PHYSICAL MODELS OF PSYCHIC PROCESS

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We speak to you today in the context of a program we have termed Engineering Anomalies Research, whose premise is rather different from that which underlies most parapsychology research. Namely, we feel it is important for engineers to assess the possible vulnerability of various engineering components and systems to human consciousness in any form.

Present engineering activities tend to focus rather heavily in two major areas: the processing of information and the processing of energy. As these technologies push toward ever more delicate components and ever more elaborate systems, we think there is some possibility we may find psychic interactions that have very practical implications, particularly in such domains as very low-level information processing via microelectronics, very large integrated circuit arrays, delicate machine-man interfaces, elaborate optical displays and complex data storage systems. We believe it is worthwhile for engineers to look into these possibilities with some of the same thoroughness and sophistication which characterizes the more conventional parts of their trade.

Our program at Princeton has two major components. One involves a series of experiments in low-level psychokinesis using a variety of tabletop devices which have been described in some of our literature. The other is directed toward precognitive remote perception and especially to the development of more analytical judging methods for such studies. It is from this complex of experiments that we draw our following remarks on theoretical modeling.

Consistent with the approach just mentioned, the bulk of our modeling effort concerns physical models, as opposed to the psychological or physiological models described by the other speakers. As has been suggested in a previous talk, here, too, one can distinguish between utilitarian models established to deal with the data at hand in heuristic or empirical fashion and more fundamental models which hopefully increase insight into the physical processes involved. We are primarily concerned with the latter, but even here there are several levels of approach.

Obviously the simplest and least interesting possibility is that the observed effects are illusory, i.e., artifacts of poor experimentation. Then

there is the possibility that the effects involve only inadvertent, common physiological or physical processes, such as heat transfer from the operator to the equipment, changes in the chemistry of the environment, etc. More interesting effects, deliberately precipitated by the operator, might also involve known physical processes, such as electromagnetic radiation from the brain structure or from inter-cardial potentials, etc.

Failing explication by such prosaic models, it may then be necessary to seek for new forms of energy or information transfer which, once identified, would still fit into established physical models. Beyond these, it would become necessary to consider amendment of the physical laws themselves, perhaps similar to that required in the generalization from classical mechanics to quantum mechanics or to special and general relativity, where the previous forms became subsumed under the more elegant formalisms.

Finally, there is the possibility that the scientific paradigm itself is inadequate and that major revision in the representation of the process of conscious observation of physical events will be required. As you will note, the several models we sketch here enter this hierarchy at various levels.

The earliest physical models of psychic phenomena tended to focus on electromagnetic mechanisms. It is possible that these derived from the contemporary early development of radio technology, whereby communication at a distance was just then becoming commonplace and hence analogies to "transmitters," "receivers" and "frequencies" appear in these models.

The electromagnetic approach has been favored by some of our Russian colleagues through the years, for example I. M. Kogan, who proposed that the effect was propagated in the very low frequency ranges, say ten or twenty hertz, again probably because of the correlation with the natural electrical frequencies of human physiology. In other efforts, modification of the earth's magnetic field was proposed and the use of the prevalent electrostatic potentials in the atmosphere. The preoccupation with screen rooms in early psychic testing reflects the efforts to separate out some of these possible processes.

Somewhat related to the electromagnetic approach are several models invoking a variety of geophysical wave processes, such as geoseismic waves, infrasonic waves, barometric waves, etc. Some of these may have evolved from interest in the equally mysterious processes of the homing of birds and animals and animal group consciousness. All classical wave models, however, present some fairly basic problems in representing psychic processes in terms of their predicted attenuation and diffraction patterns, their propagation through various types and dimensions of shielding, their

velocities of propagation and, most especially, their inability to deal with substantial amounts of precognition.

A second general category of model invokes certain concepts drawn from thermodynamics, statistical mechanics and information theory, namely the concepts of entropy and randomness, of the information content of a system, the organization of it and the reversibility of physical processes. The second law of thermodynamics states that an isolated physical system will tend to evolve toward the most random arrangement of its elemental parts, that is, to the state of highest entropy. The issue raised by these models is whether consciousness has the capacity to reverse that natural tendency, i.e., to order random processes on demand, however slightly.

One variation of this model escalates the question even one step further, to ask whether it is possibly an indigenous property of extremely elaborate and complex systems that they may embody a functional consciousness of their own—that somehow out of their very complexity, the interlockings of their systems, they derive not only abilities to learn, to reproduce themselves, to adapt to their environment, but also to exert an entropy reversing form of consciousness on themselves.

In a yet more mathematical vein, there is a class of so-called "hyper-space" models, for which we can only offer an excessively general translation. The premise here is that the normal coordinates of human experience, namely three position and one time coordinate—let us call them the "hard" coordinates—are inadequate to represent all of physical reality and should be embellished by other "soft" coordinates, if you will. Our physical systems should then be described in terms of this augmented set of coordinates and our physical laws solved in this hyper-space. In this way alternative solutions to the problem will emerge which may be useful for representing paranormal effects.

Probably the most popular category of contemporary model attempts to apply the concepts and formalisms of quantum mechanics. Of all the forms of physical representation, quantum mechanics invokes the greatest array of empirical inputs which take leave of normal human rationality and yield in their implementation a corresponding array of consequences which are at odds with our normal impressions of reality. The very quantization process itself, that limits to discrete values the energies a system can assume, certainly is at variance with our usual experience and the idea of representing particulate systems by wave functions is also foreign to our normal expectations. Out of this formalism come such unusual effects as the uncertainty principle, the exclusion principle, the indistinguishability principle, barrier penetration and, most important of all, the fact that we deal with totally probabilistic rather than deterministic me-

chanical behaviors and that the observer exerts an explicit influence on the behavior of the system. You have heard references, I'm sure, to many of the "paradoxes" which illustrate apparently paranormal behavior in quantum mechanical systems: the "Einstein-Podolsky-Rosen" paradox, "Schrödinger's Cat," and "Wigner's Friend," all telling us that quantum mechanics is predicting something that we did not expect. Similarly, the essence of the covalent bond in quantum chemistry is paranormal by classical standards. Many attempts have been made and continue to be made to transcribe such quantum mechanical effects into representations of other paranormal phenomena.

Another class of modern model is usually referred to as a "holographic" or "transform" model. Essentially what is proposed here, as we understand it, is that the information of the universe is arrayed, not in terms of position and time as we have come to perceive it, but rather as frequency and amplitude information and that the human consciousness then performs suitable Fourier transforms on this to present us with information in the more familiar form. In the sense that the space and time coordinates are thereby downgraded to less fundamental quantities, one could interpret such models to imply that consciousness can, by this mechanism, access any portion of space and time to acquire information.

What then can be said about the utility of this array of models of psychic phenomena? Our own views are that no single satisfactory model exists and that our current experiments are not likely to define one in the near future. We do feel, however, that each of the above approaches does have some useful insights and concepts to contribute to our comprehension and organization of the phenomena. It appears to us that much more fundamental issues are involved than simple repair of established physical theories or simple insertion of new forces or information transfer mechanisms. We suspect that the phenomena involved are inherently statistical, rather than directly causal, with the important proviso that the scale is very grand. By that we mean that it may be difficult to acquire adequately large data bases on our usual scales of observation in space and time.

We also suspect that human consciousness can play a role in ordering random processes, i.e., that it can insert information into a system, just as it can extract information from it and in this way restore a form of symmetry to the second law of thermodynamics.

Quantum mechanics may be our most useful analog in modeling psychic phenomena, but rather than regarding it as simply a tool, perhaps we should treat it as a much more fundamental representation of consciousness itself and of the perception processes consciousness uses. In this sense, the empirical principles of quantum mechanics would be viewed more

as laws of consciousness and perception than as laws of a passive physical universe.

Finally, it may be that psychic processes are inherently and inseparably holistic, so that the ultimate model has to integrate both analytic and aesthetic concepts before it is capable of identifying the sources of the phenomena. Putting it another way, the phenomena may arise at the interface between a scientific analytical world and a creative aesthetic world and, therefore, will require coordinates that represent both the analytical and aesthetic components.

But all of this is little more than intuitive suspicion, at this point.

DISCUSSION

ROSEN: Recently, I attended a conference in which there was a lot of free flowing discussion about paraphysics and philosophy. One idea advanced was that trying to tie the intuitive or creative mode to the analytical in an external way by erecting an axis and new coordinates might be the wrong approach. An alternative suggested was that, instead of assuming the underlying separability of the "soft" and the "hard," we assume them ultimately *non*-separable, originating from a common source. As far as the mathematics are concerned, radically non-linear models would be necessary, ones that begin, not with a coordinate system for analysis, but with *wholeness*. This is the sort of approach I feel we might consider in struggling with the "software/hardware" interface.

JAHN: I don't believe I have any quarrel with the philosophy of your suggestion. But to the extent that the topic here was the development of physical models, sooner or later one has to come to a terminology that permits one to do the arithmetic. Clearly, that ought not to be done prematurely, but, eventually, one must have a basis of representation which allows a calculus if it is to be a physical model. Other kinds of models might be pursued in a more aesthetic way.

ROSEN: Monte Ullman mentioned at the end of one of the sessions, the work of David Bohm—Bohm's insistence on wholeness, his attempt to introduce the holographic model at the quantum level. Bohm is engaged in an effort to mathematize this approach. His attempt is not reductive, but uses non-metrical forms of algebra from which metrical representations unfold. I've also been working along these general lines and Charles Musés' concept of hyper-numbers, when expressed coherently, seems to tie in with Bohm's suggestions. Bohm and Musés insist that mathematics

can be creative, does not have to be reductive. So a kind of synthesis of analytic and intuitive strategies is foreseen by some of us.

DUNNE: One of the advantages we have in considering the applicability of a variety of physical models is that it keeps us open-minded. The holographic model offers, in its use of the Fourier transform, a means of approaching the intuitive/analytical dichotomy as not a dichotomy at all, but as two different ways of representing the same thing, two sides of the coin, so to speak. And, perhaps, it offers us an opportunity to get away from the dualistic view that things have to be either/or—either mind or body, either creative or analytic. What emerges may be a mode of perception similar to the Necker cube or other so-called optical illusions. You look at it one way and it appears to have one interpretation. You look at it another way and it has another. The coordinate systems are just two different means of expressing the same concept in two different contexts.

ROSEN: Yes, that's a good analogy, but I think it should be added that when one tries to apply the holographic analysis at the quantum level, it isn't as simple as doing Fourier transforms. The problems of infinities, quantum discreteness, measurement, etc., arise at this level, making matters much more difficult and mind-boggling. You might say that the holographic analogy has validity, but to bring this solution to bear at the interface concerning us today more is going to have to be done than Fourier transforms. That is why Bohm does not yet have the mathematics in its fully developed form. We're just beginning to make suggestions; the solution has not been brought into total focus as yet.

DUNNE: Some of the concepts of quantum mechanics need not be limited to the atomic level, but can be extrapolated to apply to macroscopic or possibly human behavior. The more essential feature is that quantum mechanics acknowledges the interaction of the observer with the system being observed.

BRAUDE: Whenever this issue of the holographic model comes up, I immediately become confused. I don't know whether what I'm going to say now will make any sense, but at least let me try to express my confusion. It seems to me that when people argue that reality is in some interesting way holographic, what they're trying to analyze holographically aren't merely objects, but also facts, states of affairs and concepts, in other words, context-dependent and functional aspects of reality and not mere structural features of reality. It seems to me that the very deep error that that rests on is the notion that matters of fact, which can only be represented functionally, are really just topological or structural features of nature. So it seems to me that the insight that subverts this attempt to represent nature holographically is the idea that there are a number of conceptual grids we can place over reality. It's an old mystical notion.

The grids all apply to the same reality, but they're incommensurate, at least in many cases. That is because things that count as objects or connections between objects with respect to one conceptual grid, may not count as objects or connections between objects in other conceptual grids. So that, in merely attempting to describe reality, our context and purposes lead us to regard certain things (but not others) as objects and relations among objects and that bit of abstraction automatically rules out regarding certain other things for those contexts as objects and relations between objects.

So we have a variety of possible levels of description of reality, some of which may be connected to others in some sort of law-like way, but may be anomalous with respect to one another. In fact, another way of approaching the mind/body distinction is to see if mentalistic language and physicalistic language represent alternative conceptual grids which may or may not correlate by means of laws.

DUNNE: It appears to me that the context within which you view or measure or assess reality could very well be one of the coordinates that we're looking for. It's very difficult, once you really get into it, to separate reality from perception. And, maybe it's just one mode of transforming what we are perceiving into what we are conceiving, dependent upon the context in which we interpret our perceptions.

BRAUDE: To some extent, I'm sympathetic with that, except I don't feel that any particular context or point of view is the sort of thing specifiable in sufficiently rigorous a way to make it really useful for, let's say, a physics major, any more than any particular mental state can be characterized topologically or structurally.

JAHN: If one concerns himself with the functional value of the model, what I glean out of the so-called holistic genre of models is the question of whether the normal spatial and temporal coordinates are inherently fundamental to the phenomena under study or whether they are organizing principles the mind deploys in order to correlate the data it acquires. I think it is important, in terms of the experiments one devises, on which of those two trails one sets out. I would prefer not to argue the details of holistic modeling, but rather the question of organizing principle versus fundamental property in relation to design of experiments and interpretation of future data.

BRAUDE: Well, that seems like a much more modest enterprise and, as I understand it, I have no quarrel with that.

MORRIS: I'd like to hear you expand a little bit on your notion of the aesthetic perspective. Your last comments were that psychic processes may be inherently holistic and there may need to be an integration of both

scientific and aesthetic aspects. What do you mean by the aesthetic aspects, the aesthetic perspective and so on? Is that a general concept?

DUNNE: In exploring the psi process I think we're dealing with what is more traditionally called the intuitive. I was speaking with William Braud earlier about the fact that one can assess the lability or the inertia of a given situation and have certain anticipations about the outcome. One could draw an analogy to the act of introducing two people whom you know and whom you think should have a lot in common and thus should get along well. (If you have ever attempted to arrange a blind date, you might know what I'm talking about.) Yet even if all of these facts are in place, if the "chemistry" is wrong, it simply doesn't work. I guess when I think of the aesthetic, I think of the "chemistry," the intuitive side—what feels right, what gives you the feeling that this is the mood or the setting or the environment in which this experiment will work. The analytical aspect comes in when we try it out and find out whether indeed it did work and how well it worked.

JAHN: Let me try a little more analytical answer to your question. Physical theories are characterized by independent variables, dependent variables, parameters, in the quantum domain by quantum numbers, eigen values and so on. The question is, can one find analogs to these concepts in the softer terrain of emotional quality? Can one establish an analogy between the position coordinate and some emotional property, between the time coordinate and another emotional property? Can one get an orthogonal set of independent variables in which to represent all of the dependent variables of the emotion? I don't know, but one can try. For example, quantum mechanics of atomic structures is normally carried out in a spherical coordinate system in which one has as independent variables the radius, the two angles and the time. In this system of coordinates, one searches for standing wave patterns for the probability distribution functions. Can one talk similarly about an emotional, spherical coordinate system? Can one talk about a radius vector that has something to do with, say, the intensity of the emotional component? Can one talk about a polar angle, as it were, in an emotional coordinate system that has something to do with the attitude of the individual or individuals involved? Can one talk about an azimuthal coordinate that has something to do with context, etc? Can one then proceed to calculate, in terms of these very intangible coordinates, to consequential results?

I mentioned the covalent chemical bond, for example, which is about as "paranormal" a thing as one will find in physical theory, in the sense that the bulk of the energy of a simple covalent bond cannot be explained by any classical analogy. It arises ultimately as a mathematical consequence of the fact that two electrons interacting in an atomic system, are

indistinguishable—they can not be labeled. If we now transfer such formalism to a psychic interaction of two individuals, i.e., treat one as one atom of the molecule and the other as the other atom, quantum mechanics will predict some "paranormal" behavior of the pair.

In a similar vein, quantum mechanics regards the standing wave patterns in the potential well of an atomic system as the "realities" that can be measured. It is possible that something about the human psyche can also be represented as a wave function which, when trapped in a particular context—the "body," "mind," "personality" or whatever—assumes characteristic "standing waves" or "eigen-states" that are observable properties of the person?

STANFORD: In your paper you underline rather drastic possibilities that you're considering. One is that the paranormal phenomena may represent marginal changes from normal behavior on a very grand scale, with fluctuation times which tax human observational capacity and I think you refer to a grand scale of statistical effect. I'm wondering if you could concretize that a little bit for us—I know that it may be a difficult question, but what do you have in mind there?

JAHN: The process of emission of radioactive particles from a nucleus is classically illegitimate. The particles are trapped in a nuclear potential well that precludes their escaping by any classical means. They get out because they can "tunnel" through a potential barrier by a wave mechanical process that has analogs in the wave mechanics of optics as well as of quantum mechanics.

To represent this process, one develops a statistical model which, while impotent to tell you when any given beta particle is going to come out, does tell you how many will come out on the average over a given period of time or, equivalently, what the likelihood is of one of them coming out in a given time. This representation is useful because the scale of the event is small compared to the scale of observation. The time scales of nuclear decay are, in general, very short; the dimensions are very small. Hence, an observer in our usual world of reference can observe a great many decay events over a reasonable period of time, for a reasonable supply of radioactive material. Imagine yourself, however, a very tiny observer trapped in a single nucleus with time measuring equipment limited to a few milimicroseconds and scale measuring devices no larger than the scale of the nucleus itself. To you in that condition, a beta emission would be a singular event; it would be unpredictable, irregular, irreplicable—"paranormal." It would be a nuclear scale poltergeist, something that should not happen. So it's a matter of the relative scales of the event and the observation and this may be our problem in representing psychic phenomena. Perhaps if we had measurement scales on the order

of millennia rather than seconds and if we had access to millions of worlds rather than just one, we might be able to establish relevant statistics of these so-called paranormal phenomena. But we do not. We exist on the wrong scale for statistical experience of this class of events. One practical corollary of this view is that psychic experimentation should focus on particular effects which lend themselves to rapid accumulation of large data bases, e.g., REGs.

DUNNE: I think Chuck mentioned earlier how, according to many Eastern philosophies, enlightenment is supposed to take us many lifetimes. Maybe that's the grand scale they were talking about. It's possible that there's a wave/particle duality that exists in human consciousness. I have an individual consciousness or an individual personality which is the equivalent of a particle. But as part of the human race, I'm part of a much larger wave, the extent of which I'm incapable of conceiving or influencing to any significant degree. Depending on which point of view I want to take in terms of making a decision or acting, my acts and decisions are going to be quite different.

BRAUDE: I hope I'm not flogging a dead horse on this topic and if so, I apologize to all defenders of animal rights. You see, I'm puzzled when you talk about poltergeist phenomena and so on, as though somehow, in some very interesting way, these may be inherently statistical and not directly causal. And, so, I would just like to go back again to some of the apparently easily, directly caused phenomena of the great superstars like D. D. Home. I'm not sure what the cash value is in saying that those phenomena are inherently statistical rather than directly causal. They seem paradigmatically causal.

JAHN: I'm not exactly sure what you mean by cash value. Do you mean the ability to design poltergeist experiments?

BRAUDE: No. The physical phenomena of D. D. Home, for example, would seem to be paradigmatically causal in the sense that were it not for some apparent intention, some effort on the part of Home, these phenomena would not have ocurred.

JAHN: But you don't come out of that set of experiments with much in the way of guidance how to sit at a table and produce the same phenomena, which really would be the value of the theory, would it not?

BRAUDE: We are talking about whether the phenomena are causal or not. I think the same would hold true about shooting free throws in basketball. You could watch the greatest star do it and you know he's causing the ball to go through the hoop, but that isn't going to help other people do it, necessarily.

DUNNE: I would presume that if you asked D. D. Home what he was doing or what state he was in when these phenomena took place, he would

probably give an answer similar to Mrs. Garrett's description of a state of high indifference. It could be that the causal factors pertain to the larger wave context rather than to the individual one. Does the basketball superstar cause the ball to go through the hoop? Or does he facilitate the event by losing himself and becoming part of the larger reality of the total game? The dissolution of ego boundaries that permits much larger effects to take place is pure speculation.

JAHN: If we had at our disposal ten billion D. D. Homes all doing the same experiments and we could collect data from these, there might be some hope of quantifying a statistical theory of that type of mediumship, which would give us important parametric leverage on the phenomena. We would learn about its time span, its energy spectrum, its range etc. D. D. Home by himself is not going to provide us with sufficient data distribution for us to write the statistical properties of the phenomena.

BRAUDE: But whether or not we can get that sort of data or material presumably is not going to be a criterion for calling a phenomenon causal or merely statistical. You might say it's something in a person's physical make-up or physiological make-up that determines that he's a mathematical genius, for example. And, however rare those are, there's a sense in which you might understand it to be an anomaly of some sort when you come across a genius or a very gifted person. But when you say that a phenomenon is statistical and not causal, I find I just don't understand what that means.

JAHN: To me, "causal" implies that every time a particular set of initial conditions are met, exactly the same thing occurs. "Statistical" implies that a range of events may follow, which can be described only in statistical terms.