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On the Quantum Mechanics of Consciousness, with Application to Anomalous Phenomena

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Theoretical explication of a growing body of empirical data on consciousness-related anomalous phenomena is unlikely to be achieved in terms of known physical processes. Rather, it will first be necessary to formulate the basic role of consciousness in the definition of reality before such anomalous experience can adequately be represented. This paper takes the position that reality is constituted only in the interaction of consciousness with its environment, and therefore that any scheme of conceptual organization developed to represent that reality must reflect the processes of consciousness as well as those of its environment. In this spirit, the concepts and formalisms of elementary quantum mechanics, as originally proposed to explain anomalous atomic-scale physical phenomena, are appropriated via metaphor to represent the general characteristics of consciousness interacting with any environment. More specifically, if consciousness is represented by a quantum mechanical wave function, and its environment by an appropriate potential profile, Schrödinger wave mechanics defines eigenfunctions and eigenvalues that can be associated with the cognitive and emotional experiences of that consciousness in that environment. To articulate this metaphor it is necessary to associate certain aspects of the formalism, such as the coordinate system, the quantum numbers, and even the metric itself, with various impressionistic descriptors of consciousness, such as its intensity, perspective, approach/avoidance attitude, balance between cognitive and emotional activity, and receptive/assertive disposition. With these established, a number of the generic features of quantum mechanics, such as the wave/particle duality, and the uncertainty, indistinguishability, and exclusion principles, display metaphoric relevance to familiar individual and collective experiences. Similarly, such traditional quantum theoretic exercises as the central force field and atomic structure, covalent molecular bonds,

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barrier penetration, and quantum statistical collective behavior become useful analogies for representation of a variety of consciousness experiences, both normal and anomalous, and for the design of experiments to study these systematically.

1. INTRODUCTION

The proposition that human consciousness may exert direct influence on natural processes is hardly new. Philosphers from antiquity to the present have pondered this possibility from many perspectives. Most ancient and contemporary religions presume the efficacy of prayer and other invocatory rituals in affecting the course of physical events. Centuries of attention to metaphysics in general and to alchemy in particular testify to some archetypal conviction, even among highly analytical thinkers, that the affairs of the physical world and the affairs of the mind are, at some level, inextricably linked. Within the modern scientific paradigm, as well, numerous indications arise that consciousness can play an active, albeit subtle, role in the establishment of physical reality: in quantum mechanics, the wave–particle duality, the indistinguishability, uncertainty, and exclusion principles, and the observation effects; in special and general relativity, the importance of the frame of reference and the distortion of the metric; and in the subnuclear and cosmological domains, the deployment of progressively more subjective and aesthetic descriptors.

More direct evidence for the intrinsic inseparability of the mechanics of the physical world from the cognitive and emotional mechanics of the mind can be found in the currently compounding body of anomalous data on the interaction of human consciousness with low-level information-processing devices and systems. This class of research, barely a decade active, appears finally to be providing some systematic pattern of statistically replicable results within the long enigmatic and suspect domain of so-called psychic phenomena. Having to deal as much with impressionistic and anecdotal evidence as with analytical substance, and inevitably imbued with heavy personal and numenistic overtones, scholarly study of physic phenomena over the past century has been plagued by an excess of incompetent and occasionally fraudulent work on the one hand, and by a battery of categorical and biased skepticism on the other. Yet once these overburdens of illegitimate testimony and irresponsible criticism have been removed, there seems to remain sufficient residue of valid evidence to justify continued empirical study of such effects and serious contemplation of their implications for physical theory as well as for pragmatic applications.[1]

Admittedly, the fundamental processes underlying such phenomena appear not to lend themselves comfortably to traditional modes of scientific experimentation or to conventional formats of theoretical representation. The establishment of sequential experiments yielding regularly replicable results has proven extremely elusive, and no direct transcription of known physical, psychological, or physiological models has been effective in ordering or correlating the empirical observations. While these two major obstacles provide the basis for much of the skepticism and criticism of the field, they may also be important guideposts towards its ultimate comprehension; i.e., they may be indicators of the magnitude of the expansion in the repertoire of reason that will be required to render the anomalies comprehensible.

The purpose of this paper is to sketch the essence of a metaphorical model, developed in detail elsewhere,[2] that attempts to represent the basic role of consciousness in the definition of physical reality, in a manner that subsumes established physical mechanics and classical psychological models, but also accomodates the anomalous effects of contemporary psychic research as normal consequences of an expanded experiential paradigm.

2. EXPERIMENTAL BASE

Prototypic examples of the type of anomalous data predicating the proposed model will be drawn mainly from our own laboratory program because we are most familiar with the technical characteristics of these experiments and because they have evolved in symbiotic dialogue with the model. All of these data have been reported in detail in other papers[3–7] and here are summarized only very briefly. In one category, we shall refer to results from a number of experiments in low-level psychokinesis (PK) that employ a variety of mechanical and electronic devices to explore the vulnerability of random physical processes to the influence of human consciousness. Although these experiments differ widely in their underlying physical mechanisms and technical implementation, when addressed with comparable protocols they are found to yield indicatively comparable results. In each case, a particular microscopic or macroscopic random physical process is transcribed into a corresponding random sequence of binary or quasi-binary events suitable for rapid and precise counting. When properly aligned and tested, these devices produce calibration data closely conforming to large-sample binomial statistics, i.e., to normal Gaussian distributions, and maintain robust insensitivity to systemic or environmental artifacts.

The common protocol for these experiments calls for a number of

individual human operators to accumulate large quantities of data, contemporaneously interspersed under three states of prerecorded intention: (1) PK^+: intention to displace or distort the output distribution toward higher values than the baseline; (2) PK^-: intention to displace or distort the output distribution toward lower values than the baseline; (3) BL: intention to acquire baseline distributions, i.e., not to influence the device or process. All other conditions of the operation are maintained identical throughout. Data are recorded in redundant modes and automatically inserted on-line into a master data base. Operators are provided with various forms of immediate and subsequent feedback, such as LED displays, computer displays, and strip chart printouts, and are encouraged to employ whatever psychological strategies they find effective. No induction or relaxation techniques, psychological tests, or formal instruction procedures are employed, but efforts are made to provide a comfortable and friendly laboratory ambience. All operators are anonymous and uncompensated, and none claims unusual psychic talents.

At this writing, we have been engaged in such research for some seven years, utilizing some 40 operators who have compounded over 25 million experimental trials, comprising over 1.5 billion bits of digital information. To the extent that the results of these experiments may be generalized, the following features can be cited:

(1) The calibration data conform to theoretical expectation and display no artifactual aberrations of any statistical significance.

(2) The primary effect of the PK efforts is to shift the means of the binary output distributions slightly, usually in the intended directions, with little detectable changes in the standard deviation or higher moments. The statistical merit of these small shifts of the means depends on the number of trials processed, and can compound to highly sigificant anomalous effects over very large numbers of events.

(3) Individual operators tend to display characteristic "signatures" of achievement on such experiments. These may be dependent on the particular modes of data acquisition, but are relatively independent of the specific device or system employed.

A few illustrations of these general features are shown in Figs. 1–5. For example, Fig. 1a is a frequency-of-count distribution for some 23,000 baseline trials, each of 200 bits, of a microelectronic random event generator (REG),[3] superimposed on a theoretical Gaussian approximation to the appropriate binomial statistics for this device. With reference to the same theoretical distribution, Fig. 1b displays the results of one operator's efforts to shift this distribution toward higher or lower num-

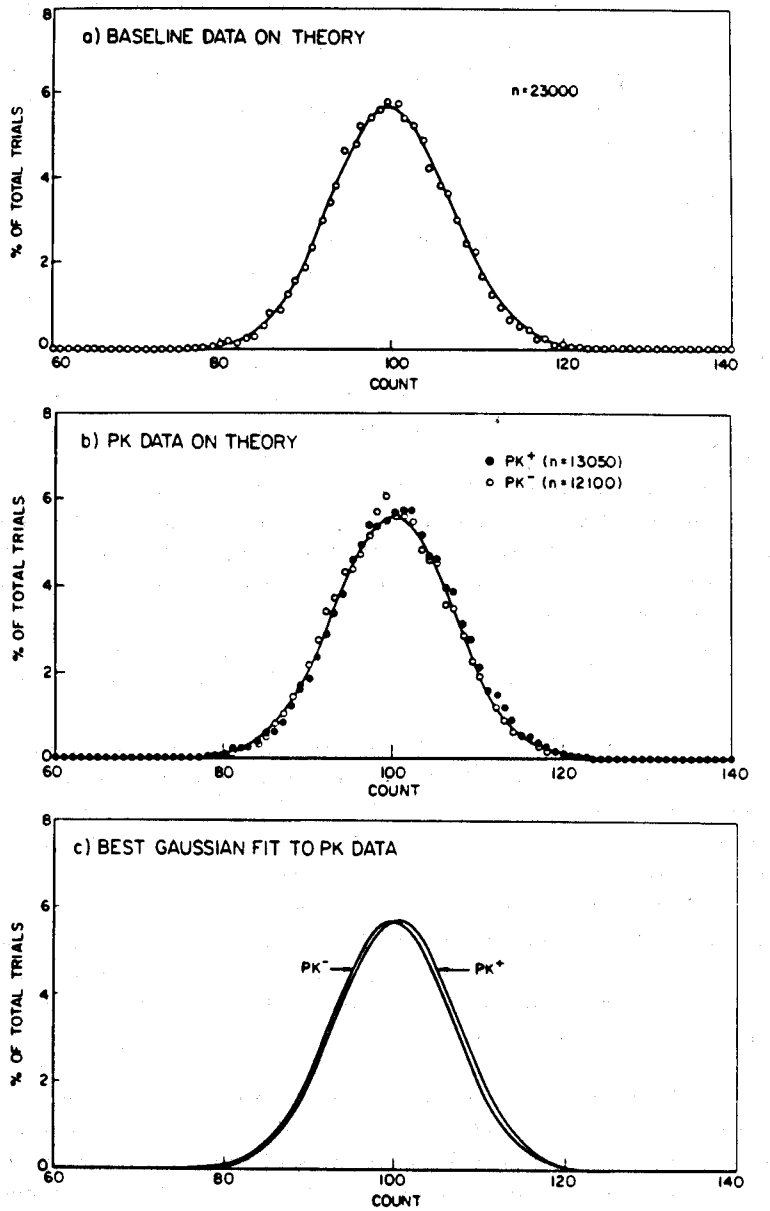

Fig. 1. REG frequency of count distributions (operator 010).

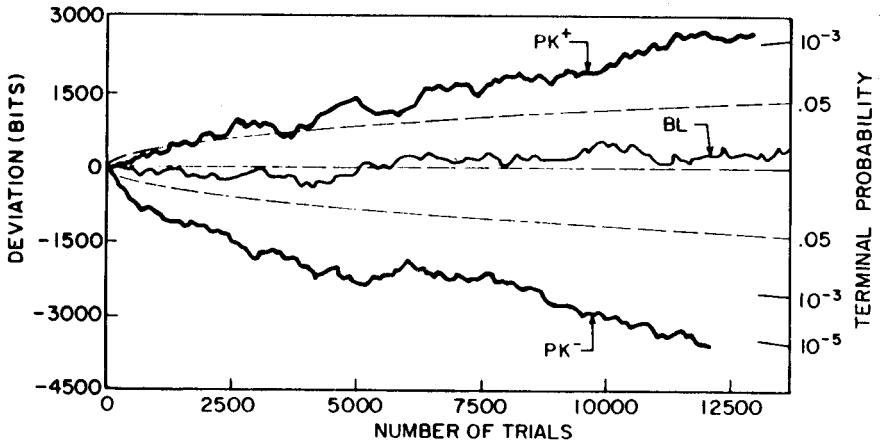

Fig. 2. REG cumulative deviations from theoretical mean (operator 010).

bers of counts over some 25,000 PK trials, and Fig. 1c shows the best Gaussian fits to these PK^+ and PK^- data. The accumulated deviation of the counts from the theoretical mean as a function of the number of trials processed for each of the three intentions of the operator are shown in Fig. 2. In this figure, the dashed parabolas are the loci of the 5% chance expectation of reaching that accumulated deviation at that number of trials, and the scale at the right indicates the range of terminal chance probabilities. In the case shown, the terminal values of the means of the PK^+ and PK^- data exceed chance expectation by several standard deviations, with the composite achievement unlikely by chance to the order of a few parts per billion.

For given operators using particular experimental conditions, such cumulative deviation patterns are found to be quite replicable and hence are referred to as "signatures." Figure 3 shows typical signatures for a few of the many other operators working on this same experiment. Some operators achieve PK results in only one direction of effort, some in neither, some in both, and some show inverted results. The PK^+ and PK^- achievement patterns for a given operator are seldom symmetrical, and are often found to be dependent on the particular conditions under which the operator is performing the experiment, such as the counting rate, whether each trial is initiated manually or automatically, or whether the operator chooses or is randomly assigned the direction of effort. For example, Fig. 4 displays the sensitivity of one operator's performance to the "volitional" vs. the "instructed" modes of data generation. A complete graphical and statistical compendium of all operator REG signatures and their dependence on such parameters is available in Ref. 3, along with summaries of

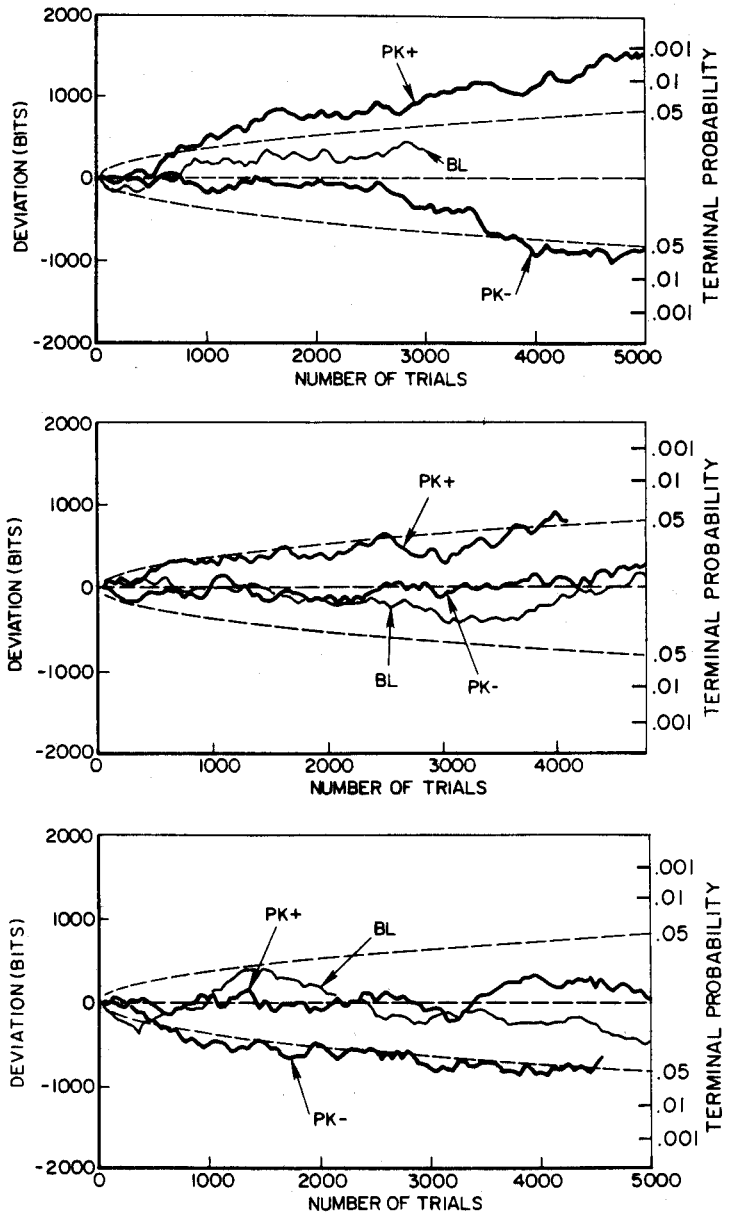

Fig. 3. REG cumulative deviations from theoretical mean (operators 080, 082, 066).

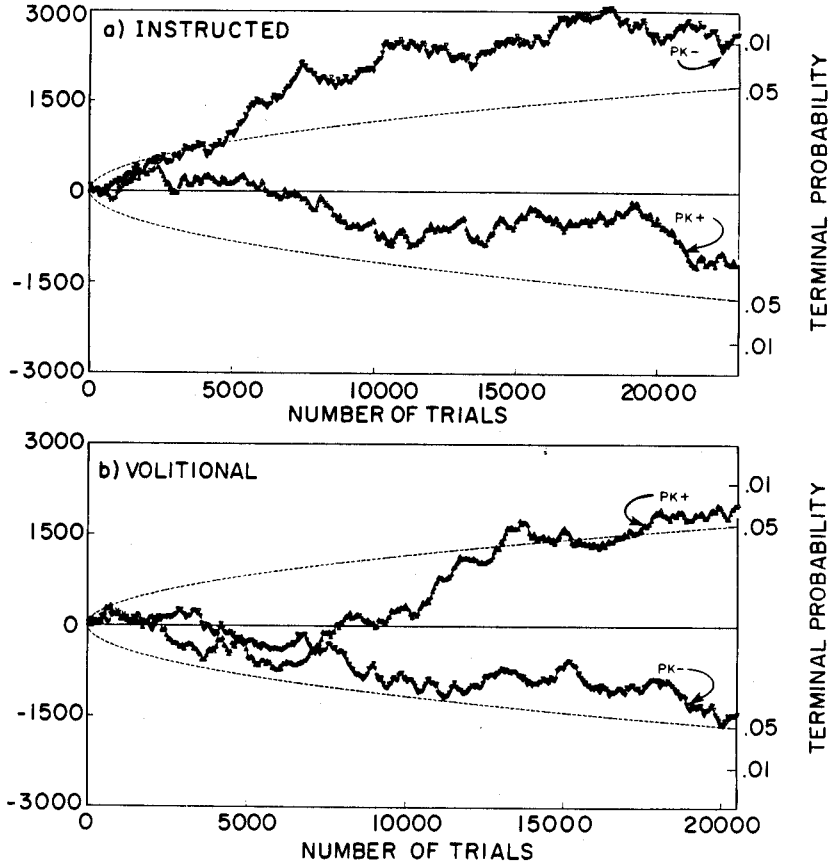

Fig. 4. REG cumulative deviations from theoretical mean: instructed/volitional (operator 055).

the entire composite data base. Comparable results have been reported by a number of other laboratories.[8]

The individual operator signatures are found to be much less dependent on the specific experimental device employed. Figure 5 compares data acquired by one operator on (a) an REG device using a standard microelectronic diode as its noise source[3]; (b) the same apparatus with that noise source bypassed by a "pseudo-random" digital string provided by a programmed array of 31 microelectronic shift registers[3]; and (c) a macroscopic "random mechanical cascade" (RMC) experiment, in which some 9,000 3/4″ polystyrene spheres trickle downward through a quincunx array of 330 3/4″ nylon pegs, whereby they are scattered into 19 collecting

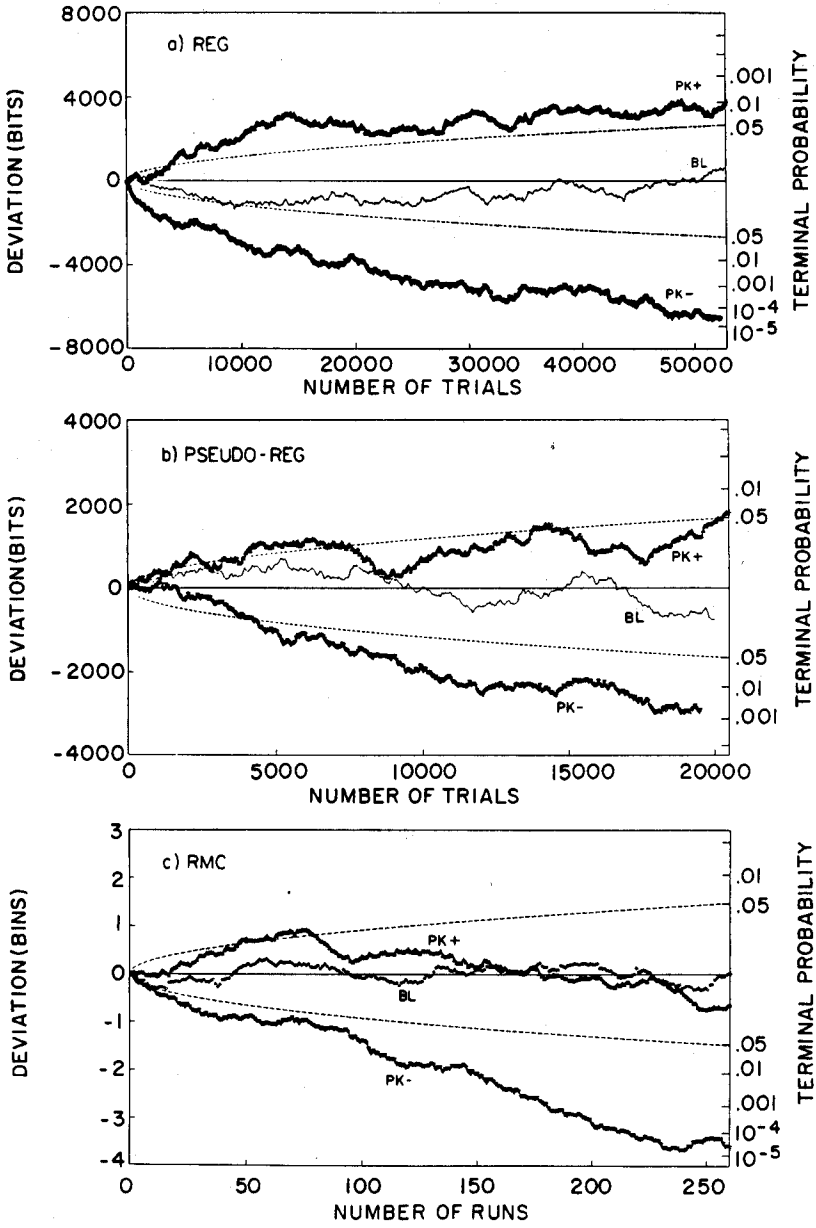

Fig. 5. Cumulative deviation signatures on three devices (operator 010): (a) random event generator; (b) pseudo-random event generator; (c) random mechanical cascade.

bins, filling them in close approximation to a Gaussian distribution.[4] Each of these graphs represents a substantial concatenation of numerous experimental series conducted over many months or years of effort. Similar correspondences have been observed for a number of other operators, despite their characteristically different individual signatures. Thus it appears that although the observed effects are clearly operator-specific, and in many cases condition-specific, they are not nearly so device-specific. Such empirical evidence speaks against phenomenological conception involving consciousness directly influencing the random physical process itself, e.g., the flux of thermal electrons in the REG, or of the polystyrene balls in the RMC, and favors a class of model that deals with consciousness interacting more holistically with the information-generating systems as a genre.

Table I summarizes the total data bases accumulated over the six-year period from mid-1979 to mid-1985 on the REG, pseudo-REG, and RMC experiments. The magnitude of these data bases and the ubiquitous charac-

Table I. PK Data Summaries[3,4,6,7]

		REG	Pseudo-REG	RMC
Number of trials		683,700	217,500	22,032,000
Number of series		76	29	56
Number of operators		28	10	15
Mean count	PK+	100.032	100.037	10.0273
	BL	100.004	99.969	10.0280
	PK−	99.971	99.931	10.0205
Fraction of series means in intended direction	PK+	0.59	0.45	0.52
	PK−	0.63	0.62	0.71
z-Score	PK+	2.191	1.397	−0.328[a]
	BL	0.263	−1.198	—
	PK−	−1.980	−2.575	−4.202[a]
	ΔPK	2.950	2.809	2.741[a]
Chance probability of means	PK+	0.014	0.081	(.371)
	BL	0.396	0.116	—
	PK−	0.024	0.005	10^{-5}
	ΔPK	0.002	0.002	0.003

[a] In the absence of theoretical mean and standard deviation, calculated as t-scores with respect to experimental baselines.

ter of the anomalous effects they display epitomize the nature, extent, and replicability of this laboratory's findings on such operator-related anomalies in random physical systems.

A second substantial body of data relevant to the proposed model has been acquired in a class of clairvoyance experiments commonly termed "remote perception" or "remote viewing." Although these experiments are superficially quite different in protocol, ambience, physical aspects, and nature of the data, analytical reductions of their results display anomalous statistical behavior similar to that found in the psychokinesis studies. The particular protocol followed is a variation on numerous similar studies elsewhere,[9–12] and is termed precognitive remote perception (PRP). Essentially, one participant, called the "percipient," is asked to generate a description of an unknown location where a second participant, called the "agent," is, was, or will be situated at a prescribed time. Initially the percipient records his impressions about the target in a free-response, stream-of-consciousness style, and then encodes them in some structured form amenable to analytical processing.

Most of the experiments reported here were conducted in a precognitive mode, wherein the percipient records his impressions before the agent visits the target and, in many cases, before the target is even selected. Two modes of target selection have been employed, with no discernible effect on the experimental results. In the "instructed" mode, the target for each experiment is randomly selected from a large pool of potential targets previously prepared by a third person not otherwise involved in the experiment or its evaluation, and maintained so that no percipient or agent has access to it. In the "volitional" mode, the target is arbitrarily selected by the agent at the time specified for its visitation.

At present, the data in hand comprise over 400 perceptions of this sort which range from virtually photographic accuracy, through varying degrees of correspondence to the details and overall ambience of the scene, to total irrelevance.[5] In some case, details that are central to the agent's view of the scene are ignored by the percipient, while minor aspects are escalated in importance. In other cases, there are spatial inversions or other geometrical distortions. Frequently, the more impressionistic aspects seem to be perceived more accurately than the analytical details.

The principal effort in this study has been to devise methods to extract from such subjective evidence some quantitative measure of the degree of anomalous information acquisition. For this purpose, a code, or alphabet, of simple descriptive queries is employed, which can be addressed to all targets and all perceptions. These "descriptors," 30 in number, range over a spectrum from quite factual discriminations, e.g., whether the scene is indoors or outdoors, whether trees are present, or whether there are

automobiles, to much more subjective aspects, such as whether the ambience is noisy or quiet, confined or expansive, hectic or tranquil. Encoding of the target is normally performed by the agent at the time of visitation, and of the perception by the percipient after he has formed a free-response impression of the target.

With the target and perception data thus encoded, a variety of analytical scoring methods, described in detail in Refs. 5, 13, and 14, are invoked for quantitative evaluation of the statistical merit of each perception in a given pool. Critical elements of each of these methods include the establishment of the *a priori* probabilities of all of the descriptors in the given target pool in terms of which the correct binary responses can be weighted; the calculation of suitable scaling scores, such as perfect scores and chance scores, to which the achieved perception/target scores may be compared; and the calculation of an empirical "chance" distribution of scores from purposely mismatched target/perception pairs. In some recipes ternary or quaternary descriptor responses are also employed, whereby the agent and the percipient can effectively reject or equivocate on a question, or express gradations of its importance.

The most powerful aspect of this coding approach is that unlike traditional impressionistic ranking procedures, digital scoring algorithms can be applied to compare any perception with a very large number of alternative targets—not just the 5 or 10 that could be compared by a human judge. From the mismatch scores, i.e., the off-diagonal matrix elements of the perception/target array, an experience of empirical "chance" compounds that permits statistical quantification of the proper target scores. Specifically, the mismatch scores for any given scoring method are found to define an "empirical chance distribution" that has Gaussian characteristics and thus supplies the parameters needed for quantitative statistical evaluation of the scores of perceptions matched to their intended targets.

The process is illustrated in Fig. 6, where the larger dashed curve is the empirical chance distribution thus constructed by one particular binary scoring method from some 42,000 such mismatched scores. In comparison, the solid line denoting the distribution of proper target scores for the 334 trials comprising our entire formal data base is seen to be distorted to the high-score side. If from that proper target score distribution is subtracted the largest component that is a subset of the empirical chance distribution (dotted curve), the residue (dot-dashed curve) should be an indication of the information acquired beyond the chance expectation for guessing. In this case, about 15% of the trial scores are involved in that extra-chance, positive information residue. More detailed numerical calculation yields a probability for this degree of information acquisition by chance of about

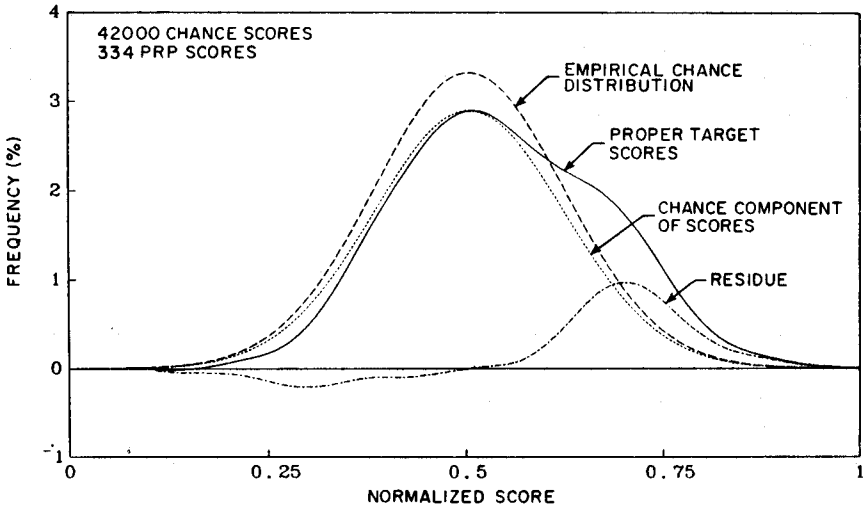

Fig. 6. PRP Score Distributions.

10^{-11} for the data and method illustrated. The other scoring methods yield comparable results.[5]

A primary interest is the dependence of this extra-chance information component on the physical parameters of the experiment, most notably the distance between the percipient and the agent, and the time interval between the perception effort and the target visitation by the agent. Within the accuracy of the data and the statistical treatment just described, no significant dependence on distance is found; up to intercontinental distances of several thousand miles, there appears to be no discernible preference for closer targets. Certainly, there is no $1/r^2$ dependence that might be expected for any physical wave-propagation mechanisms. Perhaps even more interesting is the absence of any discernible dependence of perception accuracy on the time interval, as well. Over the intervals covered by these experiments, up to 150 hours, there is no statistically significant dependence on this temporal parameter.

Thus, despite the apparently wide dissimilarities in the underlying physical mechanisms and experimental protocols compared to the PK studies, it again appears that a basically random process of information acquisition, in this case the guessing of certain details of a specific remote target location, may be distorted from its normal chance distribution to a pattern which embodies an excessively accurate component, achieved by some anomalous means.

Many other experiments conducted in our laboratory and elsewhere, yielding generally similar anomalous results, could be cited to buttress the credibility of such data,[1,3,5,8,12,43,64] but for purposes of a first dialogue with the model developed below, those just summarized will suffice.

3. PREMISES OF THE MODEL

The literature of psychic research abounds with attempts to apply various established physical formalisms to the explication of such anomalous consciousness-related phenomena.[15–23] Efforts to invoke electromagnetic theory, statistical thermodynamics, quantum mechanics, geophysical mechanics, hyperspace properties, and other approaches have been made, but none of these has proven fully adequate to the task. It is our view that no direct transposition of existing physical theory is likely to prevail. Rather, to encompass effects like those sketched above, a substantially more fundamental level of theoretical model will need be deployed which explicitly acknowledges an active role of consciousness in the definition of physical reality.

The approach proposed here presumes that reality is the product of a fully complementary and holistic dialogue between consciousness and the environment in which it is immersed. The vocabulary of this dialogue is information, in the most general sense, and comprises all physical, intellectual, and emotional currency or nomenclature having the capacity to specify or quantify the state of the environment, of the consciousness, or of the interaction between them. As invoked here, the concept of "consciousness" subsumes all categories of human experience processing, including perception, cognition, intuition, instinct, and emotion, at all levels, including those commonly termed "conscious," "subconscious," or "unconscious," and presumes no specific psychological or physiological mechanisms. The concept of "environment" includes all circumstances and influences affecting the consciousness that are perceived by it to be separate from itself, including its own physical corpus. Thus, consciousness and environment are represented as engaging in the "I/Not I" dialogue of classical philosophy, but with the definition of the interface between the two left somewhat subjective and situation-specific. The concept of "reality" is invoked in an experiental sense, subsuming both "experience" and "behavior," as appropriate.

Beyond these definitions, the model proceeds from the following philosophical hypotheses:

(1) The purpose of any physical theory, or of any other scheme of conceptual organization, is to order and correlate the experiences of human consciousness interacting with its environment. Neither that environment, nor that consciousness, can properly be addressed in isolation; only in the interaction of the two is reality constituted.

(2) The sole currency of any reality is information, which may flow in either direction; i.e., consciousness may insert information into the environment as well as extract information from it. If the physical or physiological mechanisms which convey information to and from the consciousness/environment interface are identifiable, the overall process is regarded as "normal." If any of these mechanisms are unknown, the process is regarded as "anomalous."

(3) The common concepts of physical theories, such as mass, momentum, and energy; electric charge and magnetic field; the quantum and the wave function; and even distance and time, are no more than useful organizing strategies that human consciousness has developed for ordering the chaos of information bombarding it from its environment, or passing from it to its environment. As such, these concepts reflect as much the characteristics of consciousness as of the environment. More precisely, they reflect the characteristics of consciousness interacting with its environment.

(4) It follows, then, that the concepts, formalisms, and imagery of physical theory may have metaphoric utility for the representation of the nature and processes of consciousness, including the process of consciousness examining itself. Conversely, the impressionistic descriptors of subjective experience may, in some form, be requisite ingredients of any truly general theory of reality, including physical reality.

The perspective implicit in these hypotheses is certainly not original; allusions to it may be found in the writings of many major scientists and philosophers of past and present eras. During the emergence of science as a rigorous discipline, Francis Bacon suggested that:

> "...all the perceptions both of the senses and the mind bear reference to man and not to the universe, and the human mind resembles those uneven mirrors which impart their own properties to different objects..."[24]

More recently, James Jeans repeated the insight somewhat more poetically:

> "The concepts which now prove to be fundamental to our understanding of nature...seem to my mind to be structures of pure thought..." "...The universe begins to look more like a great thought than a great machine."[25]

Similar ideas have been heard from other sectors; the founder of psychoanalytic theory, Sigmund Freud, defined "the test of science" to be:

> "...fully circumscribed if we confine it to showing how the world must appear to us in consequence of the particular character of our organization... (since) our mental apparatus...itself is a constituent part of that world which we are to investigate...,"[26]

and the renowned philosopher Arthur Schopenhauer addressed the issue repeatedly and emphatically, e.g.:

> "A consciousness without object is no consciousness at all.... Although materialism imagines that it postulates nothing more than this matter—atoms for instance—yet it unconsciously adds not only the subject, but also space, time, and causality, which depend on special determinations of the subject." "...the intellect and matter are correlatives, in other words, the one exists only for the other; both stand and fall together; the one is only the other's reflex. They are in fact really one and the same thing, considered from two opposite points of view;...."[27]

More directly pertinent to our purpose are the corresponding persuasions of many of the patriarchs of modern physics.[2b] For example, from Planck we read:

> "All ideas we form of the outer world are ultimately only reflections of our own perceptions. Can we logically set up against our self-consciousness a "Nature" independent of it? Are not all so-called natural laws really nothing more or less than expedient rules with which we associate the run of our perceptions as exactly and conveniently as possible?"[28]

From Einstein:

> "Concepts which have been proved to be useful in ordering things easily acquire such an authority over us that we forget their human origin and accept them as invariable."
>
> "The system of concepts is a creation of man together with the rules of syntax, which constitute the structure of the conceptual systems.... All concepts, even those which are closest to experience, are from the point of view of logic freely chosen conventions."[29]

And from Bohr:

> "The impossibility of distinguishing in our customary way between physical phenomena and their observation places us, indeed, in a position quite similar to that which is so familiar in psychology where we are continually reminded of the *difficulty of distinguishing between subject and object.*"[30] (Bohr's emphasis.)

Regardless of their source, if one accepts the essence of the above premises, it follows that any physical formalism may conceivably be invoked, via metaphor, to represent the characteristics of consciousness interacting with its environment. Actually, such metaphoric representation need not even be restricted to physical, or indeed to general scientific vocabulary or concepts, but could derive its analogies from any organized

philosophical schema. However, for our purposes we shall invoke the particular physical formalism of quantum mechanics, first because of the extent to which it intrinsically acknowledges the participation of consciousness in the representation of physical reality, and second because, even in its application to physical phenomena, it displays an abundance of anomalous effects at variance with classical expectation that can provide useful specific metaphors.

4. THE WAVE MECHANICS OF CONSCIOUSNESS

As an opening illustration of the metaphoric application of quantum mechanical concepts to the representation of the consciousness/environment interaction, let us appropriate the most basic dichotomy of the physical theory, the wave/particle duality. It seems fair to observe that the commonly prevailing conceptualization of consciousness is "particulate" in nature. That is, an individual consciousness is normally presumed to be rather well localized in physical space and time, interacting only with a few specific aspects of its environment and with a few other similarly localized consciousnesses at any given point in its experience. Thus, in this view, any society of consciousnesses resembles an ensemble of gas molecules in some elaborate environmental "container," bouncing around against their neighbors and against the container boundaries in some sort of grand "gas-kinetic" process.

The primary proposition of the following model is that this particulate imagery, although serviceable for certain rudimentary purposes, is as primitive as the impenetrable molecules of the Greek philosophers or, at best, as the heuristic planetary atoms of Bohr, and should be replaced by a wave-mechanical representation that subsumes it. More specifically, the hypothesis is that basic consciousness may better be represented as "probability-of-experience" waves in some generalized "consciousness space/time" domain, akin to the "probability-of-observation" waves that satisfy the Schrödinger equation

$$\frac{\hbar^2}{2m}\nabla^2\psi - V\psi = \frac{\hbar}{i}\frac{\partial\psi}{\partial t} \tag{1}$$

in physical space-time. In the absence of any interactions with the environment, these consciousness waves might thus be represented in the functional form of the free-wave ($V=0$) solutions to (1):

$$\psi(\mathbf{r}, t) = \hat{\psi}e^{(i/\hbar)(\mathbf{p}\cdot r - Et)} \tag{2}$$

characterized by particular values of consciousness "amplitude" ψ, "momentum" $\mathbf{p}$, and "energy" E.

The interpretation of such parameters, along with the nature of the generalized space/time coordinates $\mathbf{r}$, t in which they are expressed, will be major tasks for the metaphor as it evolves. At this point, we simply note that since the probability densities $|\psi|^2$ of such free waves are uniform over their entire spatial and temporal coordinate range, no experiential properties can devolve from them in this form. However, if the consciousness waves are subjected to some form of "potential profile," $V(\mathbf{r}, t)$, defined in that same generalized space/time to be representative of the environment in which the consciousness is immersed, patterns of standing waves, i.e., eigenfunctions, are established that can be regarded as indicative of the consciousness experience in that prevailing situation.

The details and sources of the environmental potential profiles that so condition the eigenfunctions of given consciousnesses also will be addressed later. For the present, we simply further hypothesize that the dominant feature of any such profile is a centered well, perhaps akin to that of an individual physical atom, that is somehow associated with the physical corpus on which the particular consciousness wave has come to be localized. This basic physiological component of the profile is then embellished by various proximate environmental details, including its physical surroundings, other nearby consciousnesses, and, to a lesser degree, more remote or global physical or sociological factors. However thus compounded, this composite potential well constitutes in essence a resonant cavity wherein the consciousness establishes wave-mechanical patterns representative of its experience and behavior in the prevailing situation. Since all of the components contributing to the potential profile are subject to change, e.g., as the physical corpus matures, moves about, or encounters various other consciousnesses or changing physical or sociological situations, the experiential eigenfunctions themselves are constantly being altered. Nonetheless, their associated eigenvalues are at any point the tangible ramifications of the ongoing dialogue of the consciousness exchanging information with its environment.

Thus, in this model, the ensemble of gas-kinetic "particles" representing a community of interacting consciousnesses is elaborated to a complex panorama of consciousness-wave eigenfunctions, each locally centered in one of a corresponding myriad of mobile and mutable potential wells associated with the host physical bodies. Each of these centered consciousness wave patterns is presumed to be capable of interacting with its neighbors and with other aspects of its environment by all the means accessible to the analogous physical wave-mechanical systems. For example, the simple gas-kinetic interparticle encounters of the particulate model

are now generalized to a more elaborate complex of interactions akin to those identified in quantum mechanical collision theory, e.g., "elastic collisions," wherein the eigenfunctions of the two colliding consciousnesses, after some transitory distortion, return to their original configurations; "inelastic collisions," wherein the state of one or both of the interacting consciousnesses is permanently altered; "radiative collisions," whereby some form of influence is radiated from or to the encounter; "reactive collisions," whereby two consciousnesses form a new bonded-consciousness system having different eigenfunctions, i.e., different experiential behavior; etc.

Such representation of consciousness in wave-mechanical terms also opens various anomalous means of communication, e.g., via tunneling or leakage of the individual bound eigenfunctions through the potential barriers separating them from their neighbors. Also available is the mechanism of excitation of the eigenfunctions to free-wave or continuum status, wherefrom they may establish some resonances with other centers in the configuration. Certain speculative applications of this continuum regime of the consciousness wave functions can be particularly fascinating, extending well into the philosophical, or even theological and mystical domains. The more immediate concern, however, is with the representation of more readily observable consciousness effects akin to the bound eigenstates and their interactions, i.e., with the characteristics of the quantum mechanical "consciousness atom."

5. THE ATOMIC STRUCTURE OF CONSCIOUSNESS

To address this task, we presume that the conservation principles on which the Schrödinger formalism is based and the mathematical operations it entails are valid for the metaphor. It is then necessary to select a coordinate system in which the eigenfunctions of experience will be expressed. Given its proliferate utility in representing a broad range of human experience on all scales from the subnuclear to the cosmological, and the inherently centered nature of the consciousness model just proposed, the spherical polar frame would seem the most appropriate. It then remains to specify the connotations to be applied to a radius, a polar inclination, and an azimuthal angle in this geometry. Clearly, the common physical-geometric interpretations of these coordinates are not adequate for the purpose, but need to be generalized to some context appropriate to the excursions of consciousness. The particular question of a quantitative consciousness metric will be discussed later, but here we arbitrarily define the spherical consciousness coordinates r, θ, ϕ in the following impressionistic terms:

r: the radial coordinate, denotes the range or depth of penetration of the consciousness into its environment; the extent of its attention to it, or of its interaction with it.

θ: the angle of inclination of the range vector, **r** to the polar axis, defines the attitude of the consciousness and thus specifies the emotional component of the interaction. If the inclination of **r** is upward from the equatorial plane ($0 < \theta < 90°$), the emotional attitude is positive (e.g., approach, attraction); if downward ($90° < \theta < 180°$), the attitude is negative (e.g., avoidance, repulsion). The equatorial plane ($\theta = 90°$) denotes dispassionate cognition, and is henceforth termed the "cognitive plane."

ϕ: the angle specifying orientation of the component of **r** in the cognitive plane, defines the cognitive orientation, or point of view of the consciousness, i.e., its strategic perspective. Thus, with reference to Fig. 7, one may represent a strongly positive thrust of consciousness into its environment with cognitive orientation ϕ_A by vector $\mathbf{r}_A$; a mildly negative interaction with perspective ϕ_B by $\mathbf{r}_B$; etc.

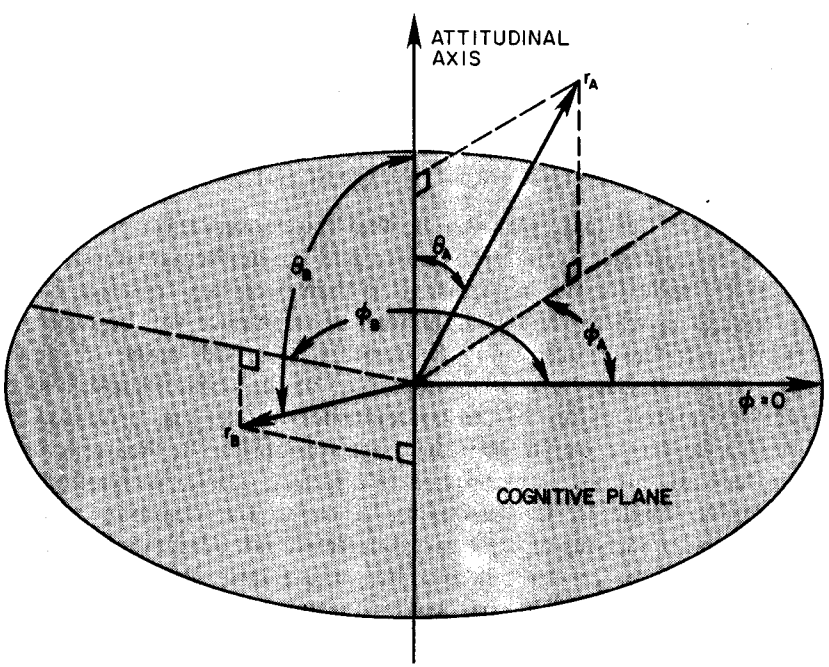

Fig. 7. Consciousness vectors in spherical coordinates.

In passing, it might be noted that these apparently arbitrary coordinate specifications have some familiar linguistic associations, in the sense that our vernacular prose frequently invokes similar geometrical terms to describe consciousness configurations. We speak of a "sphere of influence," or of "far-ranging" minds or thoughts; we acknowledge the "power of positive thinking" or the detriments of "negativity" of attitude; and we ask "what's his angle?" or "which way is he pointing?" to ascertain perspective or orientation on a matter. (Schrödinger himself was wont to speak of the "spheres of consciousness" in several of his philosophical writings.[31])

Equally crucial to the establishment of the consciousness eigenfunctions is the functional form of the potential energy well which houses them, again to be expressed in terms of consciousness coordinates. As conceptually defined, there is no basis for presumption of symmetry or functional simplicity in this profile, but for computational convenience in this first illustration it is arbitrarily presumed to be a central force potential. If the consciousness coordinates, like their physical counterparts, are orthogonal, and if all other requisite mathematical processes transpose to this domain, then the steady-state solutions to the Schrödinger equation (1) take the familiar form

$$\psi_{nlm}(r, \theta, \phi) = R_{nl}(r)\, \Theta_{lm}(\theta)\, \Phi_m(\phi) \tag{3}$$

As in the physical domain, the azimuthal solution

$$\Phi_m(\phi) = \frac{1}{\sqrt{2\pi}} e^{im\phi} \tag{4}$$

represents a sinusoidal pattern in the orientation angle ϕ, having angular wavelength determined by the integral value of the azimuthal quantum number m. Since the origin of ϕ and the phase of these sinusoids are arbitrary, there is no significance to the particular location of their nodes, and hence the probability function $|\Phi|^2$ is constant over ϕ. The implication is thus that all sectors of the cognitive plane have equal *a priori* probability for the consciousness vector, i.e., that any cognitive orientation or point of view of the consciousness is equally possible. This, of course, is a consequence of the assumed independence of the potential function on ϕ, and could be modified by employing more complex $V(\mathbf{r})$ profiles.

The distributions of $\mathbf{r}$ over the attitude angle θ take the more irregular forms of the associated Legendre polynomials

$$\Theta_{lm}(\theta) = C_{lm} P_{lm}(\cos\theta) \tag{5}$$

which comprise series of sines and cosines escalating in complexity with the

progression of the quantum numbers l and m. For the lower functions, beyond the fundamental mode P_{00} which has uniform probability over all θ, those having $m = l$ cluster around the cognitive plane $\theta = 90°$, while those having $m = 0$ cluster around the emotional axis $\theta = 0°$. In physical quantum mechanics, this geometric behavior is consistent with the identification of l as the index of the total angular momentum of the system and m as its component along the polar axis. In the consciousness metaphor, the ratio of m to l thus emerges as an indicator of the relative amounts of cognition and emotion prevailing in the interaction. As in the physical application, this ratio is not arbitrary, but is restricted by quantization rules, i.e., the ratio of m/l can take only discrete values; intermediate combinations are unattainable, predicating complex nodal patterns of the $(P_{lm})^2$ in θ. For the polynomial $P_{2,1}$, for example, the vector **r** has zero probability of being found at $\theta = 0°$, 90°, or 180°, localizing rather in the conical intermediate regimes around $\theta = 45°$ or 135°. This particular function thus represents some balance between cognition and emotion in the consciousness interaction.

The form of the radial wave functions $R(r)$ depends on the particular central-force potential invoked to represent the nature of the primary attraction between the consciousness and the physical body on which it is localized. Clearly it would be convenient to presume an inverse-square central force field and thereby inherit all of the familiar hydrogen-atom, Laguerre polynomial formalism. Given its ubiquitous occurrence in natural physical situations, this may also be an appropriate choice for the consciousness potential profile. Conceivably, it may be more complex, possibly tending toward a spherical square well predicating half-order Bessel functions or, in another extreme, towards much milder radial dependence, yielding radial waves more nearly approaching sinusoidal forms. At this point it is only necessary to assume that the radial potential profile, whatever its detail, engenders a series of nodal standing wave patterns of $R_n(r)$ of unspecified spacings and amplitudes, each embodying an eigenvalue E_n indexed by a principal quantum number n, implying a quantization of some consciousness property corresponding to the electronic energy levels of physical atoms.

These consciousness "energy" levels are regarded as indicative of the intensity or degree of investment of the consciousness, in either the cognitive or emotional sense or both, perhaps similar to the levels invoked in psychological, sociological, and metaphysical models. For example, many psychological theories propose sequential stages of cognitive, emotional, or moral development, or hierarchies of psychological needs.[32–37] In social contexts, as well, we are accustomed to the establishment of ranks—in the military, in business and industry, in

government, in religious and fraternal organizations, in academia—that attempt to label in some crude way the nominal level of investment of a consciousness in the given environment. Several mystical traditions also identify a number of energy platforms from which an individual's motivations or actions emanate, or a number of degrees of enlightenment or spiritual growth.[38] Whatever their psychological implication, these consciousness levels are presumed subject to quantized change by mechanisms analogous to those of their physical counterparts, e.g., by absorption or emission of influence radiated from or to the remote environment, or by inelastic collision with another consciousness system.

Note that the analogy can also accommodate the complexity of the consciousness interaction. The magnitude of the quantum numbers l and m, and hence the complexity of the permissible eigenfunctions, are circumscribed by the principal quantum number n, i.e., the more complex angular patterns can only be generated at the higher n's. The analogy thus predicts that the more complex interactions of consciousness with its environment can only be attained with higher investments of consciousness attention. Again, the extent to which these complexities appear in the emotional or cognitive dimensions, respectively, are indicated by the ratio of m to l.

One detail remains to complete this rudimentary consciousness atom—its internal angular momentum or spin. Given the binary nature of this quantity, its ubiquitous association with all atomic scale systems, and its central role in the exclusion principle, we propose to associate it in the consciousness metaphor with the generic passive/assertive dichotomy, akin to the so-called "yin/yang" distinction. Like the external angular momentum, the spin analogy is also basically attitudinal in nature, the essential difference between its two orientations representing the receptive/donative styles of information exchange.

The metaphor can be readily extended to "polyelectronic" atomic structures, as well, representing components of the consciousness capable of interaction with one another and with other consciousness systems. This multiplicity is useful for representation of many of the more complex features of consciousness activity, such as the ability of some individuals sharply to distinguish their patterns of attention and behavior in different sectors or simultaneously to maintain multiple important relationships with other consciousnesses on quite different bases.

6. THE COVALENT BONDS OF CONSCIOUSNESS

As another example of the metaphoric transcription of quantum mechanical formalism to the interactions of consciousness, certain aspects

of wave mechanical superposition that underlie the theory of covalent or homopolar molecular bonds can be adapted. For this purpose, it will be more efficient to employ the notation of quantum mechanical operators, as commonly applied in the physical theory to call out eigenvalues of interest. For example, a genre of "situation" operators S may be defined so that, when applied to consciousness wave functions, experiential responses to the stated situations are called forth. Thus, if an individual consciousness immersed in a given environmental profile $V(\mathbf{r}_a)$ is characterized by a set of eigenfunctions $\psi_i{}^a$, mathematical application of a situation operator S to those eigenfunctions specifies the response eigenvalues $s_i{}^a$, in accordance with the operator/eigenvalue equation

$$S\psi_i{}^a = s_i{}^a \psi_i{}^a \tag{6}$$

where $s_i{}^a$ denotes the experience of the consciousness, when it is in state $\psi_i{}^a$, in that situation. A second consciousness, in eigenstate $\psi_j{}^b$ established in its own physical environment $V(\mathbf{r}_b)$, exposed to the same situation, yields a correspondingly different experiential eigenvalue $s_j{}^b$. However, if the two consciousnesses are strongly interacting, the potential wells defining their eigenfunctions become intertwined and mutually distorted into a composite well, $V(\mathbf{r}_a, \mathbf{r}_b)$, and the wave functions themselves engage in interference or resonance processes. Via arguments such as the Heitler–London theory of "exchange energies,"[39] a set of composite eigenfunctions $\psi_{ij}{}^{ab}$ then obtains which, under operation by S displays eigenvalues transcending simple linear superposition of the separate atomic states, i.e.,

$$S\psi_{ij}{}^{ab} = s_{ij}{}^{ab} \psi_{ij}{}^{ab} \tag{7}$$

where

$$s_{ij}{}^{ab} = s_i{}^a + s_j{}^b + \Delta s_{ij}{}^{ab} + \Delta s_{ij}{}^{ba} \tag{8}$$

Here $s_i{}^a$ and $s_j{}^b$ denote the separate responses to the situation S of the first and second consciousnesses, respectively, that would prevail in the absence of the other, and the "exchange" terms $\Delta s_{ij}{}^{ab}$ and $\Delta s_{ij}{}^{ba}$ represent modifications of those responses arising because the two consciousnesses are interacting. The relative magnitudes of $\Delta s_{ij}{}^{ab}$ and $\Delta s_{ij}{}^{ba}$ to $s_i{}^a$ and $s_i{}^b$ depend on an "overlap integral" of the form

$$\Delta s_{ij}{}^{ab} + \Delta s_{ij}{}^{ba} \propto \iint |\psi_{ij}{}^{\pm}|^2 \, V' \, d\mathbf{r}_a \, d\mathbf{r}_b \tag{9}$$

where V' denotes the distortion in the sum of the separate potentials V_a and V_b caused by the proximity of their sources, and $\psi_{ij}{}^{\pm}$ denote the com-

posite eigenfunctions of the bonded system for the cases of parallel and antiparallel consciousness spins, respectively, as defined in the previous section. Thus, s_i^a and s_j^b represent normal behavior of the separate consciousnesses, and Δs_{ij}^{ab} and Δs_{ij}^{ba} may accommodate extraordinary or anomalous aspects of their shared experience.

For example, to apply this formalism to remote perception experiments like those described in Sec. 2, denote the percipient by ψ^p, the agent by ψ^a, and the experimental protocol by the mathematical operator P. In the absence of interaction between the percipient and agent, each has certain normal reactions to the experimental situation, p_i^p, p_j^a, as derived from the separate eigenvalue equations, i.e., the percipient perceives nothing about the target that is not accessible to his normal perceptual modes, and the agent reacts to the target independently of the percipient. However, if the percipient and agent are interacting strongly enough to acquire a new "molecular" wave function ψ^{pa}, additional terms appear in the composite response pattern, e.g.,

$$P\psi_{ij}^{pa} = p_{ij}^{pa}\psi_{ij}^{pa} \tag{10}$$

$$p_{ij}^{pa} = p_i^p + p_j^a + \Delta p_{ij}^{pa} + \Delta p_{ij}^{ap} \tag{11}$$

where Δp_{ij}^{pa} accomodates the anomalous acquisition of information about the target, and Δp_{ij}^{ap} the often reported experience of the agent having his attention attracted to specific details that he would normally have ignored.

The metaphor can be extended to model psychokinetic phenomena as well if the second atomic wave function, rather than representing an animate consciousness, refers to the physical device, system, or process with which the first consciousness is interacting. Thus, if the bonded operator/device system is represented by the composite wave function ψ^{od}, and the experimental protocol by the mathematical operator K,

$$K\psi_{ij}^{od} = k_{ij}^{od}\psi_{ij}^{od} \tag{12}$$

calls out bonded-system eigenvalues

$$k_{ij}^{od} = k_i^o + k_j^d + \Delta k_{ij}^{od} + \Delta k_{ij}^{do} \tag{13}$$

that comprise not only the normal experience of the operator k_i^o and the normal behavior of the device k_j^d, but two anomalous terms that can encompass any psychokinetic effects and any anomalous reactions of the operator during the effort, respectively. A very similar formalism could represent the creative effort of a consciousness addressing an analytical task

or some more aesthetic endeavor such as musical composition or artistic performance.

The molecular metaphor need not be limited to binary interactions. A third person or another physical element may be involved in the resonant system, much in the analogy of a triatomic molecule. Examples of ternary bonds in psychic experimentation would include the role of the experimenter or judge in enhancing psychokinesis or remote perception results or, conversely, the influence of a skeptical observer in depressing results,[40] much as the inclusion of a third atom weakens a previous binomer.

Note that in any of these applications, the bond is established at the level of the wave function, but is not directly observable in that form. The palpable effects are expressed only in terms of the eigenvalues called out by specific situation operators applied to the composite wave functions. The eigenvalues of the bonded system are its "normal" behavior in the prevailing environment; only when forcibly decomposed in terms of the separate system eigenvalues do the "anomalous" components appear as identifiable effects. Recall that Einstein, paraphrasing Bohr in the context of the Einstein–Podolski–Rosen paradox, put this quantum mechanical point most emphatically, even to the extent of posing the possibility that such effects could prevail when the component systems were spatially remote:

> "If the partial systems A and B form a total system which is described by its ψ-function $\psi/(AB)$, there is no reason why any mutually independent existence (state of reality) should be ascribed to the partial systems A and B viewed separately, *not even if the partial systems are spatially separated from each other at the particular time under consideration.* The assertion that, in this latter case, the real situation of B could not be (directly) influenced by any measurement taken on *A* is, therefore, within the framework of quantum theory, unfounded and (as the paradox shows) unacceptable."[41] (Einstein's emphasis)

In principle, the bond metaphor need not even be limited to simple binary or ternary resonances. Various more elaborate group interactions can be treated in analogy, say, to organic molecules, rings, and chains, even to the complexity of RNA and DNA structures. In such models, the anomalous group consciousness effects can be regarded as analogous to the various modes of information and energy transfer and storage that are characteristic of such macromolecular structures as a whole and are also inexplicable by any linear superposition of the individual atomic behaviors. Similar analogies can be made to inorganic quantum mechanical solid-state systems, such as crystals, metals, and semiconductors, where the organized or stochastic behavior of a large ensemble of interacting elements totally subsumes their individual characteristics within a diffusive wave function of the ensemble. As one of many example applications, a large sporting event with intense crowd involvement can be formulated in terms of a game

situation operator and a wave function representing the resonant system of crowd and game, yielding eigenvalues representative of the observable progress of the game:

$$g_{ij}{}^{cg} = g_i{}^{c} + g_j{}^{g} + \Delta g_{ij}{}^{cg} + \Delta g_{ij}{}^{gc} \tag{14}$$

where $g_i{}^{c}$ denotes the crowd behavior in the absence of any emotional involvement with the game; $g_j{}^{g}$ the progress of the game in the absence of an involved crowd; $\Delta g_{ij}{}^{cg}$ the influence of the crowd on the progress of the game; and $\Delta g_{ij}{}^{gc}$ the effect of the game on the reaction of the crowd. The formalism could apply equally well to the dynamic interaction of an artistic performer with his audience, or to a religious service, political rally, or mob hysteria.

Clearly this molecular bond metaphor is a long way from quantitative utility, pending more explicit identification of the wave functions, operators, and coordinates in which they are expressed, but at least one qualitative guideline for the generation and amplification of anomalous consciousness effects is already suggested. Namely, since the relative magnitude of the anomalous components of the eigenvalues depends on the degree of interaction of the participating elements, i.e., on the mutual deformation of their separate potential profiles and on the resonance of their consciousness wave functions, larger effects should occur among persons naturally disposed toward some sharing of their identity. Common examples would be the parent–child and identical-twin bonds, but less biological bases for the resonance may also qualify to various degrees, such as among lovers, close friends, colleagues, or teammates. The model also allows the external environment to play some role in facilitating such resonance, e.g., a romantic setting, a comfortable business office, a thronged sports arena, a military parade, or such ambience features as are frequently utilized in the conduct of psychic experimentation.

Application of the bond metaphor to psychokinesis situations raises the question of the definition of the "consciousness" of a nonliving physical system. Without indulging in a major digression on this issue, a few pertinent points might be noted: First, the distinction between living and nonliving systems, i.e., between systems traditionally assigned consciousness or not, is now becoming progressively more diffuse when approached from either the biological side (e.g., viruses, DNA, plasmids, etc.), or from the physical side (e.g., artificially intelligent, self-replicating physical systems). Second, the fundamental premise of the model—that reality is established only in the interaction of a consciousness with its environment—need not be formally constrained to consciousness associated with living systems. Even in the physical domain, observation of an experiment in progress

establishes reality only for the observer. If some animal is trained to observe the experiment, that animal's reality is established by its observations. If the animal is replaced by an intelligent microelectronic device capable of observing and reacting to the experiment, in the same formal sense reality is established for that device by its observation process. Whether either of the latter situations also constitutes a reality for a human consciousness depends on its independent observation of the experiment, or of the animal/intelligent device, or both. Thus, *any* functioning system capable of receiving and utilizing information from its environment, or of inserting information into it, can qualify as a consciousness for purposes of this metaphoric model.

Beyond these arguments, there is substantial informal testimony from successful operators of psychokinesis experiments that the physical systems involved exhibit anthropomorphic characteristics sufficient to engender quasi-personal interactions with them. Finally, the relevance of such entwinement of consciousness with a nonliving system is not limited to processes usually regarded as anomalous. Many aspects of artistic and intellectual creativity display similar mechanics of resonance and indistinguishability, i.e., some sacrifice of atomic identity of the artist or scholar to the bond with his instrument or task. In general, whenever any device, process, or task takes on anthropomorphic qualities in the perception of a living consciousness, it acquires thereby the requisite properties of a consciousness wave function for purposes of interaction with its perceiver.

7. THE METAPHORIC PRINCIPLES

If the proposed analogy has generic validity as a representation of the interaction of consciousness with its physical environment, then the familiar quantum mechanical principles of indistinguishability, exclusion, correspondence, and uncertainty should also find their metaphors in human experience. Although these have been implicit in much of the foregoing argument of the atomic and molecular structure of consciousness, a few further remarks on this aspect of the metaphor may help to clarify the nature of the consciousness space and its mechanics.

7.1. The Indistinguishability Principle

The inability to distinguish electrons within any interactive physical structure, such as an atom, a molecule, or a metallic lattice, has tangible

ramifications in its energy level patterns, and hence in the macroscopic statistical thermodynamic behavior of the substances it constitutes. In both a quantum mechanical and thermodynamic sense, surrender of information about the identity of the electrons leads to energy increments in both their microscopic and macroscopic states. Transposing this concept to the consciousness realm, a similar currency exchange is proposed: the surrender of individual identity in a bond between two consciousnesses leads to anomalous characteristics in the behavior of that bonded system, in comparison to the normal behavior of its separate parts.

The analytical utility of this metaphor is inevitably limited by the intrinsic vagueness of the consciousness space, its coordinates and its quantum numbers, but the essence of the effect it addresses is intuitively and experientally familiar. Many common adages acknowledge the transcendent potentialities of such sharing or surrender of identity: "it's bigger than both of us"; "two heads are better than one"; "it takes two to tango." A similar concept is articulated in certain mystical traditions, e.g., Pantanjali's description of the yogic "siddhis" associated with the sacrifice of personal identity.[38,42] However expressed, the functional import of this principle for the model and for the design of experiments to test it is much the same: An ability to exchange or share identities with another consciousness or with a quasi-conscious physical system should facilitate anomalous experience.

7.2. The Exclusion Principle

Closely related to the indistinguishability principle, indeed deducible from it, the Pauli principle precludes two identical particles of half-integer spin in a fully interactive system being found in identical states. Transposition of this concept to consciousness parameters is based on the association of spin direction with the receptor/donor, or passive/assertive dichotomies. The most familiar evidence of this consciousness exclusion principle is the normal female/male dyad. It should be emphasized, however, that the implications of this principle for the model and for controlled experimentation need by no means be restricted to feminine/masculine pairings in the physiological sense; the more fundamental requisite is that the receptor/donor roles be filled in an attitudinal sense between two participants, or between an operator and a physical device or process. Nor is it required that the roles be fixed; phased alternation of roles may be just as effective. Note in this regard that many of the normal forms of dialogue between consciousness and its environment conform to this alternating pattern, i.e., consciousness alternates between receiving information from, and giving information to, its environment.

7.3. The Correspondence Principle

In the physical domain, quantum effects become evident when the dimensions of the system involved are comparable with, or smaller than, the de Broglie wavelengths of the wave functions which represent it; when the dimensions are much larger than those characteristic wavelengths, classical continuum behavior obtains. Bohr's correspondence principle postulates a continuity of behavior and properties over the transition between those two regimes. In the consciousness analogy, therefore, anomalous behavior should ensue when the wavelengths of the consciousness wave functions become comparable with, or larger than, the characteristic dimensions of the environmental potential wells in which they are immersed, and this anomalous behavior should revert to a normal form when the wavelengths are much smaller than those dimensions.

Clearly, the utility of this metaphor is limited by the present inability to specify more precisely the nature of the dimensions of the consciousness wavelengths or of the potential wells or contexts enveloping them, in the consciousness frame. More will be said about such dimensions in Sec. 9, but here let us assume that the wavelength of a consciousness corresponds to the scope or breadth of its attention or, conversely, to the precision with which it addresses its context. More specifically, long-wavelength functions are postulated to represent the more free-flowing, holistic, generalized, aesthetic consciousness strategies, whereas short-wavelength functions represent the more precise, reductionistic, specialized, analytical styles. Similarly, the dimensions of the environmental potential well are also related to its generality or specificity: large dimensions imply a global or holistic context; small dimensions imply a precisely defined, specialized context.

The metaphor then predicts that normal behavior obtains when a consciousness function has sufficiently short wavelength for the context in which it must operate—when it can, as it were, define the characteristics of its context or environment with some precision. In those situations where the wavelength of the consciousness function is comparable with, or exceeds, the dimensions of the context it is addressing, however, precise details of the experience are surrendered in favor of various wave-mechanical effects—diffraction, interference, evanescent wave leakage, etc.—any of which may be interpreted as anomalous behavior.

It might be observed parenthetically that the traditional function of our modern educational processes has been to develop the former class of consciousness interactions at the expense of the latter—to hone the consciousness to finer and finer precision, i.e., to smaller and smaller wavelengths—so that more and more specialized contexts may be

addressed with sharpness. Consciousnesses that have not been conditioned in this manner, e.g., very young children, primitive peoples, wild creatures, and those rare adults in our society who, for whatever reason, have resisted such training, do not automatically relate to their contexts with such precision, and it is just these groups that seem to display disproportionate propensity to anomalous capabilities.[43] The prevalence of anomalous experiences in dream or trance states, which usually are devoid of precise or analytical thought, may also be supportive of this analogy. In more pathological examples, many persons afflicted with various forms of mental illness display serious inabilities to focus within consensual contexts, and also experience ineffable or incoherent impressions of reality.

This criterion for facilitating transition from normal to anomalous experience, namely that the consciousness involved become freely ranging, i.e., of as long a wavelength as possible compared to the prevailing context of the task, is supported by the impressionistic experience of our experimental operators. From them and from others in the field one hears frequent comments about the importance of retaining a "diffuse" or "open-focused" state of consciousness, as opposed to the usual requisite for analytical tasks of being "sharp" or "incisive." For more systematic study of this criterion, it is possible that various physiological oscillations, such as the brain wave patterns, the cardiac or pulmonary frequencies, or other body rhythms, may be reflective of the prevailing consciousness wave functions, and thus quantitatively relevant to the phenomena.[44]

7.4. The Uncertainty and Complementarity Principles

Much of the above argument regarding the wave-mechanical limitations on precision in a given context is relevant to the uncertainty principle and to its close relative, the complementarity principle, as well. Physically, these limitations on the simultaneous specification of two canonically conjugate variables devolve from the basic inability of a wave function to provide a well-defined representation of an object or process without invoking a broad band of wavelengths or, equivalently, from the inability of a narrow-band wave function to be confined within a small region. Thus, if a given concept is to be localized with precision in consciousness space, a broad band of consciousness wavelengths must be deployed to assess its full set of characteristics, and the consciousness state itself cannot be sharply specified. Conversely, if the consciousness is restricted to a single wavelength, e.g., to a "pure state," no detail can be established about any localized concept it addresses. Such pure states of monotonic attention are featured in various mystical traditions[38,42] and are frequently encountered in everyday experiences of "losing oneself" in a

single activity or thought, to the extent that it is difficult or impossible to describe precisely what one is doing or thinking at that time.

Thus, the consciousness uncertainty principle simply acknowledges that many states of experience are inherently complementary to one another, and in various pairs embody the same type of mutual uncertainty or trade-off in precision of specification as do conjugate physical quantities. A partial list of such consciousness conjugates might include: analysis/synthesis; observation/participation; structure/function; goal/process; responsibility/independence; reasoning/intuition; or most generically, doing/being. Note that in each case the two properties cited are not polar opposites, but are orthogonal in the sense that the degree of each must be independently specified to localize the experience in that subspace. As with the physical conjugates, there are basic limits to such localization, and hence questions of balance or optimization: excessive objectivity precludes direct experience, but excessive involvement inhibits critical judgment; excessive reductionism or attention to detail erodes the holistic or aesthetic appreciation, but excessively diffuse or excursive perspective leads to chaos in implementation; excessive sense of responsibility or obligation saps vitality and initiative, but excessive independence of behavior becomes socially untenable; etc.

Like many other aspects of the metaphor, this concept of a consciousness uncertainty principle or complementarity principle has also been suggested by many others, including the author of the physical uncertainty principle, Heisenberg himself:

> "We realize that the situation of complementarity is not confined to the atomic world alone; we meet it when we reflect about a decision and the motives for our decision, or when we have the choice between enjoying music and analyzing its structure."[45]

and the author of the complementary principle, Niels Bohr:

> "...in associating the psychical and physical aspects of existence, we are concerned with a special relationship of complementarity which it is not possible to thoroughly understand by one-sided application either of physical or of psychological laws."[46]

More recent attempts to generalize the concept to various other contexts also abound.[47–50]

Beyond the limitation on precision of specification enjoined by the principle, it may also define the most productive and fulfilling regimes of human activity, e.g., where the sense of doing and being, or analyzing and synthesizing, are in balance, or are most interpenetrating and symbiotic. Again there are the common examples of the person who "lives his job," of the actor, dancer, athlete, or skilled artisan whose impeccable mechanical

skills are complemented by subjective immersion in the role, producing a transcendent performance or product. Testimony from such genius or artistry commonly speaks to the necessity for dynamic and symbiotic balance between the skills and the immersion, the analysis and the synthesis, the doing and the being, if the highest creativity is to be attained. A similar complementarity may well be requisite to the generation of anomalous phenomena, and could be a useful criterion for the design of effective experimentation.

8. CONSCIOUSNESS STATISTICS

In physical theory, as the number of interacting particles proliferates, it becomes increasingly difficult to represent the system in the Schrödinger formalism, and eventually resort must be made to statistical arguments applied to the collective behavior. As a final example of quantum mechanical metaphors that may have utility for the representation of the normal and anomalous interactions of consciousness with its environment, consider some of the statistical consequences of the formalism and their relevance to the consciousness domain.

All statistical models ultimately trace back to the probability rules governing the elemental units involved in the statistical ensembles. For these statistical models to be viable, the probability rules must be known and expressible in some analytical form. For classical kinematic systems where the differential elements of the canonical phase space have *a priori* probabilities proportional to their volume, the resultant statistical distributions take the familiar Bolzmann form. For quantum mechanical systems, quantization and the indistinguishability and exclusion principles combine to alter the probabilities of the phase-space elements and predicate the Fermi–Dirac and Bose–Einstein quantum statistics, which embody categorically different population rules for half-integer and integer spin systems. Departure of these quantum statistics from the classical form is favored by low temperatures, low masses, and high particle densities.[51]

To transpose these concepts to the consciousness domain, we propose that reality, as generated by the interaction of consciousness with its environment, may also play by more elaborate elemental probability rules than those commonly presumed and thus, at least over some range of its parameters, may require correspondingly more elaborate statistical treatment. Specifically, for interactions for which the consciousness exclusion principle applies, i.e., for consciousnesses of half-integer spin, a Fermi–Dirac class of statistical behavior should obtain. For consciousness units or

systems of zero or integer spin, e.g., androgynous consciousness "photons," Bose–Einstein statistical behavior should prevail.

For this aspect of the metaphor to possess any utility, a number of other analogies need first to be established, namely the nature of the consciousness phase-space in which the statistics operate, and the concepts corresponding to mass, density, and temperature which determine the degree of departure from the classical form. These are discussed in the following section.

9. THE CONSCIOUSNESS METRIC

The proposed metaphoric transcription of quantum mechanics from its traditional applications in atomic-scale physical systems and processes to a more general representation of the exchange of information between consciousness and its environment retains in its formalism metric quantities corresponding to physical distance, mass, time, and electric charge; various derived properties such as momentum, energy, and temperature; and, of course, the quantization constant h. Thus, some interpretation of these properties in the consciousness domain is required if the metaphor is to be quantitatively useful for the design of experiments and the interpretation of data. In the physical domain, the definitions of such basic quantities have evolved through combinations of utilitarian empiricism and internal consistency, via consensus agreement on tangible standards of measurement. To establish comparable consciousness properties requires similar consensus definitions, but these are obviously less amenable to tangible conceptualization and terminology. The primary reference[2] pursues possible definitions and their evaluation in terms of psychological and physiological parameters in some detail; here we can only illustrate the approach briefly:

9.1. Distance

Impressionistic allusions to physical distance are commonly invoked for the description of certain cognitive or emotional processes. A particular person, idea, or situation is described as "far out," "right on," or "sharing my space," and we allow our minds to "wander" over various conceptual terrains. In formulating the consciousness atom, spherical "coordinates" were invoked, comprising a "range" or intensity scale, a cognitive "plane" encompassing all possible points of view, and a "polar inclination" accommodating the emotional component of the situation. To quantify this consciousness space, some referential standard is required—some conceptually

evident "meter" or "wavelength," as it were—in terms of which the "distance" may be specified in numerical form.

Given the nondimensional character of the basic wave equation, quantification by wavelength, i.e., by the reciprocal momentum, might indeed seem reasonable, but unfortunately this quantity is no more evident *a priori* in the consciousness frame than is the distance property itself. Failing this route, it is necessary to retreat to a more primitive metaphor for length, for example the number of units or steps required to progress from a given origin to a given goal. These may be steps of logic or association by which consciousness progresses in the cognitive plane, or orthogonal steps of emotional progression which take it in the polar directions, or combinations of the two, but all such steps entail a progressive aquisition of information requisite to specification of the prevailing reality. Collectively, these steps comprise a three-dimensional grid of experience, along which consciousness proceeds toward its goal by making certain discriminations at each juncture it encounters, much as in a puzzle maze, the game of "Twenty Questions," or any other process wherein a goal is achieved via a succession of logical or intuitive steps. Consciousness distance thus is scaled by the number of such discriminations or associations required to transfer from one experience position to another.

The concept of quantized experience is not new. William James proposed a very similar mechanism many years ago in terms of:

> "...finite and perceptible units of approach—drops, buds, steps, or whatever we please to term them, of change, coming wholly when they do, or coming not at all. Such seems to be the nature of concrete experience, which changes always by sensible amounts, or stays unchanged."[52]

Whatever their particular nature, these scaling increments of experience are inherently more impressionistic than the physical standards, and it is unclear whether they share the latter's linearity, or whether the mathematical associative, distributive, and commutative properties apply. Possibly they may have logarithmic or exponential character, as in some forms of information theory[53] or in certain stimulus/response models of behavioral psychology,[54] or they may entail more complex and hierarchical features, akin to the space-time distortions implicit in general relativity theory.

It is also not clear whether the consciousness distance grid scale is universal or varies from individual to individual, i.e., whether the same number of bits of experience or information is uniformly required to accomplish a given transposition, or whether different individuals invoke fewer or more steps for the same purpose. The latter possibility, although somewhat less tidy, need not inhibit the metaphor, provided each

individual has an internally consistent standard so that some relationship among the individual scales implicitly prevails.

9.2. Time

The identification and scaling of the analogy to physical time in the consciousness domain is equally important to the progress of the metaphor, and at least equally elusive. Initial temptation simply to transpose this property directly, i.e., to presume that the same clocks are relevant to all experiences of consciousness, probably should be set aside in the face of obvious temporal distortions in both emotional and cognitive experience. In periods of satisfying creative work or pleasurable recreation, "time rushes by"; when the activity is tedious or boring, "time drags"; and in highly emotional situations, "time stands still." Dreams, trances, and mystical, drug-induced, or near-death experiences are frequently characterized by bizarre distortions or even total irrelevance of conventional time. Such questions of internal or consciousness "clocks," or of the subjective versus objective qualities of time, have long attracted the attention of many philosophers, biologists, psychologists, and physicists.[55–59]

Just as physical time has traditionally been scaled by various regular natural phenomena, the consciousness metric needs some oscillation or processing cycle by whose period cognitive and emotional experience may consistently be timed. Again, in the absence of any quantitative knowledge of the natural period of oscillation of the consciousness wave function, a more heuristic standard must be invoked. Specifically, we postulate that consciousness, somewhat like a radar or sonar system, acquires experience of its environment by querying it, receiving response from it, and processing that response, all on some base frequency of scanning or pulsing. The physiology and psychology of this scanning or pulsing are far from clear at this point, and probably vary from one individual to another and possibly within the individual as well. To invoke a musical analogy, any given consciousness may process its experience in march time, waltz time, ragtime, or even hard rock, but nonetheless, the associated periods of oscillation can serve to scale this dimension of experience in a relatively self-consistent fashion. Thus, to express temporal rates in the consciousness domain, derivatives are taken with respect to that prevailing consciousness time.

A similar concept appears in the psychological literature in a paper entitled "Oscillations as Possible Basis for Time Perception" by E. Pöppel, who states in part in his conclusion:

> "...the temporal continuum is subjectively quantized into discrete units, which successively follow each other.... The quantization can formally be described as an oscillation. The duration of "quantum-period" seems to be

> influenced by several physiological conditions.... Individual differences can also be considerable...."[60]

Despite the vagueness of this concept of consciousness pulsation, with it so defined the basic quantization $E = h\nu$ can then be invoked to associate consciousness "energy" with the frequency of processing of information; i.e., consciousnesses of greater "energy" are those which process information at higher sampling "frequencies," perhaps somewhat like food processors, lawn mowers, or voracious rabbits devour their respective fodders. Like its physical counterpart, the magnitude of the quantization constant h must be evaluated empirically.

9.3. Mass

Rhetorical allusions to the concepts of inertial or gravitational mass in the affairs of consciousness are common. In the inertial analogy, we refer to an opportunity or task as "massive," by which we imply that the amount of information required to move the consciousness from a given position on a particular "matter," or conversely, the impact of that matter on the consciousness, depends on its importance, profundity, or consequences. In the gravitational analogy, we refer to a thought or experience as "heavy," or to a person as "weighted down" or "burdened." Conversely, we can treat an issue with "levity" or in a "light-hearted" manner. In extreme cases we acknowledge that very massive experiences are capable of distorting our consciousness perception grid and contextual framework.

The role of consciousness mass in the establishment of anomalous experiences appears somewhat paradoxical. On the one hand, the prototypical image of the intensely concentrating psychic practitioner or the oft-claimed inexplicable acquisition of information in crisis situations suggests that we should look to the high mass or "grave" end of the consciousness spectrum for such phenomena. The analogy to general relativity theory would also imply anomalous experience in densely massive situations. Yet there is a countervening body of impressionistic evidence that just the reverse may be the case—that it is a carefree attitude of "high indifference" which frees the consciousness from its normal context, allowing it to wander into other dimensions of experience and participate more intimately in the bonds and statistical ensembles that facilitate anomalous effects. In holistic health care, for example, the therapeutic value of levity in emotional and physiological healing is now being advocated.[61] It may be that both of the extremes of gravity and levity facilitate some form of resonance between consciousness and its environment that engenders anomalous effects.

9.4. Charge

Transposition to the consciousness domain of the physical concepts of electric charge and the electromagnetic field phenomena that devolve from it are also anticipated by common vernacular allusions to "charged" situations, feelings of "attraction" or "repulsion," "currents" of thought, "polarized" issues, etc. We acknowledge that particular types of experience may induce in our psyche "positive" or "negative" reactions which store energy for later release, either gradual or cataclysmic, constructive or destructive, when triggered by some subsequent event. There is frequent reference to such a concept in the psychoanalytical literature. Freud himself writes:

> "...in mental functions something is to be distinguished—a charge of affect or sum of excitation—which possesses all the characteristics of a quantity (though we have no means of measuring it), which is capable of increase, diminution, displacement and discharge, and which is spread over the memory-traces of ideas somewhat as an electric charge is spread over the surface of a body."(62)

Much as in physical electrodynamics, the presence of such emotional charge, with its attendant internal stress and pent-up energy, renders the consciousness susceptible to "forces," and to consequent deflections of its trajectory, that it would otherwise ignore. Common examples include the athlete or entertainer who becomes "charged up" for a game or performance; individual sensitivity to praise or criticism; crowd reaction to exhortation; or, in more extreme cases, emotional aberations or physical illnesses of various types in which violent reactions are triggered by relatively minor stimuli. Since the potential energy function in the physical Schrödinger equation is almost invariably electrostatic in nature, it seems reasonable that the consciousness potential profile, indicative of the prevailing environment, also depends on the charge of that consciousness. Hence, the eigenfunctions of experience should reflect this property as well.

9.5. Derived Quantities

With the metric in place, the standard recipes of physical theory may be invoked to construct an array of derived properties and collective effects that further expand the analogy. For example, from the definition of consciousness distance, it follows tht consciousness "velocity" is the rate of progress in consciousness space, per unit processing scan. The product of this property with consciousness mass thus comprises a "momentum" indicative of the rate of purposeful or significant progress in the experiences of consciousness or, equivalently, the rate of acquisition of consequential

information. As with physical objects, a consciousness operating at high momentum better resists deflection from its initial course and has greater "impact" upon collision. Via the de Broglie relation, such high-momentum consciousness is characterized by short consciousness wavelength and thus focuses more precisely on logical and analytical tasks, but is less prone to anomalous experience. In this model, anomalies are more likely to be experienced in a low-momentum/long-wavelength consciousness mode, i.e., a mode wherein the rate of purposeful progress in consciousness space is low.

Closely related to the consciousness momentum is the consciousness "kinetic energy" which constitutes the first term of the consciousness Schrödinger equation and, in conjunction with the potential energy of the environment, comprises the total energy of the system. Consciousness operating at high kinetic energy implies corresponding dynamic capacity for overcoming environmental barriers, transferring information to other consciousness systems, or otherwise influencing its surroundings or itself.

The metaphor can be pursued into collective, statistical dimensions to address interacting ensembles of consciousnesses, via the usual arguments of kinetic theory and statistical mechanics, wherein metaphoric properties of consciousness "temperature," "density," and "pressure" are defined. For example, a "hot" consciousness system comprises many individuals in states of high activity within their common environment; a "cold" consciousness system embodies much less individual activity and less frequent interactions. Since departure from classical statistical behavior is favored by low temperature, low unit mass, and high density, the analogy predicts anomalous group effects when many consciousnesses are densely juxtaposed in a common environment at low levels of activity, e.g. in a religious service, a meditation group, or a seance. Social groups involving "charge-bearing" members display particularly interesting collective effects which can be represented by consciousness "conductivities," "plasma frequencies," "Debye lengths," "Saha relations," etc., all in formal analogy to the corresponding physical quantities. Derivation of these and other properties and their application to the representation of normal and anomalous social phenomena is also undertaken in the primary reference.[2]

Clearly the establishment of a suitable metric for the consciousness domain, essential to quantitative application of this metaphoric model, is a very complex task, and still far from complete. While certain intuitive, perhaps even archetypal, concepts seem to offer a reasonable basis for consensus specification of consciousness distance, time, mass, and charge, identification of their units of measurability is beyond us at present. It is possible that such scales may eventually emerge from better understanding

of various neurochemical and neuroelectrical unit processes invoked by individual psychophysiologies in perceiving, assessing, storing, and reacting to experiential stimulation, but the basic sciences addressing such processes are themselves far from maturity. The importance of better quantification of the consciousness metric clearly predicates more substantial dialogue between traditional neuroscience research and the necessarily more empirical efforts to comprehend intuitive and impressionistic consciousness-related phenomena, both normal and anomalous.

In continuing to address this difficult issue, we may take some solace in the recognition by Arthur Eddington that the physical metric itself is not all that tidy:

> "Quantities like length, duration, mass, force, etc. have no absolute significance; their values will depend on the mesh-system to which they are referred.... There is no fundamental mesh-system. In particular problems, and more particularly in restricted regions, it may be possible to choose a mesh-system which follows more or less closely the lines of absolute structure in the world, and so simplify the phenomena which are related to it. But the world structure is not of a kind which can be traced in an exact way by mesh-systems, and in any large region the mesh-system drawn must be considered arbitrary. In any case the systems used in current physics are arbitrary."(63)

10. APPLICATION TO ANOMALOUS PHENOMENA

While quantitative prediction is clearly beyond the grasp of the proposed metaphoric model, some qualitative and semi-quantitative interpretation of our own data and those of others, as well as useful guidelines for experimental design, have devolved from its concepts and vocabulary. Essentially, the overarching idea is this: If one retains the classical "particulate" image of human consciousness as sharply localized within the physiological frame, any possibilities of it directly influencing a physical device or process, or of acquiring information from targets remote in space and time, are inexplicable. If, however, consciousness is allowed a wave-mechanical nature, metaphorically akin to certain atomic-scale physical behavior, all of the diffraction, interference, and wave-leakage processes become available, and some rationalization of such anomalous results is possible. For example, the genre of clairvoyance effects, including remote perception, may then be represented as an escape of some portion of the consciousness wave from its own centered potential well, either by excitation to free wave status or by evanescent wave "tunneling," whereby it achieves access to the remote environment. Precognition may similarly be interpreted as a seepage of consciousness waves in their temporal coordinate. For such phenomena as telepathy, psychokinesis, psychic healing,

and quite possibly for certain aspects of clairvoyance and precognition as well, the concepts of the covalent bond, or of the resonance or superposition of interacting wave-mechanical systems in general, may be serviceable. Here each participating pair—the telepathic partners, the operator and the physical device on which he attempts psychokinetic influence, the healer/patient team, or the percipient/agent pair in a remote perception experiment—are regarded as a bonded molecular consciousness having eigenfunctions substantially different from those of its separate atomic components. The extent of these differences, i.e., the scale of the anomalous effects, depends on the strength of the bonds, and these in turn on the degree of resonance between the atomic eigenfunctions and thus on their structural form, their quantum numbers, and the nature of their individual and collective environmental wells.

The primary reference[2] develops such arguments in considerable detail. Here we can illustrate only a few such interpretations briefly in the context of the two classes of experiment described in Sec. 2.

10.1. The PK Resonance

Visualize a human operator, seated before some device embodying a random physical process, such as the REG described earlier, attempting to influence its output distribution by anomalous means. Represent the consciousness of that operator by a wave function, ψ^o, written in the spherical consciousness coordinates of range (r), attitude (θ), and orientation (ϕ), and displaying, in the prevailing environmental potential profile, eigenfunctions of experience, $\psi_i{}^o$, indexed by quantum numbers reflecting their intensity (n), complexity (l), ratio of cognition to emotion (m), and passive/active "spin" index (m_s). Similarly, represent the physical device by a wave function ψ^d, engendering in its prevailing environment a series of eigenfunctions $\psi_j{}^d$ indicative of its aesthetic, functional, or even anthropomorphic character as perceived by the operator, expressed in similar conceptual coordinates and indexed by similar quantum numbers to those in which the operator's consciousness is represented. If the wave function of the operator's consciousness is not resonant in the usual wave-mechanical sense with the wave function of the device, there will be little anomalous interaction between them. Rather, they will experience an "elastic collision," with no discernible change in the normal behavior of either. If, however, some wave-mechanical resonance does prevail between $\psi_i{}^o$ and $\psi_j{}^d$, a composite eigenfunction $\psi_{ij}{}^{od}$ will be constituted whose eigenvalues of experience in the prevailing environment may be observably different from the simple sum of the separated system eigenvalues, and the statistical distribution of information emerging from the experiment over a

large number of trials will be correspondingly changed. The basic experimental strategy, therefore, is to devise pragmatic means for tuning ψ_i^o and ψ_j^d to such resonance.

The degree of this resonance depends on the superposition of the separate system eigenfunctions in the prevailing environmental potential, i.e., on an overlap integral of the form (9) where V' is the alteration in the individual potential profiles caused by the proximity of the consciousness of the operator and device (in consciousness space), and $\psi_{ij}^{\pm}$ are the composite eigenfunctions of the bonded system for parallel and antiparallel spins. Thus the desired tuning could be addressed by (1) establishment of the particular operator eigenfunction which best matches the prevailing device eigenfunction, to optimize the integral; (2) selection of the particular machine eigenfunctions which best matches the prevailing operator eigenfunction; or (3) adjustment of the overall environmental potential function to optimize the integral via the interdependent changes in ψ_i^o, ψ_i^d, and V' caused thereby.

To invoke any of these possibilities, it is necessary to have a clearer conceptual definition of the eigenfunctions of the device, ψ_j^d, that represent those features of its behavior that can be recognized and shared by the operator. These may vary from operator to operator, depending on his technical sophistication, psychological characteristics, and experimental strategy. In many cases the salient features of ψ_j^d will be embodied mainly in the nature of the feedback whereby the machine shares its information with the operator in some observable form, so that its quantum numbers, n, l, m, and m_s refer primarily to the intensity of that feedback, its complexity, the balance between its cognitive and emotional impact, and its passivity/activity, respectively, as perceived by the operator.

However, ψ_j^d is established, to proceed with the first tuning option the operator attempts, by some psychological strategy or by some intuitive subconscious scanning, to identify and maintain his own eigenstate which best resonates with that of the device as he perceives it. In other words, he seeks to adjust his quantum numbers, as defined above, to best match those of the machine. In the second tuning alternative, the perceptible character of the machine's operation is deliberately altered by changing some parameters of the information processing mechanisms it employs, i.e., by setting different numbers of samples, sampling rates, or counting modes, or by employing feedback of different type, prominence, intensity, or complexity, in a search for that combination which best resonates with the consciousness state of the operator.

Perhaps the single most critical aspect of either of these tuning processes is the correlation of the spins of the operator and device wave functions. The formalism predicts that only if these spins are antiparallel

can a stable bond arise; if they are parallel, the overlap integral produces a repulsive term, i.e., the eigenvalues of the system are displaced in the opposite direction with respect to the sum of their separate values. Consequently, anomalous effects opposite to the intended direction may be expected when the operator's consciousness function has aligned its spin parallel to that of the device's function.

Given the association of consciousness spin with a passive/active or receptive/donative attitude or style, the logic for spin-tuning thus calls for the operator first to assess whether the device seems to be active or passive in its relationship to him and then to adjust his own style accordingly. Conversely, device modes of perceived activity or passivity can be provided for an operator maintaining a fixed spin characteristic. For example, the experimental options of automatic/manual trial initiation or instructed/volitional assignment of direction in the REG experiment may be relevant to the perceived spin of the device. For many of our operators, an automatic mode of machine operation, wherein trials are initiated and results presented via the feedback at regular intervals, out of direct control of the operator, is perceived as an assertive behavior of the device to which the operator must submit. In contrast, a manual mode, wherein the operator initiates each trial at his pleasure, is perceived to place the operator in the assertive role, and the device in the receptive. A similar sense prevails regarding the operator's freedom to choose his direction of effort, vis-a-vis having to accept a random instruction from the machine.

The process may be further complicated by the possibility, raised empirically by some of our operators and having some precedent in the physical domain,[39] that the spin roles of the operators and device may alternate during a trial or a series, so that both phasing and frequency become important in retaining the resonance. For example, an operator may feel that when an LED display flashes a particular trial count, the device is playing an assertive role to which he must respond submissively; conversely, when the machine is in an information processing phase and its feedback is incoherent, the operator has his opportunity to insert information into the bonded process. Similarly, in experiments offering multiple feedback modes of differing degrees of assertiveness, an operator may shift his attention from one mode to another in an attempt to phase with his own evolving spin pattern.

Correlation of the experimental PK data base sketched earlier with the various operational modes employed confirms several strategic features that are at least qualitatively consistent with aspects of the bonded-system metaphor just proposed. For example, the achievement of most operators is quantitatively, and often qualitatively, different for the two directions of effort, PK^+ and PK^- (cf. Fig. 3).[3] Given the complete symmetry in the

technical operation of the equipment and in the protocols, this disparity presumably must be related to subjective factors in the operator's approach to the task, e.g., to nuances in the psychological parameters he applies in the high and low efforts. These may include some difference in his "quantum numbers," his "charge," or his "proximity" (r) to the task, but whatever the factor, his eigenfunction is thereby distinguished from that with which he approaches the opposite task, and the overlap integral is correspondingly altered. Similarly, with respect to the second tuning option, the performance of given operators is indeed found to be sensitive to the various operational modes of the machine, e.g., some operators display totally different results in the manual or volitional modes than in the automatic or instructed modes, or vice versa (cf. Fig. 4).[3]

Beyond those mentioned, the model suggests a number of other possible correlations on which we have a growing body of data at this time. For example, experiments currently underway to test the sensitivity of PK to spatial or temporal separations, e.g., remote PK or precognitive PK, may help sort out the importance of such physical parameters in these bonds. Other experiments employing more than one operator on a device at a given time, or more than one device for a given operator, may illuminate the superposition of PK effects and possibly establish the "valence" of the devices and/or of the operators. If both operator and device are "monovalent," a good bond should resist inclusion of a third element. If either is "multivalent," other operators or other devices might be accomodated within the "molecule," with correspondingly enhanced anomalous effects.

10.2. The PRP Resonance

The resonant bond mechanism invoked in the context of PK may be restated in several different variations to apply to PRP experiments, depending on the roles presumed for the percipient, agent, and the target characteristics in such processes. For example, if the anomalous information exchange is regarded as devolving primarily from a resonance between the agent and percipient, the formalism requires specification of the agent and percipient eigenfunctions and utilization of them in an overlap integral. In this approach, the target characteristics enter as components of the composite potential profile, wherein new eigenstates of shared experience of the percipient/agent pair are established that differ from the linear combination of their separated states. These differences must accomodate the anomalous information acquired by the percipient about the target and, as also occasionally reported in these experiments,

any influence of the percipient on the agent's pattern of attention to the target.

An alternative application of the resonant system model to PRP experiments elevates the physical target from its role as an environmental factor conditioning the percipient/agent wave functions and overlap integral, to a primary participant in the bond. In this version, the percipient is regarded as resonating with the target rather than with the agent, and the latter is relegated to an environmental role in conditioning the eigenfunctions and overlap integral. This view, which is supported by a body of experiments performed elsewhere that employed percipient/agent pairs who were total strangers, or no agent at all,[64] requires assignment of a wave function and quantum numbers to the target scene, somewhat in the same spirit as for the PK machines. The task for the percipient's consciousness is then to scan over its own range of eigenfunctions, by any psychological strategy it elects, until some resonance with the unknown target eigenfunction is detected, and thereby to infer some aspects of that target's quantum mechanical, and hence physical and aesthetic, characteristics.

In somewhat different approaches, PRP phenomena may also be represented in terms of quantum mechanical tunneling or continuum free-wave aspects of the metaphor. The tunneling or barrier penetration format depicts the consciousness eigenfunctions of the percipient, and possibly also of the agent, as permeating outward from their own centered potential wells in the form of evanescent standing waves, whereby they access remote spatial and temporal portions of their environment. For this process, the requisite tuning is more passive than in the bonded-state interactions, and more conditioned by the nature of the environmental profile than by the details of another wave function.

Again, the empirical experience of some of our PRP participants is conceptually consistent with this tunneling model. Typically, such percipients endeavor by various psychological, physiological, or environmental strategies to suspend insofar as possible the analytical, short-wavelength activity of their usual cognitive and emotional processes, which by their nature are sharply localized and incapable of much diffusion beyond their own proximity, leaving available the longer wavelengths to seep outward and scan the remote environment. To facilitate this seepage, percipients may also endeavor to reduce the potential barriers surrounding their normal tightly centered realities by relaxing the degree of attachment to their physical locus.[65]

In some extreme cases, a percipient may feel that his consciousness has been totally or partially liberated from its center to roam freely in space and time, which would correspond, in the metaphor, to escape of the eigenfunctions to the free-wave continuum. In this state, the consciousness

accesses remote locations as an outward propagating wave, reflections of which return information about those locations, a process bearing some similarity to the so-called "out-of-body experiences,"[66] including certain aspects of documented "near-death experiences."[67]

Further discussion of the PK and PRP resonances is presented in the full report,[2] along with applications of the model to several other anomalous consciousness-related effects, including collective phenomena. Also discussed there are further ramifications of the quantum mechanical principles of indistinguishability, exclusion, correspondence, and uncertainty in the consciousness domain and their implications for the design and conduct of experiments.

11. SUMMARY AND DISCUSSION

We have proposed an intensification and generalization of a basic premise of quantum theory—that reality is constituted only in the context of observation or interaction—to predicate inclusion of consciousness properties and processes in the formalism. To implement this proposition, consciousness has been represented by a mathematical wave function and the environment in which that consciousness operates by a potential profile. In the interaction of these two functions, eigenvalues are established that are presumed to represent the cognitive and emotional experiences of the consciousness in that environment.

To develop specific examples, elementary Schrödinger formalism has been applied to such basic problems as the central force potential and the covalent bond, and the metaphoric relevance of the results to human experience, both normal and anomalous, has been argued. More general quantum mechanical concepts, such as the principles of indistinguishability, exclusion, correspondence, and uncertainty, as well as certain collective statistical aspects, have also been found to bear suggestive analogies to various aspects of personal and social experience and behavior.

To pursue such metaphors to useful predictive levels, it has been necessary to impart consciousness-related properties to the various mathematical and physical indices of the formal theory, such as the quantum numbers, the coordinate dimensions, and the system metric itself. These assignments have been largely intuitive and empirical, and because of their inherent softness, preclude more than semi-quantitative application of the model to experimental situations. Nevertheless, comparison of laboratory data and the testimony of experienced operators with appropriate aspects of the model has substantiated the conceptual utility of

the metaphor. At the least, it has provided a viable perspective and a facile language for the design of better experiments, the representation of the operators' cognitive and emotional attitudes and strategies, and the initiation of interdisciplinary dialogues on the phenomena at hand.

It may be contended that the product is in essence as much a psychological model as a physical one, and that its various ramifications have their counterparts in modern psychological theory. Certainly there are suggestive similarities between the evolution of psychology from its empirical and classical phases through the then radical formulations of James, Freud, and Jung on to its contemporary hyperspecializations, and that of physics from its Newtonian era through quantum mechanics into its modern esoteric proliferations. Niels Bohr commented on this similarity early in the development of quantum mechanics:

> "...The analogies with some fundamental features of the quantum theory, exhibited by the laws of psychology, may not merely make it easier for us to adjust ourselves to the new situation in physics, but it is perhaps not too ambitious to hope that the lessons we have learned from the very much simpler physical problems will also prove of value in our endeavours to obtain a comprehensive survey of the more subtle psychological questions. ...it is clear to the writer that for the time being we must be content with more or less appropriate analogies. Yet it may well be that behind these analogies there lies not only a kinship with regard to the epistemological aspects, but that a more profound relationship is hidden behind the fundamental biological problems which are directly connected to both sides."(68)

Similarly, Pauli, who collaborated with Carl Jung on a book entitled *The Interpretation of Nature and the Psyche* observed therein:

> "...physics and psychology reflect again for modern man the old contrast between the quantitative and the qualitative.... To us...the only acceptable point of view appears to be the one that recognizes *both* sides of reality—the quantitative and the qualitative, the physical and the psychical—as compatible with each other, and can embrace them simultaneously.... It would be most satisfactory of all if physics and psyche could be seen as complementary aspects of the same reality."(69)

Jung commented on the same issue from his own perspective:

> "The microphysical world of the atom exhibits certain features whose affinities with the psychic have impressed themselves even on the physicists. Here, it would seem, is at least a suggestion of how the psychic process could be 'reconstructed' in another medium, in that, namely, of the microphysics of matter."(70)

Since our own research program deals mainly with the physical aspects of the phenomena, we have not pursued such comparisons in any formal terms. Nonetheless, if its basic premises are correct and the formalism is

internally consistent, the model should encompass all experiential phenomena, however these may be labeled and catalogued.

It may also be questioned whether more sophisticated forms of quantum theory, such as the matrix, group theory, relativistic, or quantum electrodynamic formulations, or more recent developments in quantum logic, might not be more incisive for the task. Again we concur in principle, but have demurred in order to present the concepts in the simplest mathematical terms. Even in the elementary form employed here, many other features of quantum mechanics that have not been pursued could easily be adapted to proliferate the metaphor. Most notable of these omissions are the many other applications of the Schrödinger formalism to systems whose total energy exceeds the prevailing potential profile and hence are represented by propagating rather than standing waves having continuous rather than discrete eigenvalues. Leading examples of such are the array of atomic collision problems that display a variety of anomalous physical behavior equally amenable to metaphoric adaption to other consciousness processes. Similarly, the formulations of time-dependent wave mechanics and radiation theory could similarly be transcribed.

As noted at the outset, the metaphor need not be restricted to quantum mechanics alone; any domain of physical theory could be similarly appropriated for metaphoric representation of consciousness phenomena. The concepts of the consciousness coordinates and metric are not limited to the quantum regime, and even such classical statements as Maxwell's equations, the laws of thermodynamics, and Newton's Second Law must testify to the nature of the consciousness that conceives and applies them, and thus may also be useful for representation of that consciousness.

One particular physical domain, adjacent to the quantum-atomic regime invoked here and possibly worthy of future extension of the metaphor, is that of the nuclear and subnuclear phenomena. Throughout the development and application of the model to this point, the two most elusive aspects have been the precise quantification of the metric and the specification of the potential profiles that condition the consciousness eigenfunctions. The former probably must await better understanding of the unitary psychophysiological processes and mechanisms of the human organism; the latter, however, might be refined by invoking nuclear metaphors, in the following sense: The dominant aspects of the physical potential well experienced by atomic electrons is established by the array of charge localized in the nucleus. The proposition could be made that the personal consciousness potential wells invoked in the model are similarly constituted by various arrangements of consciousness "nucleons," maintained by a hierarchy of nuclear "forces" analogous to those prevalent in the physical models and bearing some correlation with identifiable, albeit much more intense and deeply rooted psychological factors, e.g., Jung's

"archetypes."[71] Pursuit of this extension of the metaphor would require an effort of at least the scale already deployed and is well beyond the scope of this paper. Nevertheless, some attempt to represent the experiences of human consciousness as it turns inward toward its center, rather than outward toward its environment, could be a worthwhile next step.

In the broadest sense, metaphoric representations of consciousness need not even be restricted to physical, or indeed to general scientific vocabulary and concepts, but could take their analogies from any province the mind of man has attempted to organize or correlate, be it technical or aesthetic, specialized or generic, deductive or intuitive. For it is precisely through such processes of organization and correlation that the characteristics of reality are manifested. In Einstein's words,

> It is the theory which decides what we can observe."[72]

The author of the quantum mechanical wave equation, Erwin Schrödinger, put the proposition more boldly:

> "...I—I in the widest meaning of the word, that is to say, every conscious mind that has ever said or felt 'I'—am the person, if any, who controls the 'motion of the atoms' according to the Laws of Nature."[73]

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