Quantum Weirdness and Future Values
By Hardin Tibbs

The current state of quantum theory, supported by experimental results during the 1990s, strongly suggests that the physical world does not manifest its physicality until we observe it, and that this crystallizing of reality is not confined only to the quantum level, but applies in principle at the macroscopic level as well. Ever since Werner Heisenberg articulated the uncertainty principle in the late 1920s, it has been clear that what we can know about physical reality is limited not by how accurately we can measure, but by the fundamentally unresolved nature of physical reality. We can seek precise information about one aspect of, say, an electron, but if we do so we will lose the ability to know other aspects. This is because all the possible states of the electron are superposed in a state of uncertainty until our act of measurement causes the quantum wave function to 'collapse,' forcing the electron to resolve into a single one of its possible states.

Until recently, this fundamental uncertainty seemed safely confined to the nano-world of quantum phenomena, and was often described as applying only when intrusive measurements were made which in any case directly disturbed the reality they sought to measure. It is now clear that the mere act of setting up conditions that will permit observation or measurement will cause, say, a photon to act like a particle rather than as a wave, and that removal of these conditions will cause the photon to revert to its previously unresolved state. Experiments have shown that it is not necessary to actually make any measurements—the mere 'threat' of measurement will cause the behavior of photons to change. And if the conditions that permit measurement are cancelled out by additional experimental elements, then the photons revert to their earlier indeterminate state.

What this seems to tell us is that physical reality does not exist in a fully resolved or definite state prior to our attempt to extract information about its condition, but that it actually resolves into a specific state precisely in response to our effort to extract information. And this conclusion does not apply only at the level of electrons and photons—similar (but more difficult) work is now underway with whole atoms. It seems that the specificity of the physical world depends on the information we draw from it, or in other words, its concreteness is called into being by our awareness of it.

There have been some attempts to fight this conclusion, efforts to demonstrate that the physical world really is out there independently of our awareness of it, but so far these attempts have failed experimentally. By contrast, a suggestion that embraces the consciousness-dependent view, David Bohm's "it from bit" theory, has led to powerful new interpretations of quantum principles in terms of information theory.

Inevitably, these new findings are raising questions about the true nature of the world we live in. Some commentators who span C. P. Snow's 'two cultures' have pointed out that the quantum description of the world shows features that are reminiscent of the account of reality given by mystics, going back hundreds or thousands of years.

For the last 200 years or so, it has been intellectually fashionable to assume that a mystical worldview was simply a relic of a more primitive, less rational stage of human awareness. Yet similar ideas are now emerging from that most advanced and rational of disciplines, physics: and are even being verified by objective experiment. This suggests that we now have to acknowledge aspects of the mystical worldview as compatible with the most modern and advanced stage of human thinking—and now deeply entwined in the highest of technologies, the successful design and manufacture of atomic-scale electronics and our manipulation of nuclear processes.

One thing is clear: although quantum theory may have parallels with understandings from the past, for us the way forward to new understanding is through science and its application and refinement. We already know too much to fall back on older cultural descriptions of the world, and the forward momentum of science is now so great that such a retreat is academic at best. We must conclude that the growing tip of science is in fact yielding detailed information about aspects of reality that were previously understood intuitively, but without the precision that is now possible. Not only that, but we may be on the verge of understanding how these things could have been grasped intuitively in the first place.

In the brave new world ahead of us, the quest for more advanced forms of microelectronics and information technology will lead us into the heart of the quantum paradox. To make really new technologies work, we will have to learn to apply paradox and the interactive role of consciousness, working with them as practical design elements without which we will not be able to progress. Nowhere will this be more true

than in biology. Without fail, when we have developed a new technology, we have discovered that nature was ahead of us, already using aerodynamics, electricity, sonar, hydrodynamics, even coherent radiation, long before we understood them.

One of the frontiers of advanced computing that intersects with biology at its most enthralling is the study of the human brain. Currently seen as a highly advanced biological computer, the prevailing research paradigm is based on the assumption that all the brain's properties are based on its computational ability, and that once these are fully understood we will be able to replicate its attributes in an appropriately designed non-biological computer. But the brain may conceal yet more advanced technologies operating alongside its undoubted computing capability.

Some hint of what these technologies might be is suggested by the pivotal role of conscious awareness, of observation, in summoning the potentiality of physical matter into being as the concrete physical world we know. The brain is responsible for conscious awareness, and this puts it in a very special relationship with the 'realness' of the physical world. But how could the actuating principle of physical reality itself be the product of another part of physical reality such as the brain? It is evident from the latest quantum experiments that photons and electrons are responsive to information-sensitive contexts. In addition to physical matter, could there be a distinct information-interpreting aspect of reality that is involved, which we popularly call mind or consciousness?

Suppose, for example, that consciousness actually turns out to be an energy or field phenomenon. What would this imply? Biology might then be the result of an on-going interaction between consciousness and physical matter, which itself is also dependent to some degree on the interaction between quantum potentiality and consciousness. If this were the case, then the human brain would be the highest expression of this interaction, and in addition to being a sensory processing computer, it would also be a highly refined receiver or transducer of consciousness. Just as the source of television images cannot be found in the circuitry of the television receiver, so we would not then expect to find the source of consciousness within the circuitry of the brain. Instead, biologists might literally be able to discover the biological reception device for consciousness, and it might prove possible to create a computer that was also a 'consciousness receiver.'

This perspective would also give rise to a fundamentally new interpretation of biology. Our current understanding is that biology is an intricate set of complex systems consisting of physical components. This view could be replaced by an understanding of biological development and evolution, the ongoing state of organisation of the physical components, as being driven and shaped by the field energy of consciousness, which would be in some sense primary. If the mind or the self of the individual organism was a stable subset of the field of consciousness—perhaps like some form of standing wave pattern—then the biological body might come to be thought of as the biological image of the self. Biology might then be pictured as resembling a hologram with working internal structure.

While these speculations may not represent the ultimate resolution of the questions raised by the latest quantum experiments, the stage is now set for a development of this type that could ultimately have a profound impact on worldwide cultural values, as well as on the research program of biology, artificial intelligence and artificial life. If science fully acknowledges that physical reality depends to some degree on our awareness of it, the implications are far reaching. There might well be a profound re-examination of religious and mystical ideas, transforming them into a new synthesis with physical and biological science, as these inexorably continue to expand their understanding. This convergence of the 'two cultures' could result in a radically transformed mainstream worldview early in the twenty-first century.

It appears that we may now be on the brink of just such a transformation.

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