Quantum Theory and the Paranormal: The Misuse of Science

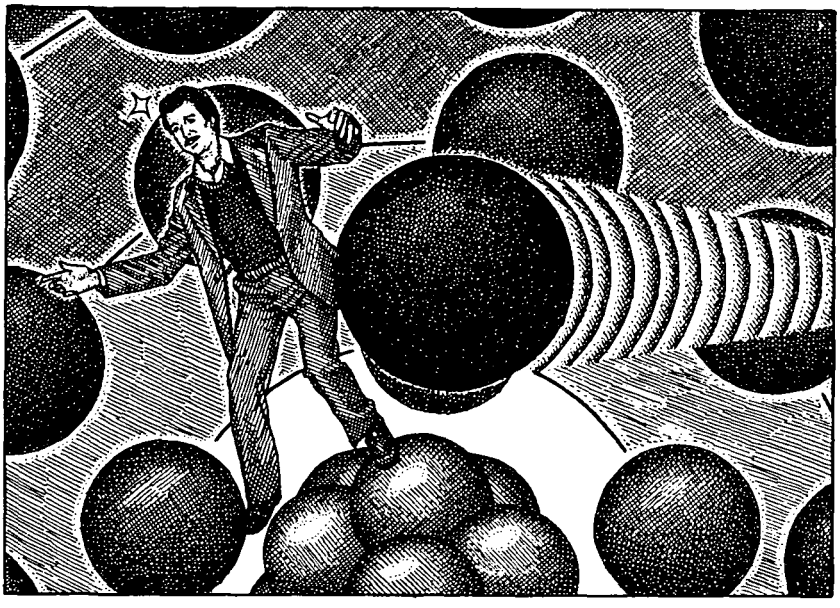
Psi promoters have picked up the jargon of quantum mechanics and in trying to apply it to the paranormal have confused vocabulary with substance.

Steven N. Shore

THE PSYCHIC WORLD has discovered microphysics. After having been oppressed for many years by physical arguments against precognition and remote viewing, the paranormalists have suddenly discovered a way out—the quantum world. It is a place where, it seems, anything can and will happen; where consciousness plays a physical role; where the "whole" is indivisible into its constituent parts; where all things communicate intimately with one another and all being is shared. In short, it is the realm in which lurk the processes long sought to explain all psychic and paranormal phenomena (astrology included).

This is the view recently promoted by several popular accounts of the "new physics": *The Tao of Physics* by Fritjof Capra, *The Dancing Wu Li Masters* by Gary Zukav, and *Physics as Metaphor* by Roger S. Jones.[1] They seek, in the noncausal and nondeterministic mazes of quantum mechanics (QM), the source of all "metaphysical" phenomena. The popularity of these books has been so great that they have even begun to contribute to the jargon of the parapsychologists. Vibrations of the vacuum, action at a distance, indeterminacy, and faster-than-light communication have begun to turn up in the speculations of those who try to provide some physical justification for their laboratory-based results. In the circles of the paranormalists, J. H. M. Whiteman and Russell Targ and Harold Puthoff have made the most extensive "public" cases for these explanations. Rather than examine the experimental claims of these investigators, which have been dealt with by other writers in these pages and elsewhere, I will simply examine the claims made by those who use the foundation of QM

Steven Shore is an astronomer. Until recently he was at the Warner and Swasey Observatory and Department of Astronomy of Case Western Reserve University and is now at the Space Telescope Science Institute in Baltimore.



to explain the paranormal.

The basic principles of QM can be stated simply: It is a language for describing the operations of a measuring device in a physical experiment at the microscopic level.[2] In this context, it allows one to envision the structure of microworld phenomena. The picture that dominates the popular perception is that of a very small observer making measurements on a physically discrete system—that of a quantum jump. The justification for even thinking that the status of a microsystem is dominated by discontinuous processes is drawn from atomic physics, where we see electron transitions in an atom taking place in discrete units, absorption and emission lines, between stationary states that are the energy levels. The fact that only certain levels appear to be allowed within an atom is analogous to the stationary states produced in a musical instrument. Musical notes are the product of a wave that reaches a stationary state (also called a standing wave). Without this analogy of an oscillation that is self-interfering unless certain conditions are maintained, the usual conception of the quantum leading to energy levels without permissible intermediates would appear logically—and experientially—incomprehensible. However, what we should keep in mind is that this is an empirical fact, not just an analogy.

This discreteness in the microscopic world can be viewed from two standpoints. One is that it is the product of our way of measuring the system, that we are requiring an all-or-nothing interpretation. The alternative is the existential approach, which, I think, is characteristic of most

working scientists: If this is what is demanded by nature, then our job is to provide the most complete description possible within the bounds of this phenomenology. The aim of QM, then, is to describe in an economical fashion the logical outcome of this picture of the microscopic world.

There is no question that the microscopic world presents many aspects that violate our macroscopically formed intuitions.[3] The deterministic world we apparently encounter daily is not coherently and completely adduced from quantum first principles. The Heisenberg uncertainty relations, in the form in which quantum theory states them, cannot necessarily be interpreted within the context of classical experience. Go to any standard text on QM, for example, and you will see the uncertainty principle stated in several different ways. The most popular, and probably the one held by most working physicists, is the so-called Copenhagen interpretation: The measurement process interferes with the system in such a way that the exact measurement of one process destroys the information available on any other system variable that is conjugate to it. This can be thought of as an artifact of the representation of the state, or of the details of the calculational procedure used in the determination of the expected outcome of any physical experiment. For example, in the famous gamma microscope experiment of Heisenberg (which he used to justify the uncertainty principle), the position of an electron under a microscope is measured by scattering a photon off the electron.[4] The momentum of the particle is disturbed (interfered with) by the scattering process in an unpredictable way, leading to an uncertainty in the momentum at the same time as we see certainty in our measurement of the position. Why? Because the quantum of the device with which we measure the system is on the same scale as the particle we wish to measure.

How do the parapsychologists (PPs hereafter) attempt to use QM to explain their results? First, in QM a composite system is seen as the product of the functions describing the individual states.[5] We can look at it this way. In human conception, there is a fifty-fifty chance that the fertilized egg will develop into a male and the same chance that it will develop into a female. In QM, we would be forced to represent this as a superposition of the two states. We know, however, that once the child is born, it is either one or the other. The philosophically minded physicist will say that before the moment of birth, while you are still in ignorance of the status of the fetus, the system is a purely superimposed state—male and female simultaneously. The measurement process—that is, the birth—instantly collapses the representation of the system to one or the other final state. Now of course the system is not in fact a superposition of the states. At the moment of fertilization the egg becomes genetically either male or female. However, since it has a finite probability of being either, the only description allowed by QM is that it is *both* until it can be directly measured. QM thus attempts to provide the entire spectrum of possible

measurements a priori; the fact that the real world only allows for one or the other to exist simply means that, in interpreting the final system, we classically describe the world as consisting of a limited number of outcomes.

The PPs now step in, insisting that the system really consists of the pregnant woman, her wishes for a child of a given sex, the doctors who will be involved in the delivery, the father who will have his own desires for the sex of the child, and the entirety of the world. All of these are *physically* acting on the fetus to determine the outcome of the birth process. In the world of the paranormal, then, the fact that QM demands a representation of any system as being intimately connected with outside influences—that QM represents every state as inherently mixed—means that even the influence of the positions of the stars must be taken into account in order properly to account for the nature of the fetus. Action at a distance by the stars and the psychic vibrations of the minds of the conscious participants should all be taken into account in the final determination of the sex of the child. As Targ and Puthoff state: ". . . the laws of physics do not absolutely forbid the transmission of information from the future to the present."[6]

At first, this appears to make some sense. After all, if the system (fetus) is in reality a subsystem (part of the mother, who is part of a family, which is part of the human population, which is a product of nature at large), all of the parts should be interconnected and therefore capable of mutual influence.

There is only one problem with this. In QM, most of the interactions of a system with the outside world are destroyed by incoherent processes, so that only those strong enough to have a direct influence on the system can act on it. The representation of the state may be a superposition of the entire "wave function" of the whole universe, but the effect of any part of the universe on the system is governed by the strength of its interaction.

For example, suppose we calculate the influence of a person on a transistor in a laboratory.[7] The transistor is an atomic device whose action results from the allowed states for the electrons due to the atomic structure of the crystal and voltage placed across it. If we look at the gravitational interaction of the observer with the device, we see that in comparison with the electromagnetic influences within the atomic structure of the transistor the strength of the couple is too weak to make any difference. If we look instead at the electromagnetic interaction between the observer and the device, we must calculate the rate of generation of electromagnetic waves from the observer and their rate of absorption by the transistor. This can be done quite simply within the physical machinery of QM. Again, we find that the effect is too weak to make any difference.

But, says the PP, we can postulate the existence of a field of unknown nature that represents the "interaction" of the observer with the transistor; we can then state that this interaction is responsible for any seemingly

paranormal phenomenon. After all, the PP says, the observer is part of the wave function of the system, so anything he does will influence the state of the system. His mere presence will influence the outcome of the experiment.

Unfortunately, the PPs insist on including the quantum mechanical action of the wave function in their supposed explanations of paranormal phenomena. The most recent of these is the attempt by Zukav in *The Dancing Wu Li Masters* to elevate Bell's theorem to the level of an epistemological breakthrough of world-shattering consequence.

Bell, who was fascinated by the problem of QM measurement, posed the following thought experiment.[8] Let us imagine that we have two electrons created initially in a singlet state—that is, they initially have spins anti-parallel to each other at the time of formation. You can envision this as trapeze flyers who link hands. Now allow these two electrons (trapeze artists) to separate in opposite directions in space. The singlet state is symmetric about the axes of motion (see Figure 1), and therefore we are

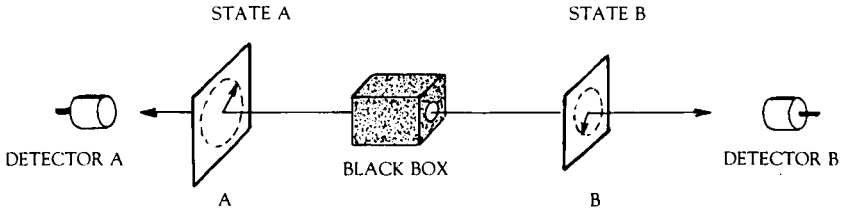


FIGURE 1

initially in ignorance about the axis along which each one has its spin aligned. One thing is certain, though. Since they were initially formed in the singlet state, any measurement made on one will immediately tell you the spin of the other—it must be opposite. The conundrum appears when we add the freedom of choice. The observer can allow the electrons to separate for a while and then choose *any* axis about which to look for the spin component. If the particles have been in flight long enough, they will be causally disconnected from each other, so that a signal traveling at the speed of light will not be able to traverse the space between them. He now makes the arbitrary measurement on one particle, and *voila!*—the other will be known to have exactly the opposite spin. However, since the observer could have chosen any axis at will, it would appear that the other particle knew about it just in time to properly anti-align along the same, arbitrarily chosen, axis.

The world of the Indivisible Whole appears again.

This result of Bell's theorem is exact in the mathematical sense. It

depends only on the notions of standard analysis—the probability interpretation of the psi-function and the QM-allowed types of mathematical operators.[9] It is, however, at this stage that the crux of the problem facing us is revealed. There must be a "dictionary" for translating Bell's inequalities into observational terms, and then yet another word list for putting it in philosophical perspective. All of QM works backwards from our observations, saying that the reality of the measurement is fixed by our choice of directions in which to measure.

Martin Gardner begins his excellent essay "Quantum Weirdness" with the following quotation from a baseball umpire: "Some is balls and some is strikes, but until I calls 'em, they ain't nothing."[10] We can continue this baseball analogy further in an explication of Bell's theorem. Imagine that we have a mythical ambidextrous pitcher who hurls two balls simultaneously in precisely opposite directions. We know in advance that one ball is blue and the other red but that they are otherwise identical. We give two catchers this rule of the game: Each is to call out the color of his ball as soon as he catches it. Thus, if the first one shouts out the color of the ball he receives as soon as he gets it, we will then know with certainty the color of the other one. Let us imagine, however, that after the pitches are thrown, at the last possible instant, one of the catchers capriciously takes a few steps backwards. This could change the order of the call, so that if the red ball would have been first we now have it as blue. Has this changed the colors of the balls in flight? Have the baseballs known in advance what the catcher would do and have they changed color in flight to accommodate the strategy? Obviously not. Yet this is the way in which the Bell theorem is interpreted by many folks of a philosophical bent.

Now, if we make these electrons and positrons, and assume that only the charges differ and that the catchers have charged mitts, the charges of which they can freely change at the last minute, the situation is closer to that imagined in Bell's experiment. Again, it would be nonsense to assert that the charges knew in advance what the charges of the glove would be.

There is nothing in this to aid the paranormalists, yet as soon as it is clothed in the language of QM the situation changes. The wave packet takes on the appearance of something that can circumvent the laws of everyday physics, an entity that knows its structure throughout spacetime at once and which can be altered by some form of action at a distance. In short, the "geistwellen" of de Broglie[11] have suddenly been transformed into real ghosts. The paranormal phenomena that require some explanation can be incorporated into the quantum theory by this advanced knowledge of the state of the world on the part of every constituent physical entity.

In the press recently, following the successful corroboration of QM by Aspect et al.,[12] a number of reports stated that action at a distance had at last been confirmed. Aspect and his colleagues found that Bell's conjectural thought experiment is in fact what is realized in the laboratory.

Put another way, Bell's theorem must be violated if QM is right, and if local measurements are not the sole determination of a body's properties. Several critical discussions of the uses of QM in parapsychological studies have been given in various places, but perhaps the most telling is the use of the methodology by the PPs themselves. The most recent is by Nash,[13] which represents a theory of extrasensory observations. His basic argument is that the extrasensory participation in the state of the system by the observer is felt before the direct measurement is made on the system, thereby causing a collapse of the state function for the system prior to direct measurement. That the system chooses which state it will be in on the basis of the ESP mode of interaction is not discussed, nor how the observer-to-be manages to control the state that the system will achieve.

This experiment is proof to the paranormalists not only of some form of action at a distance, but even more. To quote Zukav:[14]

> Superluminal quantum connectedness seems to be on the surface at least a possible explanation for some types of quantum phenomena. Telepathy, for example, often appears to happen instantaneously, if not faster. Psychic phenomena have been held in disdain by physicists since the days of Newton. In fact, most physicists do not even believe that they exist.

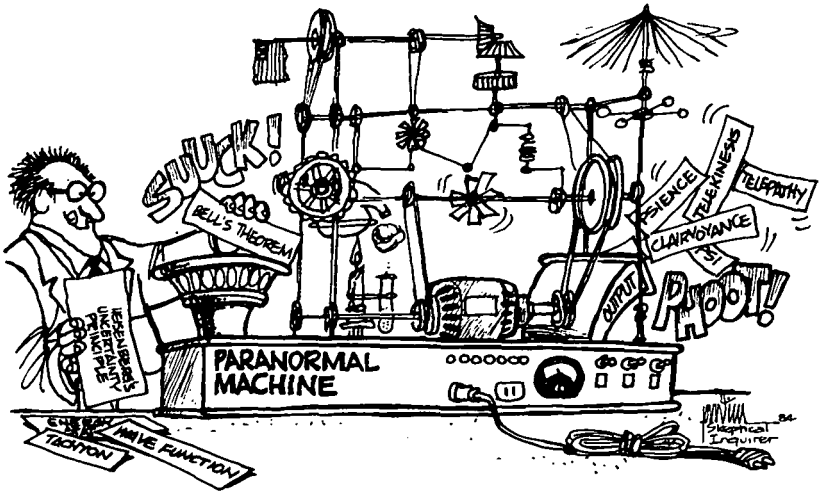
Zukav's comment that telepathy "appears to happen instantaneously, if not faster," seems to hark back to the tachyon, the hypothetical faster-than-light particle so popular about two decades ago. But let us continue with his invocation of Bell:[15]

> In this sense, Bell's theorem could be the Trojan Horse in the physicists' camp; first, because it proves that quantum theory requires connections that appear to resemble telepathic communication and second, because it provides the mathematical framework through which serious physicists [all physicists are serious] could find themselves discussing types of phenomena which, ironically, they do not believe exist.

It should be understood that Bell has never made such claims. His articles on QM theory of measurement have been sober and balanced, pointing to the necessity for studying in detail the consequences of QM predictions in light of classical concepts of local causation. The more ardent among his popularizers, though, have not let themselves be hindered by this conservatism. Zukav even references Targ and Puthoff in his footnote, who are referred to as exceptions among physicists in holding paranormal beliefs.

Targ and Puthoff, in *Mind-Reach,* invoke Bell's theorem as follows:[16]

> This Quantum Connection is codified in a theorem of great elegance known



as Bell's Theorem. This theorem emphasizes that no theory of reality compatible with Quantum Theory can require spatially separated events to be independent. Rather it must permit physically separated events to interact with each other in a manner that is contrary to ordinary experience. This aspect of modern theory, which is experimentally tested and confirmed, reveals that parts of the universe apparently separated from each other can nonetheless act together *as parts of a larger whole* [emphasis added], a statement more expected to be found in mystical writings than in a theory of physics.

Bell's theorem is concerned with the outcome of measurements on systems that obey QM. That is, as has been said of other theories of measurement, the predictions of QM are obeyed by quantum mechanical particles—a somewhat circular statement but an important one for understanding the nature of the theorem. After the particles separate it seems a natural assumption that they retain their correlated state; thus, any measurement of one particle can predict with certainty *exactly* the state in which the other particle will be measured.

In conclusion, some discussion of a few basic objections to the paranormal uses of science are in order. For the sake of discussion, let us dub this kind of theorizing *psience,* for contrast.

In any physical theory, the basic test of the theory and its attendant and necessary models is calculation and observation. A theory that serves simply to provide post hoc explanations serves no purpose other than as a

convenient tool with which to organize a diffuse body of empirical data. The ultimate use of these theories is to do more. That the data are collected is very nice, but the unification of these phenomena can only be achieved once the underlying causes are perceived, tests of these causes proposed, and the results of the tests predicted. This is precisely the opposite of psience.

In the realm of psience, any phenomenon is a thing in itself. There are no attempts to discover direct, causal relationships among these phenomena. As Bunge has pointed out, there is a lack of overall axiomatics in the conduct of inquiry. However, another point has been missed. The psientist, like the popularizer of normal science, is content to stop at the analogy. If a field of normal science presents what appears, by linguistic or pictorial analogy, a model having some of the same properties as the phenomenon the psientist is investigating, he will immediately grasp it and make it the explanation for his findings. As we have seen, there are similarities between the philosophical underpinnings of QM and some paranormal phenomena. That should not imply that there is any direct model-explicans link between the two realms. Yet the jargon of QM has become so diffused into psience that the vocabulary has become an explanation in itself—buzz words have become a replacement for calculation. This is a pathological state of scientific investigation, not normal science. It is indeed true that science has more than its share of punsters and jokers—one need only call to mind *glueballs, quarks, selfish genes,* and *hopping electrons*—but these are the clothing on the body of the theory, the mode of discourse only and not its substance.

An example of this use of jargon to replace results is the article by Whiteman in the *Handbook of Parapsychology:*[17]

> It seems therefore that any attempt to unite parapsychology with physics should adhere, substantially at least, to the language of quantum field theory in terms of "as if" fields at a level of creative potentiality.

Whiteman attempts to take the analogy of fields into the domain of the creative potential of the mind, by twisting the word *potential* (meaning possibility) to fit *potential field*—the chosen representation of the action of a force at the microlevel (as in magnetic or other particle exchange-induced fields). He goes further:[18]

> Thus above, and below, the level of scientific laws, which are substantially field equations, there is a cutoff in normal scientific thinking. The "laws of universal causation" appealed to by opponents of parapsychology and the behaviorists . . . [reference omitted] do not exist in the form supposed.

To speak of wave functions for a system and not discuss the Schroe-

dinger or Dirac equations, to speak of action at a distance without relativity or electrodynamics and Maxwell's equations, to talk about backwards causality and not mention the details of the Boltzmann equation or the Hamiltonian of a many-body system, is to behave like Mrs. Malaprop in *The Rivals,* who used to "deck her dull chat with hard words which she don't understand." No calculation within physics has ever produced a psientific result—nor can it, according to the psientists' own mode of conduct.

The psientists are not interested in results—only phrases. And in that guise, they have successfully hoodwinked many into thinking that they too can speak prose, like Molière's bourgeois gentleman, when within the context of normal science they have been doing so all of their lives. The physical world is understood not by speaking about it, or using colorful language to picture it, but by empirically and theoretically (mathematically) dissecting it. It is only, I believe, within this frame of mind that we will ever be able to peel away, in Plato's words, the veil of the unknown. That is only achieved by the action of manipulation, physically and intellectually, and not by blowing out hot air.

Acknowledgments

I wish to thank Dr. Nick Sanduleak for innumerable discussions and suggestions over the years on matters of both science and the response of the scientific community to the paranormalists. I also wish to thank Drs. Mario Bunge, James Alcock, and Paul Kurtz for their encouragement and comments during the CSICOP conference in Amherst, New York, in October 1983. Finally I wish to thank Dr. Lys Ann Shore for advice and assistance in the preparation of this paper. Some of the material discussed here has been presented in courses taught at Case Western Reserve University and at New College, University of Toronto, over the past few years, and was discussed at the CSICOP meeting during the session on parapsychology.

Notes

1. F. Capra, *The Tao of Physics* (Berkeley: Shambala Books, 1975); G. Zukav, *The Dancing Wu Li Masters* (New York: Morrow, 1979); R. S. Jones, *Physics as Metaphor* (New York: Meridian, 1982). See also M. Gardner, *Science: Good, Bad, and Bogus* (New York: Avon, 1981), p. 375, for a review of Zukav's books and for several good essays on the introduction of QM into the discussion of parapsychological phenomena in the past ten years.

2. B. d'Espagnat, "The Quantum Theory and Reality," *Scientific American,* November 1979, p. 158; W. H. Cropper, *The Quantum Physicists* (New York: Oxford University Press, 1970); G. Gamow, *Thirty Years That Shook Physics*

(New York: Anchor-Doubleday, 1966). Perhaps the best historical, and yet rigorous, introduction available is M. Jammer, *The Conceptual Development of Quantum Mechanics* (New York: McGraw-Hill, 1966), which has an excellent introduction to the EPR (Einstein-Padolsky-Rosen) paradox. See also M. Jammer, *The Philosophy of Quantum Mechanics* (New York: John Wiley, 1974).

3. For an excellent example of just how even the epistemology of the physicist is stretched by the problems of QM, see N. Bohr, "Epistemological Discussions with Einstein," *Atomic Physics and Human Knowledge* (New York: Science Editions, 1961), p. 32 ff. See also M. Born, *Experiment and Theory in Physics* (New York: Dover, 1956); L. Eisenbud, *The Conceptual Foundations of Quantum Mechanics* (Princeton: Van Nostrand Reinhold Momentum Books, 1971); A. Petersen, *Quantum Physics and the Philosophical Tradition* (Cambridge, Mass.: MIT Press, 1968; D. Bohm, *Causality and Chance in Modern Physics* (Philadelphia: University of Pennsylvania Press, 1957). There is, of course, a vast literature on this subject and many very fine introductory texts, but these are some of the more basic works that deal with the intellectual development of the subject, and it is usually these that are the basis of the paranormalists' arguments—not the ones that contain the worked problems solving the various cases for the Schroedinger equation.

4. See. W. Heisenberg, *The Physical Principles of Quantum Theory* (New York: Dover Books, 1930), and also W. Heisenberg, *Physics and Philosophy* (New York: Harper Torchbooks, 1958).

5. d'Espagnat, op. cit.; Jammer (1966), op. cit.

6. R. Targ and H. Puthoff, *Mind-Reach* (New York: Delacorte Press, 1977), p. 118.

7. The work of H. Schmidt, discussed extensively in *SI* in recent years, comes to mind here.

8. J. S. Bell, *Rev. Mod. Phys.*, 38 (1966): 447; d'Espagnat, op. cit. J. S. Bell, "Introduction to the Hidden-Variable Question." in *Foundations of Quantum Mechanics,* ed. B. d'Espagnat (New York: Academic Press, 1971), p. 171: One point may be noted: "It is easy to imagine that the classical domain could be extended to cover the whole. The wave functions would prove to be a provisional or incomplete description of the quantum-mechanical part, of which an objective account would become possible. It is this possibility, of a homogeneous account of the world, which is for me the chief motivation of the study of the so-called 'hidden-variable' possibility" (p. 172).

It is important to note that Bell was nonetheless most concerned with the formal structure of QM measurement and not of the more general applications of the wave function, since he deals only with the results of the processes and not the detailed description of the processes on the atomic level through the equations of structure and evolution.

9. See J. F. Clauser and A. Shimony, *Rep. Prog. Phys.*, 41 (1978): 1881, for the most comprehensive review of the Bell theorem and its various experimental consequences.

10. M. Gardner, *Order and Surprise* (Buffalo: Prometheus, 1983), p. 195.

11. The wave-particle picture derives from the scattering of X-rays by electrons (the Compton experiment) and the *analogy* of photon and particle behavior.

This was first adduced in more direct form by de Broglie from the behavior of X-rays and from the photoelectric effect. It is still a hard conceptual step for most students to make in the course of their education in physics. That a massive, presumably distended, body can be endowed with wavelike properties seems outlandish. It is, however, the basis of all subsequent exact calculations using the Schroedinger equation. The particular representation is dictated by a frustratingly obscure but postulationally useful insight—if a particle behaves *like* a wave (think of a fuzz-ball) then the equations of motion have a formal analogy in the wave equation. Actually, this is not a strict analogy and a technical note is in order here. The wave equation is a mathematical device that has its solutions specified completely by its initial conditions. This is what is meant by strict causality. The result can be expressed by using the familiar space-time diagram. Causality appears because the signals propagate from past to future, and through space, at a fixed speed, *c*, the finite velocity of light. All electromagnetic phenomena propagate at this speed. Even gravity waves have this rate of propagation of their influence. The Schroedinger equation, because of the formal analogy with waves, does have a similar time dependence but is really a diffusion equation and is therefore not strictly causal—it represents the random walk of the particle through spacetime. This is fundamentally different from EM waves and has served as the point of epistemological departure for those who are concerned about the relation between microscopic and macroscopic phenomena and their descriptions.

12. A. Aspect, P. Grangier, and G. Roger, *Phys. Rev. Letters,* 49 (1982):91; A. Aspect, J. Dalibard, and G. Roger, *Phys. Rev. Letters,* 49 (1982):1804. The latter states, explicitly: "Let us emphasize that such results cannot be taken as providing the possibility of faster-than-light communication."

13. Nash, *JSPR,* 1983.

14. G. Zukav, op. cit., p. 301 f.

15. Ibid., p. 302.

16. Op. cit., p. 170 f.

17. J. H. M. Whiteman, in *Handbook of Parapsychology,* ed. B. B. Wolman (Princeton; Van Nostrand Reinhold, 1977), p. 730.

18. Ibid. •