

Technoetic Pathways toward the Spiritual in Art: A Transdisciplinary Perspective on Connectedness, Coherence and Consciousness

Roy Ascott

In technology we are witnessing the convergence of dry computational systems and wet biological processes, involving the assembly of bits, atoms, neurons and genes in conjunctions that will provide the artist with a new kind of material substrate, for which I have coined the term *moistmedia* [1]. Of these components, it is the bit that is the most familiar to artists: computational systems and digital media have dominated the techno-art scene for at least 30 years. Attention in this paper, however, is directed to the atom, to the nano level of interaction, and to the molecular domain—more particularly, to an organism's information network of photons emitted by DNA molecules, paralleled technologically by the constant flows of electrons and photons across the body of the planet through telematic networks. As science digs deeper into matter, moving, re-assembling and coordinating atoms and molecules in the nanofield, the distinction between the organic and the technological is becoming less clear. Similarly our molecular knowledge may lead us to a better understanding of changes in consciousness and perception afforded by pharmacology. Whatever turns out to be the case, we are now increasingly focusing our attention on the very small, at a level far beyond miniaturization: A nanometer is one-billionth of a meter. This level of operation is, in any retinal sense and no matter how technologically augmented our eyes are, literally out of sight. So much so that the scanning tunneling microscope (STM) calls for touch [2] rather than vision to navigate the nanofield and to manipulate individual atoms. I argue below that the nanofield mediates between pure matter and pure consciousness and that its significance as an interface between two levels of reality can hardly be overestimated.

THE NANOFIELD

There are a number of ways to view the nano phenomenon. The popular view is that advanced by K. Eric Drexler [3], who has provided a mechanistic and materialist understanding of its potential. His ideas on nano-engineering and materials science promise self-replicating nanobots, self-renewing

structures and self-assembling environments, working within the body, within its environment and in outer space. While molecular robotics, positional assembly and self-organization suggest exciting possibilities for building new materials, manufacturing nano-machines and generally ordering the fundamental blocks of nature into whatever configuration we desire, there is a danger that the outcomes, even when beneficial in engineering, medical and social terms, could be spiritually hollow and as such would exacerbate rather than attenuate the excessive materialism of our time. In medicine, for example, there is the hope that artificial entities could identify or anticipate breakdowns in living systems and provide aid to failing organisms. However, some biophysicists, such as Mae-Wan Ho [4], for example, find that this view violates our understanding of the body as constituting a holistic mind-body field. If the body is seen as no more than a material collection of atoms, it may make sense to apply a materialistic strategy of repair. The living organism, however, is infinitely more complex than the cyborg model, however sophisticated, allows. Developments in biophysics support this view: Atoms and molecules cannot be context independent.

The other way of understanding the significance of our penetration of the nano world is to view these developments from the point of view of consciousness. This could lead to what could be called technoetic ontology [5], because nano is the plane on which technology and consciousness can meet. This presents a challenge to the artist that is as much metaphysical as material.

Materialists may see working in the nanofield as the endgame, but it is not necessary to embrace a radical transcendentalism to see that nano is located between the material density of our everyday world and the numinous spaces of subatomic immateriality. The STM cuts through the dense complexity of matter to focus on the individual atom—at a level that is both touchable and untouchable, immediate and remote, as Gimzewski and Vesna have shown [6]. Nano-watching changes the ratio of the senses: To touch is to know. The auditory sense can also be involved. Gimzewski has discovered that to touch the atomic plane is to hear the voices of molecules, whose sounds may signal distress as much as harmony. The atomic force microscope (AFM) allows him to hear the

ABSTRACT

The coherence of living systems may be due in part to an information network of biophotons emitted by DNA molecules. This network can be seen as parallel to the telematic networks that connect the planet. Nanotechnology can play a significant role in the emergence of a moistmedia substrate for technoetic art. Immaterial connectedness confers a spiritual dimension on both telematic art and quantum mechanics. Field theory supports the contention that the material body may be a consequence rather than a cause of consciousness. A technoetic art may locate its ground in the triangulation of connectivity, syncretism and field theory.

Roy Ascott (artist, research director), Planetary Collegium, School of Computing, Communications and Electronics, Faculty of Technology, University of Plymouth, Drake Circus, Plymouth PL4 8AA, U.K. E-mail: <roy@planetary-collegium.net>.

Based on a paper presented at the Colloquium on Art/Science/Spirituality Reconnections within Emerging Planetary Cultures, part of the First Melilla Festival for the 5 Cultures, Melilla, Spain, 18–20 July 2004.

scream of a yeast cell as it is doused in alcohol. The individual atom, rather than simply a building block for material construction, can be considered a point of access to the complexity of immaterial, subatomic domains.

BIOPHOTONICS

In the context of the brain, the nanofield provides the transition point between quarks and elementary particles, on the one hand, and molecules, cells (neurons) and neural assemblies on the other. In the context of consciousness, it is located between our material frame and the subtle body, between organs and aura. It is toward the aura, and the function of biophotons in living processes, that this text is principally directed. From the perspective of both biophysics and mysticism, a consideration is advanced about how an understanding of biophotons might contribute to a new perspective for telematic art: to find creative inspiration in the parallelism between the internal information network of biophotonic light in the body and the external networks of telematic communication. Masaki Kobayashi describes the mechanism and characteristics of biophoton emission in this way:

A biophoton is a spontaneous photon emission, without any external photo-excitation, through chemical excitation of the internal biochemical processes underlying cellular metabolism. . . . Biophoton emission originates in the chemical excitation of molecules undergoing oxidative metabolism. It is distinct from thermal radiation arising from body temperature. Biophoton phenomena have been surveyed from cellular or subcellular levels up to individual organism levels [7].

The term *biophotons* was first used by Fritz-Albert Popp [8] in 1976 to describe the quantum phenomenon of photonic emission from biological systems. All living systems emit biophotons, both those absorbed initially from the sun and those emitted spontaneously from molecules. Building on the ideas of Alexander Gurwitsch [9], the Russian biologist who introduced ideas of the “morphogenetic field” and “mitogenetic radiation,” Popp argues that every change in the biological or physiological state of the living system is reflected by a corresponding change in biophoton emission. The signals of biophotons emanating from the quantum processes of living systems are ultra-weak in strength. Because the fundamental biological processes of DNA replication and protein synthesis occur

continuously in all living systems, the emissions occur everywhere and unceasingly.

In the words of R.P. Bajpai,

The intensity of a biophoton signal should capture ongoing changes in the information content of the system. A large amount of information is generated in mitosis, so those cells undergoing division must emit intense biophoton signals. Similarly, the processes that suddenly destroy a large amount of information e.g. cell death must also emit intense signals [10].

There is a strong indication, Popp argues, of an information channel within living systems that may relate to chemical reactivity in cells, intercellular communication and biological rhythms. Cohen and Popp have shown that normal patterns of emission are disrupted in people suffering from various illnesses and diseases [11]. Without this model of biophotonic information transmission, we are thrown back on mechanistic biology, in which the role of genes is hugely exaggerated. While it can show that the genetic code in DNA molecules determines the sequence of amino acids in proteins, it cannot show how proteins are arranged in cells, cells in tissues, tissues in organs and organs in organisms.

To look for parallels between the biophotonic network and telematic networks requires some examination of the possibility of quantum behavior in information processing at the technological level. Leaving aside speculation on the eventual realization of a quantum computer [12] as a nodal agent in network structures, quantum behavior in the context of telematics will mean teleportation of particles. Photons have been teleported, and more recently there has been success in transporting the physical properties of an atom, such as its energy and spin [13]. This involves the “entanglement” of two atoms, in which a disturbance to one particle instantly affects the other, no matter how far away it is [14].

Research in biophotonics, and on electromagnetic fields, is of significance to the development of technoetic art. It may no longer be seen as paradoxical that our scientifically driven thought relates to models of consciousness and human identity based in the spiritual traditions of cultures previously dismissed as exotic or marginal. Art may increasingly take on a more psychoactive complexion, and it will be found useful to link archaic models of consciousness, such as we find in Amazonia, for example, or among the

Tsogho of Gabon; ideas of quantum coherence, such as we find in biophysics; and biophotonics research. These archaic models implicitly locate the human mind within a field of consciousness, rather than seeing consciousness as an epiphenomenon of the brain, as in Western materialist orthodoxies [15]. Altered states of consciousness can be accessed by means of ritualized forms of breathing, dancing and chanting, or by the ingestion of psychointegrator plants [16]. This understanding of consciousness as a field, and our ability to navigate it (and, as many aver, to be navigated through it by other spiritual entities) is seen most vividly in the syncretic doctrine of Afro-Brazilian Umbanda [17], which brings together African Yoruba and European spiritualist beliefs with the native wisdom and traditions of the forest. Likewise, from the Buddhist point of view, the mind is not a by-product of the brain but a field that is an entity separate from the body and confers an inherent connectedness on the human condition. This concept of “immaterial connectedness” has been brought into current scientific discourse by Hans-Peter Dürr of the Max-Planck-Institut für Physik, Munich, who argues that quantum physics reveals that matter is not composed of matter, that reality is merely potentiality and that the world has a holistic structure, based on fundamental relations and not material objects, admitting more open, indeterministic developments [18].

FIELD THEORY

Biophysics is a field-based science. Recently, field theories have been reviewed in both their biophysical and metaphysical dimensions by Lynne McTaggart in *The Field* [19], just as a field-based morphogenetic model of biological process and its spiritual implications informed Richard Shelldrake’s *New Science of Life* [20] 20 years ago. Shelldrake’s theory of formative causation states that there is in nature memory of physical order, structure or pattern that finds expression in “morphic fields.” The memory in these form-fields comes from previous forms of a similar kind. In the view of Shelldrake, morphic fields are an organizing principle of nature. Shelldrake supports the contention that genes carry only a very small part of the biological information in a living system; most of it is in the memory carried within the organizing fields of an organism. Over time, the development of a larger memory of species experience leads to the process of “morphic

resonance,” whereby at all levels in nature the form of systems is influenced by the form of previous systems. McTaggart identifies major scientists who have contributed significantly to field thinking across a number of disciplines—holistic, metaphysical, spiritual or paranormal—including Karl Pribram, David Bohm, Fritz-Albert Popp, Charles Tart, Robert Jahn, Dean Radin, Hal Puthoff, Irvin Laszlo and Mae Wan-Ho.

Field thinking informs an understanding of healing practices of various kinds. Research into the connection between the biophoton parameters and the parameters of electromagnetic fields active on living systems, such as that undertaken at the laboratory of the International Institute of Biophysics at Neuss, Germany [21], may provide some scientific validity to those ideas of self-regulation of the body to which various spiritual practices and somatic therapies subscribe. The network of “meridians” in acupuncture may be related to the body’s biophoton field, as may the *prana* of yoga. However, the very inconclusive nature of scientific research in these areas opens them, perhaps inevitably, to consumer fraud on the Web, just as Western medical jargon has long been exploited for the purposes of quackery, deception and commercial gain. However, just as the healing rituals in older cultures involved performative, interactive and imaging activity, it may be that art in contemporary society will come to acquire a more compelling value. In art, it is the field of interactivity that integrates the work, the artist and the viewer in what is both a material and an immaterial connectedness [22].

Within quantum field theory, the coherence thought to define a living organism reflects the understanding of quantum mechanics that material reality forms an unbroken whole that has no parts. As Marco Bischof argues in his introduction to Popp’s *Integrative Biophysics* [23]:

These holistic properties of reality are precisely defined mathematically by the Einstein-Podolsky-Rosen (known as “EPR”) correlations. In quantum mechanics, it is never possible to describe the whole by the description of parts and their interrelations. This holistic view of quantum theory cannot be rejected anymore because the strange EPR quantum correlations of non-interacting and spatially separated systems have been amply demonstrated in many experiments [24].

The reductionist worldview of classical physics, Bischof points out, must give way

to the understanding in quantum mechanics of the primacy of the inseparable whole and of the fundamental interconnectedness *within* the organism as well as *between* organisms, and that of the organism *with the environment*. This assertion finds support in the work of a number of leading physicists, among whom, for example, first David Bohm [25] and then Karl Pribram [26] arrived at the understanding of the holographic nature of reality: They proposed that the brain is a hologram, interpreting a holographic universe. Our brains construct what we perceive as material reality by interpreting frequencies from another dimension, a domain of primary reality, of *implicate order*, which is non-local and non-temporal. A hologram creates an illusion of three-dimensional structure where there is none.

CONNECTIVITY AND COHERENCE

Interconnectedness raises an important issue regarding the connectivity of new media art—simply put, between what fields might interconnectedness lie? How might the internal information system of networked photons interface with the external information network of our telematic planet? Art embraces the central concepts and features of the new biophysics: coherence, macroscopic quantum states, long-range interactions, nonlinearity, self-organization and self-regulation, communication networks, field models, interconnectedness, non-locality and the inclusion of consciousness. Indeed, these attributes relate to the canon of interactive art, the five-fold path of *connectivity, immersion, interaction, transformation* and *emergence*. This path relates to the shamanic path to immersion in the spiritual domain, where interaction with psychic entities is the means, transformation of consciousness is the goal and the emergence of new knowledge the outcome.

Cybernetics has shown interaction between systems to be field dependent, just as it has informed interactive art theory. Process-based art implies field awareness, in contrast to the object dependency of much art practice. In biophysics, field thinking is of importance in synthesizing the complexity of its details and as the means to model interconnectedness and non-locality.

A revision of older theories of living systems, abandoned with the successful rise of molecular biology, is now taking place. Mae-Wan Ho, a former colleague

of Popp, advances the idea of the “new organicism.” This holds that it is the total organization of an organism, rather than the functioning of individual organs, that determines all life processes. Her argument that contemporary Western scientific concepts of the organism are leading us beyond quantum theory and offering insights that reaffirm and extend our intuitive and poetic notions of spontaneity and free will is worth quoting at length:

Freeing itself from the “laws” of physics, from mechanical determinism and mechanistic control, the organism becomes a *sentient, coherent* being that is free, from moment to moment, to explore and create its possible futures. . . . The static, deterministic universe of absolute space and time is replaced by a multitude of contingent, observer-dependent space-time frames. Instead of mechanical objects with simple locations in space and time, one finds delocalized, mutually entangled quantum entities that carry their histories with them, like evolving organisms [27].

The relevance of theories of the quantum indeterminacy of elementary particles to our understanding of biological systems, especially those of the human being, was explored by Heisenberg [28], who argued that the quantum indeterminacy of a single particle is deeply influential: in mutation in the genetic code and in changes in the behavior of neurons during thought processes.

There is evidence showing that consciousness is a causal factor in biology and not just an inconsequential epiphenomenon. Starting from the analysis of the phenomenology and the experimental evidence of mind-body interaction, field models . . . may provide the necessary tools for bridging the mind-body gap [29].

In line with the claim of radical constructivists [30] that the mind constructs reality, it can be argued that the body itself, in matters of both identity and biology, owes its specificity to the mind.

Connectivity at the planetary level and entanglement at the quantum level mean that our ideas, our institutions, even our own identities are constantly in flux. Consistent with this, moistmedia may bridge the artificial and natural domains, transforming relationships between consciousness and the material world. To assist in the embodiment of this connectivity of mind is part of the artist’s task; to navigate the fields of consciousness that new material systems will generate is part of art’s prospectus.

MIXED REALITY

At the material level, Mixed Reality technology [31] provides us with another skin, another layer of energy to the body, adding to the complexity of its field. Instead of populating Mixed Reality space with (virtual) objects, we could perhaps be more integrative if we were to consider it as a medium for the creation of fields, or more precisely as an extension of the biofield itself. Just as the relationships between biophotonics and psychic states is under examination, so too might virtual space be seen as the generator of altered consciousness. Just as DNA is the main source of biophoton activity, so might Mixed Reality be the field in which new possibilities for living systems are rehearsed and from which a cybermorphology might emerge. By rendering visible the normally invisible processes of biological information exchange through visualization at a higher level, and embedding that visualization in our everyday retinal experience, a Mixed Reality environment could accelerate the transmission of biophotonic knowledge.

Since it emanates from a quantum system, a photon is a signal of a quantum nature. The whole body must be considered in a state of quantum coherence, with each molecule interacting with each other within a field. Just as the field has a regulatory effect on molecules, so molecules give the field boundaries. What then happens when a Mixed Reality environment, by merging virtual and biological systems and amplifying their interdependency, extends this boundary and redefines the field? Mixed Reality, networked reality and telematic virtuality, I would suggest, become entangled with the quantum states of coherence, leading to the emergence of universal connectivity and nonlinear relationships that exist beyond the classical constraints of space and time. Biophotons orchestrate the quantum coherence of the living being and may lead us to understand a pixel-particle exchange as having the potential to establish the quantum coherence of virtual states. The concept of coherence describes the wholeness of the organism, which, in a Mixed Reality environment, could mean the synthesis of a virtual-actual organicism. Andy Clarke proposes the inclusion of our telematic technology in the definition of the human organism [32], embracing the whole as a unified sentient field, just as Gregory Bateson argued that mind was immanent in whole systems rather than being the property of finite things and, in the con-

text of technology, saw mind as brain-plus-computer-plus-environment [33]. Western technology, in its potential for amplifying cognition and extending perception, and through its planetary connectivity, may contribute to the evolution of mind such that, far from being the negation of the spiritual as it is commonly thought to be, it will enable access to higher states of consciousness.

ONTOLOGICAL ENGINEERING

In the context of the artist's use of technology to explore consciousness, the technologies of other cultures can provide important examples. As data is stored deep in the memory space of the computer, so knowledge is stored deep in the psychic space of the shamanic world. Western codes and protocols of computer access find their equivalent in the rituals and procedures of sacred ceremonies. In traditional cultures, another technology predominates, providing its users with tools of consciousness and a spiritual technology whose use and history lie beyond the historical record. This is the technology of the psychointegrator plant, a vegetal technology. Such plants as *Salvia divinorum* or the shamanic liana ayahuasca (*Banisteriopsis caapi*), called "the vine of the soul" and used in countless communities in Brazil and Colombia, are known as teachers, imparting wisdom as spiritual avatars. The researches of ethnobotanists such as Richard Evans Schultes [34], Eduardo Luna [35] and Benny Shanon [36] document the power of these plants in their sacred setting to enable us to transform consciousness, to enter into other states of being, to communicate over great distances, to connect with other entities and to receive knowledge and instruction from the plant domain. In recent decades the use of vegetal technology to heighten spiritual experience has spread in towns and cities, most extensively in Brazil, but increasingly in other countries, largely through the practices of Santo Daime [37] and União do Vegetal. The opening up of public awareness to the power of plants to heal the body and to transform the mind will doubtless infiltrate art theory, if not immediately the practice of art. Just as the artist's fascination with new technology has led electronic art and digital art, so it is possible to foresee a chemical or pharmacological ethos arising in art.

Indeed, it is my contention that the pharmacological processes of what can be called Vegetal Reality and the compu-

tational systems of Mixed Reality could combine to create a new ontology, just as our notions of outer space and inner space may coalesce into another order of cosmography. Jeremy Narby has speculated that the origin of shamanic visions induced by the ingestion of psychoactive plants may be found in the light emitted by DNA [38]. Popp and other molecular biologists have shown that DNA emits a weak form of coherent light that has been demonstrated to work like a communication system between cells and even between larger organisms. This suggests an information network of light existing not only within the body but among all living things. It may not be too extreme to suppose that it constitutes the infrastructure of mind, accounting for the immanence of consciousness.

In the frame of ontological engineering, the West has recently pursued a more "synthesizing" approach to the study of altered states of consciousness, using the science of chemistry to investigate the organization of the brain and to provoke changes of emotion, perception and cognition. In *The Chemical Architecture of the Human Mind: Probing Receptor Space with Psychedelics* [39], Tom Ray provides the first comprehensive view of how 19 psychedelic compounds interact with the human receptome (i.e. all the receptors in the body). Understanding the chemistry of consciousness is the final objective of this research.

The space in which technoetic art might be constructed can be located by the triangulation of connectivity, syncretism and field theory. Connectivity is at the root of cultural coherence, syncretism at the root of spiritual coherence, and field theory at the root of quantum coherence.

CONCLUSION

New science is emerging from its classical carapace, creating new paradigms, defining new realities and reviving very ancient ones. This leads to an understanding of the world and ourselves in which what was classically seen as coherent is now seen as illusory, rather as if we had acquired behind-the-scenes access to Duchamp's *Étants donnés* [40] in the Philadelphia Museum of Art. In the spiritual context, dealing with illusion has not only been the province of Buddhism (maya) but is at the root of shamanism, Western spiritual disciplines and psychic practices: All address how to break the bonds of normative perception to attain the reality of higher consciousness. West-

ern art in the 20th century was also marked by the desire to break the bonds of convention, to seek emancipation from social, religious and cultural constraints. A path toward the spiritual and the desire to make visible the invisible were expressed in various ways by a number of influential artists [41]. The 21st-century art world, by contrast, seems to have largely abandoned the spiritual in favor of a strident sociology or craven submission to celebrity and capital. However, debates are stirring in art, especially in technology-based art, addressing art's relationship to science, the value of transdisciplinary discourse, the search for new metaphors and meaning, and the problem of relativism and ethics, all of which points to a dissatisfaction with the materialist culture that we have inherited. Technology, in the amplified meaning that embraces non-Western, unorthodox cultures, and art, which finds its place across disciplines and across cultures, together may mark out a pathway to the spiritual. In the process, navigating consciousness through the conjunctions of biophotonic-telematic networks, may contribute significantly to this goal.

References and Notes

- R. Ascott, *Telematic Embrace: Visionary Theories of Art Technology and Consciousness*, edited with an essay by Edward A. Shanken (Berkeley, CA: University of California Press, 2003) pp. 363–365.
- G. Binnig, and H. Rohrer, “In Touch with Atoms,” *Reviews of Modern Physics* **71** (1999) S324–S330.
- K.E. Drexler, *Engines of Creation* (Garden City, NY: Anchor Press, 1986).
- M.W. Ho, *The Rainbow and the Worm: The Physics of Organisms* (Singapore: World Scientific, 1993).
- I coined the term *technoetic* from *technology* and the Greek *noeitikos* (mind, consciousness) to mean consciousness accessed, augmented, distributed or transformed (depending on the user's worldview) by technology. This may have an ontological effect on the sense of self and of the world.
- J. Gimzewski and V. Vesna, “The Nanoneme Syndrome: Blurring of Fact and Fiction in the Construction of a New Science,” *Technoetic Arts: A Journal of Speculative Research* **1**, No. 1, 7–24 (2003).
- See <www.tohtech.ac.jp/~elecs/ca/kobayashilab_hp/BiophotonE.html> (accessed 10 November 2004).
- Popp is director of the International Institute of Biophysics, Neuss, Germany.
- L. Belousov, J. Opitz and S. Gilbert, “Life of Alexander G. Gurwitsch and His Relevant Contribution to the Theory of Morphogenetic Fields,” *International Journal of Developmental Biology* **41**, No. 6, 771–777 (1997)
- R. Bajpai, “Possibility of Photon Emission in the Fundamental Biological Processes Involving Quantum Search of Base Pairs and Amino Acids,” presented at the International Institute of Biophysics, 9 March 2000. See <www.biophotonen-online.de/abstract/abs2000-13.htm> (accessed 10 November 2004).
- S. Cohen and F.A. Popp, “Biophoton Emission of the Human Body,” *Journal of Photochemistry and Photobiology B: Biology* **40** (1997) pp. 187–189.
- A useful description of a quantum computer is found at: <www.ph.unimelb.edu.au/~marc/marc_coe/about/whatsaqc.htm> (accessed 22 May 2005).
- This result has been achieved independently by the University of Innsbruck in Austria and the National Institute of Standards and Technology in Boulder, CO. Reported in M.D. Barrett and D.J. Wineland, “Deterministic Quantum Teleportation of Atomic Qubits,” *Nature* **429** (17 June 2004) pp. 737–739.
- D. Greenberger, L. Reiter and A. Zeilinger, eds., *Epistemological and Experimental Perspectives on Quantum Mechanics* (Dordrecht, the Netherlands: Kluwer, 1999). This volume contains many research papers on entanglement. See also K.J. Resch et al., “Distributing Entanglement and Single Photons through an Intra-City, Free-Space Quantum Channel,” *Optics Express* **13**, No. 1, 202–209 (2005).
- See D.C. Dennett, *Consciousness Explained* (New York: Pantheon, 1992). Dennett could be described as the pope of epiphenomenalism.
- M. Winkelman, “Psychointegrator Plants: Their Roles in Human Culture, Consciousness and Health,” in M. Winkelman and W. Andritsky, eds., *Yearbook of Cross-Cultural Medicine and Psychotherapy* (Berlin: Verlag für Wissenschaft und Bildung, 1995) pp. 9–53.
- D. Brown, *Umbanda: Religion and Politics in Urban Brazil* (New York: Columbia Univ. Press, 1986).
- H.-P. Dürr, “Inanimate and Animate Matter: Orderings of Immaterial Connectedness—The Physical Basis of Life,” in H.-P. Dürr et al., eds., *What Is Life? Scientific Approaches and Philosophical Positions* (Hackensack, NJ: World Scientific, 2002) pp. 145–166.
- L. McTaggart, *The Field: The Quest for the Secret Force of the Universe* (New York: Quill, 2003).
- R. Sheldrake, *A New Science of Life* (London: Granada, 1983).
- See <www.lifescientists.de/ib_000e_.htm> (accessed 16 November 2004).
- R. Ascott, “Towards a Field Theory for Post-Modernist Art,” *Leonardo* **13**, No. 1, 51–52 (1980).
- F.A. Popp and L. Belousov, eds., *Integrative Biophysics: Biophotonics* (Dordrecht, the Netherlands: Kluwer, 2003).
- M. Bischof, “Introduction to Integrative Biophysics,” in Popp and Belousov [23] p. 4.
- D. Bohm, *Wholeness and the Implicate Order* (London: Routledge and Kegan Paul, 1980).
- K. Pribram, “The Neurophysiology of Remembering,” *Scientific American* **220** (1969) pp. 73–86.
- M.-W. Ho, “The Biology of Free Will,” *Journal of Consciousness Studies* **3** (1996) pp. 231–244.
- W. Heisenberg, *Physics and Philosophy* (New York: Harper and Row, 1958).
- M. Bischof [24] p. 6.
- P. Watzlawick, ed., *The Invented Reality* (New York: Norton, 1984) (originally published as *Die Erfundene Wirklichkeit* [Munich: Piper, 1981]).
- Y. Ohta and H. Tamura, *Mixed Reality: Merging Real and Virtual Worlds* (Tokyo: Ohmsha & Springer-Verlag, 1999).
- A. Clark, *Natural Born Cyborgs: Minds, Technologies, and the Future of Human Intelligence* (Oxford, U.K.: Oxford Univ. Press, 2003).
- G. Bateson, *Steps to an Ecology of Mind* (San Francisco: Chandler, 1972).
- R.E. Schultes and R. Raffauf, *Vine of the Soul: Medicine Men, Their Plants and Rituals in the Colombian Amazonia* (Santa Fe, NM: Synergetic, 2004).
- L.E. Luna and S.F. White, eds., *Ayahuasca Reader: Encounters with the Amazon's Sacred Vine* (Santa Fe, NM: Synergetic, 2000).
- B. Shanon, “Ayahuasca Visions: A Comparative Cognitive Investigation,” in C. Rättsch and J. Baker, eds., *Yearbook for Ethnomedicine and the Study of Consciousness* **8** (Berlin: VWB Verlag, 1999).
- A. Polari de Alverga, *Forest of Visions: Ayahuasca, Amazonian Spirituality, and the Santo Daime Tradition* (Rochester, NY: Park Street, 1999).
- J. Narby, *Le serpent cosmique, l'AND et les origines du savoir* (Geneva, Switzerland: George Editeur, 1995).
- T. Ray, “The Chemical Architecture of the Human Mind,” *Corante* <www.corante.com/brainwaves/archives/2005/02/05/the_chemical_architecture_of_the_human_mind_by_tom_ray.php> (accessed 3 March 2005).
- M. Duchamp, *Étants Donnés (Given: 1. The Waterfall; 2. The Illuminating Gas)*, 1946–1966.
- Kandinsky, Mondrian and Malevich, for example, believed that art could evoke a spiritual experience.

Roy Ascott is an artist and writer researching art, technology and consciousness. He directs the Planetary Collegium <www.planetary-collegium.net>, based in the University of Plymouth, England, and is a visiting professor in Design Media Arts at UCLA. His most recent books are *Engineering Nature (Bristol: Intellect Books, 2005)* and *Telematic Embrace: Visionary Theories of Art, Technology and Consciousness, edited with an essay by Edward A. Shanken (Berkeley, CA: University of California Press, 2003)*.