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# *Precognitive Telepathy II: Some Neurophysiological Conjectures and Metaphysical Speculations*[*]

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For expository simplicity in a paper that is philosophical rather than scientifically substantive (in the sense of seriously defending a specific neurophysiological theory about how the brain works in ESP experiments), I shall permit myself some framework assumptions about the functioning of CNS subsystems and single neurons. This will make it easier to discuss the methodological issues than if I were to invent a new "general substantive vocabulary" or—so clumsy as to be unfeasible—to set up a disjunction of alternative conjectures about brain function which would, even if wearisomely long and conceptually difficult, obviously have to be incomplete. Thus: I shall speak of 'cell-assemblies' without implying thereby everything that went into Hebb's exposition as to their structure, function, and development, but only the weaker and vaguer idea that neurons are synaptically linked together in functional systems in the general way that he sets forth in his classic work (Hebb, 1949). I shall refer throughout to neurons as the functional elements in experience and behavior control, despite currently open questions about whether what were formerly thought of as purely sustentacular or otherwise ancillary cells (e.g., glia) participate in processing information. Despite the large and complicated mass of evidence that has accumulated over the last decades indicating that information is "coded" in the CNS in other ways besides transmission of the classical spike potential along the fiber, I shall set aside such other forms as graded potentials, electrotonic coupling, amplitude changes in the spike, etc.

I think it obvious that none of these simplifications affects the methodological argument, so long as we may consistently (and, on the basis of what evidence we presently have, without flying in the face of well-corroborated experimental facts) conjecture that (a) the molar call depends upon the occurrence of classical spikes and that (b) in the causal chain leading finally to the integrated firing of motoneurons directly controlling the call, nonspike informational states and events in a final neuron C which is anatomically linked to an earlier A only via internuncial neuron B, are normally (always?) dependent upon the production of a spike in B. Finally, in order to present some speculative "micro-statistics" in relating the idea of quantum uncertain local outcomes to the molar call, we will use the idea that a relatively small number of neurons in one cell assembly, or in a functionally connected system of cell assemblies, can be "critical" or

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"determinative." Given suitable momentary states of the other elements in the assembly, if such and such a pattern or number of a selected group of such critical neurons fires within a specified interval, the assembly will be activated, or its activity level will exceed a threshold level of intra-assembly pulse frequencies sufficient to discharge another final common pathway neuron, or whatever the critical event farther along in the chain may be for determining the content of a molar call.

The existence of what have been variously called "critical," "command," or "pontifical" neurons has been well corroborated in several species, including primates; and command neurons are believed to exist in both perceptual and motor systems of man, although in humans the evidence is as yet only suggestive (Perkel & Bullock, 1969, pp. 468-470; Rosenbaum, 1977; Rosenbaum & Radford, 1977). A "determining influence" by a relatively small number of critical neurons (e.g., 10 of them, as hypothesized in examples *infra*) is not as unplausible as it may seem to readers accustomed to emphasizing the mass action and stochastic character of CNS processes, being actually less dramatic an example of privileged element causality in neuronal chains than some that have been empirically found by neurophysiologists. For example, the complex serial integrated movements constituting the defense reaction in crayfish can be set off by stimulating a single "command neuron" fiber with a simple train of evenly spaced electrical shocks lacking phasic or patterning relationship to the output pattern (Wilson, 1970, p. 402), which pattern involves more than half the musculature of the entire crayfish body. This phenomenon was first reported as far back as 1952 (Wiersma, 1952). A single Mauthner axon in aquarium fishes commands the sudden "jump" elicited by the stimulus of tapping the glass. In the mollusk *Tritonia* there exists a command neuron in which a *single spike impulse* suffices to elicit a long sequence of swimming movements involving much of the animal's musculature. The command fibers controlling crayfish abdominal posture affect large sets of muscles, in some cases requiring the mediating action of 300 motor neurons. Grillner and Shik (1975) have found command neurons in the cat. Schiller and Koerner (1971) found evidence that single neurons in the superior colliculus of monkey are responsible for triggering different eye movement saccades. (A corresponding many-one situation on the "input" side is also known to exist, e.g., in the visual system of the cat, see Hubel & Wiesel, 1962.) We may perhaps consider the existence of command neurons as merely the "logical" extreme case of that hierarchial organization that is ubiquitous in the CNS of complex organisms. So there is nothing antecedently improbable, and surely nothing outlandish or counternomological, in the imagined circumstance that 10 critical neurons "determine the call." All these neural elements need not, of course, be found in the same cell assembly. Each of them might play its "pontifical" role in each of 10 non-overlapping cell assemblies, or cell assembly systems, which nevertheless converge upon another "pontifical" internuncial neuron which in turn "commands" the molar call subsystem of the brain.

Taking the "total cerebral event" as a reductive complex (Reichenbach, 1938, pp. 105-111; Meehl, 1970, p. 345-346) of its part events, and taking the unit of analysis as the synapse (although it might very well be more "micro" than this, such as the quantity of disturbance at a specific locus on the synaptic scale induced

by the arrival of a presynaptic spike potential at that terminal knob, with its resultant release of transmitter substance), it seems clear that the configuration of local outcomes, and, I repeat, the cerebral event that is explicitly definable as a reducible complex of these, can, on the occasion of any given cerebral event generating a molar "call," *whether a hit or a miss,* be one of three kinds:

1 *Phi-determinate.* This means that each of the local events instantiates the "ordinary neurophysiological laws," no psi-influence by the agent's brain-event being required.

2. *Phi-violative.* This means that one or more of the local events fails to instantiate the ordinary neurophysiological laws. There is an ambiguity, as always, about when a "law of nature is transgressed," because one must explain whether he is treating the received system of nomologicals as causally complete. Thus, the laws of mechanics, if taken to be a complete empirical system for inanimate bodies in motion, seem to be "violated" or "transgressed" when a magnet deflects a steel ball rolling on a table; but when electromagnetic forces are added to the explanatory system, then the Newtonian laws relating acceleration to imposed forces are preserved, because the nomological network of mechanics is now supplemented by the nomological network of electromagnetic theory. For the telepathic situation we could find that our physico-chemical laws concerning the activity of neurons do not suffice to subsume (explain, derive) some of the local events, and for present purposes it does not matter whether we choose to view that as a case of "transgression" or as a case of "incompleteness." Either way, something is happening at the synapse which finds no place in the received law network of neurophysiology, the singular synaptic event is not an instantiation of the received phi-nomologicals, but instead constitutes an "exception" to them.

3. *Phi-indeterminate* This means that some (conceivably all) of the local events are known to be quantum-uncertain, *again without reference to any telepathic influence,* and the configuration of those which are quantum-uncertain is such that for some proper subset of calls we may speak of the total cerebral event, which determines the cognitive character of the molar call, as quantum-uncertain.

It must be stressed that the identification of these three subsets of the entire set of calls can be made without reference to the psychokinetic or precognitive telepathic relation. To identify these distinguishable subsets of calls it suffices to examine the configuration of Shackleton's brain at the moment in terms of the received "non-psi" laws of optics, visual perception, physiology of the speech [ = "tokening"] mechanism, etc.

There is an irksome problem of distinguishing between a quasi-determinate state and a significantly quantum uncertain state, analogous to the Second Law of Thermodynamics' being, strictly speaking, inconsistent with the statistical mechanics of the kinetic theory of heat. It can be shown in pre-quantum physics that "once in a while" dropping an ice cube into a boiling cup of tea should result in further heating up the tea. And physicists do not worry about the influence of quantum uncertainty upon, say, Hooke's Law applied to a bathroom scale. Some outcomes in the apparatus a physicist uses to study processes that are "small enough" so that the size of the quantum of action becomes relevant could, never-

theless, not occur with theoretical probability sufficient to require even *pro forma* mention when the physicist reports his experiment. For example, when I use macro-apparatus to study beams of electrons or patterns of photons, I do not for that purpose concern myself with the question whether closing a switch might, for quantum uncertain reasons, fail to activate the apparatus. The quantum theory does not impel us to worry much about the accuracy of a scintillation counter.

The clean, simple case would be such that when the cerebral system is phi-determinate, the hit rate for a standard 5-symbol ESP deck is exactly 1/5 but that when the system is phi-indeterminate, a "hit'' is scored. This would fit our expectations that the received physical nomologicals are all right, and that the physical$_2$ (Meehl & Sellars, 1956) isolation of the percipient's brain from the receiver's brain by experimental means has been successful. The target series is internally random, and is also random (on any sensible theory) with respect to the call series. So we have two presumably independent causal chains that happen to have been brought together in this laboratory by some experimenter but the *content patterns* of the two sequences have no rational connection with one another.

We then conjecture that in the subset of cases which independent examination of the percipient's momentary brain state shows to be quantum uncertain—so that there exists a subset of possible configurations of local quantum uncertain synaptic events for which the resultant molar consequence *would* be a hit—then the realized outcome on all such occasions *will* be a hit. On this theory, there is a simple numerical relationship between the observed hit rate and the proportion of phi-determinate calls as follows:

Let $p_d$ = Proportion of calls phi-determinate. Then the hit-rate is

$$\begin{aligned} p_h &= p_d\,({}_d p_h) + (1 - p_d)({}_{\bar{d}}\, p_h) \text{ where } {}_{\bar{d}}\, p_h = 1 \text{ as hypothesized,} \\ &= (1/5)(p_d) + (1 - p_d) \\ &= 1 - (4/5)(p_d) \end{aligned}$$

Thus, if Shackleton ran about 30% hits (i.e., 10% extra-chance) we could infer that .875 of his calls were phi-determinate. If our Utopian neurophysiologist had a sufficiently accurate micro-method of estimating the proportion of phi-indeterminate calls, and combined this value of ${}_{\bar{d}}\, p_h$ with the theoretical postulate of "perfect psi-hitting when possible" to yield a predicted molar hit-rate, corroboration of that predicted hit-rate would strongly corroborate the postulate.

While for expository purposes I have spoken of a quasi-perfected "utopian psychophysiology," it should not be supposed that this requires direct micro-level ascertainment of each of the large (but finite) set of local synaptic states immediately preceding a specific call. The notion of an advanced physiology of perception and psycholinguistics does not imply that by a combination of theory and super instrumentation we could answer all possible "local" questions about an actual ongoing cerebral state (without dismantling the recipient's brain or interfering with his cerebral processes), any more than an advanced theory of thermodynamics demands that in order to apply the mathematics of Maxwell, Boltzman & Co. the theoretical physicist claims to be able, *or needs to be able,* to say what each individual molecule has as its instantaneous components of momentum. The rate at which psychophysiology and neurology are developing

today, especially since the introduction of microelectrodes permitting both local stimulation and local unit response readings, makes it thinkable that within a generation and probably less, it will be possible to combine our molar behavior statistics on simple guessing tasks with detailed knowledge of the neuroanatomy and neurophysiology of the cerebral subsystems concerned—not, be it noted, ascertained upon the subject currently under molar experimental study— such that upper and lower bounds on the theoretical incidence of phi-indeterminate calls could be calculated by putting together this general knowledge with the molar statistics of the particular percipient's calls. Thus we would not require that thousands of microelectrodes be stuck into various of Shackleton's individual neurons by opening his skull in order to infer important neurophysiological statements from his molar guessing behavior during non-psi-effective calls (e.g., when the agent is one from whom he is routinely unable to receive, or when the lead time for the target event is pushed beyond four or five seconds into the future, or when a pure clairvoyant run is inserted during the course of the evening). We could, in Utopian psychophysiology, put together what we know of cerebral physiology and psycholinguistics and information theory plus the internal sequential properties of his molar-level calls so as to infer, say, that approximately 87% of his calls are phi-determinate. This inference makes no reference to his telepathic powers, nor to any properties, either on specific call occasions or in the long run, of the target series. This number, in quasi-utopian psychophysiology, would be computable solely by reliance on Shackleton's nontelepathic call series' properties and our general knowledge of how the visual perception and verbal systems work. The latter theory will be very complicated and based mainly upon micro-level data collected on brains other than Shackleton's. Given the estimate of around 13% phi-indeterminate calls, we extrapolate that value to the phi-effective condition for Shackleton—a conjecture, but a testable one. We then conjoin a further bold conjecture, to wit, that the psi-influence is infallible, i.e., that whenever the psi-influence *can* act on a phi-indeterminate brain state, it *does* so in such a manner as to produce a precognitive hit. Substituting these values in the above formula, we conclude that the expected hit rate should be about 30%. Corroboration of this numerical prediction corroborates our conjunction of conjectures.

Returning to the three possibilities listed above (phi-determinate, phi-violative, phi-indeterminate) how would we view each of them if a clear psi-hitting trend were in evidence? I shall say something about each but focus mainly on the third. I daresay most of us would find the first one stupefying in its spooky implications. It would mean that despite psi-hitting, the percipient's brain events run off in accordance with the ordinary micro-laws of physiology and chemistry when the agent is effectively in the system just as they do when the agent is not effectively in the system. The paradoxicality of this language does not reflect a real inconsistency, since "effective agency" means a conjunction of two things,

a. Extra-chance call/target correlation ( = psi-hitting); and
b. Correlation of (a) with selected agent's presence, eyes open, target illuminated, time lag short enough, etc.,

neither of which contains any reference or implication as to percipient's local synaptic events. The circularity here is only apparent, since we are able to ascertain

fairly stable properties of agents and of the precognitive lead time which we can then subsequently manipulate in the course of the experiment to eliminate successful precognition of the target series. So, Case 1 means that Shackleton's local brain events are determined in the usual neurophysiological way, by such things as the fluctuation in his blood sugar or a mosquito biting him or the movement of a curtain in his peripheral vision or—most important—persistence, alternation, and other more complex intraserial effects belonging to the field of psycholinguistics. When we employ an agent to whom he is consistently insensitive, or extend the precognitive lag to five seconds or more, or insert a pure clairvoyant call (in which the Geiger counters discharge but either the stimulus plates do not light up or the agent keeps his eyes shut), the same closed system of neurophysiological laws explains the pattern of Shackleton's local micro-events, and hence the molar call outcome, as when the agent is "effectively in" the causal system so that the call series tends statistically to match the target series. One hardly knows what to say about such a state of affairs, unless theological explanations are permitted. This would be preëstablished harmony with a vengeance. The Great Jokester has so arranged the cosmos that the ordinary (non-psi) physicochemical nomologicals, together with the initial conditions of the Big Bang, entail that Shackleton's brain-states are correlated with the agent's brain states (provided that certain time relations are satisfied) but that not all human beings can appear in the role of pseudo-agents for this purpose. It boggles the mind, and I shall not discuss it further here. I realize that the causal, statistical, and metaphysical issues involved in a depth-analysis of this "crazy coincidence" argument are from some viewpoints still controversial, and must content myself here with referring the reader to Grünbaum (1974), Popper's reply (1974b), his section 30 on debates with Schroedinger (Popper, 1974a, pp. 108-109), and the references cited in those sources. Popper's (1956a) example, reversing a movie film depicting the disturbance of a pond's surface owing to dropping a stone, makes the "coincidence" point well. "It would," as he says, "demand a vast number of distant coherent generators of waves the coordination of which, to be explicable, would have to be shown, in the film, as originating from one centre. This, however, raises precisely the same difficulty again, if we try to reverse the amended film" (Popper, 1956a, p. 538). Again, in replying to a criticism of the first paper, he says that to explain the reversed film sequence "we do not wish to accept the coherence of the generators as *an ultimate and inexplicable conspiracy of causally unrelated conspirators*" [my italics] (Popper, 1956b, p. 384). Despite its metaphorical character, the "ultimate and inexplicable conspiracy of causally unrelated conspirators" expresses the point beautifully. Popper attributes the same argument to Einstein in a 1909 paper, not read by me.

(Would it support Malebranche in a way he could not easily have imagined? A nontheological occasionalism that rejects the telepathic influence explanation has been held by some scientific contemporaries, as, e.g., Paul Kammerer, the unfortunate Lamarckian who postulated a kind of law of [noncausal but extra-chance] coincidences. See Appendix 1, "The law of seriality," in Koestler [1971, pp. 135-43], and Chapter 3 "Seriality and synchronicity" in Koestler [1972, pp. 82-104].)

In this connection, it is perhaps worth noting that the usual contemporary view of miracles as genuinely counternomological differs importantly from that held by (some) ancient theologians of the three Semitic religions, in that extraordinary occurrences working "in behalf of" God's people or prophets, and revelatory because of their aberrant causal structure when viewed at one level of analysis, were considered to be nevertheless "lawful" in some deeper sense. See e.g., Goldman (1975, p. 122). I have heard a conservative Christian physicist, relying on modern knowledge of the *koine* Greek phrase for heliacal rising (mistranslated in Matthew 2:2 KJV "in the East") argue from astronomical calculations that the Star of Bethlehem was a conjunction in 7 B. C. of Jupiter and Saturn in the constellation Pisces which would have been easily visible to the naked eye and in a direct line from, say Sippur through Bethlehem. Such a dramatic celestial display would have symbolic significance to Babylonian astronomers (and to Jews residing in Babylon) because Saturn was the "Jewish planet," Jupiter the "royal planet," while Pisces was the zodiacal sign of the West (to Chaldeans) and of Messiah (to Jews). Hence this "miraculous sign" was not "miraculous [ = counter-nomological]" in post-Newtonian Faustian man's usual sense. Such a view, of course, fuzzes up our theological distinctions between God's modes of agency in general providence, special providence, and miracles. It involves a physical occurrence entailed by nomologicals + initial cosmic conditions which event, given human cultural beliefs, has a "special meaning"—a kind of astronomical/sociological preëstablished harmony (see Keller, 1956, pp. 345-355). I am not suggesting a theological explanation for precognitive telepathy of Case 1 kind, but I think it interesting to note that what I called *supra* "mind-boggling" and "preëstablished harmony with a vengeance" is not without historical and contemporary examples outside the parapsychology domain.

The second possibility becomes extraordinarily difficult to explicate in any rigorous way, and I have found myself unable to do so with sufficient precision to make it worthwhile, so I content myself with an analogy. The ordinary phi-nomologicals of (utopian) received neurophysiology suffice to account for Shackleton's cerebral events when he is not functioning as a telepathic sensitive. When he is functioning as a sensitive, with an agent effectively in the system, it is as if the required "new telepathic nomologicals" exert a molar-discernible effect on 13% of the calls. This could be rather like the conjunction of electromagnetism to Newtonian mechanics, where theoretically a child's magnet retards the downhill progress of a big steel truck (as, in gravitation theory, we must hold that by crooking my finger I slightly deflect the course of the planet Jupiter) but in order to lift the truck one needs a gigantic electromagnet. In Case 2 the cerebral system is not quantum-indeterminate, nor does it display any "miracles" (in the sense that nomologicals are "violated"), but the situation is one requiring inclusion of a *new kind of force* (or influence, or field, or whatever) which operates concurrently with the ordinary phi-nomologicals of brain function and which, under some circumstances, cannot suffice to influence the molar outcome. Part of the reason for this "insignificant influence" is that the molar outcome is not finely graded. In fact, any ordinary variations in response topography such as faint differences in the loudness or assurance with which Shackleton makes a precognitive guess, are not

recorded; so that every call is either a hit or a miss, no matter how "weak" or "strong" it might be if studied in more detail. And, of course, there could be variations in the cerebral event that are not reflected in measurable features on the molar outcome, a possibility which can easily arise in a variety of ways.

The third possibility is the more interesting and the one I would like to develop at somewhat greater length. It does not matter for our purposes here whether whatever genuinely quantum uncertain event-types exist in the functioning of the human cerebral system are at the "whole synapse" (i.e., involving the "optional transmission" postulated by Lorente de Nó, where 'input' refers to all of the incoming events over the post-synaptic cell's synaptic scale), or whether what is genuinely a quantum uncertain event, considered singly, is whatever happens in the post-synaptic cell membrane directly under a particular synaptic knob when the latter emits a transmitter substance, generates an electrostatic field, or whatever. It will be convenient expositorily to refer simply to a "synaptic locus," keeping in mind that the post-synaptic neuron's optional transmission, while it might itself be "determined" by the configuration of all micro-events at the various loci on its surface, could nevertheless be quantum uncertain as a consequence of the quantum uncertainty of the several more localized synaptic scale micro-events.

I assume that physics can attach a reasonably clear meaning to quantum uncertainty of a local event (such as a discharge or not, or a spread of cell membrane disturbance timed and patterned sufficiently to get the cell over a spike threshold) and I shall speak of this condition ontologically in most of what follows. However, one may ask preliminarily how utopian psychophysiology could conclude that there was quantum uncertain optional transmission? It seems that three lines of evidence, converging on the conclusion of local quantum uncertainty, would be corroborative. First, as is already to some degree the case in the present state of neurophysiology, knowledge of the local micro-processes would suggest this conclusion on theoretical grounds, inasmuch as the distances, times, and energies involved in the transaction are sufficiently minute so that the quantum of action has relevant order of magnitude. Already in the 1930s a theoretical argument of this form was advanced persuasively by Hecht together with experimental findings that a half dozen photons suffice to produce a detectable retinal response. Second, experimental study of the convergence of local influences, whether measured or experimentally produced by us, could show that these synaptic input manipulations, while (like changing slit size in the diffraction experiments) altering the statistical parameters, cannot bring the post-synaptic consequence under strict nomological control, i.e., they can raise or lower the transmission probability but a basic "optional transmission" persists. Third, despite some bias away from a strict 50:50 "chance" of spiking once having assigned the parameter, we might discover that the internal sequential pattern of the cell's firing or not firing was random.

It seems necessary to differentiate between the (theoretically uninteresting) situation where the total cerebral event resulting in a behaviorally identifiable molar outcome ("call") is a random micro-consequence of the configuration of local quantum uncertain synaptic states, in the same sense that the distribution of steel balls at the end of a finite trial on a Galton Board is the outcome of

accumulated and dependent random results when each marble strikes various nails on the way down; and the theoretically interesting case in which the molar cerebral event, while still a "resultant" or "configural consequence" of the local synaptic event, including some that are quantum uncertain (while others may not be on a given call), is not such a random result but shows a "configural selection" with respect to the precognitive target. We must also forestall any important element of stochastic slippage between those local synaptic events that are, so to speak, "decider" events and the subsequent events in the chain of cerebral occurrences that direct the controllee tokening machinery. That is, we avoid concern about phenomena like aphasia, Freudian mis-speaking, non-Freudian slips of the tongue, and the like which are not of interest for the present purpose. It is not necessary to assume that no such phi-determined aberrations in the subsequent causal sequence ever take place, but presumably they are relatively rare in this situation; and in any case their influence should be to reduce psi-hitting to the extent that they have a statistically discernible effect in the molar call series. Hence, it seems a harmless simplification for present purposes to assume that there is quasi-complete determinism obtaining between the "deciding" mechanisms of the brain and the tokening mechanism that produces the vocal or written molar call. If the molar call is a quasi-nomological consequence of the configuration of local synaptic events on those occasions in which Shackleton's brain is on the knife-edge, that is, when the call is phi-indeterminate, and, further, if the distribution of local synaptic events, no matter how considered with respect to one another or with respect to the previous sequence of events of the same loci, satisfy a random statistical model by all of the usual tests of randomness, sequential and configural, then I shall refer to the molar cerebral event as determined by a *quantum uncertain cascade.* Roughly, this phrase means that "everything is random with respect to everything," including all configural features, in the sequence of patterns of local events. However, we note that three kinds of uncertainties may jointly obtain, *and strictly so,* despite what might be a good—even a perfect—rate of psi-hitting:

1. Each local synaptic event is quantum uncertain, as explained above.
2. Each local synaptic event is completely random with respect to the remaining synaptic events, taken singly and collectively.
3. Each local synaptic event is random with respect to the target.

*Nevertheless,* each single synaptic event may have a stochastic inferability (and some of them, under some occasions of the total cerebral state, may have perfect inferability) *when we consider jointly the pattern of other local events and the target.* If Shackleton's brain scores a hit whenever a hit is scorable, configural laws would obtain such that a disjunction of conjunctions of locally uncertain synaptic events can be necessitated by a requirement that the target must be successfully "hit" by the molar call.

A more interesting conceivable case, which is also somehow more plausible, perhaps because the molar guessing behavior has the properties of a constrained stochastic process, is one in which the configuration of quasi-nomological phi-determinate cerebral systems active at the moment of the percipient's call renders the brain rather like a "biased coin," that is, where the cerebral system is quantum

uncertain but the distribution of probabilities is not symmetrical with respect to the molar character of the call *h* or *t*. It seems antecedently an improbable hypothesis that all cerebral situations that could *possibly* (i.e., by at least one configuration of quantum uncertain local synaptic outcomes) yield a specified molar call, say, "heads," would be so constituted as to the locus and potential causal influence of each of the quantum uncertain synaptic events that these events, when considered collectively, would make either molar outcome equally probable. The molar guessing behavior suggests the contrary, to wit, that whether there are no radically indeterminate cerebral events in the eyes of Omniscient Jones, or whether, as we are currently conjecturing, there are *some* radically quantum uncertain cerebral events, the probabilities in either case are not routinely symmetrical for all molar call outcomes but tend instead to have varying degrees of statistical bias. How would this "biased brain state" be constituted at the utopian neurophysiologist's micro-level?

Consider the hypothetical case of 10 "critical neurons" each of which is in a quantum uncertain state (to fire or not to fire) during the causally effective time interval just preceding a molar call. For simplicity we will assume that each *individual* quantum uncertain synaptic event has $p = ½$ (hardly the way it would work, but that refinement makes no difference in the present argument). Suppose further that the condition for a molar call of character *h* is that any 9 of the 10 quantum uncertain critical neurons should fire. So if two or more fail to fire, the call will be *t.* If this configural event is internally random and the psi-hitting phenomenon is of psychokinetic origin, what do we expect? The probability of a molar call *h* is the sum of the last two terms in the binomial expansion $(½ + ½)^{10}$, that is, the molar probability of a hit in such a situation is $p < .011$, so that considering the subcollective of such calls, almost 99% of them should be "tail" calls. On a straightforward application of the psychokinetic theory of psi-hitting, if we define the subset of targets that follow two seconds after calls arising on this type of cerebral configuration, we should expect to see a distinct, and possibly quite pronounced, psychokinetic "influence" shifting the target distribution away from H:T symmetry toward p(H) << p(T). If, on the other hand, the target marginals of our psi-hitting table remain fixed at approximately ½ for this subset of targets defined by the cerebral constellation of the associated calls, it means either that the hit rate must decline or, at least, that the hits which occur must be heavily concentrated on successful calls of tails. On the precognitive telepathy interpretation, we expect that there will be a nonrandom configural selection under such cerebral circumstances, so that the relative frequency of 9:10 *h*-favorable quantum uncertain firings will *not* be correctly estimated by summing the last two terms of the appropriate binomial, that is, the character of the target as a head or a tail influences the selection of the configuration of local synaptic outcomes so as to produce the usual high hit rate. It would of course be especially interesting if, as postulated *supra,* the configuration of local outcomes should *always* be such as to generate a hit whenever the immediately preceding phi-determination of the total cerebral system gave rise to a momentary pattern of quantum uncertain synaptic states such that at least one selection of the possible configurations of local outcomes would generate a molar call to match the target. But such an extreme case as

this is not required to make the argument. It suffices to show a departure from the pure chance expectancy over the 1,024 possible patterns of local outcomes at 10 quantum uncertain synaptic loci. The combination of a stable symmetry of target marginals with systematic distortions from a random distribution of the configuration of quantum uncertain local outcomes argues strongly against psychokinesis in favor of precognitive telepathy. Here again, the defender of the counterhypothesis is in the position of saying that when the agent is in the system, etc., the percipient's brain delicately adjusts the psychokinetic force so as to maintain the hit frequency while also maintaining symmetrical target marginals in the fourfold table. Such an interpretation does not flow naturally from the simple psychokinetic conjecture but is content-decreasing and *ad hoc,* in addition to the oddity mentioned earlier that the percipient's brain "knows how" to generate psychokinetically a random sequence in the target but not in its own guessing pattern. I have described the situation ontologically and without reference to what kind of utopian neurophysiological micro-techniques would be needed. But I take it as obvious that there is a molar counterpart to these micro-cerebral circumstances, consisting of what has already been observed in the actual analysis of the Shackleton and Stewart series about the difficulties of psi-hitting following certain strongly biased pre-call blocks.

There is a philosophically fascinating "configural selection" possibility that I plan to develop elsewhere but will briefly adumbrate here by way of conclusion. We need a bit more terminological stipulation to consider it, which I hope extends, without confusing, the brain-event semantics proposed *supra.* If the momentary stimulus situation conjoined with the cerebral state consequent upon the immediately preceding events (especially the preceding call sequence as far back as it is influential) nomologically entail a particular call, the system may be described as *micro-determined.* Suppose that this condition does not strictly obtain, but that the joint firing probabilities for all the elements in the relevant cell assemblies are such that the molar character of the instant call is nearly certain (in the same sense that the experimental physicist considers it "certain" that an ice cube will be melted when dropped into a cup of hot tea, despite kinetic theory's showing that there is a non-zero probability that the ice cube will get colder and heat up the tea). Then the instant call will be said to be *quasi-micro-determined.* If neither of these conditions obtains, then the system at the moment of the instant call will be said to be *micro-uncertain.* If the cerebral system is quasi-micro-determined, and the nomologically necessary (or overwhelmingly probable) molar outcome matches the target, the system will be said to be *hit-determinate.* If the system is micro-uncertain and there exist one or more possible quantum uncertain patterns at the indeterminate synaptic loci such that, if any one of these outcome patterns were to occur, the outcome would constitute a target hit, the system is described as in a *hit-possible* state. Then there could be evidence for a "systematic molar outcome-selected cerebral process." Such evidence would consist in showing, over a series of hit-possible occasions, that the configural selection of positive and negative fire/not fire outcomes at the relevant quantum uncertain synaptic loci is *not random with respect to the distribution of possible molar call outcomes,* despite the two statistical facts that:

a. Local quantum uncertainty obtains at each synaptic locus w.r.t. its electrochemical input and surround; and
b. The internal sequence of outcomes ("fire/not fire") at each single synaptic locus is random.

Such a state of affairs, in which a nonchance predictability of a local quantum uncertain outcome is possible only by reference to the rest of the configuration when the latter is related to the molar outcome as being a "hit'' or a "miss'' with respect to the target, would be a rational basis for saying, roughly, "The entire cerebral system 'chooses' freely so as to effect a certain result." If this reasoning is essentially sound, I shall further argue that the usual positivist dichotomy which says, by assuming reducibility of the system function to the component functions, that a person's mind-brain must either be *determined* or *act randomly* ("capriciously," "by chance") is a false dichotomy. It is a natural conclusion for a materialist-reductionist to make, and for most of us reared in the Western scientific tradition it seems "obvious." But it is a mistaken dichotomy when dealing with a system whose parts are quantum uncertain but whose configural events lead nomologically to a molar outcome that can be mapped onto a molar target. The development of this argument, of great interest to moral and juridical philosophy, I must leave to a separate paper [Meehl, 1989].

My colleague Professor Emeritus Herbert Feigl urged upon me (some 20 years ago, in the early days of the Minnesota Center for the Philosophy of Science) a criticism which he does not currently make, but which is plausible enough to be a likely thought of numerous readers, so I shall attempt to deal with it. The criticism is that one ought not to refer to an event as being "indeterminate," whether the indeterminacy is of a quantum-mechanical kind or has the sort of (debatable) indeterminacy that Sir Karl Popper and others allege to hold even in classical physics (Popper, 1950, 1966) if it is theoretically predictable given sufficient knowledge of the conditions. That the configural cerebral event can be correlated with an external event (e.g., psi-target) despite complete randomness both within the local part-event sequences and zero correlation between each local sequence and the target, while surprising to many on first hearing, is easily shown (Meehl, *et al.,* 1958, Appendix E, "Indeterminacy and Teleological Constraints," pp. 328-338, whose line of reasoning I still consider sound after 20 years, although I no longer hold to the Lutheran theology there providing context; Meehl, 1966, 123-124; 1970, fn 27, pp. 351-352). In psychometrics the formal situation has been called 'configural scoring' (Meehl, 1950; 1954, pp. 132-133; Horst, 1954). The general principle is that of asymmetry in the relationship between "pairwise independence" and "total mutual independence" among a set of event-variables, the former being a necessary but not sufficient condition for the latter (Cramér, 1946, p. 162; Feller, 1957, pp. 114-117, the theorem being due to S. Bernstein). If we have $m$ synaptic loci and associate them with the (molar) target event, these $(m + 1)$ event variables are not mutually independent if psi-hitting occurs, but they may nevertheless be pairwise independent; so each synaptic variable may be independent of the target variable.

But Feigl's revised objection is not aimed at Bernstein's paradox. Feigl objects to calling the local events "indeterminate" if they are *in any way* lawful, and surely

if they are, in principle, predictable. In the Geiger counter experiment as I have imagined it the event is not predictable, if we believe the received physics, because the configuration of local synaptic events that generates a molar call is, according to the analysis *supra,* a function of the quantum-uncertain and hence radically unpredictable radioactive decay process two seconds in the future. So 'predictable' is not the right word, if we have in mind forecasting in time by a quasi-Omniscient Jones, who (unlike God) is "inside time" but who (unlike us) has a precise and complete knowledge of the nomologicals and the momentary conditions of the system. If physics is true, quasi-Omniscient Jones cannot predict Shackleton's micro-cerebral events because those events are chosen on the basis of their being a member of the proper subset of configurations of local synaptic outcomes that would generate a molar "hit," and a molar "hit" *is not defined* the moment before these events occur because the determinative event in the backward causal chain has not taken place yet and is itself, according to physics, radically indeterminate.

The notion of configural selection, where the cerebral subsystem seems "as a whole" to determine one or more quantum-uncertain local events ideologically, could theoretically be made *testable* in the strong sense by technological advances in single-unit micro-electrode procedures (currently available) that are not so far out as to be science fiction. Suppose the neurophysiologist of A.D. 2000 could identify and analyze pontifical cell-assemblies in telepathic subjects. He could then, at will, micro-stimulate specified subsets of neural elements in such assemblies. Hence he could select varying firing patterns on different trials, such that only certain (pre-calculable) outcomes at the "free" loci would produce a molar "hit." If the transmission probabilities remained stable at each "free" locus, but the patterns of free locus events were strongly influenced by the joint (target + micro-stimulated neural) events—in the extreme case, completely determined by them—such experimental manipulability would strongly support the configural selection hypothesis. Thus, the experimenter selects a pattern $F_k$ of local firings to be brought about by microelectrode single unit stimulation, such that the assembly can "work" to yield a molar call '*l* ' iff free elements (*a*, *b*, *c*) all fire. It turns out that they *do* so iff target turns out to be L, not if target is R. The experimenter has, so to speak, "manipulated the *abc* events conditionally"—he has employed his microelectrodes to produce $F_k$ which assures that "if L, then l" will be true. Since the long run statistics show that $F_k$ does not influence L, we infer that it operates by influencing l.

But someone may say that an event, though unpredictable, should not be characterized as "indeterminate' if it fits into a nomological system—never mind whether some of the independent variables' values that must be plugged into the laws relied upon happen, in strange cases like precognitive telepathy, to occur at a subsequent time. I do not believe any substantive issue hinges upon the semantics of this objection. If somebody wants to say that the macro-cerebral event is unpredictable but determinate, being a disjunction of a large number of quantum-uncertain micro-events which configurally suffice to generate a molar call that *will* constitute a hit against the target *when the target appears* (so that after the target has appeared we can retrospectively assert that the local outcomes were determined by the character of the target), I have no objection. It remains

interesting and important that the individual local outcomes are quantum-uncertain, and that there is no logical or mathematical inconsistency in saying that they are individually quantum-uncertain from the standpoint of their immediate physical surroundings even if we could say (given "idealized psi-hitting") that *one* among the proper subset of local configurations which would suffice to generate a molar hit, whenever a molar hit is possible, will be "chosen." I remind the reader again that the target sequence is internally random, so that even if there were no way in which the many-one correlation of quantum-uncertain local synaptic events with molar call outcomes could permit the sequence of single call events to be wholly random with respect to the properties of all target events and their patterns, they could still be perfectly random, call by call, as a sequence, since they are only required to "match" the target sequence which is itself internally random. It is important to get a clear picture of the nonrandom, systematic relationship involved here, otherwise one fails to see the almost unique character of the kind of causal relation being discussed. What a utopian physiologist knows is that the supernormal hit rate comes about because, on all occasions when the phi-initial conditions of Shackleton's brain are such that given the phi-nomologicals, there exists at least one configuration of locally quantum-uncertain synaptic outcomes that would generate, as a molar consequence, a call that matches the target two seconds in the future, such a call will be made, i.e., such a configuration of local outcomes will "occur." What would we have to know in order to derive this configuration? We would have to know the target, and the quasi-determinate cerebral constraints, in order to ascertain which configurations of locally quantum-uncertain outcomes would generate a molar hit; but we would still not be able to infer which of these hit-effective configurations will be (*or was*) realized. With knowledge of the micro-details (such as even Utopian psychophysiology might lack as regards the single occurrence) the evidence for this "choice" would be statistical in nature, and would presumably have to refer jointly to the molar outcome and the target, because from the standpoint of probability theory, any one configuration is as likely as any other.

I speak of this above as being "almost unique," because such configural principles as the Pauli Exclusion Principle (which, as I understand it, is not derivable from more fundamental physical postulates), or the famous two slit experiment, seem similar to our setup, in that a sort of "gestalted" characteristic of a system is referred to in excluding or predicting something about one of its components. That reference must be made to the agent's brain and not to somebody else's brain in Calcutta 20 years ago is comparable to the fact that the Pauli Principle refers to elementary particles belonging to the same system, so that an electron on the earth can have the same four quantum numbers as an electron in Alpha Centauri belonging to a different system, or to another cadmium atom adjacent to it.

It is worth noting that Hume, in setting out the conditions for something being a cause, thought it necessary to mention a conjunction of three things: (a) contiguity, (b) succession, and (c) constant conjunction, without, so far as I can discern, raising the question how one could even begin looking for (b) and (c) without (a). That is to say, in canvassing the possible candidates for "causes" of a certain event or events of a certain kind, the very meaning of 'invariable sequence'

involves the other two notions, since we do not search for possible causal ancestors among *all* events however remote in space-time, and we would have no rational basis for including or excluding such if we did fecklessly begin with a blind search throughout the whole space-time continuum. (I once heard a physicist confronted with an anti-Copenhagen query "You don't assume that the elementary particle recorded by your scintillation counter is in a physicist's lab setup in Berlin, do you?" reply "Well, *some* of it is." Does he really mean it?)

It is interesting to consider the analogy between the two slit experiment and the telepathic experiment as here analyzed, because physicists generally assume that there is nothing about that slit through which the photon passes (especially during those low intensity variants in which no two photons are likely to be in the apparatus at the same time) that can be influenced by the presence of the other slit or by other photons passing through it on other occasions. There is nothing "local" about the condition of slit 1 traversed by Photon Abner that is changed by what Photon Beulah did a micro-second ago in passing through slit 2. And the post-slit momenta of Abner and Beulah are each quantum-uncertain. But the statistical distribution of post-slit momenta as revealed by the photographic scatter pattern is inferable from knowledge of the total experimental arrangement. The physicist does not feel obliged to ascertain what other macro-apparatus arrangements exist in another building across the campus, let alone one at Cal. Tech. while he is experimenting at MIT! In the precognitive telepathy set up, what I am sketching out is a theoretical interpretation in which there is a rock bottom configural postulate that refers (somewhat vaguely) to an individual human brain in a precognitive telepathy experiment, and then, having made that preliminary molar identification, goes on to say that if there exist possible configurations of local synaptic quantum-uncertain outcomes such that the macro-consequence of those outcomes will be a call that constitutes a hit, one of such will be " selected." I do not know how I would go about discussing attenuated forms of this that would arise if we start moving into the brains of chimpanzees or excised subregions of Shackleton's brain and the like, but colleagues who are informed about the current state of physics assure me that in that respect the relation between micro-events analyzed quantum-theoretically and the experimental situation described classically still remains somewhat puzzling. As I am given to understand, the sometime allegation that the classical laws are *derivable* from the quantum-principles is not based upon valid proofs except for very special cases. Let me hasten to say that I do not intend in the least to invoke the less than satisfactory state of quantum mechanics as an *argumentum per obscurium.* But since I have invoked the conjecture by Schroedinger, Jordan, Eccles, Hecht, and others as to genuine quantum-uncertainty at some micro-level of neural function, it seems appropriate to point out that an inherently and irreducibly *configural* statement of the kind I use: "If a hit is possible…," does have analogies in quantum-theory outside the human telepathic domain.

## Summary

There appears initially to be a kind of "explanatory symmetry" between precognitive telepathy and psychokinesis, such that a statistical correlation observed between cognizing events in a percipient's cerebral system and the target events cognized could, in principle, be explained either by forward causality (call → target: psychokinetic influence) or by backward causality (call ← target: precognitive telepathy). In this paper I have argued that it is nevertheless possible to design an experiment which would tend strongly to discorroborate one in favor of the other. The experiment relies conjointly upon the randomness of radioactive decay processes and the nonrandomness of human guessing behavior. A target series generated by radioactive decay processes should according to theoretical physics display no internal organization (departure from randomness, negentropy, sequential dependencies) and the information theoretical formulas for various orders of redundancy should over the long run yield maximum entropy on a target series so generated. By contrast, the calling behavior of the human percipient will display significant redundancy, with or without the occurrence of significant psi-hitting. Significant psi-hitting should be reflected, on the psychokinetic hypothesis, in a distortion away from maximum entropy within the target series. Whereas if the causal system is one of precognitive telepathy the target series entropy should be unaffected by the presence/absence of the percipient, operation of an effective/ ineffective agent in the system, or by the occurrence/ nonoccurrence of significant psi-hitting. It is predicted on the precognitive telepathic theory that the entropy of the call sequence during successful psi-hitting should be increased. These predictions can be made with considerable confidence on the basis of present available molar behavior data, without further refinement in our detailed knowledge of the micro-functioning of the cerebral system. Taking that presently feasible experiment as a jumping-off place, further conjectures are elaborated on three possible ways in which precognitive telepathy might take place in the cerebral system, and the notion of a *gestalted selection of patterns of quantum uncertain synaptic events* is delineated. One consequence of this analysis is rejection of the customary positivist dichotomy between psychological determinism and completely random (capricious, "chance") behavior in favor of a conception that involves genuine choice or selection by the total cerebral system, a selection ideologically defined by reference to target matching. On this conjecture, the local synaptic events are individually quantum uncertain, but the statistical properties of selection among possible configurations of such events are incompatible with an interpretation that makes the molar outcome simply a result of independent and random synaptic events ("quantum-uncertain cascade"). While sufficiently complicated *ad hoc* theories might still preserve a psychokinetic interpretation, it is suggested that such interpretations would constitute a content-decreasing, degenerating research program. For some quantitative experimental values of psi-hitting it is shown that a psychokinetic theory would be numerically incompatible with preservation of entropy in the radioactive decay sequence by constraining the target marginals.

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