Journal of Scientific Exploration, Vol. 15, No. 1, pp. 21–31, 2001 0892-3310/01

20th and 21st Century Science: Reflections and Projections

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Abstract–Twentieth century natural science opened onto a bewildering array of empirical anomalies and bemusing heuristic theories that testified to grossly inadequate comprehension of atomic-scale structures and processes. Subsequent decades saw remarkable advances in the acquisition of more definitive data, the formulation of functional models, and the postulation of profound philosophical interpretations of these curious quantum mechanical phenomena. Later periods featured the prodigious applications of this arsenal of new understanding in such diverse domains as nuclear weaponry, energy, technology, health care, communications and information processing, and space exploration and utilization. All of this mighty implementation notwithstanding, at the close of this era, much as in the preceding classical science period of the 19th century, fundamental ontological understanding of the natural processes of our cosmos again began to appear inadequate to encompass newly emerging bodies of anomalous empirical evidence, in this case primarily related to the role of consciousness in the establishment of physical experience.

As we enter the 21st century, science seems poised to execute a similar evolutionary cycle of advancement of their comprehension and relevance. We are opening with a steadily growing backlog of demonstrable physical, biological, and psychological anomalies, many of which have been featured in the meetings and journals of this society, and most of which seem incontrovertibly correlated with properties and processes of the human mind, in ways for which our preceding 20th century scientific paradigm has no rational explanations. Meanwhile, our theorists are laboring along progressively more tortuous trails of non-linear dynamics, complex and chaotic systems, entanglement theories, zero-point vacuum fluctuations, string and superstring theories, microtubules and neuronal networks, in convoluted attempts to accommodate the phenomena without conceding their intrinsic subjectivity, perhaps reminiscent of similar earlier struggles to preserve geocentric celestial mechanics by epicycloidal orbit theories or to accommodate Rydberg's spectra within classical radiation models. While these esoteric efforts may provide some ad hoc utility in representing and cataloguing specific anomalous phenomena, they lack the capacity, individually or collectively, to compound to a totally comprehensive representation. That can only be approached when consciousness, in all of its subjective and objective ramifications, is accepted from the outset into scientific conceptualization as an essential, central, and proactive factor in the establishment of physical reality. This major concession must also bring with it the redefinition of other sacred scientific tenets, such as the rigid replicability and objectivity requirements, and the admission of such foreign concepts as transdisciplinary metaphor, intersubjective resonance, and teleological causality as both enabling factors and analytical tools. Specific conceptual schema for comprehensive formulation of such an expansion of scientific methodology are at present rare and primitive, but two examples can be sketched to illustrate the requisite complementarity of physical and psychological factors.

Keywords: anomalies — consciousness — future of science — history of science — Modular Model of Mind/Matter Manifestation (M^5) — philosophy of science — Science of the Subjective

On the threshold of the 20th century, the physical science profession was sitting rather smugly on its academic duff, quite content with the elegance of its theoretical concepts and formalisms, and with the burgeoning practical applications thereof. Newtonian mechanics had been firmly established by many empirical demonstrations in astronomical and terrestrial venues; the heuristic concepts of the thermal sciences were enabling rapid proliferation of the prime movers that had initiated the industrial revolution; and the completion of Maxwell's electromagnetic relations had generated a radiation theory that was revolutionizing public communication. A naïve consensus abounded that most of the hard work of natural science had been done; that only mop-up tasks remained. As their towering patriarch Lord Kelvin (Thomson, circa 1884) proclaimed:

> There is nothing new to be discovered in physics now. All that remains is more and more precise measurement,

a sentiment echoed by their contemporary hero, A. A. Michelson (1894):

> The more important fundamental laws and facts of physical science have all been discovered, and these are now so firmly established that the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote. ... Our future discoveries must be looked for in the sixth place of decimals.

But over only the next few years, this same community of scholars was suddenly deluged by a blizzard of atomic-scale anomalies that severely challenged much of their comfortably nestled classical science. The frequency distribution of blackbody radiation departed drastically from the classical electromagnetic expectations; newly accumulated data on atomic and molecular spectra and atomic-scale collisions were totally inexplicable on the basis of the prevailing atomic and molecular models; the photoelectric effect, the Compton effect, the Franck-Hertz, and Davisson-Germer experiments, and the specific heat of solids all showed little agreement between empirical observations and the established concepts; and the growing theoretical and pragmatic interest in gaseous plasmas as a fourth state of matter was poorly supported by any viable theoretical formulations that could be mustered.

Having shattered the tranquility of the physical science establishment of that day, this array of anomalous phenomena then stimulated a flurry of theoretical responses that carried with them disturbing philosophical implications. Over a relatively short span of reaction, a sequence of strange new concepts appeared, such as the quantum of energy (Planck, Einstein); the planetary atom (Bohr, Sommerfeld); the wave-mechanical atom (Schrödinger, de Broglie); matrix formulations of atomic structure and interactions (Heisenberg, Wigner); and the bewildering quantum mechanical principles of uncertainty (Heisenberg), exclusion (Pauli), complementarity (Bohr), and indistinguishability (Heitler), to name only a few. Overlaid on all of this were the bewildering mechanics of special and general relativity (Einstein), and the subatomic structures and behaviors of nuclear scale "elementary" particles (Fermi et al.). From the start, these concepts seemed so logically and experientially implacable that their philosophical ramifications were hotly debated, both inside and outside the quantum physics community. Notwithstanding the intensity and endurance of these discussions, few of the philosophical enigmas were fully resolved, and the paradoxes of wave/particle duality, the role of the observer, and the Einstein-Podolsky-Rosen correlations continue to bemuse us even today.

Some blame for this failure of resolution may be attributed to the intrusion of the Second World War into the professional and personal lives of the leading scholars of that day, which severely restricted their ability to communicate with one another and forced their creative attention to be turned toward wartime applications of quantum and nuclear science. Those applications of atomic energy in military weaponry clearly dominated the middle portion of the 20th century, first in concluding the hot war, and subsequently in imbuing the cold war with its global lethal threat. But from that war-based technology have evolved many peacetime applications: in atomic energy and nuclear medicine; in solid-state electronics and digital information processing; in space exploration and utilization; and in many other venues that have brought immense benefits to human culture and have vaulted contemporary science into a dominant social factor. Yet ironically, this center-stage importance of modern applied science and technology, with its huge political, financial, educational, and cultural spin-offs, may also have served to suffocate, or at least to stagnate, more profound contemplation and comprehension of those fundamental processes of our physical world that had surfaced a few decades earlier. So, at the close of the 20th century, we find a monumentally extensive and complex scientific community that is more concerned with its applications, its economics, its politics, and its administration, than with advancement of its basic understanding. And regrettably, these priorities have been excessively reflected in our individual and collective public values, in our corporate and governmental initiatives, and in our educational strategies, at all levels.

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Thus, at the dawn of the 21st century, we again find an elite, smugly contented scientific establishment, but one now endowed with far more public authority and respect than that of the prior version. A veritable priesthood of high science controls major segments of public and private policy and expenditure for research, development, construction, production, education, and publication throughout the world, and enjoys a cultural trust and reverence that extends far beyond its true merit. It is an establishment that is largely consumed with refinements and deployments of mid–20th century science, rather than with creative advancement of fundamental understanding of the most profound and potentially seminal aspects of its trade. Even more seriously, it is an establishment that persists in frenetically sweeping legitimate genres of new anomalous phenomena under its intellectual carpet, thereby denying its own well-documented heritage that anomalies are the most precious raw material from which future science is formed.

Let us turn to these current anomalies and ask what new science they may spawn. The readership of this Journal surely needs no lexicon of these topics. It is precisely the constellation of subjects that the Society for Scientific Exploration has been studying, talking, and writing about since its formation, and comprises all of the subtle and mysterious ways that living creatures perceive, interpret, and influence the world they inhabit. Whether we are investigating anomalous mind/matter interactions, remote perceptions, poltergeists, reincarnations, UFO phenomena, strange creatures, inexplicable meteorological effects, or alternative healing modalities, we are at some level, explicit or implicit, addressing the role of consciousness in the establishment and behavior of physical reality. And for this intellectual crusade we have very little science in hand: very little vocabulary, a scant concept base, and few mechanics, assessment criteria, or experimental facilities. Another major intellectual break-out, of a scale, vision, and courage comparable to that of the quantum era, is required to start science rolling forward again.

What should be the character of this break-out? First to be emphasized is that we do not need any destructive revolution that discards sound scientific methodology or threatens systematic scientific logic. Rather, we require an evolutionary broadening and deepening of the scientific venue and perspective, more like its evolution into quantum and relativistic domains of the past century, to extend its intellectual power into study of the full reach of the human mind and spirit. In an earlier article (Jahn & Dunne, 1997), we attempted to define and justify a "Science of the Subjective," which proposed the following expansions of the scientific paradigm:

- A proactive role for consciousness that would elevate it from a passive observer of the physical world, to a purposeful agent in its behavior.
- Inclusion of subjective experience as well as objective properties in the scientific arsenals of concepts, data, analyses, models, and interpretations.

- The acceptance of teleological drivers in all forms of mind/matter interactions; specifically, the efficacy of intention and resonance, within a context of relevance or meaning, in facilitating physical change.
- Clearer distinction between causality and correlation in both material and mental events.
- Recognition of the interconnectedness of the physical, psychological, and philosophical aspects, leading to greater reliance on transdisciplinary metaphors for representation, interpretation, generalization, and unification of consciousness-related phenomena.
- Relaxation of replicability criteria for complex, multi-statistical physical, biological, and psychological systems and processes.

Clealy, such extensions of scientific perspective and strategy present huge problems in orderly identification, representation, quantification, and interpretation of experiential phenomena, but the potential benefits of this pursuit are even more awesome. For from its success, science could aspire not only to benevolent stewardship of the physical world, but also to productive understanding of the interactions of its living inhabitants with it, and with one another.

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If this new era of science is to retain the incisiveness and rigor of its immediate predecessor, it must continue to feature a vital dialogue between empirical experience and logical reasoning, i.e., between experiment and theory. The major changes required on both sides of this dialogue will be the inclusion of the various subjective aspects just mentioned. Incorporation of intuitive, aesthetic, and metaphoric dimensions into research protocols, although largely eschewed by 20th century mainstream science, need not pose insurmountable tactical problems. To some extent, contemporary research in the family of psychological disciplines has already established some lexicon of empirical concepts and heuristic methods for the evaluation and correlation of subjective aspects with objectively specifiable physical results. But to extend such provincially circumscribed correlations into more universal theoretical formulations representative of the global interplay of mind and matter will require far more expansive and courageous scholarly creativity.

Some 15 years ago we proposed a rather speculative and tentative step in this direction in an article entitled “On the Quantum Mechanics of Consciousness, with Application to Anomalous Phenomena” (Jahn & Dunne, 1986). In it we postulated that experiential reality was constituted only in the interaction between consciousness and its environment, neither of which could be separately specified in any strict ontological sense. Consequently, any conceptual scheme to represent that reality must embody the attributes of consciousness as well as, and on a par with, those of the physical world. We went on to appropriate the concepts and formalisms of quantum mechanics as a viable metaphor for such reality-producing interactions of consciousness with its environment, primarily because of its observational or "Copenhagen" interpretations, but also because of the evident transposability of the various quantum mechanical concepts and principles into subjective venues. More specifically, we represented consciousness by Schrödinger wave functions and its environment by potential profiles that subsumed all of the relevant tangible and intangible influences bearing on it. The permissible standing waves, or eigenfunctions, of the consciousness waves in the environmental profiles were then interpreted as the objective and subjective experiences of the former in those venues. In this manner we were able to construct consciousness "atoms" of individual experience, consciousness "molecules" representing interpersonal bonds, consciousness "wave/particle dualities" that could legitimize various consciousness-related physical anomalies, and quantum-statistical ensembles of consciousnesses that could be applied to group interaction situations. We also found useful similarities between several quantum mechanical principles and various aspects of common and anomalous human behavior.

Clearly this model lacks the capacity for quantitative predictability, at least at this stage of its development, but it has provided us with a facile concept base and associated vocabulary for the interpretation of empirical results and the design of more effective experiments. While it has been criticized as "only a metaphor," we would note that from its ancient times to the present, science has always drawn heavily from many metaphors adapted from general human experience that only later were refined to more narrowly specific, quantifiable, and measurable physical properties. Nor does the prevailing resistance to inclusion of subjective features in the scientific representation adequately acknowledge the extent to which personal inspiration and intuition have stimulated and enlightened most scientific work. While our research papers continue to be rejected by mainstream science journals on insular categorical grounds, such as "This is more psychology than physics," or "This journal is restricted to the 'exact' sciences," such exclusion of subjective dimensions from the workshop of science was not endorsed by the most profound scholars of the quantum era who had glimpsed the sublime complementarity between the worlds of mind and matter. As Niels Bohr (1961) put it:

> The analogies with some fundamental features of the quantum theory, exhibited by the laws of psychology, may not merely make it easier for us to adjust ourselves to the new situation in physics, but it is perhaps not too ambitious to hope that the lessons we have learned from the very much simpler physical problems will also prove of value in our endeavors to obtain a comprehensive survey of the more subtle psychological questions. ... it is clear to the writer that for the time being we must be content with more or less appropriate analogies. Yet it may well be that behind these analogies there lies not only a kinship with regard to the epistemological aspects, but that a more profound relationship is hidden behind the fundamental biological problems which are directly connected to both sides. (p. 20)

A similar conviction had been expressed earlier by Wolfgang Pauli (1955):

> [P]hysics and psychology reflect again for modern man the old contrast between the quantitative and the qualitative. … To us … the only acceptable point of view appears to be the one that recognizes *both* sides of reality—the quantitative and the qualitative, the physical and the psychical—as compatible with each other, and can embrace them simultaneously. … It would be most satisfactory of all if physics and psyche could be seen as complementary aspects of the same reality. (pp. 207–208, 210)

And from the other side of the epistemological dialogue, the great psychoanalyst Carl Jung (1954) saw the same sublime complementarity:

> The microphysical world of the atom exhibits certain features whose affinities with the psychic have impressed themselves even on the physicists. Here, it would seem, is at least a suggestion of how the psychic process could be 'reconstructed' in another medium, in that, namely, of the microphysics of matter. (p. 89)

Much more recently, a number of theoretical physicists have returned attention to this mind/matter complementarity and in some cases have gone so far as to propose that, at a very deep and subtle "ontic" level, mental and material processes are intrinsically inseparable, and that it is only when these processes "emerge" into "epistemic" tangible experiences that the distinction becomes relevant. Atmanspacher (2000b) speaks of the practical consequences of such a primordial unity:

> Assuming that there is an 'ontic reality' from which mental and material properties emerge as separable or separate, then it is the relationship between those mental properties which we observe epistemically. Since the basis of the two domains is the ontic reality, one could speak of a 'vertical' causation (some kind of symmetry breaking) from one ontic to two epistemic 'realities.' In such a scenario there is no reason to talk about the relationship between the two epistemic domains in terms of causation. There are only correlations, so to speak remnants of the former 'oneness' of the ontic reality. These correlations are what we observe, perceive, or experience.

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Akin to such contemporary thinking, we are currently developing another model for representation of mind/matter interactions, tentatively labeled "Modular Model of Mind/Matter Manifestations" (M^5). Details of this model and its experimental and theoretical implications will be presented in a forthcoming research article (Jahn, in press), but its salient features are these:

1. Not all interactions of consciousness with the physical world involve direct mental attention to tangible substances or systems, or employ established modes of information exchange.

2. In many cases, especially those manifesting anomalous effects, various levels of the subconscious mind may be invoked to access, process, and transmit information between the conscious mind and the material world.
3. In so doing, the subconscious mind may utilize a sub-tangible physical domain that underlies the tangible universe, much as the subconscious mind underlies the conscious.
4. Thus, in this model, the conscious mind gains anomalous access to the tangible world by the circuitous route sketched in Figure 1.
5. The key issues for profitable applications of this model are the information transfer processes across the interfaces between the various domains, specifically:

   - The sequences of physical, physiological, and neurological processes by which information about the tangible world is transmitted to the brain and subsequently assembled into conscious experiences and interpretations thereof; or, inversely, the conversion of conscious intention into a sequence of neurological and physiological functions that ultimately affect the tangible world;
   - The modes of communication between the conscious mind and the subconscious mind;
   - The relationship between the tangible physical domain and its sub-tangible substrate;

   and, most importantly,

   - The interaction of the subconscious mind with sub-tangible matter.

6. At their deepest levels, the subconscious mind and the sub-tangible physical domain may commingle to the point of indistinguishability. In this view, conscious experience and tangible physical effects may be regarded as emerging from a single basic source, whence they retain certain correlations or synchronicities that appear anomalous in any dualistic representation (Atmanspacher, 1997, 2000a).
7. All of these processes may be overlaid or permeated by some sort of ineffable "supreme source" which energizes, inspires, enables, and mediates the participatory components of the composite system.

Some pragmatic ramifications of such a model for anomalies research are reasonably clear. On the experimental side, one of the most evident implications would seem to be to shift from operator feedback modalities that display the target system performance in consciously explicit and engaging formats, to subtler, more implicit schemes that distract the operator's conscious mind from the intended task, thereby providing a more propitious environment for its submission to some subconscious process. Also suggested would be the use of physical target systems that by their complexity, non-linearity, or quantum-mechanical multiplicity can accommodate a proactive role for the opera-

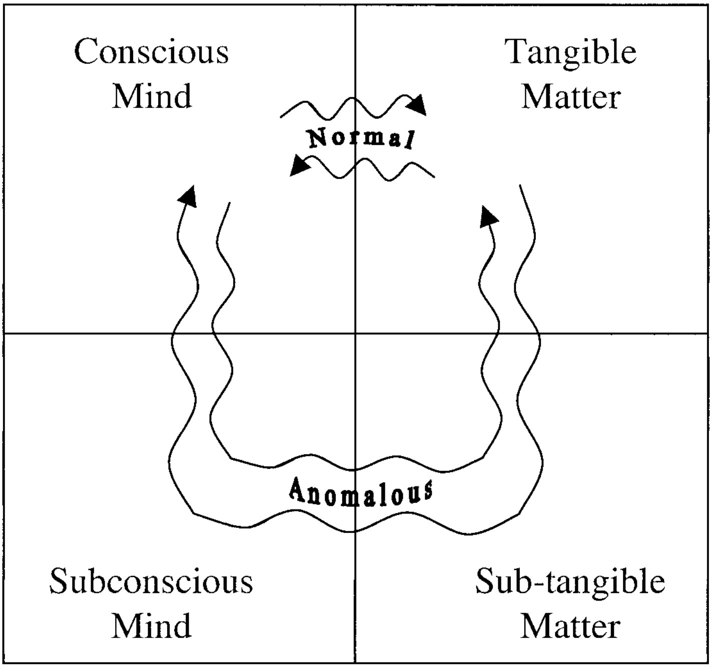

Fig. 1. Modular model of mind/matter manifestations (M^5). In “normal” interactions, the conscious mind receives information directly from, or inserts information directly into, its material environment using known physical and neurophysiological processes. In “anomalous” interactions, however, information may flow on a more circuitous route, via the unconscious mind and a sub-tangible physical regime.

tor’s subconscious input. In retrospect, prior experimentation has already supported these strategies, albeit via some negative results. Specifically, those experiments providing the most explicit and engaging feedback displays have tended to yield weaker anomalous effects than those involving more rudimentary feedback (Jahn et al., 1997), aesthetically subliminal feedback (Jahn et al., 2000), or no feedback at all (Dunne & Jahn, 1992).

On the theoretical side, more sophisticated psychological models of the transmission of information, both subjective and objective, between the conscious and subconscious mind, specifically dedicated to the realization of intention and resonance in specific situations, are needed. Similarly, some distillation of the many extant sub-tangible physical models, specifically focused on reification of pre-emergent information from the sub-tangible regime into the tangible empirical venues, should prove relevant. In this regard, the radical postulate of a fundamental holism of mind and matter at the deepest level of existence might derive some support from incisive re-examination of millennia of human experience with prayer, alchemy, magic, and other esoteric practices that implicitly and explicitly presume this unity.

Like the quantum mechanical model mentioned earlier, the M^5 concept invokes many of the "Science of the Subjective" features listed above, and it will be resisted because of its intrinsic wedding of psychological and physical experience, and its ultimate dissolution of the Cartesian cut. While this has been foreign to 20th-century science, it will become essential to the science of the future. Without it, science as presently cast will inevitably stagnate and become progressively less effective in addressing the cultural needs of this new century. William James (1956) foresaw this demise more than a century ago:

> The spirit and principles of science are mere affairs of method; there is nothing in them that need hinder science from dealing successfully with a world in which personal forces are the starting point of new effects. The only form of thing that we directly encounter, the only experience that we concretely have is our own personal life. The only completed category of our thinking, our professors of philosophy tell us, is the category of personality, every other category being one of the abstract elements of that. And this systematic denial on science's part of personality as a condition of events, this rigorous belief that in its own essential and innermost nature our world is a strictly impersonal world, may conceivably, as the whirligig of time goes round, prove to be the very defect that our descendants will be most surprised at in our boasted science, the omission that to their eyes will most tend to make *it* look perspectiveless and short. (p. 327)

To incorporate this broadening of its purview and paradigm may be the greatest challenge science has ever faced. But with these subjective dimensions astutely and creatively installed and functioning harmoniously within its traditional analytical rigor, science—in its fullest and noblest definition—will be in a far more powerful position to enhance the quality of life on this planet than ever before in its history. And historians of science, looking back on this 21st century 100 years from now, may properly record it as the most brilliant scientific age of all.

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