to give a reproducing, regenerating life cycle. The energy, in effect, circulates among complex cascades of coupled cyclic processes within the system before it is allowed to dissipate to the outside. These cascades of cycles span the entire gamut of space-times from slow to fast, from local to global, that all together, constitutes the life-cycle. Each cycle is a domain of *coherent* energy storage - coherent energy is simply energy that can do work because it is all coming and going together, as opposed to incoherent energy which goes in all directions at once and cancel out, and is therefore, quite unable to do work.

Coupling between the cycles ensures that the energy is transferred directly from where it is captured or produced, to where it is used. In thermodynamic language, those activities going thermodynamically *down*-hill, and therefore yielding energy, are coupled to those that require energy and go thermodynamically *up*hill. This coupling also ensures that *positive* entropy generated in some space-time elements is compensated by *negative* entropy in other space-time elements. There is, in effect, an internal energy conservation as well as an internal entropy compensation. The whole system works by reciprocity, a cooperative give and take which balances out over the system as a whole, and within a sufficiently long time (Ho, 1997a). The result is that there is always coherent energy available in the system, which can be readily shared throughout the system, from local to global and *vice versa*, from global to local. That is why, in principle, we can have energy at will, whenever and wherever it is needed. The organism has succeeded in gathering all the necessary vital processes into a unity of coupled non-dissipative cycles spanning the entire gamut of space-times up to and including the life-cycle itself, which effectively feeds off the dissipative irreversible energy flow. In thermodynamic terms, the living system can be represented as a superposition of cyclic non-dissipative processes, for which entropy production balance out to zero, $SDS = 0$, and dissipative, irreversible processes, for which net entropy production is positive, $SDS > 0$.

But how can energy mobilization be so perfectly coordinated? That is a direct consequence of the energy stored, which makes the whole system *excitable*, or highly sensitive to specific weak signals. It does not have to be pushed and dragged into action like a mechanical system. Weak signals originating anywhere within or outside the system will propagate throughout the system and become automatically amplified by the energy stored, often into macroscopic action. Intercommunication can proceed very rapidly, especially because organisms are completely *liquid crystalline*.

The liquid crystalline organism

Several years ago, we discovered an optical technique that enables us to see living organisms in brilliant interference colours generated by the liquid crystallinity of their internal anatomy. We found that all live organisms are completely liquid crystalline - in their cells as well as the extracellular matrix, or connective tissues (see Ho *et al*, 1996; Ross *et al*, 1997). Liquid crystals are states of matter between solid crystals and liquids. Like solid crystals, they possess long-range orientation order, and often, also varying degrees of translational order (or order of motion). In contrast to solid crystals, however, they are mobile and flexible and highly responsive. They undergo rapid changes in orientation or phase transitions when exposed to weak electric (or magnetic) fields, to subtle changes in pressure, temperature, hydration, acidity or pH, concentrations of inorganic molecules or other small molecules. These properties happen to be ideal for making organisms, as they provide for the rapid intercommunication required for the organism to function as a coherent whole. (Images of live organisms taken from video-recordings may be found in Ho, 1997c)

This imaging technique enables us to literally see the whole organism at once, from its macroscopic activities down to the long-range order of the molecules that make up its tissues. The colours generated depend on the structure of the particular molecules - which differ for each tissue - and their degree of coherent order (see Ross *et al*, 1997 for the mathematical derivation showing how, for weakly birefringent material, the colour intensity is approximately linearly related to both intrinsic birefringence and the order parameter). The principle is exactly the same as that used in detecting mineral crystals in geology; but with the important difference that the living liquid crystals are *dynamic* through and through. The molecules are all moving about busily transforming energy and material in the meantime, and yet they still appear crystalline.

The reason is because visible light vibrates much faster than the molecules can move, so the tissues will appear indistinguishable from static crystals to the light transmitted, *so long as the movements of the constituent molecules are sufficiently coherent*. In fact, the most actively moving parts of the organism are always the brightest, implying that their molecules are moving all the more coherently. With our optical technique, therefore, one can see that the organism is thick with coherent activities at all levels, which are coordinated in a continuum from the macroscopic to the molecular. That is the essence of the organic whole, where local and global, part and whole are mutually implicated at any time and for all times.

Those images draw attention to the wholeness of the organism in another respect. All organisms - from protozoa to vertebrates without exception - are polarized along the anterior-posterior axis, or the oral-adoral axis, such that all the colours in the different tissues of the body are at a maximum when the axis is appropriately aligned in the optical system, and they change in concert as the axis is rotated from that position.

Knowledge as intercommunication in a participatory universe

The images demonstrate something profound about the nature of knowledge. Are the colours really in the organisms? Yes and no. They are dependent on the particular organism and its physiological state, but no colours would be produced unless we set up the observation in a certain way. Therefore, the observation, and hence the knowledge gained, is always dependent on both the observer and the observed. It is an act of intercommunication, which, in the ideal, is just like that between different parts of the organism (see below). The authenticity of the knowledge gained depends on this delicate balance of obtaining information while respecting the object of one's interrogation. That is why one uses minimally invasive, nondestructive techniques for investigating living organization, which allows organisms to be organisms (Ho, 1993). Crude, destructive methods of interrogation will invariably yield misleading information of the most mechanistic kind, reinforcing a mechanistic view of organisms and of the universe.

In the same way, as we participate in universal wholeness, in Laszlo's quantum holographic field, we do so with the requisite sensitivity and respect. Knowledge is always a gift one accepts with responsiveness and responsibility. Let us look at how intercommunication takes place within the organism.

The quantum holographic body field of the organism

There is no doubt that if we could look inside our bodies the same way we have done for the small creatures, we would see our living body as an incredibly colorful, liquid crystalline continuum, with all parts rapidly intercommunicating and colours flashing, so that it can act as a coherent whole. (That may be why we say we are off-colour when we don't feel well.) One has been led to believe that intercommunication in large animals like ourselves depends on the nervous system controlled by the brain. However, that may be only half the story, as nerves do not reach all parts of the body, and animals without a nervous system nevertheless have no problems in acting as a coherent whole.

The clue to the other half of the story is in the connective tissues which make up the bulk of most animals including ourselves. These are the skin, the bones, cartilage, tendons, ligaments and other tissues that fill up the spaces between the usual organs. Most people still think that these tissues fulfill mechanical functions of protection and support, like packing material. However, we now know they are all liquid crystalline, and have much more exotic properties.

The connective tissues are further connected to the intracellular matrices of all individual cells which are also liquid crystalline. There is thus an excitable, liquid crystalline continuum for rapid intercommunication permeating the entire organism, enabling it to function as a coherent whole, as we have directly demonstrated with our noninvasive optical imaging technique. This continuum constitutes a "body consciousness" that precedes the nervous system in evolution (c.f. Oschman, 1984, 1993); and I suggest, it still works in tandem with, and to some extent, independently of the nervous system. This body consciousness is the pre-requisite for conscious experience that involves the participation of the intercommunicating whole. *When the body is fully coherent,* intercommunication is

instantaneous and nonlocal. By nonlocal, I mean that distant sites, say my left hand and my right hand, take no time at all to reach agreement as to what to do next, so it is impossible to know where the "signal" originated. This is the *quantum* coherent state.

The quantum coherent state is a very special state of being whole, which maximizes *both* local freedom and global cohesion (see Ho, 1993). This is due to the *factorizability* of the quantum coherent state (Glauber, 1970) in which the parts are so perfectly coordinated that the correlations between them resolves neatly into products of the self-correlations of the parts, so the parts behave as though they are independent of one another. Remember the huge superorchestra I mentioned earlier? Factorizability of the quantum coherent state explains why the body can be performing all sorts of different but coordinated functions simultaneously. As I am writing this paper, my metabolism is working in all the cells of my body, my trunk and leg muscles are keeping in tone so I don't collapse into a heap, while the muscles in my arms and fingers are working together in just the right way to make the appropriate taps on the keyboard, and my eyes are tracking the words on the monitor screen; and hopefully, the nerve cells in my brain are firing coherently. All that is possible also because noiseless and instantaneous intercommunication can occur throughout the system when the system is coherent. In practice, quantum coherence occurs to different degrees, and factorizability is never perfect except in the ideal. Nevertheless, our body approaches that ideal, which also tends to be restored after decohering interactions (see Ho, 1997a,b).

The coherence of brain and body consciousness

From the perspective of the whole organism, the brain's primary function may be to mediate coherent coupling of all subsystems, so the more highly differentiated or complex the system, the bigger the brain required. Substantial parts of the brain are indeed involved in integrating inputs from all over the body, and over long time scales. But not all the coordination required is provided by the brain, for this coordination seems instantaneous by all accounts.

Thus, during an olfactory experience, slow oscillations in the olfactory bulb (in the brain) are in phase with the movement of the lungs (Freeman and Barrie, 1994). Similarly, the coordinated movement of the four limbs (or all the hundreds of limbs in the millipede) in locomotion is accompanied by patterns of activity in the motor centers of the brain which are in phase with those of the limbs (Collins and Stewart, 1992 ; Kelso, 1991). That is a remarkable achievement which physiologists and neuroscientists alike have taken too much for granted. The reason macroscopic organs such as the four limbs can be coordinated is that each is individually a coherent whole, so that a definite phase relationship can be maintained among them. The hand-eye coordination required for the accomplished pianist is extremely impressive, but depends on the same inherent coherence of the subsystems which, I suggest, enables instantaneous intercommunication to occur. There simply isn't time enough, from one musical phrase to the next, for inputs to be sent to the brain, there to be integrated, and coordinated outputs to be sent back to the hands (see Hebb, 1958).

I raised the posssibility that a "body consciousness" works in tandem with the "brain consciousness"of the nervous system. I suggest that instantaneous coordination of body functions is mediated, not so much by the nervous system, but by the body consciousness

inhering in the liquid crystalline continuum of the body. (The nervous system is also liquid crystalline, however, the known activities of the nervous system are not based directly on their liquid crystalline properties.) Ho and Knight (1997) following Oschman (1984, 1993), review evidence suggesting that this liquid crystalline continuum is responsible for the direct current (DC) electric field permeating the entire body of all animals, that Becker (1990) and others have detected. Furthermore, this liquid crystalline continuum possess all the properties required for a body consciousness that can register tissue memory of previous experiences.

Becker (1990) has demonstrated that the DC field has a mode of semi-conduction that is much faster than nervous conduction. During a perceptive event, local changes in the DC field can be measured half a second before sensory signals arrive in the brain, suggesting that the activities in the brain may be pre-conditioned by the local body field. Becker located the DC body field to "perineural" tissues such as the glial cells. But we believe it is located in the liquid crystalline continuum of the connective tissues (Ho and Knight, 1997).

Up to 70% of the proteins in the connective tissues consist of collagens that exhibit constant patterns of alignment, as characteristic of liquid crystals (Knight and Feng, 1993). Collagens have distinctive mechanical and dielectric properties that make them very sensitive to mechanical pressures, changes in pH, inorganic ions and electromagnetic fields. In particular, a cylinder of water surrounds the collagen molecule, giving rise to an ordered array of bound water on the surface of the collagen network that supports rapid "jump conduction" of protons, or positive electric charges. Proteins in liquid crystals have coherent motions, and will readily transmit weak signals by proton conduction, or as coherent electric waves. Thus, extremely weak electromagnetic signals or mechanical disturbances will be sufficient to set off a flow of protons that will propagate throughout the body, making it ideal for intercommunication.

The liquid crystalline nature of the continuum also enables it to function as a distributed memory store. The water bound on the surfaces of proteins are known to be altered when the proteins change their shape. Proteins undergo a hierarchy of shape changes over a range of time scales and of different energies. The shapes are clustered in groups that have nearly the same energies, with very low energetic barriers between them. Thus, global shape changes in a liquid crystalline network can easily be triggered, that will, in turn, alter the structure of bound water. As the bound water forms a global network in association with the collagen, it will have a certain degree of stability, or resistance to change. By the same token, it will also retain tissue memory of previous experiences. Additional chemical modifications of the collagen network may also contribute to this memory. The memory may consist partly of dynamic circuits, the sum total of which constituting the DC body field.

A yet more interesting possibility is that the liquid crystalline continuum may function as a quantum holographic medium, recording the interference patterns arising from interactions between local activities and a globally coherent field. This is exactly analogous to Laszlo’s (1995) suggestion that the "zero-point field" of the universe functions as a universal holographic medium, recording the experiences of all the particles, each of which is subject to influences from the rest of the universe as well as feedback from the particle’s own activities on the universal medium. If the organism is coherent as I have suggested, then the conditions are there for a quantum holographic memory store in the liquid crystalline continuum of the body itself. Holographic memory is unique in that it is distributed globally,

and yet, can be accessed and recovered locally. It captures an aspect of the organic whole in developmental biology that has completely eluded mechanistic understanding. It is that which can give rise to the subjective self, or psyche, that guides and regulates all vital activities towards a specific end. It is possible that biological development is based on the same holographic memory so that the entire organism can be engendered locally in a germ cell, from which the organism is, in turn, recoverable.

Thus, consciousness is distributed throughout the entire body; "brain consciousness", associated with the nervous system, being embedded in "body consciousness". Brain and body consciousness mutually inform and condition each other. The singularity of purpose of the individual is based on a complete coherence of brain and body. The implications for holistic and psychic health are clear. A stressful situation will affect body consciousness through subtle ways in which mechanical pressures build up in the body to block intercommunication. That acts on the nervous system to give a diminished self-image of the body, which feeds back on the body in a vicious cycle that further undermines the individual's physical well-being. By contrast, a supple body is a responsive body that moves and responds with the greatest of ease. It leads to a buoyant self-image that again feeds back to further enhance all bodily functions.

Quantum coherence and brain consciousness

Many recent studies of brain activities are revealing impressive largescale spatiotemporal coherence that suggest the brain also functions with a high degree of quantum coherence (see Ho 1997b and references therein). These come from measurements carried out with the ultrasensitive, noninvasive SQUID magnetometer, also referred to as magnetoencephalography (MEG) (see Iaonnides, 1994) as well as conventional electroencehalography (EEG) (Gray *et al*, 1989; Singer, 1995; Freeman and Barrie, 1994). Multichannel MEG, in particular, provides high speed, high resolution information of spatiotemporal coherence in brain activities. Studies conducted over the past 5 years have revealed 40 Hz activities that are coherent at both deep and superficial layers of the brain. Similarly, Freeman (1995) and his coworkers, recording simultaneously with an array of 64 electrodes from the rabbit cortex, found oscillations that are coherent over the entire array, for which no obvious "sources" could be identified.

Computer scientist, Marcer (1992 ; 1995), proposes a quantum holographic model of consciousness in which perception involves the conversion of an interference pattern (presumably between a coherent wave-field generated by the perceiver and the wave-field reflected off the perceived) to an object image that is coincident with the object itself. This is accomplished by a process known as phase conjugation, whereby the wave reflected from the object is returned (by the perceiver) along its path to form an image where the object is situated. In the act of perceiving, the organism also perceives itself situated in the environment, and through active phase conjugation directed throughout its body, forms an image of the self coincident with the organism itself, so "self" and "other" are simul-taneously defined (Ho, 1997b). What is the source of the coherent wave-field generated by the perceiver? Could it be the body field itself? Or the body field as modulated by the nervous system? This could be subject to empirical investigation.

In the same way that body consciousness associated with the liquid crystalline continuum registers memory of its experience, brain consciousness registers memory of sensory images. The idea that brain memory is distributed and holographic has been suggested by a number of neurobiologists over the past 40 years (see Ho, 1997b for more details and references). Holographic memory storage is orders of magnitude more efficient than any model that makes use of "representations" because holographic memory employs actual physical simulations of processes (Marcer, 1992, 1995) and do not require lengthy sequences of arbitrary coding and decoding of isolated bits. Marcer suggests that the brain stores experienced holographic spatio-temporal patterns and compares stored with new patterns directly, recognition and learning being reinforced in "adaptive resonance", thus also making for much faster processing.

As mentioned before, the liquid crystalline continuum supporting the body field may also take part in memory storage, although this possibility has never been seriously considered. Laszlo (1995) goes even further to suggest that much of memory may be stored in an ambient, collective holographic memory field delocalized from the individual; and that memories are only accessed by the brain from the ambient field. This ambient field may well be our collective unconscious. One can begin to see the organism with its own local quantum holographic field as a microcosm of the universal field in which it participates.

The organism's macroscopic wave function and universal entanglement

If quantum coherence is characteristic of organism and psyche, as I have argued here, then the organism will possesss something like a macroscopic wave-function. This wave function is ever evolving, entangling its environment, transforming and creating itself anew. There is no "collapse of the wave function" as required by conventional quantum theory (cf Bohm and Hiley, 1993; see also Ho, 1993, 1997b). When quantum systems interact, they become mutually entangled, and there may be no resolution of their respective wave functions afterwards. So one may remain entangled and indeed, delocalized over past experiences (i.e., in Laszlo's ambient field). Some interactions may have time scales that are extremely long, so that the wave function of interacting parties may take a correspondingly long time to become resolved, and largescale nonlocal connectivity may be maintained, possibly accounting for synchronicities, as Laszlo (1995) suggests.

The "whole" organism is thus a domain of coherent activities, constituting an autonomous, free entity (see Ho, 1996a), *not* because it is separate and isolated from its environment, but precisely *by virtue of its unique entanglement of other organisms* in its environment. In this way, one can see that organic wholes are nested as well as entangled individualities. Each can be part of a larger whole, depending on the extent over which coherence can be established. So, when many individuals in a society have a certain rapport with one another, they may constitute a coherent whole, and ideas and feelings can indeed spread like wildfire within that community. In the same way, an ecological community, and by extension, the global ecology may also be envisaged as a super-organism within which coherence can be established in ecological relationships over global, geological space-times (see Ho, 1993, 1997d). What of the global community of human beings who can potentially intercommunicate in a matter of seconds, given the marvels of informational technology? Could they also be envisaged as a super-organism?

There is an important debate going on in the global arena concerning "globalization" - the idea that the greater part of our life is determined by global processes in which national or local cultures, economies and borders are dissolving. While some are questioning the reality of globalization (eg, Hirst and Thompson, 1996), others see the globalized economy as the greatest threat to the survival of the global community (Korten, 1995). The problem with the globalized economy under the current terms is that it does not respect the autonomy of individual persons, local communities or nation states, nor does it enable universal participation of all the parties concerned. Local autonomy and universal participation are some of the pre-requisites for a coherent, sustainable global society (see Ho, 1996c, 1997c), in which the players must also be sensitive and responsive, or responsible and accountable. Instead, "unaccountable corporate powers" (Korten, 1997) effectively rule the world, depleting the earth's natural resources with impunity, degrading the environment and creating poverty on a massive scale. The challenge of globalization is, indeed, to create a fully participatory global society, served by an appropriate global economy, that maximizes *both* local autonomy and global cohesion, as consistent with the quantum coherence of a truly organic system.

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