THE SCIENCE OF NON LOCALITY AND EASTERN APPROACHES TO EXPLORING ULTIMATE REALITY

A SYMPOSIUM BY TEMPLETON FOUNDATION

Geneva — 21st to 23rd June 2002.

Muhammad Suheyl Umar

All things by immortal power,

Near or far,

Hiddenly

To each other linked are.

That thou canst not stir a flower

Without troubling of a star.

The Mistress of Vision

Francis Thompson

Religion is relevant to the chief concerns of our century. It can no longer be assumed with impunity that religion was a primitive superstition outgrown by civilized, rational man. One has also to take into account the fact that contemporary mind is science-ridden and for it science has become a sacral mode of knowing, the court of ultimate appeal for what is true, occupying today almost exactly the place that Revelation enjoyed in the West in the Middle Ages and in the East fairly recently. Through a misreading of science, our contemporary mindset suffers from a loss of faith in transcendence, in a reality that encompasses but surpasses our quotidian affairs. The loss is considered to be serious, and also (ironically) unnecessary, for our loss of the Transcendent World has resulted from a conceptual mistake. We assume that the modern world has discovered something that throws the transcendent world into question, but that is not the case. It is not that we have discovered

something. Rather, we have lost sight of something. For reasons that are completely understandable but nonetheless regrettable, we have unwittingly allowed ourselves to be drawn into an enveloping epistemology that cannot handle transcendence.

Science studies the empirical world. Religion seeks to understand and bind us to the entire scheme of things in which God is pre-eminent. There can not be any conflict between the two if, and when, each sticks to its proper task. A conflict arises when either oversteps its proper limits. Religion does this if / when it interferes with science's attempts to understand the empirical world, the physical world of nature. Science oversteps its limits if / when it claims to be able to access, and give definitive answers (without the help of religion) to ultimate questions, such as who are we, how did we get here, what is the meaning of life, and is there life after death? Historically, both have overstepped their proper bounds. In the West, theologians were guilty of this when (in the 16-17th centuries) they interfered with scientific pursuits. Now the shoe is on the other foot. Today, most of the transgressions come from science's side. Templeton Foundation's *Humble Approach Initiative* is a different enterprise, however. But before I come to it, a word about the "tunnel vision" of our present epistemology seems called for.

Our loss of the Transcendent World has resulted from a mistake. In various ways perceptive observers have been saying this for a century or so. It could be summarised in a way that can strip the mistake to its bare bones, reducing it to virtually a syllogism as follows:

1. ***Science has become our sacral mode of knowing***. As court of ultimate appeal for what is true, it occupies today almost exactly the place that Revelation enjoyed in the West in the Middle Ages and in the East fairly recently and which it still holds for a vast number of believers outside the fold of the modern academia and its intellectual offshoots. An intellectual historian has pointed out that already a hundred years ago Westerners had come to have more confidence in the periodic table of chemical elements than in anything the Bible asserts. The Orientals have followed suit.

2. ***The crux of science is the controlled experiment***. I am speaking of course of modern science. Generic science (old as art and religion) relies on reasoning from careful observations, but what distinguishes modern science is its introduction of the controlled experiment and reliance on it as

decisive. It is this addition that has caused modern science to take off from generic science and remake our material and conceptual worlds. It explains our confidence in science as well, for the controlled experiment delivers proof, winnowing hypotheses and retiring those that fail its test.

3. ***We can control only what is inferior to us***. Intentionally control, that is, for chains can fetter my movement without being my superior. Also, this principle holds only between orders of existence, for within the same species variables can skew the picture: the Nazis controlled the Jews without being superior to them. By superior/inferior I mean by every criterion of worth we know and probably some we know not. Many things are superior to us in size (the moon) and brute power (an earthquake), but neither are superior to us in all respect, including intelligence and freedom. Human beings controlled the American buffalo more than vice verse—it's that kind of correlation between intended power and orders of existence that this third point flags.

4. The conclusion follows inexorably. ***Science can disclose only what is inferior to us***. Have we ever in any science course or textbook encountered anything that exceeds us in every positive attribute we possess? The question is rhetorical —the answer is not. What might beings that are superior to us be? Disengaged from matter or discarnates? Angels? God? The point is, if such beings exist, science will never disclose them for the sufficient reason that it is they who dance circles around us, not we them. Because they possess perimeters we are not even aware of, let alone able to control, it is impossible for us to reduce the variables that pertain to them to the point where experiments could produce on/off, clear-cut proofs.

Nothing in this "syllogism" proves that there *is* anything superior to us, but it does prove that *if* there is, science cannot bring it to light. It proves that conclusively, I would think, save to those whose enthusiasm for science leads them to associate that word with truth in its entirety rather than with truths that are discovered by a particular method. This confuses things to no end. It also does science the disservice of rendering it amorphous and forcing

it into the impossible position of trying to be all things to all people, eventually where it falls short of that goal now.[185]

If we liken the scientific method to a flashlight, when we point it downward, towards the path we are walking on say, its beam is clear and bright. Suppose, though, we hear footsteps. Someone is approaching, and to see who it is we raise the beam to horizontal level. (This represents the social sciences and the light they cast on our species). What happens? The light starts to flicker; a loose connection has developed. The social sciences can tell us some things about ourselves—the physiological substrates of experience and how people behave on average. The complete person as an individual, though, eludes its clutches. Replete with idiosyncrasies, freedom, and commitments, to say nothing of soul and spirit if such components exist, she/he slips through the meshes of science as sea slips through the nets of fishermen. To tie this directly to our syllogism's conclusion—that science can disclose only what is inferior to us—it is axiomatic in the social sciences that in investigating areas where freedom figures, subjects must be kept in the dark about experimental design. This places them in a tilt relation to scientists who know more about what is going on than they do. Finally (to complete the analogy), if we tilt our flashlight skywards— towards the heavens may we say in present context— its light gives out completely. Its batteries drop to the bottom of the casing leaving us completely in the dark. Once again this does not prove that the heavens are populated. It argues that if it is, science cannot apprise us of that fact, much less introduce their denizens.

And science is what now provides us with our sense of reality— we are back to where our syllogism took off. And back to why it is imperative that we get rid of the tunnel vision of modernity and, to carry the analogy forward, consider an other than flashlight world to live in. Unaware of what has happened— blind to the way method has vectored metaphysics and

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[185] Absence of evidence is not evidence of absence—it might help students break through the metaphysical muddle of our time if we taught them to chant this as a modern mantram. Because the science of acoustics has nothing to say about beauty, it doesn't follow that "*Allahu jamilun*" isn't true. It's easy to see this in restricted domains, but expanding the point to worldviews is difficult, hence J. C. Smart's report that positivism is dead except in religion. So to drive home the exposé of our modern mistake which I have been circling, I want to return to my syllogism and run through it again by way of an analogy.

epistemology constricted worldview— modernity with a stroke of its methodological pen has all but written off the region of reality that religion up to the last century or so has been riveted to. As E. F. Schumacher reflected toward the close of his life: most of the things that most of humanity has most believed in did not appear on the map of reality his Oxford education handed him as it launched him on life's adventure!

Templeton Foundation's *Humble Approach Initiative* is informed precisely by the realization that we briefly outlined in the foregoing remarks. The assumption of classical physics that physical reality is local— that a point in space cannot influence another point beyond a relatively short distance— was challenged by Nicolas Gisin's 1997 experiments involving twin photons in which light particles were shown to communicate with one another instantly. Linked to research in atom optics conducted by Alain Aspect in the early 1980s, the revelation led some scientists to argue that physical reality on the most basic level is an undivided wholeness. Does it also imply that the stark division between mind and world is an illusion? The mystical traditions of all major religions have conceived of spiritual reality as, in some measure, a unified essence. Sufism, an Eastern approach to the divine rooted in Islamic faith and practice, has stressed the centrality of *tawhid,* the assertion of God's fundamental unity, to our understanding of the world and ourselves. God's love for creation gave existence to the universe, according to Sufi teaching, and human love for God closes the gap between the Creator and His creatures. The philosophic expression of Hinduism known as the Vedanta emphasizes the substantial and essential identity of the individual soul with the unqualified and unqualifiable Absolute *(Atman is Brahman).* Can the scientific concept of non-locality aid us in exploring the ultimate reality beyond time and space and causation? Can Eastern approaches to divinity help us, in turn, to find meaning in the fantastic and ongoing revelations of modern science beyond the thrill of the chase and of discovery itself?

To consider the broad implications of correlations between properties of quanta, thirteen scientists, theologians, and philosophers met in a symposium on the northern shore of Lake Geneva from 21st to 23rd June 2002. They came together to explore the implications of quantum non-locality for the character of physical reality, as well as the uses of the concept of complementarity— Niels Bohr's logical framework for acquiring and comprehending scientific knowledge— in understanding the relationship

between parts and wholes, the fundamental unity of creation from Eastern perspectives, and the search for meaning in modern science and mystical traditions.

The symposium was a part of the Templeton Foundation's *Humble Approach Initiative*. The goal of the initiative is to bring about the discovery of new spiritual information by furthering high-quality scientific research. The "humble approach" is inherently interdisciplinary, sensitive to nuance, and biased in favour of building linkages and connections. It assumes openness to new ideas and a willingness to experiment. Placing high value upon patience and perseverance, it retains a sense of wondering expectation because it recognizes, in Loren Eisley's haunting phrase, "a constant emergent novelty in nature that does not lie totally behind us, or we would not be where we are." A fundamental principle of the Templeton Foundation, in the words of its founder, is that "humility is a gateway to greater understanding and open[s] the doors to progress" in all endeavours. Sir John Templeton believes that in their quest to comprehend ultimate reality, scientists, philosophers, and theologians have much to learn about and from one another. The humble approach is intended as a corrective to parochialism. It encourages discovery and seeks to accelerate its pace.

Quantum non-locality and its implications for the character of physical reality, or what has been termed the "quantum reality" problem, is an enigma that has tantalized physicists, philosophers, and an ever-widening public for decades. The pertinent literature is vast, and it would appear that just about every conceivable avenue of approach to the problem— no matter how seemingly farfetched— has been advocated somewhere and explored. Gone are the days when the authority of physics could be invoked in support of a single established world-view! What has happened is that the pre-quantum scientistic world-view (now termed "classical") has come to be disavowed "at the top": by physicists capable of grasping the implications of quantum theory. And this in turn has called forth an abundance of conjectured alternatives, competing with one an other, as it were, to fill the ontological void— a situation that has prompted one recent author to speak of a "reality

market place". Quantum mechanics, if you will, is a scientific theory in search of a *Weltanschauung*. The search has been on since 1927.[186]

Meanwhile the spectacle of a dozen top-ranking scientists promoting twelve different world-views is hardly reassuring; and there is the temptation to conclude that truth is unattainable, or, worse still, that it is relative, a matter simply of personal opinion.

What is called for, however, is a closer look at the foundations of scientific thought: at the hidden assumptions that have conditioned our contemporary intellectual perceptions. A modest probe into matters generally ignored suffices to reveal a startling fact: it happens that every quantum-reality position thus far enunciated hinges upon one and the same ontological presupposition, a tenet which moreover derives from the philosophical speculations of Galileo and Descartes, and which, surprisingly enough, has been sharply and cogently attacked by some of the most eminent philosophers of the twentieth century. It may indeed seem strange that an ontological assumption that has thus become suspect, to say the least, should have remained unchallenged throughout the length and breadth of the quantum reality debate; but one must remember that the notion of which we speak has become ingrained in the scientific mentality to the point where it can hardly be recognized as a presupposition, let alone as a spurious premise that must go.

If we can remove this error, try to emerge from the "tunnel vision", and expose this virtually ubiquitous assumption as the fallacy it is, the pieces of the quantum puzzle begin to fall into place. The very features of quantum theory, in fact, which, prior to this ontological rectification had seemed the most incomprehensible, prove now to be the most enlightening. As might be surmised, these features bear witness, on a technical level, to an ontological fact, a truth which had hitherto been obscured. We have to identify this elusive and fallacious premise, and refute it with optimum cogency and, following this, we need to give a revised account of the *modus operandi* by which physics is defined, an account which no longer hinges upon the now disqualified axiom. This done, we shall be in a position to reflect anew upon the salient findings of quantum theory, to see whether these strange and

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[186] It was the time when Iqbal mentioned it for the first time in his writings, especially in his *Reconstruction of Religious Thought*, pp. 55-56.

puzzling facts can at last be understood. And this is the task which, partly at least, was accomplished at the symposium entitled "The Science of Non Locality and Eastern Approaches to Exploring Ultimate Reality".

At the top of the list of "strange facts" that demand an explanation stands the phenomenon of state vector collapse, which could well be termed the central enigma of quantum physics. It poses a fundamental problem that cannot be ignored or by-passed if one would understand the nature of the physical universe, and its relation to whatever other ontological planes there be.

Considerations of this kind, meanwhile, need not detain the working physicist, nor do they alter the fact that quantum mechanics is beyond doubt the most accurate, the most universal, as well as the most sophisticated scientific theory ever advanced by man. In a thousand hair-splitting experiments it has never yet been proved wrong. But quantum theory does more than answer a multitude of questions: it also raises a few of its own. And whereas classical physics, which by comparison is both crude and inaccurate, generally inspires dreams of omniscience, the new physics counsels caution and a becoming sobriety; hence the Templeton Foundation's *Humble Approach Initiative*.

It also needs to be emphasized that despite its seemingly "specialized" nature, the quantum-reality problem is beyond doubt the most universally significant question hard science has ever posed. What it demands, clearly, is an integral world-view that breaks radically with the accustomed the "classical" world-view; and that is what the symposium tried to achieve.

But some where, during the course of its historical development, western thought took a sharp turn in another direction. It branched off as a tangent from the collective heritage of all humanity and claimed the autonomy of reason. It chose to follow that reason alone, unguided by revelation and cut off from the Intellect that was regarded as its transcendent root.[187] Political and social realms quickly followed suit. Autonomous

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[187] See Martin Lings, "Intellect and Reason" in *Ancient Beliefs and Modern Superstitions*, rpt. (Lahore: Suhail Academy, 1988, 57-68; F. Schuon, *Gnosis Divine Wisdom* London: J. Murray, 1978, 93-99; S. H. Nasr, "Knowledge and its Desacralization" in *Knowledge and the Sacred* (Edinburgh: Edinburgh University Press, 1981, 1-64; Huston Smith, *Forgotten Truth* (San

statecraft and excessive individualism in the social order were the elements that shaped a dominant paradigm that did not prove successful.[188] A few centuries of unbridled activity led Western philosophy to an impasse.[189]

Commenting upon the situation, Huston Smith remarked, "the deepest reason for the crisis in philosophy is its realization that autonomous reason—reason without infusions that both power and vector it— is helpless. By itself, reason can deliver nothing apodictic. Working, as it necessarily must, with variables, variables are all it can come up with. The Enlightenment's "natural light of reason" turns out to have been a myth. Reason is not itself a light. It is more than a conductor, for it does more than transmit. It seems to resemble an adapter which makes useful translations but on condition that it is powered by a generator."[190] The nature and direction of these "infusions" is still being debated.[191] It is with this end in view that thirteen scientists, theologians, and philosophers met in the symposium. Their brief introductions are given below. Collected papers of the Symposium are in preparation.

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PARTICIPANTS OF THE SYMPOSIUM

Francisco: Harper San Francisco, 1992), 60-95. Also see his *Beyond the Post-Modern Mind,* Wheaton: Theosophical Publishing House, 1989).

188 See René Guenon, "Individualism" in *Crisis of the Modern World,* (Lahore: Suhail Academy, 1981, 51-65. Also see Social Chaos" in the same document.

189 For a few representative writings that indicate this situation, see "Scientism, Pragmatism and the Fate of Philosophy, *Inquiry*, No. 29, p. 278, cf. Huston Smith, *Beyond the Post-Modern Mind*, loc. cit. p. 142; Hilary Putnam, "After Empiricism" in *Behaviorism*, 16:1 (Spring 1988); Alasdair MacIntrye, "Philosophy; Past Conflict and Future Direction," *Proceedings and Addresses of the American Philosophical Association*, Supplement to 16/1, (September 1987); also see *Proceedings of the American Philosophical Association*, Vol. 59 (1986), and Kenneth Baynes et al., *Philosophy*: *End or Transformation*? (Cambridge: MIT Press, 1987).

190 Huston Smith, "Crisis in Modern Philosophy", in *Beyond the Post-Modern Mind,* Wheaton: Theosophical Publishing House, 1990, 137.

191 Huston Smith has pointed towards the possibility of accepting these "infusions" from *Philosophia Perennis* or *Religio-Perennis,* the sapiential doctrines of mankind. See his "Two Traditions and Philosophy" in *Religion of the Heart –Essays Presented to Frithjof Schuon on his 80th Birthday,* (Washington, D.C.: Foundation for Traditional Studies, 1991, 278-296. In this regard also see F. Schuon, "Tracing the Notion of Philosophy," *Sufism Veil and Quintessence* Lahore: Suhail Academy, 1985, 115-128; *Logic and Transcendence*, trans. Peter N. Townsend (New York: Harper and Row1975.

Bruno Guiderdoni is a director of research at the Paris *Institute of Astrophysics* (IAP) and an expert on Islam. A graduate of the University of Paris where he earned a Ph.D. in astronomy in 1986, he held a post-doctoral fellowship at the French Academy of Sciences for two years before receiving an appointment to the research staff of the IAP, which is supported by the French National Center for Scientific Research. He was promoted to his present position in 1992. Dr. Guiderdoni's research has focused on the birth and evolution of galaxies. He has produced a number of key papers that have contributed significantly to the elaboration of the paradigm of "hierarchical" galaxy formation, the theory that galaxies are the result of mergers and collisions between smaller star swarms, and participated in the discovery of the uniform glow of the cosmos at far-infrared wavelengths invisible to the human eye. He is currently working on simulations of galaxy formation that are used to interpret observations made of the universe's most distant large-scale structures. Dr. Guiderdoni is an associated scientist on the European Space Agency's two scientific satellites, Herschel and Planck, that will be launched in 2007 to survey the full far-infrared and submillimeter waveband and measure the fluctuations in the temperature of cosmological background radiation with unprecedented resolution and sensitivity. He has published more than 100 scientific papers and organized eight international conferences in his field. Before undertaking his graduate work, Dr. Guiderdoni fulfilled his national service obligation as a physics teacher in the French high school in Casablanca. Introduced to Islam in Morocco, he embraced the faith in 1987, and from 1993 to 1999, he was in charge of a television program, "Knowing Islam," that is broadcast by the state TV channel in France. Under the aegis of the Islamic Institute for Advanced Study, he has lectured widely on spirituality and on his views about the connections between science and religion. He has played an active role in promoting inter-religious dialogue, particularly among the Abrahamic traditions. Since the tragic events of September 11, he has spoken out often on the values of humility and tolerance in any search for truth. Dr. Guiderdoni's paper was entitled: ***"Islam, Contemporary Issues in Science and Religion"***

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Anindita Niyogi Balslev, an expert on classical Indian as well as Western thought traditions, is an associate research professor of philosophy at the University of Copenhagen. Born in Calcutta, she received her

bachelor's degree with honors from Calcutta University, took a master's degree in philosophy there, and went on to earn a Ph.D. in philosophy from the University of Paris in 1968. She has been a fellow at the Indian Institute of Advanced Study and a research lecturer at the Center for Cultural Research at Denmarles Aarhus University, as well as a senior lecturer at Aalborg University in Denmark and a visiting professor at the University of Kentucky, Rutgers University, and Aarhus's Institute for the History of Ideas. Dr. Balslev was a senior advisor to the Danish National Institute for Education Research in 1996, and in 1998, she held the Asutosh Mukherji Chair at the National Institute of Advanced Study in Bangalore, India. Dr. Balslev has organized a number of international conferences around cross-cultural and interdisciplinary issues and delivered invited talks in Asia, Europe, and North America on the interface between science and religion. Her articles in academic journals explore, among other issues, the problem of time, notions of self, and the meaning of consciousness in the context of Indian thought. In addition to editing two volumes, she is the author of *A Study of Time in Indian Philosophy* (1983 and 1999) and *Cultural Otherness: Correspondence with Richard Rorty* (1991 and 1999). Dr. Balslev is currently writing a new book entitled "I-Consciousness: A Cross-Cultural Inquiry." **Anindita Niyogi Balslev's** paper was entitled: ***"Ultimate Reality and Subjectivity".***

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Physicist **Raymond Y. Chiao** is widely known for pioneering experiments in the twilight zone of quantum mechanics where objects can pass through solid walls. His recent work involves investigations of faster-than-light phenomena. He has measured how long photons take to "tunnel" through a barrier that ought to be impenetrable and found that they appear to outpace the speed of light when they are successful in reaching the other side. Born in Hong Kong and educated in the United States, he earned a bachelor's degree from Princeton University, where he was elected to Phi Beta Kappa in his junior year, and a Ph.D. in physics from the Massachusetts Institute of Technology in 1965. After teaching at MIT for two years, he joined the physics faculty of the University of California, Berkeley and was named a full professor in 1977. Dr. Chlao has held a Woodrow Wilson Fellowship and an Alfred P Sloan Fellowship. A member of Sigma Xi, he won the second prize of the Gravity Research Foundation in 1981 and the

Scientific Innovation Award for Outstanding Work in Modern Optics from the Center for Advanced Study at the University of New Mexico in 1986. He is a fellow of both the American Physical Society and the Optical Society of America. Dr. Chiao has published some 125 papers in major scientific journals. He edited *Amazing Light* (1996), a volume dedicated to the Nobel laureate Charles H. Townes on the occasion of his eightieth birthday.

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William C. Chittick, a professor of comparative studies at the State University of New York, Stony Brook, has written extensively on Islamic philosophy with special emphasis on the Sufi tradition. A graduate of the College of Wooster in Ohio, he received a Ph.D. in Persian language and literature from Tehran University in 1974 and later studied at the Imperial Iranian Academy of Philosophy in Tehran, where he also served as an assistant professor in 1978-79. Dr. Chittick had begun his teaching career at the Center for the Humanities at Aryamehr Technical University in Tehran. He returned to the United States just before the Iranian Revolution and in 1981 accepted an appointment as an assistant editor of Columbia Universitys *Encyclopedia Iranica* (1982-85). In 1983, he was named an assistant professor of religious studies at SUNY Stony Brook. He was promoted to his present position in 1996. Dr. Chittick has been a visiting professor of Arabic literature at Harvard University. A former member of the board of editors of the SUNY Press, he has held a Fulbright Fellowship and two fellowships awarded by the National Endowment for the Humanities. In 2000, he was awarded the Mevlana Ozel Odula by the Kombassan Foundation in Turkey. In addition to numerous articles in scholarly journals and contributions to encyclopedias, histories, and collected works, he has translated a dozen major Persian and Arabic texts into English and is the author or co-author of eleven books. His most recent studies are *Sufism:* A *Short Introduction* (Oneworld, 2000) and *The Heart* of Islamic *Philosophy: The Quest for Self-Knowledge in the Teachings of Afdal al-Din Kashani* (Oxford University Press, 200 1). **William C. Chittick's** paper was entitled: ***"The Search for Meaning in the Islamic Intellectual Tradition".***

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The director of the Indian Institute of Astrophysics in Bangalore for the past decade, **Ramanath Cowsik** has made wide ranging contributions to

theoretical physics, experimental physics, and science management. He formerly headed the Gravitation Group at the Tata Institute of Fundamental Research in Bombay with which he was associated for forty years. His papers pointing out the astrophysical and cosmological consequences of finite neutrino masses contributed to the basic paradigm for studying galaxy formation and dark matter. Dr. Cowsik also has advanced knowledge of the behavior of cosmic rays at low and high energies, and his discussion of non-thermal particle populations inside supernova remnants have led to a physical understanding of their spectra. In the course of his experimental searches for new feeble forces and tests of Einstein's principle of equivalence of inertial and gravitational masses, he designed a new kind of torsion balance with which he performed the first laboratory experiment searching for the so-called "fifth force"— a hypothesized addition to the four fundamental interactions between objects in nature. Investigating the dust of presolar diamonds, rubies, and carborandum embedded and preserved in meteorites, Dr. Cowsik has been able to infer the formation of these materials in stellar winds and to estimate by a completely new method the age of the Milky Way. Recently he explored the Himalayas to establish a unique site for optical infrared astronomy in Ladakh on the border of Tibet. Dr. Cowsik was born in Nagpur in central India and took his baccalaureate degree at the University of Mysore. He earned a master's degree in physics at Karnatak University and, after further graduate work at the Atomic Energy Training School in Mumbai, he received his Ph.D. in physics from the University of Bombay in 1969. He had joined the Tata Institute as a research associate in 1961, and he subsequently became a research fellow, a fellow, a reader, an associate professor, a professor, and a senior professor there. Named a Distinguished Professor in 1996, he retired from his faculty position earlier this year. Dr. Cowsik has held a research fellowship at the University of Chicago and been a visiting lecturer and assistant professor at the University of California, Berkeley, a senior visiting fellow at the Max Planck Institute for Physics and Astrophysics in Munich, and a distinguished visiting professor at Washington University in St. Louis. Currently serving on the governing council of the Commission on Cosmic Rays of the International Union of Pure and Applied Physics, he is a fellow of the Indian National Science Academy, the Indian Academy of Sciences, the National Academy of Sciences, India, the Indian Geophysical Union, and the Third World Academy of Sciences. In addition to invited lectureships, he is the recipient of many other honors,

including the Vikram, Sarabhai Award for Space Sciences, the Shanti Swarup Bhatnagar Award in Physical Sciences, a NASA Public Service Group Achievement Award, the Third World Academy of Sciences Award in Basic Sciences, the Vainu Bappu Memorial Award of the Indian National Science Academy, the S.N. Bose Birth Centenary Award of the Indian Science Congress Association, and the Padma Shri Award from the President of India. Dr. Cowsik has published some 180 papers in scientific journals and is the editor of *Cosmic Pathways* (1985) and two other books. **Ramanath Cowsik's** paper was entitled: ***"A triad of non-localities".***

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Nicolas Gisin is the group leader for the Optics Division of the Group of Applied Physics at the University of Geneva. He is also a professor of physics at the Swiss university. His research is at the crossroads between modern optics and quantum physics, and he works both on conceptual issues and on their application. Dr. Gisin's experiments in long distance quantum entanglement are at the heart of quantum information processing and have made him an international leader in the emerging field of quantum cryptography-a technique using single photons of light to send secret messages with the assurance that no one has eavesdropped on them. A graduate of the University of Geneva, he took his undergraduate degree and earned master's degrees in mathematics and in physics there as well as a Ph.D. in physics in 1981. His dissertation was awarded a prize by the Louis de Broglie Foundation. Dr Gisin did post-graduate work in optics at the University of Rochester and upon his return to Switzerland in 1984, he joined a start-up company, Alphatonix, dedicated to the development of fiber instrumentation for the telecommunications industry. Four years later, he joined a Swiss software company. In 1988, he accepted an invitation to return to his alma mater as head of the optics section of the Group of Applied Physics. His work won worldwide attention in 1997 when he reported the results of an experiment in which he split a light beam in two, at a facility near the Geneva train station, and sent the resulting pair of photons in opposite directions over fiber-optic cables to detectors located more than six miles apart. Dr. Gisin confirmed that a stimulus applied to just one of the twin beams instantly determined the state of the sibling photon as predicted by quantum theory. What Albert Einstein called "spooky action at a distance" has been the focus of much of Dr. Gisin's subsequent research. It

is increasing our understanding of the information content of quantum states and holds promise not only for encryption but also computation among other applications. Dr. Gisin has published some 200 papers in scientific journals. Once a nationally ranked field hockey player, he also finds time to work with Swiss youngsters interested in the sport.

University Professor of Interdisciplinary Science and a professor of physics at George Mason University, Greek-born **Menas Kafatos** has explored the implications for physics and for philosophy of particle "entanglement" over long distances in two books. Written with his George Mason colleague Robert Nadeau, *The Non-Local Universe* (Oxford University Press, 1999) and *The Conscious Universe* (Springer-Veriag, 1990 and 2000) consider the potential of nonlocality to transform our understanding of the nature of reality. Dr. Kafatos, who is a native of Crete, received his bachelor's degree from Cornell University and a Ph.D. in physics from the Massachusetts Institute of Technology in 1972. After three years of post-doctoral research in astrophysics at the University of Colorado and the NASA/Goddard Space Flight Centre, he joined the George Mason physics faculty and was promoted to full professor in 1984. Dr. Kafatos won international attention for his early work in theoretical astrophysics, particularly his work on black holes, those "ghosts" of massive dead stars whose gravitational imprint, frozen in space, challenges physicists to broaden their cosmological perspective. His current research interests include Earth observing and Earth systems science, foundations of quantum theory, the nature of consciousness, and cosmology. In 1991, he founded George Mason's Institute of Computational Sciences and Informatics, which evolved into its School of Computational Sciences. Four years later, he founded the Centre for Earth Observing and Space Research (CESOR). He still serves as director of CESOR and as principal investigator of several federally funded George Mason programs for the effective use of data anticipated from the next generation of space platforms among other activities. Dr. Kafatos is an honorary member of the Romanian Academy of Sciences and currently serves as vice president for education of the American Astronautical Society. He has published some 165 scientific papers and is the co-editor of six books and the co-author of four others. Menas Kafatos' paper was entitled: ***"Non-locality, Consciousness and the Emerging New Science"***

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Azim A. Nanji is director of the *Institute for Ismaili Studies* in London. Born in Kenya, he took a first-class degree with honours in literature and religious studies at Makerere University in Uganda and received a Ph.D. in Islamic studies from McGill University in 1972. After spending a year as a post-graduate research and teaching fellow at McGill's Institute of Islamic Studies, he joined the religious studies faculty of Oklahoma State University, where he became a full professor in 1983. In 1988, he was named professor and chair of religion at the University of Florida, a position he held for the next ten years. Dr. Nanji also has been a Visiting Killam Fellow at Dalhousie University in Halifax, Nova Scotia and a Margaret Gest Visiting Professor of Religion at Haverford College. He has received a Rockefeller Fellowship, an American Institute of Indian Studies Senior Research Fellowship, a Canada Council Award, and a research grant from the National Endowment for the Humanities. An elected member of the American Society for the Study of Islam, he delivered the plenary lecture at the National Conference on Religion, Philanthropy, and Civil Society in Washington in 1994. He is a member of the steering committee for the Aga Khan Award for Architecture and was previously co-chair of the Islam Section of the American Academy of Religion as well as a member of the editorial advisory board of the *Journal of the American Academy of Religion.* Dr. Nanji has published some forty scholarly articles and book chapters and is the editor of three books and the author or co-author of two others. His 1978 study, *The Nizari Ismaili Tradition,* won the Council of Canada Publication Award. **Azim Nanji's** paper was entitled; ***"The Science of Nonlocality and Eastern Approaches to Exploring Ultimate Reality — A Perspective from the Muslim Philosophical Tradition.***

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An investigator probing images of galaxy clusters produced by the Hubble Space Telescope for clues to the distribution of "dark" matter, the dominant but unseen gravitational influence on the cosmos, **Priyamvada Natarajan** is an assistant professor of astrophysics at Yale University with an abiding interest in the philosophy of science. Born in the south of India, she received bachelor's degrees in science and in mathematics from the Massachusetts Institute of Technology then pursued graduate work in MIT's program in science, technology, and society before taking a Ph.D. in astrophysics at Cambridge University in 1998. Awarded a research fellowship

at Trinity College, Cambridge, she continued her work in England for the next several years before accepting an appointment to the Yale faculty in 2000. Dr. Natarajan's research focuses on a range of topics in astrophysical cosmology. Among other questions, she is investigating the role of gamma-ray bursts in star formation, how groups of galaxies may form and change over time, and the evolution and scale of the massive whirlpools, known as black holes, in their centres. She serves on the advisory committee of the American Association for the Advancement of Science's Program of Dialogue on Science, Ethics, and Religion and on the board of advisors of the John Templeton Foundation. In addition to some thirty papers in scientific journals, Dr. Natarajan has published a collection of poems.

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Ravi Ravindara is a professor emeritus at Dalhousie University in Halifax, Nova Scotia where, until his recent retirement, he had been professor and chair of comparative religion, professor of international development studies, and adjunct professor of physics. Born in Patiala in the Punjab area of northwest India, he earned his bachelor's and master's degrees at the Indian Institute of Technology in Kharagpur and a Ph.D. in physics at the University of Toronto in 1965. Subsequent to a post-doctoral fellowship in physics at Toronto, he held a post-doctoral fellowship in philosophy at Princeton University and a postdoctoral fellowship in religion at Columbia University. He began his teaching career as an assistant professor of physics at Dalhousie in 1966. Formerly a visiting member of the Institute for Advanced Study in Princeton and a visiting member of the Indian Institute of Advanced Study in Simla, he has been the visiting Kern Professor of Science and Spirituality at the California Institute of Integral Studies and the Korett Visiting Professor of Philosophy and Medicine at the Pacific Medical Centre in San Francisco. The founding director of the Threshold Award for Integrative Knowledge given by the Swiss Threshold Foundation, he formerly served as chair of its selection committee. Dr. Ravindra is the recipient of numerous research grants and a John Templeton Foundation Science and Religion Course Program grant as well as fellowships from the Canada Council the Social Sciences and Humanities Research Council of Canada, and the Shastri Indo-Canadian Institute. He formerly served as a director of the International Theosophical Society's School of the Wisdom in Madras, India, a member of the board of advisors of the John Templeton

Foundation, a member of the board of judges for the Templeton Prize, and a member of the advisory committee for the Program of Dialogue Between Science and Religion of the American Association for the Advancement of Science. Dr. Ravindra has had a long and deep interest in the metaphysics and practical spiritual disciplines of Hinduism, Buddhism, and Christianity. Among contemporary spiritual teachers, he has been influenced by Jiddu Krishnamurti and Jeanne de Salzmann, who was a pupil of George Ivanovitch Gurdjieff. In addition to publishing more than 120 articles in scientific and scholarly journals, Dr. Ravindra is the author or co-author of ten books. Among them are the highly influential *Whispers from the Other Shore: Spiritual Search East and West* (1984 and 2000*)* and *The Yoga of Christ in the Gospel According to St. John (*1990 and 1992*).* His most recent study, *Science and the* Sacree4 was published by the Theosophical Publishing House in 2000. A new book, *Krishnainurti in the Long Line of Rishis in India, will* be published next year by Munshilal Manoharlal Publishers in its Builders of Indian Philosophy Series.

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The founding director of the *Center for Quantum Philosophy*, a division of the Zurich-based Institute for Interdisciplinary Studies (IIS), **Antoine Suarez** conducts and promotes research on the foundations of quantum theory and seeks to stimulate discussion of its metaphysical implications. He is a native of Spain and graduated from the University of Zaragoza before pursing graduate work in experimental physics at the University of Fribourg in Switzerland. Dr. Suarez took his Ph.D. in natural science at the Swiss Federal Institute of Technology (Eidgenössische Technische Hochschule Zürich or ETH) in 1975. While at ETH, he not only became interested in the philosophical significance of quantum mechanics, but also in genetic epistemology. For more than a decade, he was engaged in research on cognitive growth that led to the development of improved methods for teaching mathematics and science to children. Dr. Suarez directed the Swiss think tank, IIS, from 1985 to 1993*,* and with major support from the Leman Foundation, he undertook studies that brought the insights of philosophers, theologians, and ethicists to bear on advances in science. Since assuming his current position in 1989, he has conducted and facilitated, with support from the Odier Foundation, experimental research on correlations of nonlocal quantum, that is, faster-than-light influences on phenomena. With Valerio

Scarani, he was the first scientist to propose experiments using moving measuring devices to investigate the tension between quantum mechanics and relativity, especially whether there is a real time ordering behind nonlocal influences. Dr. Suarez actively collaborated with Nicola Gisin's Group at the University of Geneva in carrying out the work. Recent results suggesting that relativity's tools for dealing with the flow of time are irrelevant in the realm of quantum processes have strengthened his interest in exploring possible links among levels of reality. In addition to articles in scientific journals, chapters in volumes of collected works, and an early study on the relation of thought to action in adolescents, he is the editor (with Alfred Driessen) of *Mathematical Undecidability, Quantum Nonlocality and the Question of the Existence of God* (Kluwer, 1997).

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Muhammad Suheyl Umar is the director of Pakistan's Iqbal Academy in Lahore, a research institution devoted to the works and teachings of the Muslim poet and philosopher Muhammad Iqbal, a political activist known as the father of modern Pakistan. Suheyl Umar is also the founding editor of *Riwayat,* an intellectual journal in the Urdu language that has published articles on science, philosophy, and mysticism for the past twenty-one years, and the editor of *Iqbal Review,* an academic quarterly published alternately in Urdu and English, which has both Persian and Arabic editions. A graduate of Government College in Lahore where he took both a baccalaureate degree and master's degree in English, he earned an M.Phil. in Iqbal studies at Allama Iqbal Open University in Islamabad and, after nearly two decades in educational administration and academic publishing, a Ph.D. in philosophy from Punjab University in Lahore is in progress. Umar began his editorial career as managing partner of Suhail Academy, a publishing company in Lahore, and in the early 1980s served as secretary general of Al-Manara Academy and as vice principal and head of the English department at Al-Manara Public School. He was named deputy director of Iqbal Academy in 1984 and assumed the directorship in 1997. Formerly chief editor of *Al-Ma'arif* and editor of *Studies in Tradition,* he served as academic director of the Institute of Islamic Culture in Lahore for two years and was named an honorary fellow in 1992. The next year he was a visiting scholar at the International Institute of Islamic Thought and Civilization in Kuala Lampur, Malaysia. In addition to articles published in scholarly journals, he has edited

a number of volumes of Iqbal's writings and collections of various literary works in Urdu. He also has published bibliographies and descriptions of extant manuscript collections in Pakistan and has several new works in preparation. **Muhammad Suheyl Umar's** paper was entitled: ***"The Science of Nonlocality-Perspectives and Implications".*** [192]

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One of the world's leading researchers in the field of quantum physics, **Antone Zeilinger** is professor of physics and director of the Experimental Physics Institute at the University of Vienna. His work first received international attention in 1997 when he and his colleagues at the University of Innsbruck, where he was then directing the Institute of Experimental Physics, confirmed the possibility of quantum teleportation by demonstrating, through the use of pairs of entangled photons, that the properties of one particle can be instantly transferred to another over an arbitrary distance at the speed of light. More recently, Dr. Zellinger's quantum interference experiments with "buckyball" molecules (whose shapes resemble the geodesic domes designed by R. Buckminster Fuller), so far the largest objects to have demonstrated quantum behaviour, have attracted the notice of the scientific community. By proving that clusters of seventy carbon atoms obey quantum-mechanical rules, he has extended the quantum domain further than ever before. Born in Austria, Dr. Zellinger studied at the University of Vienna and earned a Ph.D. in physics and in mathematics in 1971. After a lectureship at the Technical University of Vienna, a Fulbright fellowship at the Neutron Diffraction Laboratory of the Massachusetts Institute of Technology, and professorships at MIT, the Technical University of Vienna, and the University of Innsbruck, he accepted his present position in 1999. Dr. Zeilinger has been a visiting professor at the University of Melbourne, the Technical University of Munich, and the College of France, as well as an adjunct professor at Hampshire College in Amherst, Massachusetts, and a visiting research fellow at Merton College, Oxford. The former president of the Austrian Physical Society, he was named Austrian Scientist of the Year in 1996. His many other honors include the Senior Humboldt Fellow Prize, Germanys Order pour le Mérite, the 2000 Science Prize of the City of Vienna, and the 2001 World Future Award. Dr. Zeilinger

[192] This paper is included in the present issue of *Iqbal Review*.

is a fellow of the American Physical Society, a member of the European Academy of Arts and Sciences, and an honorary professor of the University of Science and Technology of China. He serves on the editorial boards of the *Foundations of Physics Letters* and *Physical Review A*. The author of more than 200 papers published in major scientific journals, he is co-editor (with Dirk Bouwmeester and Artur Ekert) of *The Physics of Quantum Information (*2000*)* and most recently (with Chiara Macchiavello and G. Massimo Palma) of *Quantum Computation and Quantum Information Theory,* which was published last year by World Scientific. Mindful of the practical applications of his research for the processing and transmission of information, including quantum teleportation, quantum cryptography, and quantum computing, Dr. Zellinger is also intrigued by the epistemological implications of quantum physics. He has met with the Dalai Lama to discuss them and has challenged his scientific colleagues to consider which notions appearing distinct and even opposed today will turn out to be so for future generations.