COMMUNICATION AND PARAPSYCHOLOGY

PROCEEDINGS OF AN INTERNATIONAL CONFERENCE

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Edited By
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INTRODUCTION

ANGOFF: I am Allan Angoff of the Parapsychology Foundation. For the Trustees, I open this Twenty-eighth Annual International Conference and call to order this first session. This conference, addressed to the theme, "Communication and Parapsychology," is the current contribution to an annual series established three decades ago by the founder of the organization, Eileen J. Garrett. She was a friend of learning and a pioneer parapsychologist who, in that early era as it now seems, comprehended so well the importance of bringing together regularly from all over the world, the scientists, the researchers, the men and women of learning so often working in isolation from colleagues, and sympathetic observers, so that they could compare views on findings in parapsychology and related areas.

The first Annual Conference of the Parapsychology Foundation was held at the University of Utrecht, the Netherlands, and at that first session, it is well to recall now, Gardner Murphy, the Foundation's Director of Research, proclaimed in his opening address, and I quote Dr. Murphy:

"I would emphasize five words," he said at that first conference of the Foundation. "*Scientific, international, democratic, informal, courageous.* As scientists, we shall neither attack nor endorse, but we must continue to give our eager attention to every fact and look forward to an era when we shall have suitable methods and suitable facts to warrant continuous yet scientifically solid statements about the relations of human personality to that world that appears to transcend description in terms of the concepts of time and space now known to us. It seems to me," concluded Dr. Murphy, "that the scientific spirit can lead us to an integrated conception of the nature of man more satisfying than that which we now possess. In this integrated effort, of all the modes of our understanding of man, parapsychology will, if our work be done well, play a vital role."

That was Gardner Murphy at the Foundation's First Conference in Utrecht, the Netherlands. This distinguished scholar and scientist died earlier this year. The Parapsychology Foundation dedicates this Twenty-eighth Annual International Conference to his memory.

And now, Ladies and Gentlemen, I would like to present the President of the Foundation—Eileen Coly.

EILEEN COLY: Thank you. All I'm going to do is bid a good morning to participants and observers, and welcome you all to this conference. I suggest we start at once with the presentation of the papers.

PSI FUNCTIONING WITHIN A SIMPLE COMMUNICATION MODEL

ROBERT L. MORRIS

Defining What We Mean by Psi

Recently several writers have questioned the relevance of communication models for the understanding of psi (e.g., Braude, 1979; Edge, 1978; Stanford, 1978). Part of the problem appears to involve the variety of definitions that can be given the concept of communication. In an earlier paper (Morris, 1975), I defined psi in the following way. "Psi involves one of two things: (a) an organism appears to receive information from—to be influenced by—some aspect of its environment through means not presently understood; or (b) an organism appears to impart information—to influence—some aspect of its environment through means not presently understood. If we combine the two, psi becomes apparent communication between organism and environment across barriers to known means of information exchange. The term "apparent" is used because the communication is implied, by an observed correspondence between organism and environment, but cannot be proved because no means can be specified. We cannot designate a specific path of information flow, and we therefore cannot conclusively label the true origin or true recipient of the apparent communication." (p. 117)

If one examines the various anecdotes and experimental studies labeled as psychic by the parapsychological community, we find that in each case there is an observed organismic event or set of events that appears to resemble an environmental event or set of events in some meaningful way, meaningfulness determined by observer criteria.

Observed organismic events can range through several categories: (1) the complex contents of intense personal experiences and their associated verbal reports; (2) simple impressions and their behavioral representations; (3) choice from known alternatives, plus a behavioral manifestation; (4) generalized somatic impressions and their

behavioral and/or psychophysiological manifestations; (5) a variety of behavioral and physiological manifestations not readily identified with any specific experiential event; (6) an intentional experience such as simple wishing for a simple goal, or complex wishing for a complex goal, often accomplished by specific imagery of the goal and/or processes leading to the goal, plus a behavioral representation of that experience; (7) an externally assigned intention and the objective record of that assignment; and (8) an inferred need and/or wish, which inference is based upon a set of assumptions about the needs of an organism with respect to a set of conditions in its environment. In each case, there is an aspect of the organismic event which renders it observable to a third party. For events in the last two categories, the organismic event is inferred on the laws of input observables; for events in the first six categories, the organismic event is inferred on the basis of output variables.

What is the range of environmental events? Basically the limits are determined only by our own capacities to attribute meaning. The environmental event in a psi experience can be literally any event that we can relate in a meaningful way to one or more of the organismic events listed above.

Let us examine this conceptual linkage in action by considering an anecdotal and an experimental example for each of our eight categories of observables.

(1) Verbal reports of complex mental events. Anecdote: A sensitive enters an old house and describes in detail having experienced a child whose "spirit" remains behind in the house; a check later reveals a child similar in many respects to the sensitive's description had died in the house two years earlier. Experiment: a subject attempts to generate imagery about a concealed target picture and then draws a picture of an axe and labels it; later a blind judge rates the subject's imagery as much more like the target picture, a peace pipe, than the other control pictures, because the shapes were almost exactly the same and both represented an implement frequently associated with American Indians.

(2) Behavioral concomitants of simple impressions. Anecdote: A woman starts to worry about her baby and wheels the baby's carriage inside; moments later slate falls off the roof onto the pavement where the carriage had been. Experiment: a subject is asked to press a button every time he feels he is being stimulated by a remote event; later analysis shows that he tended to press the button more often when the experimenter was being actively stimulated than during control periods.

(3) Behavioral manifestations of choice from among known alternatives. Anecdote: An individual consistently makes money off the bookies by selecting winners at the horse races. Experiment: A subject consistently guesses correctly the identities of individual cards in a deck of ESP cards a day in advance of the actual composing of the deck from a table of random numbers.

(4) Behavioral or physiological manifestations of somatic impressions. Anecdote: A young woman feels sick to her stomach and has to be excused from school; when she gets home she learns that her father was seriously injured at work and is in the hospital. Experiment: A subject is asked to be responsive whenever a sender is stimulated; the subject shows stronger physiological arousal each time the sender receives an electrical shock than during a control period.

(5) Behavioral and physiological manifestations not readily identified with any conscious experience. Anecdote: A man in an elevator "absent-mindedly" gets off a floor earlier than he intended and runs into the very person he was intending to meet. Experiment: A subject, unaware he is in an ESP study, is given a simple pursuit-rotor task to perform; he makes significantly more errors during periods in which a close relative is being shown slides of congenital deformities than during control periods.

(6) Behavioral representation of wishing for a specific goal. Anecdote: One person shouts a curse at another, stating that a close relative will shortly die; two weeks later the cursed one's mother breaks a leg and recovers very slowly. Experiment: A gambler, using a throwing cup and banking board, announces in advance that he will throw sevens; he proceeds to throw significantly more sevens than would be expected by chance.

(7) An objective record of an externally assigned intention. Anecdote: One individual tells another she will make the second person's horse win a race; the second person shows the first which horse he had bet on, and that horse then wins. Experiment: A subject is given a written set of target instructions about how to bias the behavior of a colored light display governed by a random event generator; the behavior of the lights then conforms to the subject's assignment to a statistically significant extent.

(8) Environmental circumstance designed to induce a need and provide an opportunity for it to be fulfilled. Anecdote: Several people are on board a lifeboat which careens out of control towards shore; in a seemingly "miraculous" fashion, the boat barely slides through the only gap present in the treacherous reefs. Experiment: Chicken eggs about to hatch and in need of heat are placed under a heat lamp which is either

activated or kept off each minute by a governing random event generator; the light stays on significantly more times when the chicken eggs are present than during control periods.

There may well be other categories; the above are sufficient to illustrate the range of coincidences capable of being labeled as psychic. (It is understood that the above examples are brief and in any given case may well be amenable to explanation in quite ordinary terms.) As stated earlier, the meaningfulness of the resemblance between the organismic and environmental events is defined by observer criteria. It can range from a simple duplication of pattern in the psychophysiology of two organisms, with no apparent conceptual translation required, to two events whose relationship must rely on considerable conceptual translation from one to the other for meaning to be detected. The events need not be contemporaneous; they need not resemble each other perceptually; they need not resemble each other thematically. All that is necessary is that they resemble each other in some way that matches an observer's criterion for meaningfulness. If the observer has a good imagination, then a great range of anecdotal material may be labeled as evidence for psi. For controlled research, the researcher presumably has specified in advance the criteria in operation during any specific research project; otherwise evaluation of the role of chance would be impossible.

If we are going to define psi in terms that will allow the application of communication models, we must close off the apparent open ends to this conceptual system. The most effective way to do this, a way strongly tied in with the method of analysis of psi studies, would be to rule out of court all aspects of meaning not specified in advance in accord with criteria linked to the intended mathematical evaluation procedure.

Our final definition of psi, then, becomes: any resemblance between the objective record of an inferred organismic event and the objective record of an environmental event that has been linked conceptually in advance to the organismic event by an external observer, such that (a) the resemblance cannot be accounted for in terms of presently identifiable channels of information flow, and (b) the resemblance is strong enough that chance can be reasonably ruled out through the application of accepted mathematical procedures.

Selecting a Useful Definition of Communication

Communication is a term derived from our ordinary language system and as such it has assumed a variety of meanings. MacKay (1972) has described five uses of the concept of "communication"

between A and B: (a) a correlation between events at A and B; (b) a causal interaction between A and B; (c) transmission of information between A and B regardless of the presence of a sender or recipient; (d) an action by organism A upon organism B; and (e) a transaction between organisms A and B. Each constitutes a subset of the one preceding it. All five have frequently been used, and although MacKay prefers to restrict the concept of communication to uses (d) and (e), it would appear that the usage truest to our definition of psi would be (a). All of the others imply that one of the events causes (or at least contributes to) the other. Such causation is not compelled by our definition of psi; recent surveys of the major attempts to theorize about psi (e.g., Chari, 1977; Rao, 1978) provide several examples of attempts to construct acausal theories of the operation of psi. Perhaps the best known of the latter is the notion of synchronicity, an "acausal connecting principle," developed most extensively by Jung and Pauli (1955) to explain anomalous coincidences. Our broadest, most flexible definition of communication, then, would be any meaningful correlation between two sets of events, with meaning to be defined in accord with criteria developed by the observer/reporter and whomever else wishes to state that communication has taken place.

Researchers who prefer to construe psi as involving at least contributory causality, may prefer a definition of communication at levels (b) or (c). Some researchers, such as Stanford (e.g., 1978), posit a causal connection between A and B, but not true transmission of information between A and B. Stanford construes psi as occurring when a disposed system (generally an organism with needs) is confronted with a random event generator (REG) of some sort which is capable of generating outcomes that will be favorable to the disposed system. Stanford explains: "The selection of the favorable REG outcome occurs precisely because if that REG outcome occurs it will eventuate in a favorable circumstance. This is proposed to occur because of how the world is built, not because of any kind of internal guidance by the organism. The model does not propose how this occurs, but only that it does occur under specified circumstances. Which output of the REG is selected is a function of which outcome would eventuate in the favorable circumstance, not of guidance mediated through the mind or central nervous system of the organism. It is as though nature anticipates the consequences of various outcomes and weights the probabilities accordingly." (p. 208)

Stanford's model thus is descriptive, and, although it makes predictions which are falsifiable, it does not offer a true explanation of the cause-effect relationships it posits. As Standford explains elsewhere in the article, he does not feel that information transmission

is part of that cause-effect interaction since there are many findings in parapsychology (which we will consider below) that appear incompatible with information transmission models.

Stanford does not regard his model as a model involving communication, preferring to define communication at MacKay's level (c), in which information transmission takes place. Most communication theorists prefer level (c) also, as it allows liberal usage of the concepts that have evolved from Shannon's (1948) classical model of a communication system: an information source (not necessarily organic) places a message of some sort in a transmitter; the transmitter sends an encoded signal through a channel to a receiver; the receiver decodes the signal, thus allowing the message to reach its destination (also not necessarily organic). The message is capable of being distorted to varying degrees by noise in the channel. A crucial concept in information theory is the notion that the clarity with which the message is transmitted is dependent upon the signal to noise ratio—the greater the ratio, the clearer the message, all other factors being constant. Given the apparent overall weak strength and inconsistency in psi, there is the often declared hope that information theory could produce some very useful ideas in this area.

Can parapsychology make use of the sophisticated advances in information theory? To do so, it must define its communication at least at MacKay's level (b) and ideally at level (c), assuming for the latter that psi involves genuine information transfer, complete with source, receiver, encoding and decoding, channel, and noise. There are problems with making these assumptions, given the present data base in parapsychology, problems which will be discussed shortly.

As for defining communications at levels (d) and (e), the levels preferred by MacKay, these levels require the involvement of organisms at both the sending and receiving ends and thus would have insufficient generality.

In the next two sections, I will consider the methods and findings of parapsychology in more detail, to assess further the appropriateness of defining psi communication at levels (a), (b) and (c).

The Methods of Parapsychology and their Implications for Causality

As we research the question of psi, we appear to do business using procedures which themselves imply cause-effect relationships. Science itself is an active process; researchers do not stand by as simple observers of an unfolding acausal drama. Rather, they formulate hypotheses, design studies to implement them, conduct the studies and assess and interpret data. All of these acts represent attempts to cause

events to happen, to set things in motion, vary conditions and observe the effects.

In almost all parapsychology studies conducted to date, the researcher conceptualizes, at least in crude, general form, a message to be sent, selects a source for the message and a receiver for the message, and erects barriers to all known means of information transmission (channels) that might link the source and receiver. Following this the potential communication system is activated; the receiver is monitored and later compared with the source. Thus the research community tries to approximate level (c) in all respects except for the existence of the channel.

Since the researcher must rule out all known means of information transfer that might link source and receiver, this means that information transmission between source and receiver must be blocked, *and* that source and receiver must both be informationally isolated from any third set of events that might impart information to the other two, thus synchronizing source and receiver such as to simulate communication between the two. One cannot, for instance, allow the agent to select what to send, even from a restricted target pool. In free response studies, for instance, an agent allowed to select which of four target pictures to send might select the one most relevant to the news of the day (e.g., a fireplace, if there had been forest fires in the news); the receiver might be likely to select the fireplace for the same reason the sender did; both would have been influenced by an external third event. This is an old problem, of course, and to eliminate it today's researchers know they must randomize the material that is to serve as the message.

The experimenter must set in motion a set of events that will "cause" the message selection to be adequately random, in hopes therefore of "causing" the receiver to behave as though it had received the messages as selected. Any well-done study must have such an experimenter involvement, and its logic thus assumes that manipulations of the message at the source served as a contributary cause of the behavior of the receiver.

This is not to assert that psi involves no acausal relationships; I'm simply asserting that our methodology compels us to collect data that reflect those elements of psi that can reach expression in functional, causal interactions. And to the extent that we seek to understand and control the phenomena we observe, we are constrained to the study of cause-effect relationships.

The same is not necessarily true for studies that rely exclusively upon natural observation. So long as we remain passive observers, simply recording coincidences and describing the relevant events fully, then

we are not necessarily participating in a study of causal relationships. This raises an interesting point. Conceivably, psi may involve both acausal and causal relationships. If so, then perhaps we may learn of both by doing both naturalistic and controlled studies. If we spot an apparent relationship in nature that we cannot obtain under controlled circumstance, that might provide some evidence for acausality in the observed relationship. A major problem with this, of course, is that purely observational studies by their very nature leave open the possibility of presently understood factors accounting for the correlation observed. This has consistently put limits on our ability to conclude much on the basis of naturalistic observation alone (see Morris, in press, for a further elaboration of the problems involved in drawing conclusions from naturalistic observations).

A final possibility should be mentioned briefly—it is conceivable that even the experimenter is involved in some greater, acausal coordination scheme, such that his/her intentions do not truly represent the deliberate manipulation they may seem to; that the details of target selection were themselves somehow present within the context of some sort of acausal system. Such an assertion is at present impossible to falsify or verify.

The Data Base of Parapsychology and Its Implication for Information Theory Modeling

As mentioned above, the procedures used in parapsychology not only imply the study of causal relationships; they also stay very close to the core concepts in a standard Shannon-style communication system, save for the channel, which is procedurally eliminated, but, for many researchers, still conceptually implied. As also mentioned above, however, many of the findings of parapsychology on the surface appear to be incompatible with the notion that psi represents information transmission from source to receiver. Let us consider these purportedly incompatible findings in turn.

(1) Psi appears independent of space. Standard information transmission models involve information flow along a channel having spatial characteristics, and distance traveled is a variable. Yet it is often claimed that psi is independent of distance between sender and receiver. There are two sets of points here. First of all, depending primarily on the properties of the channel, distance may have little if any effect upon the clarity of the message, and the notorious inverse square law pertains only in certain circumstances. Second, the relevant data base in parapsychology is not at all clear. No single study has ever compared psi success when target distance was systematically varied and all other factors were held constant. Given that distance was varied,

many would argue that subjects could become aware (perhaps even psychically) of distance as a variable, such that the subject's psychological characteristics, such as confidence, feeling of challenge and so on, would covary and render interpretation of results unclear. The only extensive survey of studies comparing two or more distances was Osis' (1965) survey. Although he found a systematic decline in percentage of hits as distance increased, he neglected to note that the study involving the furthest distances (Osis and Pienaar, 1956) indeed found considerable evidence of psi in the opinion of the authors, in that two separate running conditions produced psi hitting on one condition and an equal amount of psi missing on the other. In my opinion, the distance data overall do not at present seriously threaten the applicability of information-theory models (nor do they overtly support it).

(2) Psi appears independent of time. For standard information theory models, order is important and time is clearly a relevant variable. Yet the data from precognition studies suggest that information can flow backwards in time, that messages can be received before they originate and so on. Once again, in my opinion, the data base bearing on the concepts of precognition and retrocognition is unclear. Specifically, it seems to be that all procedures by which one might hope to infer information flow forwards or backwards in time are amenable to interpretations involving alternate paths of information flow within the present. The alternatives are easy to see for retrocognition. If a subject is asked to respond to information supposedly hidden in the past, any response the subject makes can only be assessed for accuracy by recourse to some record of the past event that continues to exist in the present. Given that such a record exists, it could just as easily have served itself as the actual source of information.

With regard to precognition, the alternatives are more complex. In a precognition procedure, a subject makes a response to an event (target) that will be determined at some later time. Unfortunately, all ways of determining that later event are potentially amenable to psychic influence themselves. Suppose someone makes a decision of some sort to determine the target; that decision might reflect ESP on the part of the decider, such as to construct a match between guess and target. If a random physical event is used to determine the target, that event may be influenced by psychokinesis, such as to produce a match. If a complex set of random events already in existence at the time of the subject's guess is reprocessed through a fixed set of rules, such that no new information is generated after the subject's guess, then the subject may simply have used ESP of those present events. Certain procedures for selecting targets stretch such alternative explanations rather far.

For instance, one could have the targets generated by digits drawn from the published records of stock market transactions, such that the human decisions that finally determine the target are all drawn from humans who not only do not know of the study, but are highly motivated to be serving their own interest in other directions. I have not been able to obtain clear-cut evidence of precognition under such circumstances, and the precognition literature is not strong when such procedures have been used.

For present purposes, the important point is that precognition may not be a phenomenon that must be accounted for by any information-transmission model.

(3) Cognitive complexity of target material does not seem to matter. Probably the most difficult findings for present-day information theory to model are those that deal with changes in the cognitive complexity of target material. One of the earliest examples of the problem was provided by Foster (1940), who compared open matching and blind matching procedures. In open matching, the subject is presented with a deck of individually concealed target cards, and a set of face-up "key cards," one for each kind of symbol. The task is to place each target card in front of the key card corresponding to its identity, such that to be successful one need only know the identity of the target card. Blind matching is more complex, in that the key cards are concealed so that their identity is not known; to be successful, the subject must now use information from both key card and target card. Foster noted that subjects tended to do much better on blind matching than would be expected, given their rate of scoring on a comparable open matching task.

Some of the blind matching research (e.g., Rao, 1964) asked subjects to match target cards in one language with key cards bearing the same words in an unknown language using an unknown alphabet. It was almost as though one were saying to a subject, "Your goal is to place each card in the correct pile, as we define 'correct,' and that's all you need to know." Subjects showed evidence of being able to match words within a language, even in the unknown language, but not necessarily across languages.

This procedure intrigued me a great deal, as I was one of Rao's subjects who did well matching across languages. I thus decided to push the point even farther, choosing as my psi task a procedure used by many researchers to rule out the presence of psi in the selection of precognition targets. The procedure, described more fully in Rhine and Pratt (1957), involved a way to generate a six-digit entry point into the Rand Corporation's million digit random number table (Rand

Corporation, 1955). The procedure was as follows: take a two-sided die; throw it twelve times, thus producing four three-digit numbers; multiply these four sets of numbers together; multiply that product by itself backwards; take the result and extract the square root to six digits of the last ten numbers on the right; convert the first digit to 1 or 0 and the fifth to 0 or 5, on an odd-even basis; use the resultant six digit number to enter the random number table; use the numbers following the entry point to determine the precognitive target order. The idea was that the experimenter could not use PK to make the dice produce a favorable entry point because there would be no way to know what numbers to make the dice come up, assuming that even with ESP operating the experimenter would still have to work back through the numerical manipulations. However, if we hypothesize that ESP operates in some sort of all-or-nothing or goal-oriented way (diametrically, to use Foster's term), then such a task becomes quite possible.

I thus set up a study with myself as subject and a coworker, Cynthia Weaver, as experimenter. My job was to generate twelve digits which, when processed mathematically in the way described above, would produce an entry point which would in turn produce a predominance of odd or even numbers, in accordance with a preset target sheet. Half of the time I threw a die twelve times. Half of the time, in a counterbalanced way, I called digits off the top of my head. I had no idea how many numbers in the table I might be responding to, so for the pilot study I arbitrarily decided in advance to score the results of the first five numbers after the entry point, the first ten, 25, 50, 100, 200, 500 and 1,000. This would allow further assessment of how complex a task could be done, e.g., if it only worked for the first five numbers, that would be informationally far simpler than if it worked throughout the first thousand. My results for the pilot study were encouraging for the verbal calling method only; the die throwing results were at chance. A positive result was obtained at every tallying point overall, to a statistically significant extent for the first 50 and first 100 numbers following the entry point.

Having obtained a positive result, I then repeated the procedure, this time stating in advance that my criterion for declaring the significance of the second study would be based on an analysis of the results for the first 100 digits only, since that cutoff point had produced the strongest results initially. The results for the second study confirmed the first—the results at the 100-digit stopping point were quite significant (p .01, two-tailed) for the verbal calling procedure. The dice results once again were quite close to chance (Morris, 1968).

This study has not been systematically pursued, primarily because I wish to use someone other than myself as subject, so I can vary conditions and test some hypotheses, and I have had a hard time finding others who are interested and motivated by the procedure. I have described the study in some detail because I feel that it and studies like it represent a real challenge to our attempts to provide models for psi based on information theory.

There are other areas of research in which the link between source and receiver have been conceptually complex. Several studies (surveyed by Palmer, 1978, pp. 188–193) have involved covert ESP tasks—aspects related to the target of which the subject was unaware, as well as studies in which the subjects were not aware that they were participating in an ESP test at all. Something of meaning to the subject was somehow embedded in the general experimental context, and evidence found that the subject nevertheless responded to it. Such a finding is similar to the implied communication in many spontaneous case reports, in which individuals suddenly respond in some way to a remote tragedy to a loved one whom they had no ordinary reason to suspect was in trouble. In these cases, it is as though the subject were somehow scanning the environment, processing and filtering out what would seem to be incredible amounts of information, responding in strength only to those signals that take on strong meaning for them. This happens all the time in ordinary perception, of course, but on a much smaller scale in terms of the potentially available information to be screened out.

Within the area of psychokinesis several analogous challenges exist. An issue raised by Rhine (e.g., Rhine and Pratt, 1957) concerns the fact that subjects appear not to need to have much information about their targets to exert an influence upon them. This is especially true of recent work in which the targets are minuscule, short-duration events in the circuitry of random event generators. Subjects can even succeed when the REGs are generating information at extremely fast rates (e.g., Schmidt, 1976, whose REG generated 300 trials per minute), so long as the information is displayed to the subject fairly slowly. It should be noted that, although many REG's select and display only one or two trials per second, their generation elements can be producing potential decisions available for selection at rates in excess of several hundred times a minute.

Of additional interest is the fact that several PK studies (surveyed by Stanford, 1977) have involved concealed target instructions, such that subjects would presumably have to use ESP to know how to influence the target. Despite the increased complexity of the task, subjects

performed at least as well in these studies as in studies in which subjects had more information available about the target.

A final area noted by Stanford in his survey is the presence in several successful PK studies of targets whose very existence was not known to the subjects—subjects were frequently not at all aware that they were in a PK study.

The overall impression from these studies is that increasing the informational complexity of the psi task does not necessarily appear to reduce performance, save for some mild evidence that high-speed PK may not work so well and that cross-language matching does not appear to work as well as within-language matching. Additionally, psi testing procedures appear to work even when the information processing necessary to make a correct response would seem considerably beyond the organism's capacities.

Although the data base in this respect is still somewhat sparse, the evidence is strong enough that consideration of such studies and their implication must be borne in mind by anyone hoping to generate models for psi based on the assumption that information transmission is involved.

Modeling Information Flow Pathways

Assuming that the considerations raised above have not deterred us from construing psi in information theory terms, we must now confront a very important implication of the apparently loose constraints placed upon psi functioning by such factors as space, time, and informational complexity—namely, that in any given study we may design and conduct, there are many potential pathways for information to flow. As we set up our studies, we designate a source, message and receiver, put information into the source and monitor its potential arrival at the receiver. Yet we may have several different potential sources and receivers, in addition to the ones the researcher has chosen, which may be responsible for whatever evidence of communication we observe.

Consider the organismic events and environmental events we discussed earlier. For present purposes, these will represent the sets of events whose measurements will eventually be compared by the researcher to test for the presence of psi communication. Each set of events has a set of factors which contributes to its final characteristics, its contributory causes. In the usual study, the experimenter controls the contributory causes for the events to serve as designated sources, e.g., the selection of a target pool and random selection of a specific

target for each trial. The receiver event has a set of contributory causes also, some due to constraints placed by the researcher, some due to a host of antecedent variables affecting the receiver, some of indeterminate origin and some, ideally, due to psychic information transmission. Good experimental design means ruling out all presently understood means by which the contributory causes of the designated source event could transmit information to the contributory causes of the receiver event, and vice versa. If the contributory causes to source and receiver events share information, that shared information will increase the likelihood that source and receiver events will be meaningfully related. (Consider our earlier example in which a forest fire in the news constituted shared information for contributory causes of both source and receiver events.)

Now comes the problem: even though we now have what appear to be quite adequate procedures for preventing such information sharing by presently understood means, we are totally unable to prevent potential psychically mediated information sharing. As we examine each possible contributory cause, we must consider that each may conceivably be a psi receiver, influenced by some external event (a psi source) not necessarily under the control of the researcher. If a contributory cause related to the designated source receives information psychically from a contributory cause related to the designated receiver, or vice versa, then there is psychically mediated information sharing which will make designated source and designated receiver likely to resemble each other, such that we will mistakenly decide that information flowed directly from our designated source to our designated receiver.

Any attempt to model information flow in any given study must take into account the multiplicity of information flow pathways that may conceivably join designated source and designated receiver. The success of any such attempt will be greatly dependent upon our ability to understand the full range of contributory causes involved in any specific study. (Analogous reasoning can be applied to our attempts to describe any spontaneous report or event observed in the field, the main difference being that in the field we are likely to be less able to assess the contributory causes involved.) Additionally, source events may in due course generate further events, representations of the source event in experimental records and so on; any of these further events may, themselves, serve as the actual source.

Let us explore these notions by considering some experimental procedures presently in use, which represent extremes with regard to the number of known contributory causes at work. A favorite

procedure for illustrating these problems (see also Morris, 1975) is the chair test (e.g., Eisenbud, 1973), occasionally used as a precognition test for selected sensitives. Someone designated by the researcher as a psi receiver is given the identifying number of a chair in a lecture hall and asked to describe the person who will sit in that chair at a later lecture. The chair number is sealed inside an envelope; the transcript of the receiver's statements is sealed in a second envelope; and both are placed together in a third envelope. Later, notices about the lecture are distributed, people decide to attend, they arrive at the door and are assigned chair numbers, they take their seats, and at some time during the lecture they hear the receiver's transcript read aloud. The members of the audience are asked to assess how much the transcript resembles themselves; they are asked to stand up if they consider the transcript very accurate. If the person sitting in the correct chair stands up, the study is considered successful. One can also statistically compare the correspondence rating of the correct person versus those sitting in the other chairs.

When such studies have been done, they have been regarded as precognition studies, with the source being the person in the correct chair and the receiver the person asked to generate impressions about the source. However, there are alternatives. Once the receiver has given a set of responses, these responses become represented in different ways. Perhaps they were tape recorded or written by hand; this original record would then be typed up, perhaps edited; by the time it gets sealed in the envelope and closed off informationally, its contents exist in the memories of at least two people and perhaps more.

All of this information may serve as source material for those involved in the contributory causing of who finally sits in the target chair. Once the lecture notices are sent out, a variety of potential lecture attenders start making contributory decisions; should I attend? when should I depart? when should I arrive? and so on. At some similar time, people conducting the lecture may be making contributory decisions about how to assign seat numbers to the incoming members of the audience. Of those potentially attending the lecture, of course, some may resemble the transcript description more than others. Thus, one set of alternative information flow pathways would be those extending from the original impressions to those who decide who will sit in the target seat, such that someone who resembled the impressions would arrive in time to get assigned the target seat.

Perhaps the above does not come to pass, and whoever sits in the correct chair has no special resemblance to the transcript. However, once the transcript is read, whoever sits in the chair may psychically

receive the information that he/she is in the correct chair and will thus be inclined to detect more resemblance than those in other chairs. Other procedural decision makers may also have had opportunity to contribute to the outcome. If we accept the possibility of precognition, that opens even more possibilities.

The chair procedure involves many people and many complex events spread over a considerable time period. Now let us consider another procedure with these dimensions considerably compressed. The subject is placed in front of a random event generator attached to four display lights. The REG is fed by a noise diode and displays a new decision once a second. Which light is selected for display on each trial is recorded by computer and the data are tabulated automatically. The subject's task is to increase the number of doublets (consecutive identical decisions) during the experimental period, which always lasts from fifteen minutes after the hour to thirty minutes after the hour. The REG's performance during this 15 minute period is always compared with one of the other 15 minute periods in the hour, on a rotating basis in accord with a sequence set up at the start of the study. Human contributory decisions are kept to a minimum. A set of rules for target selection was chosen at the start of the study, and all the data collection, storage and analysis has been handled by computer from then on. The main problem with this study, as with all PK studies, is that the PK source could easily be anyone involved at all with the study at any conceptual level. Schmidt (1975) has argued that anyone who observes the outcome of a PK trial may contribute to its success, even though that observation may take place considerably after the REG events that nominally determined the display. By this line of reasoning, anyone who later reads a writeup of a study may conceivably be an observer-influencer.

Thus, even apparently simple, straightforward experimental designs are amenable to alternative information flow pathways. To the extent that we wish any precision in our modeling, therefore, we may be compelled to develop and refine procedures that involve as few opportunities for contributory causation as we can.

Summary

Given the basic nature of parapsychological concepts, methods and findings, it would appear that the most productive uses of communication concepts lie at MacKay's levels (b) and (c). Level (a), in which acausal connections are considered, is very difficult to conceptualize and construct testable hypotheses on. The very process

of hypothesis testing relies upon acceptance of at least contributory causality, insofar as it relies upon deliberate manipulation of experimental variables to observe their outcome. This problem is well illustrated by the Everett-Wheeler-Graham "Many Worlds" view of reality (e.g., DeWitt and Graham, 1973), in which all quantum uncertainty is removed by positing that all possibilities in fact happen, each in its own universe, such that the number of universes expands at an infinitely large rate. Such a view is concomitant with the apparent goal-oriented nature of psi—a psychic event happens when an observer tracks a universe in which the goal was accomplished, regardless of "how" it got accomplished. The problem with the EWG view is that it cannot be tested (e.g., there's no way to falsify it) and it does not discuss the nature of the observer adequately. As for the Jung-Pauli "acausal connecting principle," they do not at any time demonstrate the acausal nature of their phenomena, and in truth it would be impossible to say anything more of two coincident events than that one has not at the present time located any point of information sharing among elements in their sets of potential contributory causes. One way to show this problem is to consider that each coincidence put forth as evidence for synchronicity can easily have more than one path of psi-mediated information flow constructed for it, as we did above for the chair test. In short, all phenomena describable in terms of level (a) are potentially modelable at levels (b) and (c).

We can now consider some major conceptual systems that would appear to occur at level (b), causal interactions, such as Stanford's "conformance behavior"; various notions of direct mental or spiritual action, parallel to the laws of physics, but not encompassed by them; and the various notions of what I have called earlier (Morris, 1975) "message ubiquity," which state that there exists some sort of universal repository of all information and that psi occurs simply when the designated receiver accesses the repository.

Such idea systems have relatively little difficulty in accounting for the capricious and complex nature of psi. However, even they are at present difficult if not impossible to test, largely due to problems in determining which informational pathways may be operating. They also do not preclude the transfer of information in the sense of level (c), transmission of information; the strongest arguments against information transmission are those put forth earlier, and they are merely problematic, not conclusive at this time.

In many respects the stongest evidence for psi functioning at level (b) would be the consistent failure of intelligent modeling at level (c). Intelligent modeling at level (c) must bear in mind the full range of

phenomena presently encompassed within parapsychology's data base. It should take into account the likelihood of alternate information flow pathways, and it should emphasize, for the present, research into these procedures in parapsychology which represent the hardest for modeling in information theory terms: the apparent sparsity of space/time and informational complexity constraints. If we hope to find a channel, we must articulate constraints. The longer we go without constraints, the more our modeling and theorizing will founder on vague and untestable concepts; the more potential constraints we eliminate, the more evidence we provide for the absence of a true channel and the need for modeling at level (b). And that task I leave to those far wiser than I.

BIBLIOGRAPHY

Braude, S., "Objections to an information-theoretic approach to synchronicity," *J. Am. Soc. Psych. Res.*, 1979, *73*, 179–194.

Chari, C. T. K., "Some generalized theories and models of psi: A critical evaluation," In *Handbook of Parapsychology* (Wolman, B., ed.), New York: Van Nostrand Reinhold, 1977.

De Witt, B., and Graham, N. (Eds.), *The Many-Worlds Interpretation of Quantum Mechanics*, Princeton, N.J.: Princeton University, 1973.

Edge, H., "A philosophical justification for the conformance behavior model," *J. Am. Soc. Psych. Res.*, 1978, *72*, 215–232.

Eisenbud, J., "A transatlantic experiment in precognition with Gerard Croiset" *J. Am. Soc. Psych. Res.*, 1973, *67*, 1–25.

Foster, A., "Is ESP diametric?" *J. Parapsychology*, 1940, *4*, 325–328.

Jung, C. G., and Pauli, W., "*The Interpretation of Nature and the Psyche: Synchronicity and the Influence of Archetypal Ideas on the Scientific Theories of Kepler*, New York: Pantheon, 1955.

MacKay, D., "Formal analysis of communicative processes," in *Non-Verbal Communication* (Hinde, R. A., ed.), Cambridge: Cambridge University Press, 1972.

Morris, R. L., "Obtaining non-random entry points; A complex psi task," in *Parapsychology Today* (Rhine, J. B. and Brier, R., eds.), New York: Citadel Press, 1968.

Morris, R. L., "Tacit communication and experimental theology," in *Research in Parapsychology 1974* (Morris, J. D., Roll, W. G., and Morris, R. L., eds.), Metuchen, N.J.: Scarecrow, 1975.

Morris, R. L., "Building experimental models," *Journal of Communication*, 1975, *25*, 117–125.

Morris, R. L., "An updated survey of methods and issues in ESP research," in *Advances in Parapsychological Research, Vol. 3* (Krippner, S., ed.), New York: Plenum, in press.

Osis, K., "ESP over distance: A survey of experiments published in English," *J. Amer. Soc. Psych. Res.*, 1965, *59*, 22–42.

Osis, K., and Pienaar, D. C., "ESP over a distance of seventy-five hundred miles," *J. Parapsychology*, 1956, *20*, 229–233.

Palmer, J., "Extrasensory perception: Research findings," in *Advances in Parapsychological Research Vol. 2: Extrasensory Perception* (Krippner, S., ed.), New York: Plenum, 1978.

Rand Corporation, *A Million Random Digits*, Glencoe, Ill.: Free Press, 1955.

Rao, K. R., "Studies in the preferential effect. IV. The role of key cards in preferential response situations." *J. Parapsychology.*, 1964, *28*, 28–41.

Rao, K. R., "Theories of psi," in *Advances in Parapsychological Research, Vol. 2, Extrasensory Perception* (Krippner, S., ed.), New York: Plenum, 1978.
Rhine, J. B., and Pratt, J. G., *Parapsychology: Frontier Science of the Mind*, Springfield, Ill.: Thomas, 1957.
Schmidt, H., "Toward a mathematical theory of psi," *J. Am. Soc. Psych. Res.*, 1975, *69*, 301–319.
Schmidt, H., "PK experiment with repeated, time displaced feedback," in *Research in Parapsychology 1975* (Morris, J. D., Roll, W. G., and Morris, R. L., eds.), Metuchen, N.J.: Scarecrow, 1976.
Shannon, C. E., "Mathematical theory of communication," *Bell System Technical Journal*, 1948, *30*, 50–64.
Stanford, R. G., "Conceptual frameworks of contemporary psi research," in *Handbook of Parapsychology* (Wolman, B., ed.), New York: Van Nostrand Reinhold, 1977.
Stanford, R., "Toward reinterpreting psi events," *J. Am. Soc. Psych. Res.*, 1978, *72*, 197–214.

DISCUSSION

STORM: What is the difference operationally or specifically between causal interaction and transmission of information?

MORRIS: That is one of the problems we have to tease out. I'm not sure how to construe a cause/effect relationship that does not involve information transmission. I have never been able to do that. I think mainly that it could be possible to demonstrate cause/effect type relationships without being able successfully to define a particular form of information transmission. So we would have a failure at that point, which wouldn't mean there is no such information transfer, but basically would say, "We haven't found one yet." I think we can demonstrate cause/effect relationships and it seems to me that by doing so, we probably also demonstrate information transfer relationships, but I don't think we can assume we do.

STORM: Would you say that the concept "cause-effect" is an interpretation placed on the events by us?

MORRIS: The notion of a classical cause/effect relationship, I think, has been shown to be conceptually pretty weak. What I have in mind here is an idea of a contributory cause or factor, such that we may not, for any given effect, be able to specify the complete set of contributory causes. Just because we found a contributory cause wouldn't necessarily prove, in and of itself, that there was no additional acausal component in the system.

STORM: My personal life is lived in a world of which space and time are very definite aspects. I can think of very little in my life that is not

essentially dependent on the space/time coordinate system. How do I understand what it means to say that psi phenomena or space/time are independent, when all my rational experience is with space/time?

MORRIS: You're best off addressing that to someone other than myself, because it seems to me that all of the studies that have been conducted are done by people dealing in space/time. What they do is find coincidences; they find anomalies which look as though they defy our present understanding of space/time. And I think it can be demonstrated that any procedure for demonstrating precognition is amenable to alternative information flow pathway modeling, which is not independent of space and time. I think this is an assertion that was made all too quickly by key people in the history of parapsychology. It may be true. I'm not denying that it's true. I just simply say it's not been demonstrated yet. It has not been demonstrated that parapsychology and its findings are independent of space and time, as many of us would love to label them.

RUDOLPH: I'd like to address the point about the relationship between information theory and information transmission models. One of the things I'm trying to work out for myself is whether Shannon's Information Theory itself requires an information transmission model. My current thinking is that it does not. Shannon probably had information transmission in mind when he developed his theory, and most people think in terms of information transmission, but I don't think the mathematics requires it. Certainly, the concept of a channel as simply two variables which are correlated would come under your category (a) of communication. When you add a source and a destination, and an encoder and a decoder, then it seems as though you would have to drop down to level (c). But I don't think so. I just concocted a little communication system which has a channel with two outputs which we normally think of as input and output; it has an encoder and a decoder and the source and the destination both receive information. I think the mathematics apply to that. So I would just like to propose that perhaps Shannon's Information Theory really can be used to model processes at communication level (a).

MORRIS: Right. I won't comment on that until after your paper. I think you have a very interesting point.

NASH: Communication and information theory is an attempt to provide terminology and principles of communication in order to make it understandable, manageable and predictable. Evidence is convincing that information transfer is sometimes mediated by psi and,

in the absence of an adequate explanation of psi, it is desirable that communication theory be examined as a possible explanation of paranormal intercourse. I see no evidence, however, that communication and information theory provides an understanding of what basically takes place when one person's thoughts become those of another, even when the event is brought about by normal means, much less when it occurs through psi.

MORRIS: Yes—I think it's a tool. It's not an attempt to understand. It's a procedure by which understanding presumably can be enhanced, and that's the function it served in terms of increasing our understanding of other communication systems.

RUDERFER: You mentioned Dr. Osis' survey of 1965 which, as I recall, was a statistical survey in which he found that, from the data he analyzed, ESP fell off as a two-fifth power of the distance. Dr. Osis did some experiments after that with a number of receivers throughout the world in which he found that there was essentially no change with distance, and that's more relevant than his survey because it's an actual experiment. He did find in one of his correlations that there may have been a slight drop-off with distance, but it was very small. I pointed out to him that his experiments were sufficient to eliminate the possibility that ESP falls off as the square of the distance or as a two-fifth power of the distance, and that they indicated that ESP is space independent.

MORRIS: I think the main problem would be whether or not he had the strong possibility of a confounding variable with differential motivation with different distances, even though the people involved in his studies were not aware of what distances they were operating on at the time. I think that, also, those studies and others like them show that information appears to occur over rather extensive distances. I don't think they would indicate, in and of themselves, that we could then conclude that we now know that it's independent. I think that goes beyond the data.

RUDERFER: I thought you were talking about a survey only, not his experimental results after 1965.

MORRIS: No. I described the survey in my remarks. I was taking into account also his experimental data.

IRWIN: Bob, I have a certain amount of sympathy with your idea of distinguishing precognition and retrocognition from other forms of ESP, but how would you account within your present system for precognition of natural disasters in which there is no apparent human factor?

MORRIS: Let us consider something like a landslide. There it would be a matter of whether or not the person was in some sense making an integration of presently available information. Landslides don't occur in certain kinds of rock formations: they occur in others, and there is a fair amount known about the antecedent conditions for them. And one of the alternative kinds of hypotheses to precognition—actually, the one that I didn't mention, is the possibility of an integration of presently existing information in such a way as to offer a "best guess" estimate of future events. This sounds, on the surface of it, somewhat absurd. It's made slightly less absurd because of the problems with regard to the apparent psi success at informationally complex tasks already, like some of the PK data. We're not in a position to rule out of court right now that people may be able to process very complex information in that way. As a matter of fact, the study that I did on myself addresses itself to that issue. I was using a procedure frequently used to determine precognition targets, and I think that some of the anecdotes from some of the psychics may be of some use here. I recall Douglas Johnson describing to us that he had two totally separate levels of anticipations of the future—one of which he regarded as the one he had most frequently, and that was very probabilistic in nature. He got the feeling that if he told a person, "Look, as of right now, you're about to die," that that information could interact with the person in such a way as to lead him to do things to reduce the probability of that death's occurrence. However, he said upon rare occasions he felt he got a truly precognitive experience, which was of something that was unalterably going to happen, which couldn't be interfered with.

If you anticipate a plane crash, perhaps what you're anticipating is your anticipation, or your experience may occur at that moment at which somebody involved in fueling the plane is getting into a violent fight with his wife, such that he's going to come to work madder than hell and screw up the way that the fuel is put in. Those are the kinds of alternative possibilities one has to look at, and I think they are testable. I think the timing of a precognitive experience is important. Why do you have it now? When did the information arrive? Has it been with you since your embryonic days and only came forth into experience at a certain time? Or is it possible that one has a precognitive experience at some sort of final moment, at which time factors determining that future event have now raised its likelihood of occurrence close to certainty? You could do that kind of study with random event generators. We've done something a little bit like it that I don't really want to get into right now, but I think that possible explanation at least could be falsified experimentally.

RUDERFER: I want to come back to the subject of distance for a minute. Distance is a physical variable and if you can establish some variation with ESP and distance, this is very important, as was pointed out. In looking through your paper, I don't see any reference to Dr. Osis' work after 1965, and I just wanted to clear that up. Were you discussing his 1965 survey and his paper with Turner in 1956 only?

MORRIS: In the paper, I was citing that as the overall survey of a set of studies in which he had thought he had found a decline. In my remarks later on in the paper and in my summary statement in the distance section, I was taking into account all of the distance research that I know of, although I did not list them in the bibliography.

RUDERFER: So you're saying that there is possibly a defect in his actual tests which he reported in 1972?

MORRIS: Yes, I'm saying they could be confounded by motivational variables.

RUDERFER: And that includes his test that he reported in the *Proceedings* of the ASPR in 1972, I think?

MORRIS: Yes. Unfortunately, when you vary distance, it is very difficult to say for sure you have not also varied the motivation of the people. I've discussed this with Dr. Osis, and he was trying to get at that question in a way that I think is very useful. In one of the studies he did, he administered to people the Rosenzweig Picture Frustration Test. His hypothesis was that someone who would be more frustrated, and would show up as officially more frustrated, would be the kind of person who would be more frustrated at trying to work over a long distance, and you would expect his results to be different from the others. And I think this issue could be addressed by further work along that line, because if you say that increasing distance produces a motivational confounding, you should be able to get at that. In some informal research that I was doing with myself as subject, I was led to the possibility of pre-testing people on a task having different levels of ostensible complexity, and then selecting people who showed a clearcut decline when they were faced with a more complex task, and a set of subjects who showed a clearcut incline, as though they rose to the challenge. Then take those two sets of subjects and try the distance work with them. If they both leveled out to flat even, then I would say that was better indication that distance didn't matter. But what I'm saying is that distance might not have mattered because of some sort of canceling of two different kinds of motivational systems which could

have been activated. I think the issue is resolvable through further research.

RUDERFER: Then what you're hypothesizing is that a subject's success is dependent on his emotional way of considering distance—he might improve with distance or he might decline with distance, but you have no experimental data.

MORRIS: That kind of experimental data has not been provided yet. I think that a person's motivation, his attitudes towards distance, etc., should contribute to the intensity of his score.

RUDERFER: The last point I want to make is that Dr. Osis used about a hundred people. Now, only if there was a great difference between these two emotional aspects would it show up in an experiment, otherwise, with a hundred people, statistically it would pretty well average out.

MORRIS: That's right—that's the problem.

RUDERFER: So from that point of view, the evidence does favor that psi is fairly independent of the distances we have on earth.

MORRIS: But if you used a large number of people, then these two alternative factors, as you say, would be more likely to cancel out, and that would produce results of the sort that he found.

RUDERFER: All I'm saying is that the objection that you have would be canceled out with a large number of people, unless it was very one-sided.

MORRIS: Possibly so.

RUDERFER: You would be left only with the variation of distance independent of the emotional factor.

MORRIS: In order to know that, you'd have to really test further with the people involved. I'm not unsympathetic to the notion psi is independent of distance. I just don't think that the data at present have really demonstrated it. It's been demonstrated, I think, that psi can occur over considerable distances, and I don't see its independence yet.

INFORMATION PROCESSING THEORY AND PSI PHENOMENA

HARVEY J. IRWIN

One of the essential facets of the theme "Communication and Parapsychology" concerns the view that psi experiences have an informational basis. The argument presented in this paper is that in both ESP and PK there is a deal of information processing which plays a crucial role in effecting the particular psychic experience. Further, this is held to be the case irrespective of the nature of the link between the state of mind and the state of an environmental system that feature in the paranormal event. The link may have a physical or mechanistic basis, in which case it may be appropriate to regard the event as involving information transfer, or alternatively the link may be governed by purely teleological factors (e.g., Beloff, 1978; Stanford, 1978) without any actual transfer of information between mind and environmental system. Irrespective of this, the manner in which the mind deals with certain information will here be advanced as being fundamental to an understanding of psi phenomena.

In endeavoring to establish the nature of the mind's role in psi I have over the past two years explored this issue in the context of a particular view of mind known as *information processing theory*. Under this approach the mind is modeled as a system which processes information, that is, one which may accept inputs, extract information from them in a sequence of specifiable stages, store relevant information for future reference, and, if necessary, act upon the information to produce outputs. Thus instead of speaking of "mind," many cognitive psychologists now refer to the *human information processing system*. Evidence has been derived for a number of specific processes or processing loci in this system, the main ones of which are shown in Figure 1.

There is insufficient time to discuss the functions of each processing locus featured in Figure 1's representation of the human information processing system, but I have provided such details elsewhere (Irwin,

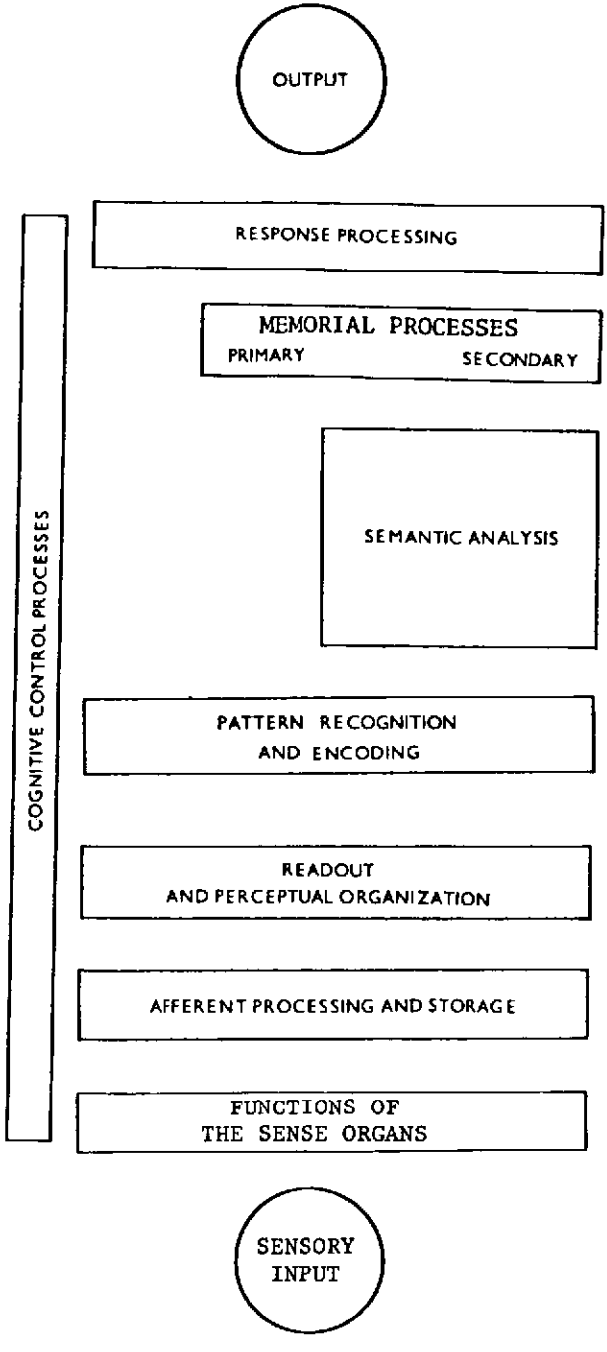


Figure 1. The human information processing system.

1979). In any event, it is sufficient in the present context to outline just a few of the more salient characteristics of the model. One characteristic is that information generally flows in an upward direction; hence processes depicted towards the bottom of the figure are typically applied before those of higher level loci. Consciousness is a high-level function and is posited as one of the processes of primary memory. Loci between the sense organs and semantic analysis therefore function *preconsciously*: the individual may be conscious of the net results of these processes, but not of the processes themselves. Another feature of the model is that the flow of information is neither passive nor automatic. Various control processes actively serve to determine information flow according to the needs, motives and expectations of the individual. Of particular significance in this regard is the operation of certain control processes which enable subjectively important information to be admitted to consciousness and which prevent or inhibit admission of irrelevant or unpleasant items.

Two fundamental modes of the system's operation may be distinguished. First, the system may deal with sensory inputs. These are admitted via the sense organs, and information processing proceeds from this level. Second, the human information processing system also handles internally generated information. The latter mode of operation concerns what may be termed thought processes or *ideation*, and it includes such mental experiences as reminiscence, dreaming, imagery, intuition and problem solving. Basically what happens in the ideational mode is that information stored in secondary ("long-term") memory is retrieved and admitted to the locus of pattern recognition, whence it may proceed up through the system and possibly reach the level of consciousness (primary memory). Therefore, while the two modes of the system's operation do rely on a number of the same processing structures, they do differ in one important respect: only the processing of sensory inputs calls on loci below that of pattern recognition.

Now, due to the limited capacity of the system (see Irwin, 1978b), at any one time processing will tend to be predominantly committed to just one of these modes. However, the two modes are not totally exclusive in their operation. For example, even while the individual is heavily engrossed in thought, some degree of environmental monitoring is maintained. Similarly, internally generated information can intrude in the processing of sensory inputs. Hallucinations are perhaps an extreme instance of this.

These then are some of the general characteristics of information processing theory's view of the mind. Before considering ESP and PK within this context, the rationale of such an approach to psi

phenomena should be discussed. Essentially the argument is that if psi is a product of the mind, it is reasonable to examine the applicability of one particular model of mind to such phenomena. However, the case can be put more strongly than this. There have been many attempts to account for psi on the basis of some theory of mind (e.g., see Rao, 1977, for a review). Nevertheless, while these previous efforts have been of some assistance to the progress of parapsychology, typically they have featured two major disadvantages. In the first place, the relevant theories of mind tended to be purely philosophical, and often metaphysical, in nature. Commonly there was scant evidence for them, and indeed many were simply untestable. Additionally, it was rare for the theories of mind to be independent of the conceived nature of the psi phenomena for which they were designed to account; that is, presumed properties of psi were actually employed as a basis for constructing the theory of mind.

It is in these respects that application of information processing theory to psi experiences has some potential value. The latter approach to mind was developed with no preconceptions of the nature of psi and indeed with total lack of cognizance of the field of parapsychology. It is based on a considerable quantity of painstaking research in psychological laboratories, and has been successfully employed in investigating and conceptualizing a wide range of "normal" cognitive phenomena. Hence, if accounts of psi experiences can be formulated in similar terms, greater faith may be placed in these accounts than in ones whose evidential foundations are inadequate and whose very formulation was dependent on presumed properties of psi. Another important consideration is that, in view of the extensive empirical data on human information processing, analysis of psi in this context would be likely to lead to the generation of new hypotheses for investigation. An information processing approach to psi, therefore, is potentially both pertinent and fertile.

On these grounds I have explored (Irwin, 1978a) and developed (Irwin, 1979) an information processing model of ESP. In formulating the model, a major point of choice concerned the processing mode which can best accommodate extrasensory experiences. In other words, does ESP parallel the processing of sensory inputs, or is it more akin to the processes of ideation? Some parapsychologists who advance a physical basis for ESP seem to regard extrasensory experience as a sensory-like phenomenon. Such also is the popular view of ESP; the man on the street apparently believes that in the sixth sense there is a third eye which can provide us with second sight (to mix a few numerical metaphors). Alternatively, a number of parapsychologists

now maintain that ESP is dependent upon memorial processes for its expression, that is, it seems to entail retrieval of paranormally acquired knowledge in the ideational mode rather than being a sensory experience as such. An examination of the relative merits of the alternative approaches (Irwin, 1979) led me to reject the pseudo-sensory view and to formulate a *memory model* of ESP. I will, therefore, direct the present discussion primarily to the memory model.

The idea that ESP reflects memorial processes is, of course, not an original product of the information processing approach. In the early 1960s, for example, Marshall (1960) and Price (1964) speculated along these lines, and in 1966 Roll pubished the paper which provided the principal impetus for subsequent research on the association between ESP and memory. What the information-processing analysis has achieved is to make this view of ESP more explicit, that is, to develop a general hypothesis into a relatively detailed model of extrasensory experience.

The memory model of ESP may be summarized as follows. The initial systemic point of activation in ESP is a trace or trace-network in secondary ("long-term") memory. The means by which secondary memory is thus activated is as yet unknown. It may have a physical basis, or it may be due to teleological causes. In any event, the activated memory trace constitutes the extrasensory "input" that forms the basis of the experience. The type of secondary trace held to be crucial to ESP is that which encodes structural information, that is, one which comprises coded representations of primitive sensory features. Hence ESP stems from activation of secondary memory traces that are structurally "relevant" to the psi-source or target.

This process, here termed *concordance*, may be associated with fragmentation, disorganization and distortion. For example, if the target is a picture of a bicycle, there is a possibility that the memory trace (or trace network) corresponding to a *flower* might be activated also, since the radiating configuration of a flower is structurally relevant to the nature of a spoked wheel. Further, there may be more than one "relevant" trace thus activated, either concurrently or over the period in which concordance occurs, and this may contribute to fragmentation. The consequent instability of trace activation is the basic sense in which psi inputs are "weak."

While concordance between an extrasensory target and a secondary memory trace may be determined in a purely objective, perhaps physical, fashion, it is possible that the formation of this relationship could also be governed, at least in part, by subjective factors. Thus, defensive functions might operate even at this early stage of

extrasensory processing. For example, following the suggestion of Kreitler and Kreitler (1974, p. 282), some instances of psi-missing may stem from a tendency to form concordance in terms of negation. Hence if the psi-source is a circle, the trace-networks activated in some people's memories may correspond to the information "non-circular."

Subsequent processing of the activated information will depend on many factors, such as the individual's attitudes towards psi phenomena, his current cognitive state, and whether the ESP task is intentional or non-intentional. Subject to these various influences, the processes of pattern recognition may be applied to the structural information that has been activated in memory. This locus, it will be recalled, is the first stage in the mediation of memorial information into (or at least towards) consciousness under the processing system's ideational mode of operation.

Pattern recognition involves comparison of the input's primitive sensory or structural features against those of previously experienced inputs. Since different inputs may have a number of primitive features in common, pattern recognition normally requires selection among possible alternative interpretations of an input. It is in this phase of selection that further defensive processes may operate, so that the pattern taken to be "recognized" at this locus may be one which has less than the maximum number of features in common with the actual input. If the psi-source is the letter G, the selected pattern may in fact be "C," or even more defensively, "R." Pattern recognition of extrasensory information is further complicated by the typically weak state of the "input." During the period of concordance several structurally relevant traces may be activated, both intermittently and concurrently, so that the set of features to be recognized at this locus may be unstable and indefinite. Thus, various effects operating at the level of pattern recognition could potentially interfere with the veridicality of ESP.

The information "recognized" at this locus may then be coded in a form appropriate for its semantic analysis and for its admission to consciousness. Psychological research suggests there are at least two distinct types of coding, one in which the information is represented in visuospatial terms (the visual code) and another in which representation is phonemic (the name code). While both codes may be established for a given extrasensory input, typically one code will be dominant in subsequent stages of processing. The choice of code here will depend on the nature of the input itself, the other current cognitive activities of the individual, and his habitual tendency to utilize one particular code more frequently than the other (i.e., his cognitive style).

Encoded extrasensory information may next be subject to the (preconscious) processes of semantic analysis. One of the first semantic

features to be elaborated is the pleasantness or unpleasantness of the information for that individual. If the psi input is identified at this stage as emotionally disturbing, additional defensive processes may be applied, with various possible effects. Further (denotative) semantic analysis may be aborted, so that the individual may become aware only of an unspecific emotional reaction. For example, he may be suddenly overwhelmed by a feeling of grief, and it is only in subsequent rational analysis that a possible focus for this feeling is established. In more extreme circumstances, the input may be so traumatic that it is prevented from reaching the level of consciousness (the defense mechanism of repression). Alternatively, there may be established a semantic code which is contrary to the content of the psi input (inversion or reaction formation). This may be another source of psi-missing.

The admission of extrasensory information to primary memory and consciousness is by no means automatic. In this regard, the information must compete with other concurrent inputs and a selection made on the basis of the relative subjective importance of the various items of information. If the psi input has little interest for the recipient, it will remain unattended and the individual will have no conscious appreciation of its existence. On the other hand, if the subject's defensiveness is sufficiently low and the relative importance of the psi input sufficiently high, extrasensory information may be admitted to consciousness in a comparatively veridical state.

The form of the conscious ESP experience will generally depend on the code employed in mediating semantic analysis of the psi input. Thus, visual coding may lead to a psi experience in the form of a telepathic dream or visual hallucination, for example. Similarly, reliance on the name code may result in an intuitive experience or in an auditory hallucination. If neither of these codes accompanies the semantic code into consciousness, the percipient will merely have a vague and formless notion of the meaning of the input. Hence, he may be unable to specify the psi-source, yet still show an inclination to make responses semantically associated with the source.

It is also possible for the results of semantic analysis to be mediated directly to the locus of response processing. In this case a very simple response may be evoked without conscious appreciation of any rationale for such behavior. For example, the individual may experience an "unseen force" pushing him to one side, with the associated response being largely beyond his volitional control.

This then is the proposed course of processing under the memory model of ESP. With the exception of concordance, each of the systemic processes described above has been independently demonstrated to

occur in "normal" cognitive functioning; the recognized principles of information processing theory have here been simply extended to an analysis of ESP.

The degree of evidential support for this analysis is certainly encouraging. The interested reader will find a detailed examination of the evidential bases of the memory model in a book by the author (Irwin, 1979). Generally speaking, there are three areas in which such support is found. First, there are experiments which confirm the major premise of the model, that ESP depends on memorial processes for its expression. For example, in a task with both a memory component and an ESP component, Kanthamani and Rao (1974, 1975) found that correctly recalled items tended to be associated with psi-hitting and incorrect recall with psi-missing. Such results suggest that extrasensory processing is not merely similar to that involved in reminiscence, but that psi input actually utilizes memorial processes for its mediation into consciousness.

A second area of evidence relates to the involvement of specific processing loci in ESP. Various empirical studies of ESP have identified certain characteristics of extrasensory processing which seem to implicate the locus of pattern recognition and all higher loci. Further, there does not appear to be any evidence that the functions of loci below that of pattern recognition are required for mediating extrasensory information into consciousness. Evidence of the involvement or noninvolvement of specific levels of processing in ESP does vary in quality from one locus to another, and in some cases the data are consistent without being conclusive. Nevertheless, the overall pattern of the evidence does support the view that extrasensory processing is akin to the ideational mode of the system's operation.

Finally, the efficacy of the information processing approach to ESP is supported by the fact that psi processing does conform to the principles known to govern the operation of the human information processing system as a whole (Irwin, 1978b; Irwin, 1979). That ESP is subject to these holistic principles is significant. It indicates that extrasensory processing not only parallels that in the ideational mode, but such processing actually takes its place among other "normal" cognitive functions in competing for the system's limited resources.

The memory model of ESP thus finds support from a number of diverse perspectives. In light of the above outline of the model it is worthwhile reiterating two of the major advantages of this type of approach. One advantage is that the interpretation of extrasensory experience is based on an independent model of mind, that is, on a model which was developed with no preconceptions or suppositions as

to the nature of psi. It is, therefore, possible to utilize the results of information-processing research to further our understanding of ESP. For example, one might establish in information processing terms the basis of various altered (or discrete) states of consciousness and on these grounds generate predictions from the memory model as to the precise systemic functions through which different states of consciousness affect ESP performance. In general, then, our reliance upon an independently established model of the mind means that parapsychological research will not be limited too severely by the adequacy of our current conceptions of psi.

A further advantage of the memory model is its detail of exposition. For example, the nature of extrasensory experience is held to reflect the functions of a number of distinct loci in the information processing system. This permits generation and testing of hypotheses concerning many different facets of the model. The detail of the model is also conducive to relatively precise formulation of such hypotheses. These points are all the more notable in view of the fact that many parapsychological theories in the past have not been particularly fertile or precise in their generation of testable implications.

An information processing analysis is also applicable to the phenomenon of psychokinesis. In this case, however, the evidential foundations of the model are less extensive than for ESP, since there has been comparatively little research into the cognitive correlates of PK. Nevertheless, a model of PK has been constructed primarily in the hope that it will encourage such research. The basic premise of the model is that, from the subject's point of view, PK performance is *goal oriented*. Thus, on the basis of the work by Schmidt (1974) and Stanford (1977), PK is held to be dependent upon the arousal of a need to which the outcome of psychokinetic action is relevant.

Associated with this need is the conceptualization of a specific change in the environment which the individual (implicitly or explicitly) believes would satisfy or reduce the aroused need. Information processing underlying goal conceptualization may involve the locus of consciousness, as in the case of intentional PK tasks. However, representation of the goal in consciousness is not a necessary condition for the occurrence of PK. The existence of nonintentional PK cogently testifies to this fact. A review of the available data (Irwin, 1979) suggests the state of the information processing system that is actually necessary for PK is the activation of structural information in secondary memory.

The underlying processes leading to this crucial state are specified elsewhere in some detail (Irwin, 1979). Basically, the model proposes that in intentional PK the encoded goal-relevant information is

mediated into secondary memory via the locus of consciousness (primary memory); in nonintentional PK, on the other hand, such mediation is entirely subconscious. In positing secondary memory activation as the key cognitive condition for psychokinetic effects, the fundamental psi phenomena of ESP and PK are united. Both phenomena entail the formation of a concordance relationship between an environmental state and a trace-network in the structural stratum of secondary memory. In a sense, ESP and PK are seen as symmetrical aspects of psi, distinguishable primarily in the presumed causal direction of the concordance relationship.

It should be noted that in the case of PK, establishment of an efficacious concordance relationship does not presuppose goal conceptualization to be in terms of ultimate causal mechanisms. For example, in psychokinetic effects on a random event generator (REG) it is not envisaged that the individual has formulated, even subconsciously, the PK goal in relation to the electronic circuitry or quantum processes of the REG's internal machinery. Rather it is likely that the goal here is encoded in terms of the *output* of the REG. Thus, the potential environmental event may be enacted by relatively complex apparatus, but such complexity may not be relevant to the psychokinetic enhancement of the potential event's occurrence (e.g., see Schmidt, 1974). On the other hand, under the information processing approach the conceptual complexity of the PK goal itself would be expected to have a somewhat more significant bearing on PK performance. The actual potency of this factor has yet to be adequately determined (Irwin, 1978b).

Recently I performed an exploratory test of the central hypothesis of the memory model of PK, that PK stems from activation of secondary memory. The essential procedure was as follows. The experimental session for each subject involved a test of secondary memory and a nonintentional PK task. In the memory test the subject was given a list of ten paired associates (such as PARTY–OCEAN and ENGINE–ARTIST) to memorize in a period of three minutes. Immediately after this acquisition phase the subject performed a digit-coding task. The latter type of task effectively prevents rehearsal of the paired associates and ensures that their subsequent recall reflects their representation in secondary rather than primary ("short-term") memory. Recall was tested after two minutes on the coding task.

The nonintentional PK task was run concurrently with the acquisition phase of the memory test. Here a random event generator was employed to produce pairs of words which were displayed on a video screen. These word-pairs were formed on the following basis: from the ten paired associates of the memory task the first word of one

of the paired associates was randomly selected and combined with the second component of a paired associate. Thus on each trial there would be a video display of any one of a hundred (10 × 10) different items such as PARTY–ARTIST and ENGINE–OCEAN (as well as PARTY–OCEAN and ENGINE–ARTIST).

Now, as far as the subjects were concerned, this study was simply an experiment on memory. The video screen was not visible to them, and indeed the whole apparatus had no ostensible part in the procedure, appearing as part of the laboratory "furniture." The PK task was, therefore, a nonintentional one. The objective of the PK task was to generate word-pairs matching the paired associates that the subject was concurrently endeavoring to learn. It was hoped that a need to achieve this objective would be induced by the memory task itself, in conjunction with advice from the experimenter that the subject should strive to avoid mixing different items from the paired-associate list during the acquisition phase.

Most current theories of PK (at least at first glance) predict that under the above procedure, there will be enhanced video generation of word-pairs corresponding to all ten paired associates. Under the memory model, however, it is predicted that psychokinetic enhancement will occur only in cases where the relevant item is effectively represented in secondary memory; that is, only with those paired associates correctly recalled in the test of secondary memory will the incidence of their video appearance be above chance. Paired associates that the subject does not recall correctly are presumably not represented effectively in secondary memory, and, therefore, the memory model of PK predicts chance-level generation of word-pairs that correspond to these items.

The results of the exploratory study support the memory model. There was no evidence of a general PK effect in generating matches to all ten paired associates. However, the generation of paired-associate matches did depend on whether or not the paired associates were recalled correctly. Indeed, for correctly recalled paired associates the mean incidence of video appearances was significantly above chance expectation; the remaining paired associates were generated at a rate nonsignificantly below chance level.

It therefore appears that, at least in the case of PK initiated by *people*, activation of some type of secondary trace or trace-network may be a necessary condition for the occurrence of PK. That is, if effective activation of goal-relevant information in secondary memory is not achieved, the state of the target system can not be psychokinetically influenced by the subject. Of course, secondary memory activation is

not a sufficient condition for PK. It is also necessary for a concordance relationship to be established between the secondary trace-network and the environmental target system. Precisely what is entailed in the latter process is not yet clear, but presumably it is a function of both subject and target factors. For example, the subject's attitudes towards PK would affect not only the processing of target information and its secondary representation, but also the very formation of a concordance relationship. Additionally, psychokinetic concordance would depend on the nature of the target state (e.g., whether or not it is a potential event) and on the characteristics of the natural mechanisms by which such an event is enacted (e.g., whether by deterministic or by random processes).

In general, then, the information processing approach to psi phenomena appears viable and productive of research. Of course, additional work remains to be done. The structurally related models of ESP and PK warrant further development, particularly where the concept of concordance is concerned. For example, one may inquire if it is possible for concordance to have a physical basis, or is it best regarded as a teleological process, that is, can concordance be equated with Stanford's (1978) concept of conformance? Even if these specific issues cannot be resolved in the short term, it is essential to gain some understanding of the factors which govern the formation of a concordance relationship in ESP and in PK.

The memory models of psi phenomena do have their limitations. The source of some of these limitations is the fact that information processing theory is based almost exclusively on *human* cognitive performance. Now, without some appreciation of the nature of information processing in subhuman animals, it may well be inappropriate to apply the memory models in their present form to an analysis of anpsi (i.e., psychic phenomena in animals). Further, these models may be totally irrelevant to psi interactions between non-living systems, whereas Stanford's (1978) conformance model at least admits the possibility of such interactions. Whether or not these sorts of limitations will prove serious remains to be seen.

Nevertheless, information processing theory does seem to be contributing to our understanding of psi phenomena associated with humans. At the very least the memory models' consistency with available data supports the efficacy of regarding psi phenomena as having an informational basis. In this sense, information processing theory presents an important perspective in the area of communication and parapsychology.

BIBLIOGRAPHY

Beloff, J., "Teleological causation," paper presented at the Second International Conference of the Society for Psychical Research, Cambridge, March 28–30, 1978.

Irwin, H. J., "ESP and the human information processing system," *Journal of the American Society for Psychical Research*, 1978, *72*, 111–126. (a)

Irwin, H. J., "Psi, attention, and processing capacity," *Journal of the American Society for Psychical Research*, 1978, *72*, 301–313. (b)

Irwin, H. J., *Psi and the Mind: An Information Processing Approach*, Metuchen, N.J.: Scarecrow Press, 1979.

Kanthamani, H., and Rao, H. H., "A study of memory-ESP relationships using linguistic forms," *Journal of Parapsychology*, 1974, *38*, 286–300.

Kanthamani, H., and Rao, H. H., "The role of association strength in memory-ESP interaction," *Journal of Parapsychology*, 1975, *39*, 1–11.

Kreitler, H., and Kreitler, S., "ESP and cognition," *Journal of Parapsychology*, 1974, *38*, 267–285.

Marshall, N., "ESP and memory: A physical theory," *British Journal for the Philosophy of Science*, 1960, *10*, 265–286.

Price, H. H., "Memory and paranormal cognition," paper presented at the Seventh Annual Convention of the Parapsychological Association, Oxford University, September 3–6, 1964.

Rao, K. R., "On the nature of psi: An examination of some attempts to explain ESP and PK," *Journal of Parapsychology*, 1977, 41, 294–351.

Roll, W. G., "ESP and memory," *International Journal of Neuropsychiatry*, 1966, *2*, 505–521.

Schmidt, H., "Comparison of PK action on two different random number generators," *Journal of Parapsychology*, 1974, *38*, 47–55.

Stanford, R. G., "Experimental psychokinesis: A review from diverse perspectives," in B. B. Wolman (Ed.), *Handbook of Parapsychology*, New York: Van Nostrand Reinhold, 1977. Pp. 324–381.

Stanford, R. G., "Toward reinterpreting psi events," *Journal of the American Society for Psychical Research*, 1978, *72*, 197–214.

DISCUSSION

STORM: I do want to say first that I found your paper terribly exciting and interesting. I think, actually, mainly because of my own interest in computing. I wonder if you would let me give you two questions at once and then you can answer them. You separate perceptual organization from consciousness. As a neophyte in the parapsychology community, I wonder why you do that, because I have a vague impression that perception is an integral part of consciousness. That's my first question. My second question is this: the experiment you describe seems to have language in it in an essential way. Now, have you considered or done experiments or thought about testing this hypothesis in a situation where no language is involved?

IRWIN: As to the distinction between perceptual organization and consciousness, there is a good deal of evidence that there is a series of

perceptual processes applied to information whether the information is coming through the sense organs or is retrieved from memory, and that these various processes are applied below the level of consciousness. I suppose the classic example with which you might well be familiar would be that of subliminal perception, where there is evidence that considerable information processing has occurred, that the meaning in fact, has been extracted from the input, yet the individual is unable to report any awareness or phenomenal representation of that input. For that reason it is postulated that consciousness is a relatively high-level process in the system and that these other perceptual processes operate at a preconscious level.

Regarding your point on the role of language in the PK study, that study certainly did use words which the subject was asked to learn. I have not yet considered the use of non-verbal material. However, it is an interesting idea. Whether I have the equipment that could actually generate non-verbal material and whether the subject can be presented with an analogous memory task with non-verbal material, I'd have to give further thought to, but it certainly is worth consideration.

STORM: On the perceptual organization and consciousness, is it possible that an alternative explanation is that what we're calling perception is really an integral part of consciousness and what we really have is some factor that occasionally intervenes and prevents it from reaching its full expression in consciousness, rather than saying it's a level-type structure?

IRWIN: It is possible. Nevertheless, most human information processing psychologists would explain these differences in quality or richness of consciousness experience in terms of preconscious processes and the depth and elaboration of these processes that have preceded phenomenal representation.

STORM: In your diagram, do you think there are separate components such as you've labeled in the box, that if we had a reality inspector who could tell us everything about everything, he would say, "Yes, there is a readout and perceptual organization mechanism," and then in some other place there is a semantic analyzer, and in some other place there is something else, or do you mean this to reflect the competence of a normal human being and not necessarily the constituents that are present?

IRWIN: If it were possible to open the lid on the mind and have a look inside, I am not proposing you'll find little boxes with these labels on them. This is purely a model. Evidence for each one of these processes

comes from experimental work. Admittedly most of that experimental work is with the standard laboratory animal, the first year psychology student, who may not be typical of the general population, but I am reasonably confident that the types of processes delineated in this model are reasonably representative of the general population. That is not to say that individual differences do not occur. I mentioned the idea of cognitive styles briefly in the paper. The way in which a person deals with information and permits it to flow through the system, varies from one individual to another. There has been some very important work by Hunt relating differences in intelligence to these types of processes, so I think it is quite possible to accommodate individual differences within this type of model.

NASH: Dr. Irwin's experiment in support of his thesis that PK stems from activation of memory is ingenious and I congratulate him for it and for his significant results. However, I believe that even though in his experiment the PK task was not intentional, his methodology did not preclude the possible effect of motivation. Both the memory of a particular word pair and its PK production could independently stem from motivation for that particular word pair. To say that motivation for a particular word pair would depend upon its being remembered before it could cause its PK production, would be to beg the question.

IRWIN: Under the memory model PK is not due to processes in the item's actual retrieval but to the activation or establishment of the item as a secondary memory network. Certainly motivational factors (in the broadest sense) would influence the establishment of these traces, so I would not dismiss motivation as an irrelevant issue. Thus, to a degree it may be reasonable to argue that certain paired associates were not recalled and their psychokinetic generation not enhanced because particular items held little interest for the experimental participant. By no means is that inconsistent with the memory model.

However, I gather that you would want to press that point further and interpret the results of this exploratory study as possibly a motivational artifact. Well, as far as the memory task is concerned the "motivational" differences among stimulus items would relate to the interest value of their idiosyncratic associations for the given individual. I do not think it reasonable to assume, however, that in the PK task the associations for target-matching word pairs would necessarily be more interesting than those of inappropriately paired words. Hence, under the motivational argument one would also expect to find significant above-chance generation of certain pairs which were not target items, but which, nevertheless, were of "interest" to the

individual. The prediction would therefore be for an additional net PK effect on word pairs that did not correspond to the paired associates presented to the target. There was no evidence of such an effect.

ULLMAN: With regard to your comment about processing in the ideational mode, in relation to dreams, for example, you point to memory, which is an important factor in the structure of dreams, and you point to defensive operations, which are also a significant factor in the production of dreams. But I don't think you mentioned, unless I missed it, what I think is a very special and unique quality of dreams, and that is the creative transformation of the memory into a metaphor for the purpose of gaining greater power of expressiveness. Perhaps concordance may come not only in terms of activating memory traces, and not only in terms of perhaps looking for relationships through the defensive operations, but also in terms of the metaphorical transformation of memory.

IRWIN: With regard to the symbolic representation of information in dreams, this would primarily be a function of a level of the system we call semantic analysis. I think it would be very interesting to try to model dream processes within the human information processing context. As far as I know, that has not been successfully done. I don't think there is any conceptual difficulty, however, in trying to account for symbolic representation in paranormal dreams (telepathic dreams, for example.) There is no suggestion that such representation is in any way different in kind to symbolic processes in normal dreaming or indeed to the symbolic processes that you also find in subliminal perception. You may recall a number of experiments reviewed in Dixon's *Subliminal Perception*, for example, indicating that when subliminal stimuli are presented to a subject he may well be unable to give an accurate description of the input even on a guessing type of response task, but nevertheless he might be disposed to give responses which are symbolically related to the subliminal inputs. In that you find these processes in both paranormal and "normal" situations, I think it would certainly be feasible to model symbolic processes on the same basis for both.

RUDOLPH: I'm interested in the role of emotion in psi. I wonder whether you could comment on whether information processing theory models the role of emotion.

IRWIN: It does so only indirectly. The effect of emotional influences or emotional states is more or less summarized under the rubric arousal level, and there is certainly a good deal of evidence that the level of

arousal of the individual has an effect on the nature of cognitive processing. Now, theoretically, that could be extended to an analysis of PK or ESP tasks under aroused or non-aroused states. To actually go into specific states and look at the effects of depression or happiness on information processing functions is somewhat beyond the model at this stage. We recognize that these various states have an informational processing basis: in order for you to feel happy or depressed, a certain amount of information processing has gone on. Thus, processes of semantic analysis would lead you to believe that this particular input is happiness arousing or is a depressing one. But information processing psychologists do not yet know how that then leads to differences in the way information comes into consciousness and to differences in the way the subject "feels."

MORRIS: When Bill Roll first put forth his ideas on the topic, one of the problems we kept on going around with was what kind of experience wouldn't draw from memory. You can have memories that would seem to be rather cohesive, or you can say, "O.K., imagine a cat-frog-squash," and you could put together a component of catness and a little bit of squash and a little bit of frog and come out with something which you've never ever seen before, but is composed of little bits and pieces of memory. And so, I was wondering if you've given any thoughts to what kinds of experiences might really falsify the notion or might indicate that no such memory trace had been involved somewhere or another along the line. A lot of the modeling that you do is probably equally valid if the initial point of activation is a memory trace or trace network or something a little before that, but a memory trace comes to be involved rather quickly. And the other issue is, do you have any feelings as to how that selection of initial traces would take place? Would you regard it as selecting rather cohesive memories at the start, or really little tiny bits, building blocks of experience? You'd have memories at both levels?

IRWIN: I think both types of memory representations would be involved depending on the situation. If, for example, the individual has a dream that Aunt Mary has died in a car crash in a particular city, then presumably there are memories for those specific bits of information about Aunt Mary, car crashes, death and that city. In that type of situation it would be reasonable to argue that these fairly gross levels or units of memory are activated. On the other hand, I don't think that applies to all cases. For example, there are some spontaneous cases in which people acquire information about individuals they've never met, or about situations in which they have had relatively little

personal experience. In those types of situations, the content of the experience might very well be built up from smaller bits of memorial information. For example, a person may dream of a particular individual he has never met before, doing some particular action, and then subsequently he may actually experience that event. Here it would be necessary to argue that what is being activated is a whole set of little independent bits of memorial information such as a man, a certain height, hair of a particular color, a big nose, etc., and that these in some way collectively lead to the experience.

Regarding your earlier point, I recognize that one difficulty of the model is trying to devise a situation in which target-relevant memories are not represented in the system and thereby allow the theory to be disproved. Any theory must have the opportunity for disproof. I've given some thought to that, primarily in the use of children living in pre-literate societies or in societies where there is no contact with either written or pictorial material. If we can then run ESP tests with such materials, it may be possible to test the basic assumption of the memory model. Another option would be to use laboratory animals as subjects.

MORRIS: Whenever a trace is activated, as you've described here, it sounds as though you're not necessarily assuming that such activation automatically leads to experience of that memory trace activated. I was wondering what evidence there is that bears on the question of the activation of the memory trace in some sense of this sort and what is then involved in bringing it into experience. To some extent we're all electrically activated all the time. In what sense are you really talking about activation of a trace in the sense that it wasn't activated before, but then doesn't lead necessarily to an experience?

IRWIN: The sort of parapsychological evidence I had in mind was Douglas Dean's work with plethysmograph measures and emotional ESP targets. Under these conditons it is reported that subjects may not have any conscious experience which reliably relates to the type of target, and indeed their attempts to guess the targets' identity may also be at chance level. Nevertheless on the basis of the subjects' plethysmograph records it may be possible to discriminate trials on which the targets were emotional from those on which neutral targets were used. The implication is that concordance has occurred here, but the information activated in memory has not been mediated all the way up to the level of consciousness.

MORRIS: I would agree with that. My question is more, are there any psychobiological data bearing on the issue of a memory trace being

activated in such a way that it's clearly more activated than before, but does not lead to experience? Is there evidence that one can in any real sense activate a memory trace in way you're talking about without there being any concomitant experience? Because I agree here, your model has to account for some of the data you've just described, and so that's a crucial issue. Can you have meaningful activation of a memory trace without conscious experience?

IRWIN: I am not in a position to cite any neurophysiological data on the issue, but perhaps some work in the area of attention may be relevant here. In certain circumstances, unattended material of which we are not immediately aware may emerge in consciousness at some later time, frequently by way of a dream the following night. Now, for the period before the dream the only way in which this information could be maintained in the system is as an activated memory trace. Thus, during the pre-dream period there is a trace or trace network in an active state with no concomitant conscious experience. There are other cognitive phenomena consistent with this notion. In other words, there are independent grounds for supposing that trace activation can occur without concomitant phenomenal representation.

CHARACTERISTICS OF PSI COMMUNICATION

CARROLL B. NASH

In the broader definition of communication as being transfer of information, all paranormal mediation is psi communication. However, in the narrower sense employed in this article, communication consists of transfer of information between cognitive individuals. Not included in psi communication under this definition are clairvoyance from inanimate object to mind and psychokinesis from mind to inanimate object. It is not known whether psi communication is accomplished by a telepathic effect on the percipient's mind or by a PK effect on his brain. However, as telepathy, clairvoyance and psychokinesis may be no more than distinctive conditions under which a single underlying psi-function operates, there may be no need to attempt to distinguish between the characteristics of psychic transmission with each of these three modalities of psi.

To be effective, psi communication must impart a message, i.e., convey meaningful information. It must consist of more than a mere correspondence between the targets the agent sends and the symbols the subject calls. To my knowledge, a message has been conveyed by psi in only two experiments. In one of these, Milan Ryzl (1966) reported the transmission of a message with the Czechoslovakian subject Stepanek. By means of the repeated-guessing technique, five three-digit numbers were transmitted without a single error. Because Stepanek's psi ability was expressed by identifying whether the white or the green side of a concealed card was uppermost, the target number was encoded into a certain sequence of green and white sides, and the subject was asked to ascertain by ESP the color of the uppermost sides of the target cards. After the colors of the targets were determined by majority vote analysis, the color sequence was decoded into a number sequence. In the other experiment, the word "peace" was transmitted by a similar method (Carpenter, 1977).

Psi transmission may be manifested in several ways, as will be discussed in this paper. One of these is in preverbal communication between mother and child. The American psychiatrist Jan Ehrenwald (1955)

postulated an early mother-child relationship of symbiosis or mutual benefit, with telepathy playing the most significant part. The American psychiatrist Berthold Schwarz (1961) assembled a collection of ninety-one incidents in which he or his wife ostensibly served as the telepathic agent with his daughter when she was between one and three-and-a-half years old. Paranormal communication between mother and child also apparently occurred in the case of a feeble-minded, nine-year-old Latvian girl named Ilga. Although the child was unable to read under usual conditions because of word blindness, she was able to recite what was written in a book gazed at by her mother in another room (Bender, 1938).

That psychic communication may occur spontaneously is indicated by the many cases which have been reported, 15,000 in the collection of Dr. Louisa Rhine alone. Although such cases cannot be considered to constitute proof of paranormal transmission because of the possibility of chance coincidence, poor observation, faulty memory and deliberate fraud, it was because of such claims that man was led to test for psi experimentally. Because psi communication has been established as occurring in controlled tests in the laboratory, it is reasonable to assume that some ostensibly paranormal spontaneous communication is actually due to a psychic factor, although it may be impossible to determine whether or not any given spontaneous experience is paranormal.

Spontaneous psi communication may take the form of an impression, a dream or an hallucination. In many cases, the agent in the transmission may lack even unconscious intent, whereas the percipient always shows some degree of motivation (L. E. Rhine, 1956). However, many instances of ostensible paranormal communication have been reported in which the agent seems to be an important participant in the process. The following is an example, from the author's collection, of ostensible psi communication initiated by the agent and taking the form of an impression in the percipient. "When I was in high school, I was organist for two Episcopal churches. This meant traveling from one town to another with the priest. After the second service my mother would pick me up at noon or a little after. One morning the priest informed me that the second service would begin and end a half-hour earlier. I had no time to call my mother, nor did anyone else. All through the service I kept thinking, 'Mother, come for me at 11:30.' As church let out I dashed out to find my mother waiting. Her first words were, 'Well, here I am.' She then recalled a previous experience we had during World War II. My father was in the Navy, stationed in Gulfport, Mississippi. My mother and I were

traveling down to see him. Mother had written him to meet the bus at a certain time. En route, however, we were able to get connections which would get us there five or six hours earlier. Mother told me to think very hard of Dad. We both thought very hard, and sure enough there he was to meet the bus. He said he just knew we would be on that bus."

Ostensible psychic communication in the form of a dream is illustrated by the following case from the author's collection. "I read a story late one evening before going to bed which made a great impression on me. When I retired, my husband was sound asleep. The next morning he told me about his dream which was unusual because of the infrequency of his dreaming. I couldn't believe my ears because of its similarity to the first page of the story I had read the night before. My husband dreamed that he was driving along a deserted stretch of road. It was dusk and he could only see within the area of his headlights beam. As he rounded the curve, his headlights flashed on a creature that stood upright on the left side of the road, and the lights flashed in its green eyes. The thing, which resembled a dragon, looked at him in the glow of the headlights and scampered up the embankment. In the story I had read, a young man was riding in his car on Arizona desert. It was dusk and he could only see within the beam of his headlights. He rounded a curve and in the beam cast by the headlights he could see two creatures on the left side of the road staring at him with green eyes. They looked like dragons. As he came close, one scampered up the side of the road and the other followed."

Spontaneous psi communication in the form of an hallucination is usually auditory or visual, but may be expressed by means of some other sense modality instead. The following is an account from my files of a somatic hallucination. "During World War II, I was in London and worked at the Church Canteen after working hours. While there I became very attached to Teddy and his wife—he was a British soldier. He was much older than I and had no children of his own. I think I felt he had taken the place of my father who had passed away when I was seven. It was at one of these dances that I experienced a terrific burning sensation over my face, hands and arms and I mentioned it to my partner who was Teddy's buddy. The pain was almost unbearable. The following day my partner called me to say that at the exact time I had experienced the burning sensation a gas tank had exploded burning Teddy's face, hands and arms."

In some cases an out-of-body experience may provide a means of communication by psi. In this experience, the individual in a dreaming or waking condition not only feels that he has left his physical body, but may see it as if from a distance. The experience may occur spontaneously but, in some individuals, may be induced. In certain

cases an apparition of the person having the out-of-body experience is seen by an individual at the spot where the out-of-body experiencer seems to be. In several nineteenth century experiments an individual succeeded in making his apparition visible to another (Tyrrell, 1953). In a recent experiment reported by Robert Morris (1974), a kitten in the room to which an out-of-body experiencer attempted to project himself, decreased its activity to a statistically significant extent during out-of-body periods in comparison with control periods. The most parsimonious hypothesis for paranormal out-of-body experiences is that they are the result of ESP by the out-of-body experiencer and by the individuals who perceive his presence at a distance from his body.

Psi communication is not limited to humans, but may occur between man and lower organism. In a study of the horse Lady, who could spell out the answers to questions by using her nose to point out letters and numbers, the Rhines (1929), by carefully guarding against the possibility of giving sensory cues, tentatively concluded that the horse responded to paranormal communication. In another study, the experimenter gave silent commands to a dog who obeyed although the experimenter's head was shielded from the animal's view to prevent sensory cues (Bechterev, 1949). One command was to go to the side of the room, jump upon a chair and paw a portrait on the wall.

Whether communication by psi can take place between living individuals and spirits of the deceased is a question yet to be satisfactorily answered. Reports of such events occur as far back as biblical accounts. One of these describes what may have been an early forerunner of a modern spiritualistic seance. Saul, king of the Jews, engaged in ostensible paranormal communication through the witch of Endor (I Samuel 28:0–15) with the dead Samuel, although Saul had earlier tried to suppress psychically gifted persons, Saul was correctly informed through the communication that he and his sons would die the next day in a battle with the Philistines.

In the sixteenth century, the mathematician John Dee at Cambridge University held seances in which ostensible paranormal communication with spirits took place. The communicating spiritual beings were not human spirits, and some of them were said to be angels (French, 1972). The idea of communication with distinctly human spirits established itself in the popular consciousness in the eighteenth century through the teaching of the Swedish philosopher Emanuel Swedenborg, who had dreams and hallucinations in which he engaged in paranormal communication with the deceased (Toksvig, 1948).

As a force of some magnitude, however, spiritualism had its beginning in 1848 in Hydesville, New York, in the house of the Fox family, whose members were disturbed by continual rappings

(Podmore, 1902). It was soon discovered that the rappings consisted of two raps for "yes" and one rap for "no" in answer to questions supplied by members of the Fox family and visitors. The signals declared that a murdered man was buried in the cellar. Subsequently, the skeleton of a man was said to have been found buried near the cellar in a space between two walls. Rappings followed the two Fox sisters even when they changed their residence. A system was devised based on raps in answer to the letters of the alphabet, and some of those who sat with the Fox sisters found that they had similar powers. The movement spread until in a few years hundreds of mediums were conducting thousands of seances across the United States and Europe. Even after many tests had indicated that the raps were not produced by normal means, the Fox sisters confessed to fraud and then retracted the confession. Such instability is a frequent characteristic of psychics and, although it compounds the difficulty of evaluating the phenomena associated with them, it does not of itself negate their paranormality.

Sometimes messages received by an Ouija board or a planchette purport to come from departed spirits. A message written by a planchette used by a female participant and Hensleigh Wedgwood, brother-in-law of Charles Darwin, purportedly came from a deceased female by the name of A. Grimbold (Myers, 1893). According to the message, she had been burned at the stake in March, 1605, for being an accomplice to the murder of her mistress, Mrs. Clarke, in Leicester. The murder was carried out by two men—Bradshaw and Harrison. The latter was A. Grimbold's lover and had promised to marry her if she helped. Bradshaw was hanged; however, Harrison was released through the aid of powerful friends. Through advertising in newspapers, Wedgwood was able to locate a little-known book on the history of Leicester which corroborated the existence of Alice Grimbold and the events in the message written with the planchette almost three centuries later.

Throughout the first third of the twentieth century, several English-speaking psychics in different parts of the world, some of whom had not met one another, produced statements by means of automatic writing or automatic speaking, each of which alone had little meaning, but which complemented one another and were found to be interconnected (Salter, 1948). These cross-correspondences purported to emanate from some deceased psychical researchers as an attempt to provide evidence of their survival. While the cross-correspondences might be explained by unconscious telepathy between the automatists, no parallel is known for telepathy on such a large scale or with like complexity.

The personalities of the ostensible spirits expressed by some mediums may closely resemble their former living characteristics. The "spirit" of George Pelham, manifesting through the American medium Leonore Piper, picked out 30 of his former friends from 150 persons who had sittings and made not one mistake (Hodgson, 1898). He spoke to them of their common memories and reacted towards them as the living George Pelham would have done. That the personality communicating through the medium is not necessarily that of a deceased individual, however, is indicated by communications from fictitious persons and from individuals later discovered to be still alive (Flournoy, 1900). The English parapsychologist Soal (1926) had conversations with a communicator in several seances, only to find out three years later that the individual who was presumed to be deceased was still living.

Some mediums have one or more controls or spirit guides who purportedly relay messages from other deceased individuals or regulate the direct communication of these entities through the medium. In order to determine whether the personalities of the medium, the control, and the spirit communicators are measurably different, Whately Carington (1935) applied Carl Jung's word-association tests to each of them. A list of words is read to the subject, he replies with the first word he thinks of and his response time is measured. A reaction pattern characteristic and distinctive of the individual is formed. The response times of the medium and her control to given words were found to be negatively correlated. The counter-similarity was judged to indicate that the psychic revealed a different side of her own personality in the control than that which was present in her normal state, and that the control was a secondary personality of the medium probably formed around a nucleus of repressed material. Unlike the control, the spirit communicators did not display any personality relationship with the psychic. However, the fact that a given spirit communicator did not show a similarity of response with different mediums lessens credibility for their autonomy.

Secondary and multiple personalities are known to develop in some individuals with hysteria. Sybil had 16 alternating personalities each appearing one at a time and some being unacquainted with others (Schreiber, 1973). The appearance of spirit personalities in mediumship bears some resemblance to the occurrence of multiple personalities in hysteria. Some of the spirit personalities are subconscious dramatizations of the medium based on information normally or paranormally obtained. Whether any of them are due to spirits of the deceased is a question awaiting further evidence.

Psychic phenomena purportedly due to spirit influence are also interpretable on the basis of the super-ESP hypothesis (Gauld, 1961). According to this hypothesis, such phenomena result from the use of a virtually unlimited range of ESP by living individuals, sometimes in combination with a personality constructed in the psychic's unconscious mind. With no known limits to ESP faculties, any document, object, or bit of human knowledge, even if it is only in someone's unconscious mind, may be accessible to the percipient. Because the existence of spirits has not been established, and because ESP and the human dramatizing ability are known facts, the super-ESP hypothesis may be more parsimonious than the spirit hypothesis. According to the principle of parsimony or Occam's razor, entities, e.g., spirits, should not be postulated to explain a phenomenon that can be accounted for without them.

Proponents of the spirit hypothesis, however, point out that ESP has not been shown to be capable of producing paranormal phenomena with the complexity of, for example, the cross-correspondences. According to them, it would require a sophistication of ESP far beyond that for which there is present evidence. They maintain that the spirit hypothesis requires fewer unsupported assumptions to explain certain paranormal phenomena than does the postulation that the psychic events are produced by complex paranormal interactions of minds at an unconscious level. They, therefore, hold that the super-ESP hypothesis is not as parsimonious as the spirit hypothesis.

Some of the characteristics of psi transmission have been revealed by experimentation. On the basis of classical physics, paranormal communication may be extraphysical, in the sense of being independent of space, time and physical causality. Experiments have failed to establish a decrement in psi communication with distance or with time. That psi is not a physical force is suggested by failure of metal chambers and cages to prevent its occurrence, even though the containers were impervious to the transmission of most electromagnetic waves. Although psi is not encircled by the present boundaries of physics, changes in the concepts of the latter science may eventuate in its inclusion of paranormal phenomena. On the other hand, if mind proves to be basic to matter and physical phenomena are found to be only special manifestations of psychical activity, the science of psi will subsume physics rather than becoming encompassed by the latter.

The information that is transmitted by psi may be incomplete or modified in its manifestation. In tests of paranormal communication with drawings as targets (Warcollier, 1938), changes in their extrasensory perception included the following: (1) Either the idea or

the form of the target was perceived without the other. (2) Only a fragment of the target picture was perceived. (3) Important elements of the picture were juxtaposed. (4) Certain portions of the picture were inverted. (5) Elements of the target picture were reorganized into an identifiable form different from the original configuration. (6) The target picture was elaborated. (7) The target picture was transformed into a different but visually similar image. (8) The target picture was represented symbolically or by an associated idea.

Experiments indicate that certain characteristics of the percipient may affect psychic communication. Sex, age and intelligence may have qualitative effects on paranormal transmission, but they are not limiting factors to its occurrence. Paranormal communication has been found to occur in both sexes, at all ages and throughout the range of human intelligence. Certain attitudes and personality traits of the percipient have been associated with communication by psi. These include mood, motivation, emotional stability, extraversion and belief in ESP. One direction of each trait results in a positive manifestation of psi and the opposite tendency results in no psi transmission. Experimental evidence also indicates that psi communication may be facilitated by relaxation and by hypnosis.

Experimentation has also revealed characteristics of the agent affecting paranormal communication, and they have been found to be similar to those of the percipient, e.g., mood, motivation and belief in ESP. The emotional relationship between the agent and the percipient is an important factor in psi transmission, the success of the communication being higher when either the agent or the percipient likes the other and highest when they have mutually favorable feelings. An increase in the number of agents has been reported to favor psi transmission (MacFarland, 1938); however, any improvement that may ensue has not been found to be proportional to the number of agents used.

Experiments indicate that psi may be voluntarily directed to a particular target; however, it may be unconscious either with respect to the subject's intent to use it or with respect to his cognizance of success in its use. In the first case, the subject employs psi without conscious intent, i.e. it is nonintentional, although it may be used to fulfill a need or desire. In the second case, he uses psi intentionally, but without consciousness of whether or not he is succeeding.

Several studies indicate that ESP may be used unconsciously to fulfill a need or desire. In one of them (Cox, 1956), it was found that significantly fewer passengers traveled on trains on the days of accidents than on comparable days. Although some of the passengers

may have consciously precognized the train wreck, most of them presumably avoided the train on that day without realizing their true motive.

That psi may be used intentionally, but without consciousness by the individual of whether or not he is succeeding, is indicated by the fact that, when making his call, he is usually not conscious of whether his attempt at intentionally expressing psi has been successful (Woodruff and George, 1937). On the other hand, the fact that some experiments using immediate feedback of success to the subject have resulted in a higher level of scoring (Targ, Cole and Puthoff, 1974) indicates that the subject may be conscious of applying psi. If the subject did not have some consciousness of his mental or physical state when he was using ESP, he would not be able to learn to improve its use by causing the mental or physical state to occur again. Such success in the positive reinforcement of psi suggests that subjects can learn to communicate by paranormal means.

In experimental tests, psychic communication is generally found to have a low degree of efficiency even with successful subjects. For example, the highest of Rhine's exceptional subjects had 50 percent more misses than hits. Furthermore, paranormal ability fluctuates, and its occurrence is unpredictable even in gifted psychics. The expression of psi generally undergoes a chronological decline, and may even be expressed negatively to produce scores significantly below mean chance expectancy, a phenomenon observed with sufficient frequency to be given the special name of psi missing. Frequently, however, the score will increase in the terminal part of the experiment or experimental division to approach its initial level.

Both psychical and physical theories have been offered to explain psi communication. The fundamental concept in psychical explanations of paranormal communication is that of a cosmic consciousness or an absolute, an ancient mystical idea which has persisted into the age of science. The German philosopher Edward von Hartman (1855) suggested that in ESP the mind of the seer is in connection with the absolute and, through the absolute, with other individual minds. The American philosopher and psychologist William James (Murphy and Ballou, 1960) believed that all individual minds are linked together by a common universal mind of which each individual mind, in a conscious state, is unaware, but which is accessible to all subjects in a state of trance.

Physical theories of psi transmission have involved both electromagnetic waves and elementary particles. It was early postulated (Ochorowicz, 1887) that psi communication is the result of electromagnetic waves produced by the brain of the agent and received by

the brain of the percipient. Brain waves were finally identified by the German neurophysiologist Hans Berger in 1928. However, because they cannot be registered at a distance greater than a few millimeters from the head, he proposed that paranormal communication is accomplished by psychical waves (Berger, 1940). Later it was suggested that psi communication is accomplished by extremely low frequency (ELF) electromagnetic waves (Hogan, 1967). Such waves are not stopped by metal chambers and cages and travel completely around the earth with almost no attenuation. Hence, their proposal as mediators of psi avoids the failure of psychic transmission to be hindered by metal containers or by distance. It is theoretically possible that brain activity of the sender could be transduced into electromagnetic waves and that these electromagnetic waves could be transduced into brain activity of the percipient, thereby accounting for paranormal communication. However, it is not apparent how electromagnetic waves that can penetrate a metal enclosure could sufficiently interact with matter to mediate psi, or how they could account for clairvoyance or for precognition.

Several physical or quasi-physical elementary particles have been postulated as the means of paranormal communication. Electrons that travel to the brain of the percipient from the brain of the agent were suggested as the conveyor of ESP (Forel, 1918). The neutrino was also postulated as the carrier of psi (Hammond, 1952). The neutrino may be the most ghostlike of all the elementary particles as it has virtually no physical properties—no mass, no electric charge, no magnetic field. A neutrino travels with the speed of light and can go entirely through the solid body of the earth as if it were so much empty space. Tachyons, particles with an imaginary mass and traveling with a velocity greater than that of light, have been considered as possible carriers of ESP information (Chari, 1974). Similar particles, called psitrons, were also proposed as bearers of ESP information (Dobbs, 1965). As they have mathematically imaginary mass, they can traverse space with a velocity exceeding that of light without frictional loss of energy. If captured by critically poised neurons in the percipient's brain, they might then trigger off a chain reaction of neuron discharge. The postulation of particles that are not intercepted by matter avoids the difficulties afforded the electromagnetic-wave hypothesis by the ineffectiveness of physical shields and the absence of distance attenuation. However, it is not apparent how particles that are not stopped by matter could be stopped by the percipient's brain.

Another physical explanation of psi communication avoids the criticisms of ESP mediation by electromagnetic waves or elementary particles. It lies in quantum theory. According to quantum mechanics a

physical system, e.g., an atom, has an infinite number of states that are continuous, are spread out in space, and compose a state vector or wave function called psi (not to be confused with the psi of parapsychology). The physical system is not in one of these states alone, but in the totality simultaneously. When measurement is carried out on the physical system, it undergoes a sudden discontinuous change—a collapse or reduction of the state vector or wave packet into one of its component states. Only when a measurement is performed—that is, when it is observed—does the physical system enter a single one of its component states. No energy is transferred in this process.

The American physicist Evan Walker (1975) identified the combined consciousness of the coupled observers with the hidden variables that are believed by some quantum physicists to be responsible for state-vector collapse. In acts of psi, the consciousness of the percipient and the consciousness of the agent are hypothesized to act together to select the particular state into which the wave function of the percipient's or the agent's brain is collapsed. Among those possible states of the brains of the percipient and agent is one in which the call and the target are alike. Because the hidden variables are independent of space and time, they can effect the collapse of state vectors of systems that are spatially and temporally separate. Thus, equating the combined consciousness of the observers with the hidden variables provides an explanation for psychic communication. It would be but a step further in quantum theory to conclude that quantum events cannot occur without an observer and that they are the products of observing consciousness. Should physics take this step, it would find that its basis in the scientific hierarchy was constituted by the science of psi.

That physics is on its way to taking this step is indicated by five of seven recent experiments on photons and protons, the results of which, according to the American physicists John Clauser and Abner Shimony (1978), are explainable only by action at a distance (psi in parapsychological terms) or by abandoning the realistic view of the physical world in which external events are assumed to exist whether or not they are observed. In these experiments, the two members of a pair of photons or protons were brought together and, in that state (according to quantum mechanics) had opposite spin directions, although it was undetermined which of the two particles had an up spin direction and which had a down spin direction. The two particles were allowed to separate and, when upon observation the spin of one of them was determined either to be up or down, the spin of the other was found to be in the opposite direction at a later moment when it too was observed, although until the latter observation was made the spin

direction of the second particle was undetermined. Thus, the spin of the second particle was determined by an observation of the first particle even though at the time of the observation the two particles were separated by a considerable distance. Although the observation of the first particle did not interact with the second particle, it determined its spin direction. According to these two physicists, only two conclusions are possible. Either the spin of the second particle was instantaneously determined when the spin of the first particle was observed, or the spin of the second particle was not determined until it, too, was observed. In the first case, instantaneous action at a distance (*author's insert* parapsychological psi) would have to be accepted. In the second case, the assumption of the reality of the particle before its observation would have to be replaced by the view that its existence was brought about by its being observed. In that case, in my opinion, mind would be basic to matter, and parapsychology would underly physics in the scientific hierarchy. It appears to me that the results of these experiments, instead of supporting the Cartesian dualism of interaction between mind and matter, are consistent with the metaphysical concept that mind is the cause of matter and matter is the product of mind.

Parapsychology and quantum mechanics appear to be merging in their depiction of the nature of reality. In their confluence, the universe takes the form of a multiplicity of holistically related events each of which occurs only at the moment it is observed, the observations being spatially and temporally independent of the location of the observers, whose minds are coupled into a single unit. Perhaps, there is but one mind, the universe consisting of it and the observations it makes. The postulation of one mind of which the minds of individuals are facets avoids the pitfall of solipsism and provides an explanation of the existence of physical events before humans evolved to observe them. The relationship between such a mind and God is a theological rather than a parapsychological question.

BIBLIOGRAPHY

Bechterev, V. M., " 'Direct influence' of a person upon the behavior of animals," *Journal of Parapsychology*, 1949, *13*, 166–176.

Bender, H., "The case of Ilga K.: Report of a phenomenon of unusual perception," *Journal of Parapsychology*, 1938, *2*, 5–22.

Berger, H., *Psyche*, Jena, Germany: Gustav Fischer, 1940.

Carington, W., "The quantitative study of trance personalities," *Proceedings of the Society for Psychical Research*, 1935, *43*, 319–361.

Carpenter, J. C., Unpublished research. See *Journal of Parapsychology*, 1977, *41*, 43–44.

Chari, C. T. K., "The challenge of psi: New horizons of scientific research," *Journal of Parapsychology*, 1974, *38*, 1–15.

Clauser, J. F. and Shimony, A., "Bell's theorem: Experimental tests and implications," *Reports on Progress in Physics*, 1978, *41*, 1881–1927.

Cox, W. E., "Precognition: an analysis, II." *Journal of the American Society for Psychical Research*, 1956, *50*, 99–109.

Dobbs, H. A. C., "Time and extrasensory perception," *Proceedings of the Society for Psychical Research*, 1965, *54*, 249–361.

Ehrenwald, J., *New Dimensions of Deep Analysis: A Study of Telepathy in Interpersonal Relationships*, New York: Grune & Stratton, 1955.

Flournoy, T., *From India to the Planet Mars: A Study of a Case of Somnambulism with Glossolalia*, New Hyde Park, N.Y.: University Books, 1963. Orig. publ. in French in 1900.

Forel, A., *Jour. für Psychol. und Neurol.*, 1918.

French, P. J., *John Dee*, London: Routledge and Kegan Paul, 1972.

Gauld, A., "The 'super-ESP' hypothesis," *Proceedings of the Society for Psychical Research*, 1961, *53*, 226–246.

Hammond, A. L., "A note on telepathic communication," *Proceedings of the Institute of Radio Engineers (IRE)*, 1952, *40*, 605.

Hartman, E. von, *Spiritisms*, London, 1885.

Hodgson, R., "A further record of observations of certain phenomena of trance," *Proceedings of the Society for Psychical Research*, 1898, *13*, 284–582.

Kogan, I. M., "Telepathy, hypotheses and observations," *Radio Eng.*, 1967, *22*, 141.

MacFarland, J. D., " Discrimination shown between experimenters by subjects." *Journal of Parapsychology*, 1938, *2*, 160–170.

Murphy, G. and Ballou, R. O., *William James on Psychical Research*, New York: Viking Press, 1960.

Myers, F. W. H., "The subliminal consciousness," *Proceedings of the Society for Psychical Research*, 1892, *8*, 436–536; 1893, *9*, 1–128.

Ochorowicz, J., *De la Suggestion Mentale*, Paris, 1887.

Podmore, F., *Mediums of the 19th Century*, New Hyde Park, N.Y.: University Books, 1963. Orig. Publ. under Title *Modern Spiritualism*, London: Methuen, 1902.

Rhine, J. B. and Rhine, L. E., "An investigation of a 'mind-reading' horse," *J. Abnorm. Soc. Psychol.*, 1929, *24*, 449–466.

Rhine, L. E., "The relationship of agent and percipient in spontaneous telepathy," *Journal of Parapsychology*, 1956, *20*, 1–32.

Ryzl, M., "A model of parapsychological communication," *Journal of Parapsychology*, 1966, *30*, 18–30.

Salter, W. H., *The Society for Psychical Research: an Outline of its History*, London: Society for Psychical Research, 1948.

Schreiber, F. R., *Sybil*, Chicago, Ill.: Henry Regnery Co., 1973.

Schwarz, B. E., "Telepathic events in a child between 1 and 3½ years of age," *International Journal of Parapsychology*, 1961, *3*, no. 4, 5–52.

Soal, S. G., "A report on some communications received through Mrs. Blanche Cooper," *Proceedings of the Society for Psychical Research*, 1926, *35*, 471–594.

Targ, R., Cole, P., and Puthoff, H. E., *Techniques to Enhance Man/Machine Communication*, Stanford, California: Stanford Research Institute, July, 1974.

Toksvig, S., *Emanuel Swedenborg: Scientist and Mystic*, New Haven: Yale University Press, 1948.

Tyrell, G. N. M., *Apparitions*, London: Duckworth, 1953.

Walker, E. H., "Foundations of paraphysical and parapsychological phenomena," *Proceedings of an International Conference on Quantum Physics and Parapsychology*, New York: Parapsychology Foundation, Inc., 1975, 1–53.

Warcollier, R., *Experimental Telepathy*, New York: Arno Press, 1975. Orig. publ. by Boston Society for Psychic Research in 1938.

Woodruff, J. L., and George, R. W., "Experiments in extrasensory perception," *Journal of Parapsychology*, 1937, *1*, 18–30.

DISCUSSION

BYERS: Do you assume that there is any utility in carving up the world so that we can make a distinction between theological and parapsychological? Are these not questions of how the show works?

NASH: No, but some people have a theological frame of mind and they have to be satisfied as to the scientific viewpoint. I hope not to infringe on their territory.

BYERS: Are you going to allow the world to be carved up into territories like that?

NASH: I don't think it's the province of the scientist to attempt to tell the theologist what he should think. I certainly would resent it if they told us what to say.

ULLMAN: I'm happy to see your comments on the possible hints we may get from these formulations by physicists that might be helpful to us in understanding paranormal phenomena. But wouldn't you say that if you're moving in the direction that postulates this different order of existence—this order of a universal mind or perhaps, in another physicist's (Bohm) terminology, an enfolded order, or an implicate order or a non-manifest order—then, in a sense, the question of communication is irrelevant; that the information is there and is there everywhere.

NASH: Yes, I think, however, we would have that question concerning our own minds; how do we communicate within our own minds? How does one part of our mind communicate with another part? For example, if we can call up a memory which is in one part of our mind into our consciousness, that would be, in a sense, communication. I think if there were one mind, that would answer the problem of communication, in that it would make it seem to be the same problem that occurs in explaining communication within parts of an individual's mind. It would explain communication between different minds because there would be only one mind.

STORM: The problem is with what an observation is and if this is a reasonable picture, then are we observations and if we are, of what mind?

NASH: Well, my concept would extend this theory to the universal mind, which I presume is what you're postulating. You would be an

observation of that mind, but at the same time your mind would be a part of it. I don't think there would be much difference between your mind and the universal mind. I think individual minds are like tips of icebergs protruding from an underlying universal consciousness. So I would not think there would be a need to distinguish what part of the mind is observing what other part.

STORM: Would there be any principles or rules that would restrict what we would anthropomorphically call possible observations?

NASH: I would think not. That would be up to the universal mind. Whatever it dreamed up to observe would be observed and we would call that physical reality.

RUDERFER: When you discussed the collapse of the state vector, you said "No energy is transferred in this process." This is a common error in interpreting what happens. I discussed this with Walker a few years ago at some length, and I insisted that if there was an information transfer there had to be an accompanying energy transfer, and he insisted that there was no physical correlation with this collapse of the state vector. But, he did finally state that there was a physical correlate, and that was that the observer and the receiver had to meet at some time before or after the event. In other words, the world lines of the observer and the receiver had to cross at some time. That's a physical event. Well, as soon as you admit that, of course, then you have to raise the question, "Well, what happens when they meet that affects the observed event?" So, it is not really correct to infer that there is no energy transfer in these interpretations. There is something missing in the quantum theory interpretation which is not yet revealed.

IRWIN: I'd like to comment on your coverage of accounts of ESP in terms of physical or quasi-physical elementary particles. You tend to reject these accounts on the basis that it is not apparent how particles that cannot be stopped by matter (such as a Faraday cage) could be stopped by the percipient's brain. Is it possible that the motion of particles is itself associated with a field-like effect? That is, although the particles are not actually stopped by the brain, might not they produce a field effect upon the brain as they pass through?

NASH: I think that that is a valid suggestion. I conceived of electromagnetic waves as occurring within an electromagnetic field, and in that case, what you're suggesting would be covered by the electromagnetic wave hypothesis.

IRWIN: Well, the field may not be electromagnetic, but certainly some sort of field effect might occur.

NASH: I don't think that there are any known physical fields other than electromagnetic and gravitational. You could postulate gravity, which has been done, as a mechanism for psi mediation.

MORRIS: In your description of a universal mind as an observer, would you feel it would be necessary to have someone else observing the universal mind?

NASH: No, I think that Broad answered that question when it was postulated by J. W. Dunne, who had precognitive dreams which turned out to be true and he felt that he could travel back and forth in space as an observer, but then it was argued that there had to be an observer of the observer in an infinite regress. C. D. Broad, Professor of Philosophy at Cambridge University pointed out that such a regress is not necessary.

MORRIS: But that would have been an argument conducted without reference to the interaction of an observer with the collapse of state vectors, so we'd have to ask whether that argument would apply in this kind of circumstance, because that's really where you're bringing in the observer now.

NASH: In other words, you're saying that there has to be an observer of an observer. I just don't follow that argument. My intuitive inability to follow it is supported philosophically by Broad.

ULLMAN: You make a point about how infrequently conscious, meaningful messages can be transferred by this mechanism. Do you have any idea as to why we have this mechanism in the first place—this psi communication?

NASH: I think it has biological survival value. For example, one might save his life by ESP of events that are taking place around him.

ULLMAN: I agree with you that there is an adaptive purpose somewhere hidden in the picture. The only point I want to make is that psi doesn't seem to be a mechanism for conveying information very clearly or effectively. But it does seem to have an alerting or arousing function of some kind. I think that, perhaps, it does that more effectively than transfer meaningful information.

STORM: On the need for an observer of an observer, in institutional, orthodox Christian tradition as elaborated, say, by Thomas Aquinas, this problem was dealt with by proposing that there was an ultimate observer who was able to observe himself perfectly. He was separated from himself in this act of observation by something which was called the Holy Ghost. The Father was the observer; the Son was the

observed, and the relationship between them was the spirit. I've always resonated to that. It's amazing that this need for an infinite regress into observation was dealt with by Thomas Aquinas and others in the Scholastic period.

BARKER: You cited Louisa Rhine's statement that the percipient always shows some degree of motivation. There's a particular susceptibility to influence him. How does this relate to the observer and the mind? What is the function, then, of this motivation—the activation of psi communication?

NASH: I would say that in that case the percipient would be the observer as the cause of the psi effect; the agent might not be involved at all. The percipient might be reading the agent's mind thereby producing the psi effect. You wouldn't have to have an agent for a paranormal event to take place, and in that case, the percipient would be the observer who collapsed the wave packet and caused the event to occur.

BARKER: One of the most striking features of many of her cases was that the supposed agent was completely oblivious to his role in psi communication, and was doing something completely different from what the percipient was perceiving at the time.

NONVERBAL COMMUNICATION AND ESP

PAUL BYERS

In this paper I will describe the methodological and epistemological history of the study of human communication in general and nonverbal communication in particular. This will be important to psi research, I believe, because the limitations of our earlier approach to the study of human communication eliminated much of the total spectrum of human interpersonal phenomena, including ESP. More recent approaches to the study of human communication, particularly nonverbal communication, show promise of including ESP and other psi phenomena in their scientific domain.

That part of the scientific world concerned with human behavior and particularly human relations is changing rapidly. We are moving away from our attachments to our own preconceptions about how humans work and are moving toward a more unbiased study of how nature works.

First, then, I will describe the older view of human communication and the limitations this imposed on our research domain. Then I will show how research in ESP in particular and psi phenomena in general has suffered from this limited research view. Then I will describe another research stance—one that has evolved particularly in nonverbal communication research—which enables us to embrace all natural phenomena. And lastly I will consider the implications of this new view of man and of research. Accepting the existence of psi phenomena will inevitably imply accepting a radical, wholistic shift in our view of almost everything.

In the beginning the study of communication was the study of messages. There were individuals who created or originated messages. There was some form of encoding messages, usually into language. There was the transmission of messages by speech or some medium such as newspapers, movies, television. Eventually the message was received by someone who decoded (derived meaning from) the message. And, lastly, the message had some effect on the receivers. Not surprisingly, this paradigm was the same as that used by the industry

which designed the technology for the wire or wireless transmission of information. Information was organized energy. Claude Shannon, a scientist at Bell Labs, and Warren Weaver, a social scientist, collaborated to produce a document[1] which described the fundamental paradigm for both technological and human communication. This has also been the basic paradigm for ESP research.

There are two beliefs underlying this approach to the study of communication. First is the overwhelming importance of language as the basic encoding form of messages. Language is our most valued capacity which distinguishes us from all other forms of life. The ability to speak, read and write has enabled us to create a vast civilization with a history. We evaluate each other on the basis of our language proficiency. We are pleased when our children speak early and we hope they will learn to read as early as possible. Reading scores of students are the single most important popular success index of a school. Our personalities and much of our status as humans seem to be derived from our language—our message generating—proficiency. We are scarcely distinguishable from our language messages.

With this popular and even scientific view of language messages, it is not surprising that there has been enormous popular and scientific rejection of any communication system without an observable transmission system—ESP. In the prevailing scheme of human affairs, this would be cheating at least and potentially dangerous and manipulative at worst.

The second assumption or belief inherent in the communication paradigm I have described is that each person is an individual related to each other individual primarily through his messages. Animals affect each other solely through actions, but humans speak or write to each other. There has been, admittedly, some ambivalence here. The pen is mightier than the sword on one hand. But actions speak louder than words on the other. In either event we believe that we do things to each other by means of our messages. Messages are causes which have effects. Communication study simply borrowed the Newtonian paradigm. If there were those who wanted to look outside the constraints of this Newtonian cause-effect paradigm, they were simply out of luck because they had neither a methodology nor an acceptable logic to work with. Science cannot be blamed for refusing to accept a piece of the human puzzle when there is no way to fit the piece into the existing scheme of puzzle-solving. Only the non-scientist can accept an idea through illogical belief or faith.

The multi-disciplinary interest in human relations sprouted the

sub-discipline called communication. And that sub-discipline, in turn, eventually sprouted a sub-sub-discipline called nonverbal communication. This began a search for new methodologies, since we were now foraging for knowledge of human affairs without the security and direction of our belief in the predominant language base of messages. We still clung to the cause-effect paradigm, however, and we began to look for nonverbal messages and their effects. We tried to hang on to our familiar methodologies by talking of nonverbal language and of breaking the nonverbal code. But the most formidable problem to arise was that of trying to extract meaning (messages must have meaning) from nonverbal behavior. The meaning of messages was seen as the essential effector in communication process. Korzybski had already pointed out that human relations were confused to the extent that the language meanings which sender and receiver perceived in a message were not identical.

Perhaps the first significant breakthrough in the study of nonverbal communication came when Ray Birdwhistell, working with Margaret Mead, Gregory Bateson and others, offered the concept and methodology of kinesics,[2] the systematic study of body motion, facial expression and gesture. Birdwhistell did not look for meaning in nonverbal messages, nor did he separate verbal from nonverbal communication. Communication, he said, was a process that had a structure which could be found only by examining both or all participants in the communication process as a single unit. Communication was now a matter of dynamic relationships rather than cause-effect events. At last communication research had begun to escape the confines of the Newtonian cause-effect paradigm and language was no longer the predominant mode of information transmission or exchange. At first, Birdwhistell was regarded by many in the communication research enterprise as a curious or fascinating, but not entirely scientific, innovator. He had begun to work in terms of a new paradigm. Atlhough he did not personally reject ESP and other human sensitivities that were still outside a strict scientific domain, his research interests remained confined, to my knowledge, to the human expression and management of information that was bounded by genetic inheritance on one hand and learning on the other.

Birdwhistell and his associates, by opening the door to a new paradigm for the study of human communication, gave his students and followers (of which I was one) new scientific territory to explore. In my view, the inevitable trajectory of this research direction is toward a full understanding of the human's capacities, which will include those phenomena which we have been calling psi.

I will, later in this paper, discuss more fully the dimensions of the newer paradigm in nonverbal communication research and some of the data that have emerged and something of the strategies for handling those data. But first I want to point out that there is still a great division in the study of nonverbal communication. Most workers still adhere to a focus on messages and, essentially, a cause-effect view of the world. It has been difficult for many to understand that the human, individually or collectively, is not the ultimate concern of our scientific curiosity, but that the human exists in a matrix of relationships, in some larger-than-human whole, which is becoming available for study if, at the moment, only inferentially.

ESP research has, unfortunately, suffered the consequences of the earlier inappropriate research paradigm. The central focus, in both ESP research and in communication research, has been the message which is seen as transmitted between a sender and a receiver. The consequence, both for ESP research and communication research, has been that, instead of studying "how nature works," we were preoccupied with the futile effort to prove that "how man thinks that nature works" was correct. J. B. Rhine spent much of his life trying to prove (or disprove) the existence or reality of the ESP process. But, looking back, he actually demonstrated that the prevailing conception of this communication form was incorrect.

I want, now, to describe and discuss the research paradigm that is emerging in nonverbal communication and which, I predict, will enable us to embrace ESP as a communication form. One way to begin this would be to trace the evolution of the ideas involved, citing the persons who contributed significant pieces. But for the present purposes I will, first, cite a number of data-observations which, when set alongside each other, have simply required new research formulations. Then, since these new formulations imply a shift in what we call reality, I will describe the stance again in terms of the nature of that reality.

Daniel Stern, a research psychiatrist studying mother-infant interaction, found that when, during play, the infant locked into eye-contact with his mother, his amount and rate of movement (arousal state) increased and that when this arousal approached (apparent) overload, the infant winced and looked away and his arousal state decreased until the procedure was repeated. Stern says, "The goal of play activity is the mutual regulation of stimulation so as to maintain an optimal level of arousal which is affectively positive."[3]

I cite this to illustrate that a simple act has significance on multiple levels of analysis or understanding. The mother and infant are

"playing." On another level they are reinforcing mother-child bonding. And on still another they are mutually regulating their individual and joint arousal. A cause-effect explanation would be trivial. Neither, at the bio-social level, is doing anything to the other. The process is shared. No information, in the usual sense, is being transmitted or exchanged, but some form of heightened energy is shared. The process involves communication, but there are no messages.

If a person is wired to a galvanic skin response biofeedback machine which measures skin conductivity (which is a function of arousal or anxiety), his arousal will almost invariably increase when he makes eye-contact with another person. Similarly, almost anyone can experience an increase in his own arousal if he deliberately prolongs eye contact with another person. We do not understand why eye contact works this way (nor do we understand why it sometimes does not). But in our new research paradigm we do not ask "why" questions, we ask only how it works. Again we have a communication involvement without messages and without anyone doing anything to another. We are required by these eye-contact data to recognize that, underlying our popular cause-effect interpretations, there are determined biological processes at work. We can impose our message and our cause-effect interpretations on one level of explanation, but this is scientifically trivial until we recognize how nature is working at deeper levels.

I have a piece of film in which a woman is seen to cross her legs and a man nearby is seen to shift his gaze to her legs. It was not staged. My classes almost invariably report that the man looks because the woman crossed her legs. They impose a cause-effect explanation on the events and, simultaneously, imply a time sequencing. But when the film is viewed frame-by-frame it is apparent that the single frame (i.e. 1/16 second) on which the leg begins to cross is the same frame in which the man's head begins to turn to look at it. Anyone who has looked carefully (i.e., frame-by-frame on film) at human interaction recognizes that the actual organization of interpersonal events often does not conform to our popular conception of human relations.

In my own research[4] I have found that people carry out tasks at rates of movement that are appropriate to the task, but that when two or more people are in communication, talking or just being together, their onsets of body movement and the motor onsets of the intercostal muscles producing speech syllables fall on a shared rhythm train. The rhythm train is always, basically, a 10 cycles-per-second rhythm and the interactants are phase locked. A syllable never follows the preceding syllable until a minimum .2 second has elapsed, but the onset of the

second syllable may follow the onset of the preceding one at intervals of .2, .3, .4 second or other beats of the underlying 10 cycles-per-second train. One simply cannot have a comfortable conversation or interaction with another without sharing this underlying rhythm. The details of this research may be found elsewhere, but the implication from this and other research is that all humans (and higher mammals) have an underlying biological capacity to "get it together." By using psychophysiological instruments, one can demonstrate that synchrony between or among people moves them toward what they perceive as comfortable involvements or states and that the absence of this synchrony or rhythm-sharing is sensed as uncomfortable.

There is a cultural group in South America who have a practice that demonstrates one unexpected way this rhythm-sharing phenomenon can work. The Yanomamo are called by their ethnographer The Fierce People.[5] It is their cultural style to behave arrogantly, aggressively, threateningly. When they come together to talk, even on some ceremonious occasions, they are expected to display their fierceness, but avoid conflict. Many careful tape recordings have been made of this group and from these it is possible to hear what, impressionistically, sounds like an aggressive screaming match. But when the talk is carefully measured, it is found that each speaker begins his burst of shouting precisely one tenth of a second after the other's speech onset. They shout about three syllables in a burst or set and then start over.[6] The result is a fast moving speech dance that is incredibly accurately timed. This precision of interpersonal synchrony precludes anger or bad feeling, in my judgement and, indeed, the ethnographer reports that this kind of talk is likely to emerge whenever a conversation begins to get overheated.

Another example: Manfred Clynes, who has developed the science of sentics,[7] has discovered that humans around the world have a capacity to express a certain finite range of emotions precisely and nonverbally. Clynes asks his subjects to rest a finger on a piano-key-like apparatus and to express anger, joy, love or other emotions by pressing the key. He can measure the time and space dimensions of the pressure accurately and has found that people around the world express the same emotions in the same way. He believes from this and other research concerning brain function, that humans have identical "essentic shapes" genetically programmed in their brains and that this universal repertoire of feeling or emotion, unless it is contaminated by some interference, enables all humans to express their feelings (states) with great precision and to perceive the expressions of others with equal precision. While Clynes has studied finger-pressure expressions

for convenience and replicability, he assumes that these specific time-space configurations are expressed and perceived in human touching, music, art, architecture, etc. Again, our folk notion of the uniqueness of each individual is subject to the qualification that there is an underlying universality and that the communication of emotion takes place through biologically determined processes that are well below the threshold of easy awareness.

The five examples of nonverbal communication and research—and the verbal example from the Yanomamo—are but a small sample of current communication research using a paradigm that is radically different from the older one.

The first significant difference in the paradigms can be understood as a matter of levels of organization—of communication, of behavior and of the entire cosmos. Only some levels are available to human perception, research, or even human comprehension. In the Stern research on mothers and infants there is one level on which we perceive play. Play is commonly and non-scientifically defined as simply some activity which is fun. It has no deep purpose beyond enjoyment. At this level we are dealing only with commonly shared descriptions which have no definitions. Much of our daily lives is lived and perceived according to such invented and preferred folk logic that has only minimal relationship to the way nature works. Now we have begun to study human events and relationships in terms of another logic. Stern can talk about play on one level while discovering an underlying natural process ("the mutual regulation of stimulation . . .") on another level.

The same event, examined on two levels, may even seem contradictory. The Yanomamo shout obscenities on one level, but carry this out in a way that ensures peace and cooperation on another. When we study ESP or other psi phenomena in terms of our folk conceptions of communication, we simply cannot understand the process. But as we penetrate deep enough into the natural workings of information sharing, which is a prerequisite for survival, we will recognize that it is not ESP or other psi phenomena which are rare or incredible, it is our own preference for an untenable mythology about the human relationship to his larger natural contexts that had been the problem.

Karl Pribram, who has spoken at these meetings, points out that the only natural reality is vibration or frequencies. The external world reaches us through vibration or frequency—light, sound, heat, and other forms that we have only begun to recognize. Our human brain receives vibrations or impulses from its neural receptors and translates

these into the material reality we then believe we perceive. Reality in the form we recognize is constructed in our heads with time and space dimensions which have no counterparts in the primary reality of frequency or vibration. And in this model ESP becomes easy to understand. All the available energy or information is out there all the time without our limitation of time and space and he who can, by circumstances we only dimly recognize, escape or bypass the interfering education of his brain can share the information.

We have, for reasons that I am not inclined to explore, believed that human relations are carried out by communication which is the transmission of isolatable messages from one person to another. But we cannot disprove an opposite view: that all human relations and human-environment relations proceed by some ESP process and are, immediately after the fact, reported to our awareness in a form that allows us to infer that our acts were individually purposive. There are quite respectable scientists who suggest that all human purposive thought is after the fact of our behavior, not before it, and that our thinking is simply a kind of news report of what has already happened.

I submit that we are free to choose which view to take. The view that we think about and "cause" our own behavior, has severe limitations—one of which is that we cannot resolve the matter of ESP in that popular paradigm. The second view bypasses our human preconceptions and opens up the natural world for investigation.

Hominidization, that point in human evolution where we locate the beginning of conscious thinking, enabled us to live in a theater of our own design. Because, perhaps, we are a recently evolved species, our life-theater simply isn't good enough for our continued survival. We have believed and carried on much of our scientific research within the frame of our arbitrarily constructed reality. We have studied our own theater and how it works. And we have mistaken that for natural reality.

As Gregory Bateson has written: "Insofar as we are a mental process, to that same extent we must expect the natural world to show similar characteristics of mentality."[8]

When we have transformed ourselves such that we can understand the natural workings of ESP, we will then automatically share its possibilities.

BIBLIOGRAPHY

1. Shannon, C. E. and Weaver, W., *The Mathematical Theory of Communication*, University of Illinois Press, Urbana, 1949.
2. Birdwhistell, R. L., *Kinesics and Context*, University of Pennsylvania Press, Philadelphia, 1970.

3. Stern, D. N., "Mother and infant at play: The dyadic interaction involving facial, vocal, and gaze behavior," in M. Lewis and L. Rosenblum (eds.), *The Effect of the Infant on its Caregiver*, (The Origins of Behavior series, Vol. 1) Wiley, New York, 1974.
4. Byers, P., "Biological rhythms as information channels in communication behavior," in P. P. G. Bateson and Peter H. Klopfer (eds.), *Perspectives in Ethology, Volume 2*, Plenum Press, New York, 1976.
5. Chagnon, N. A., *Yanomamo: The Fierce People*, Holt, Rinehart, and Winston, New York, 1968.
6. This analysis of the Yanomamo tapes was carried out by Paul Byers and reported in Byers, *op, cit.*
7. Clynes, M., *Sentics, the Touch of Emotions*, Doubleday, New York, 1977.
8. Bateson, G., *Mind and Nature, A Necessary Unity*, E. P. Dutton, New York, 1979.

DISCUSSION

NASH: Dr. Byers, would you consider movements through a school of fish or through a flock of birds nonverbal communication? And if so, would you consider it to be non-causal? And then my second question is, do you think one-sixteenth of a second frame is sufficiently long to establish that the woman's leg did not move before the man's eyes?

BYERS: Well, in order to answer your first question, I will have to rephrase it to: am I willing to ascribe the label of nonverbal communication to this or that—and anyone can put any labels he likes. I don't like them. I'm interested in finding out how behavior is organized within one person or within a group, including schools of fish. We can go to ninety-six frames a second rather than a sixteenth. What the data show on the film is that within a sixteenth of a second, they're together. Beyond that, I can't say. We don't believe that within a sixteenth of a second would represent response time.

MORRIS: When I was at U.C. Santa Barbara, a fellow in the music department, Stephan Krayk, talked about the practicing procedure that he and the other three members of his string quartet used. They would spend a certain amount of time practicing face to face on a new piece, and then would do their final rehearsals by each going to a separate corner of the room, facing away from the others and then playing. They would consider themselves ready for their performance when they could conduct their business totally removing cues from each other in that way. And since you said you'd been a musician yourself, I wonder if you find additional parallels of this sort of sharing of communication in terms of shared musical performance either just privately or on stage.

BYERS: Yes. I believe that there are a great many activities that we call sport or art or one thing or another which, at the appropriate level, are actually exercises in synchronization. I don't understand why they did that particular thing in that way; maybe it had some value. But I would consider perhaps the highest form of communication the string quartet or the jazz improvization group who follow the same beat very closely, although each in terms of his own personality may bend it this way and that, but never lose it. Then we have that form of human group interaction which is saying to everybody, "I am closely in tune with the group and being entirely my own individual self at the same time." That's very difficult to carry out in real life, so that we go to jazz concerts, we play music, we sing in choirs, we walk down the street together, we sit in classes, we sit in meetings like this with one or another form of visible synchronization, which reminds us where we are and who we are in relation to each other, even though we pretend that we're paying attention to the content.

RUDERFER: In your talk, you mention communication where there was a lag of exactly 0.1 seconds, by which I presume it was distributed around a mean of 0.1 seconds, and this is the case of the two men shouting at each other. This 0.1 seconds is a very interesting number because it represents the refractory period of a neuron very closely. If we use that as a model, a particular number of neurons which are turned on as an expression of an emotion, which, of course, would be changing all the time—this would indicate that the end of the first person's momentary emotion within that 0.1 second, was picked up by the other person, which allows the model of some form of communication between the brains of the two. I mean, direct communication between the neurons of the two if these numbers are correct and accurate. So that indicates that perhaps your model of nonverbal communication is just that—a form of unobservable communication between the neurons and brains.

BYERS: I think careful research on this shows some variation, first of all, since there's nothing so mechanical in humans and it would come out at a fraction that had a decimal point with a lot of numbers. But I believe, although we haven't the empirical evidence yet (it shouldn't be difficult to get), what we're talking about is the alpha rate. I have a film of Eskimos doing nothing but standing around and what movements they do make are all falling on a rhythm train. In this case, one tenth of a second would be very fast to move, so the visible train is about four-tenths. This is also a standard military march rate; it's also an even octave of heart rate at rest. I believe there is a lot of human activity, that this is not just a communication phenomena and that it does as you say,

represent neurological activity. People become mutually entrained and if you like to think of it as neurons linked, I think of it as being an artifact of our culture—that we think of humans as individuals and I prefer the Asian model in which the fingers of a hand are individual and yet they're part of one thing. That the human species and probably other life is part of one whole and that from time to time we invoke that whole, and at other times we stress the individuality of the parts. I don't disagree with you. I think that's a reasonable interpretation.

RUDERFER: The only reason I brought it up is because if that interpretation also fits the facts, then you have two possible interpretations, and the second one is exactly what is required for ESP communication. It differs, it seems to me, from what you said before—that you didn't believe it was essentially an ESP mode of communication.

BYERS: This is partly a matter of language. You see, while I'm not addressing ESP directly, I'm presenting evidence that covers ESP, and what I intended to say is I'm not inclined to do the labeling. That here's the evidence, here's what we're doing, and this is so close that I think it's the same thing, but I don't want to carve it out and say, "Ah, ha—this is ESP." That's just the observable relationship.

BARKER: I'm not entirely sure that I understand exactly what you're saying, so if you'll forgive me, I'll ask it as a question and check up with you. What I understand you're saying is that people can get it together in the presence of a very wide range of sensory cues which have biological indices which are measureable. Presumably, if I understand you correctly, the same kind of thing is happening in the absence of any kind of sensory cues when what we call ESP occurs. Is that correct? Is that what you're saying?

BYERS: Well, yes, but I would amend that slightly. I don't really believe that we have yet had the wisdom to look at all the phenomena that are involved in human relations. I mean, neither Dan Stern nor I have any explanation whatever of why eye contact produces what it does. I can easily demonstrate that in almost all instances when two people make eye contact, their arousal state as measured by GSR goes up. I have no idea what's happening. That is, I believe there are processes involved in the wave kinds of things that may very well be in there. There has been work done on biological effects of small ions and types of electrical activity beyound those which we understand at the moment, even though we have instruments that will measure the contrasts.

BARKER: Are you suggesting that there is some kind of psychobiological phase lock which occurs between two individuals in the absence of sensory cuing, that occurs simultaneously with ESP?

BYERS: Well, yes. But what I intended to say there too is I don't think we know what the full range of sensory cuing is. We only know that which we have been able to say we see and label. One of the reasons I don't like the expression ESP is that it implies extrasensory. Now I don't believe the world is carved up into sensory and extrasensory. It's only *we* who are carving it up that way, but we can't see that with our current lenses in technology. I think when we get on the other side of that, we'll drop the "para" in paranormal, the "E" of ESP and understand how the show works. It's our inability to see this, and it's our, in a sense, inappropriate, unnatural way of carving up the world that has given rise to these strange labels like "normal," "paranormal," "ESP," and "SP," and it's all part of one show. We have gotten muddled in the process of trying to figure it out.

STORM: I have two questions and they're both asking for counsel and advice. One is, why have we gotten muddled? While I have some ideas myself, I'd like to know what you think. And the other is, I've read off and on about entrainment and I've never been impressed with the idea until now. I want to know what can I do in my daily life and what can I do as a teacher in particular so that I can capitalize on this entrainment process?

BYERS: Well, I give my classes lists of exercises to achieve just that. First of all, to become aware that rhythms exist, that they exist between people. To sense just by the experience of watching whether they feel good or bad internally about their relations to rhythms, so that they become sensitive to them. I would maintain that the teachers of small children should be assessed and hired on the basis of their capacity to adapt to the range of rhythms of other people, rather than knowledge of curriculum materials. And I would consider that our biggest problem in the area at the moment is devising ways of becoming clearer about how we sensitize people to their rhythms. How do we devise exercises which will make them more aware. Because that's what human relations at this lower level is all about. We're just beginning to look at groups and beginning to look at film which can be slowed down and seen at a slower speed. It will, indeed, also help to meditate.

STORM: I smell a little threat of control as of *1984* as we become more and more adept at managing entrainment. Do you?

BYERS: No. That's not unfamiliar to me. I worried about that at one time. You see, I do recognize that Hitler used entrainment to great success in his enterprise in marching. So did the peace marchers in Washington. There's no content involved. This is a human mechanism. If our consciousness is such that we want to control and do each other in, sure, this is a tool. Same as a knife, you can use if for good or harm. But I believe that as we become more aware of that, at the same time we will be less inclined to use it destructively, although there are always those who do. On the plane yesterday, I read two things in *Brain/Mind Bulletin*. One in which Willis Harman, a social policy analyst at Stanford Research Institute, said science is a cultural artifact, a partial look at partial reality. The other one was in a book called *Cognitive Psychology and Information Processing: An Introduction*, by Roy and Janet Lachman and Earl Butterfield. A quote from that is, "Joseph Weitzenbaum has recently gone so far as to conclude that all scientific claims, even those based directly on mathematics and formal logic, are fundamentally acts of persuasion. This conclusion may sit badly with some of our colleagues. However, it is consistent with some well thought out views of the scientific enterprise. We cannot but agree with the conclusion."

ULLMAN: I think a good many parapsychologists are just as uncomfortable with the terminology as you are. They don't like words like "paranormal," and even "parapsychology," and come up with neutral terms for something we don't yet understand. Of course, the investigators in the Soviet Union, no longer able to sweep the data under an idealogical rug, advocate what I think is a very wise course. Let's look at all our disciplines in terms of the existing mysteries and see how psi fits in. Perhaps from a historical point of view, parapsychologists at first had to say we're different, but the time has come to say we're no different and move on from there. The other comment was that when you spoke about being in tune with a group and being yourself at the same time, you were really giving a definition of healing, psychotherapy, and emotional growth.

IRWIN: Given some participants in a standard extrasensory testing situation, what type of indices would you envisage being used to test your interpretation?

BYERS: Well, I'm not inclined to take people into a lab—poke, prod, or do other kinds of experimental things with them. I've run into too much research in which one has made observations of the naturally occurring phenomena that the psychologist has taken into the lab and said, "Ah, ha, it doesn't work." One of the best examples of that is the

tenth of a second cycle that's the basic underlying rhythm; most behavior cannot occur within tenths of a second. This has been taken into the lab and they have come up with seven cycles per second as more common—so that some writers have said, there is a variation between seven and ten. What I have found is that when people are in communication, the invariable observable rhythm that can be derived from film is based on an underlying one, two, four-tenths of a second—the octave relationships there. But when people *perform*, such as radio announcers, newscasters, that does not show one-tenth of a second. What happens when you go into the lab and ask people to do something in what amounts to a non-natural situation, you get results which are almost guaranteed to confuse the natural observations.

IRWIN: Can you imagine a natural situation occurring in which such a test could be made?

BYERS: Film any dyadic or group interaction and start looking at onsets of movement.

IRWIN: I was talking in terms of testing your interpretation of ESP.

BYERS: Oh, I haven't considered it in terms of ESP. My concern has only been how the behavior is organized and finding that in communication, sharing is a better concept than exchange of messages. I extrapolate that to ESP and suggest that what we're doing is sharing, not information, but as Monte Ullman suggested earlier, feeling states.

EXPERIMENTER EFFECTS IN BEHAVIORAL RESEARCH AND THEIR IMPLICATIONS FOR RESEARCH ON NONVERBAL COMMUNICATION

ROBERT ROSENTHAL

For twenty-three years now I've been studying the behavior of people who study behavior, working basically on the social psychology of the psychological experiment. My special interest in the psychological experiment has been in the operation of experimenter expectancy effects. That's the phenomenon whereby experimenters tend to get the results they expect to get, not because they're so terribly clever about anticipating what nature is really like, but simply because they do expect it.

I've also been very much interested in the operation of teacher expectancy effects—the phenomenon whereby teachers get the results they expect from their pupils simply because they expect those performances from their pupils. My colleague, Don Rubin, who has the Chair of the Department of Statistics at the Educational Testing Service in Princeton, and I have recently finished a quantitative review of 345 experiments of interpersonal expectancy effects for the new journal, *The Behavioral and Brain Sciences*.

What we found was that the estimated average size of the effect of teacher expectations and experimenter expectations was very substantial in magnitude, about .7 of a standard deviation. A standard deviation is a unit of dispersion or variability to give you a handle. Most of you are familiar with IQ tests, so if you haven't heard of standard deviation, you intuit that 100 is the average IQ and 115 or 120 is one standard deviation above the mean. So in terms of IQ units, two-thirds of a standard deviation would be maybe 10 IQ points or maybe thirteen IQ points, depending on the particular IQ test. But that's just to give you a feel for it, what we call the magnitude of the effect. Gene Glass, incidentally, found in his review of the psychotherapy literature an effect size somewhat similar to the one that we had found in our review of the interpersonal expectancy literature.

Now, you may fairly ask, what does this stuff on effect sizes have to do with parapsychology? Quite a lot, actually, as I rediscovered from a very instructive luncheon chat with Monte Ullman. I think that lots of failures to replicate psi phenomena are not failures to "get the effect," but basically failure to employ sufficient statistical power. Lots of new studies have been proposed here. I'm very dissatisfied with the use that has already been made of all the studies that have already been done. That's not a failing of parapsychology per se; I'm just as unhappy with all the experiments that have been done in the hundreds of areas of psychology and sociology as well. We have conducted thousands of experiments and keep coming to the conclusion that we don't know anything. There's a growing literature in the area of research methodology which teaches something about how to combine and how to organize the results of experiments that have been done. I think the employment of some of these techniques would be very salutory to parapsychology, as it would be to the other behavioral sciences. I do have to confess that one of my own recent research interests has been how to combine probabilities and how to summarize domains of research.

Back to the data. Of those 345 experiments, a very sizeable subset was designed and conducted in such a way that it would be very hard to figure out how experimenters communicated with their research subjects as to what they wanted them to do, or how teachers communicated to their pupils in some standard micro-teaching situations what their expectations had been for these pupils' performance, without invoking some kind of unusual subtle communication process—whether you want to call it ESP or nonverbal cuing it doesn't matter—but it was, in any case, a fairly subtle phenomenon. Let me quickly review some of the evidence that led us to conclude that it was a fairly subtle phenomenon.

One of the tasks that we have often used in our own experiments on interpersonal self-fulfilling prophesies has been to show photographs of faces to research subjects. These faces are held up for the research subjects by experimenters whom we have employed. Half the time these experimenters think these faces they're showing are faces of people who have experienced success and half the time they think they're faces of people who have experienced failure. However, they're always the same photographs. And it turns out that if the experimenters think that they are showing photographs of successful people, they tend to get those photographs judged to be of more successful people by their research subjects than if they believe that these photographs are of unsuccessful people. Or, in a Rorschach situation, if they have

been led to expect that their patients or their clients or their testees are people who tend to see a lot of animal movement patterns in the inkblots, they will get more animal movement responses from their research subjects than will those who don't. This is the kind of experimental evidence that goes to make up the 345 experiments that I've been talking about.

In the photo rating task, for example, every experimenter reads the same instructions to every subject, so it's hard to know how he communicates the expectancy unless it be by nonverbal or ESP type cues. If you put screens between experimenters and subjects, you do tend somewhat to decrease the magnitude of the phenomenon of expectancy effect, but it doesn't go away, so there's some visual effect.

In Winnipeg, in the laboratory of John Adair in collaboration with Joyce Epstein, they did the following brilliant, extraordinary experiment.

They conducted the basic photo rating study. Experimenters were led to expect that their research subjects were going to rate the photos as being of successful people. Other experimenters were led to expect failure ratings from their subjects. The results they obtained were in line with those that had been obtained before. That was Stage I.

Stage II was the following: Unbeknownst to experimenters in Stage I, all of their readings of the instructions (and they all read the same instructions to those subjects of Experiment I) had been tape-recorded. Experiment II involved a whole new group of research subjects who were brought in to be "run." These subjects were brought in, but they were not "run" by experimenters at all. Indeed, there were no experimenters. All there were were spoors and traces of experimenters, namely, the tape-recordings that had been made in Study I of them reading instructions to those other subjects. You have new subjects coming in. The secretary in the psychology department tells them to walk down the hall; there are signs in the hall that tell them "turn left," and they turn left—"open door"—they open door—"proceed to tape-recorder," they proceed to tape recorder. "Push a button" (there's a sign that says "button") so they push the button and each of the thirty subjects hears what one of the thirty subjects in the first experiment heard. Precisely that and nothing else! So now what we have is the audio portion of Experiment I, which is now conducting Experiment II.

What Adair predicted was a loss of statistical significance of the expectancy phenomenon, but maybe still a trend in the right direction, because, after all, the tone of voice would be important. And although you have lost all the video non-verbal cues, at least the audio is still

there. The results were quite shocking. Adair and Epstein found they had just as large an effect of experimenter expectations when there was *no* experimenter, i.e., just the spoors and traces. The audio tape had produced just as significant an effect for this new bunch of research subjects, as the experimenters' expectations had for the original group of subjects. They had a kind of bottled interpersonal self-fulfilling prophecy on these audio tapes. It was all there. How they read the instructions was what turned the trick. Other experiments have been done to show the importance of nonverbal communication in this process of mediating interpersonal self-fulfilling prophecies.

Not only human subjects have been found effective recipients of these interpersonal self-fulfilling prophecies, but animals as well. Bertrand Russell, in 1927, intuited something about how animal subjects in laboratories might be affected by the caretakers, the laboratory directors, the psychologists and the ethologists with whom they come in contact. Russell said, "Animals studied by Americans rush about frantically with an incredible display of hustle and pep; whereas animals observed by Germans sit still and think, and at last evolve the solution out of their inner consciousness."

We did some experiments with animal subjects as well. We arbitrarily labeled half of our animals as "maze-bright," and half of them as "maze-dull." We found to our surprise that experimenters expecting rats to perform well got smarter rats, even though the same rats had been assigned at random to those expecting good and poor performance. The performance that they expected was the performance that they got.

Throughout much of this research on interpersonal self-fulfilling prophecies, we made movies. Some of this work was in the late fifties and early sixties, long before video-tape was in general use, so we started with film.

As experimenters interacted with their research subjects, say in the photo-rating task, we made sound/motion pictures of the interaction and then we had observers code the behavior, making relative judgments of what was going on in the interaction between the experimenters and subjects. We found, for example, that male experimenters conducted a more friendly experiment than did female experimenters, and that female subjects elicited different behavior from their experimenters than did male subjects. For example, only twelve percent of experimenters ever smile at a male subject when they conduct these perfectly standard psychological experiments. However, seventy percent of the experimenters smile at female subjects.

How long does it take to read these perfectly standard instructions?

We found that it mattered whether you were male or female. For example, if you were a male reading instructions to a female subject, it took you longer to read them than if you were reading them to another male. Or if you were a female experimenter reading instructions to a male, it took you longer to read them than if you were reading them to another female (all the experimenters' subjects were about the same age), thus, opposite sex dyads lasted longer in the conduct of these "perfectly standard" psychological experiments.

One of the nice things, from the point of view of nonverbal communication research, that you can do when you have the sound/motion pictures is that you can split off the channels of information—audio from video. You get one group of listeners just to listen to the sound track. They never see what happened. You get another group that watches the silent film and never hears what happened. Then you get a third group that has both the sound and the video portion. Ratings based on these different channels taught us a number of things.

For instance, male experimenters were friendlier to female subjects than to male subjects, both in tone of voice and in movement patterns. Not a big surprise. Female experimenters were more interesting. When they were interacting with female subjects, they were judged as quite friendly in movement patterns. They decreased interpersonal distance, they leaned over close. They were judged not very friendly, though, in tone of voice. When the same female experimenters were conducting experiments with male subjects, they were judged not so friendly in the video portion—that is, they didn't decrease interpersonal distance particularly—but were judged very friendly in tone of voice. So it appears that the sexes may have different things to say to each other in different channels of communication.

Nonverbal communication is very subtle. Much of the work that we have done has been in laboratories. But some of the work has been in schools, in clinics and in hospitals. One of our earlier ventures into the hospital setting was an attempt to understand something about the outcome of treatment of alcoholics as a function of nonverbal cues that doctors might give the alcoholic patients when they first come in contact with them.

We had available a series of nine interviews with doctors, each of whom had been in charge of the emergency admissions ward of a large, urban, high-quality hospital. A lot of alcoholics go through those doors in the emergency ward. They had a new treatment center for alcoholics which had been established right there in the hospital. For each of the nine doctors, we had a success rate—what proportion of the alcoholic

patients could he get to go into treatment? Some of the doctors were very good at getting their alcoholics to go to treatment and others weren't very good at all.

From each of the nine interviews, we clipped out a one-minute taped portion of their answer to the question: "What's been your experience with alcoholics?" We took this one-minute tape clip, and ran it through a low pass band filter that removed the frequencies above 500 hertz. What's left sounds like conversation heard through a closed door or a heavy curtain. You can certainly tell it's human speech. Though you can make out an occasional fraction of a word, you can't really understand what's being said. But you can certainly get the tone of voice. Content-filtered tapes were made from the original one-minute tape clips where you can hear what was said. They were then played for undergraduate students who made ratings of the degree of hostility in the doctor's voice. There's a point six correlation here: the greater the degree of hostility in the doctor's tone of voice in talking about alcoholics, the more successful the doctor had been in getting alcoholics to go into treatment. Point six is a very, very substantial correlation in behavioral science research. Not very high in physics or engineering or even in economics, but it's very high for most of the behavioral sciences. That was a very dramatic result, and it's one of the factors that led us to develop the PONS test—the Profile of Nonverbal Sensitivity.

The Profile of Nonverbal Sensitivity is a test that measures sensitivity to cues in eleven different channels of nonverbal communication (see Figure 1). For background, let me go back to the doctor's voice study because the two things that will be new to you are "CF" and "RS"—Content Filtered and Randomized Spliced Speech, so before I go into details of the PONS test, I'd better tell you something about both of those.

In Content Filtered Speech you just knock out the high frequenices. I'm going to play you some excerpts of some ordinary English statements that were made in four different affect quadrants. There will be a statement by a female and by a male made in a positive-submissive way; another in a positive-dominant way; another in a negative-submissive way and another in a negative-dominant way. So there are these four kinds of affects. Now, I'm going to play the content-filtered part and see if you can understand the words and then see if you can easily detect what the affect is. Then, after I've played the content-filtered speech for you, I'll play you the same four excerpts randomly spliced. Randomized splicing is an alternative way of getting rid of the content if you're a nonverbalist and want to study tone of

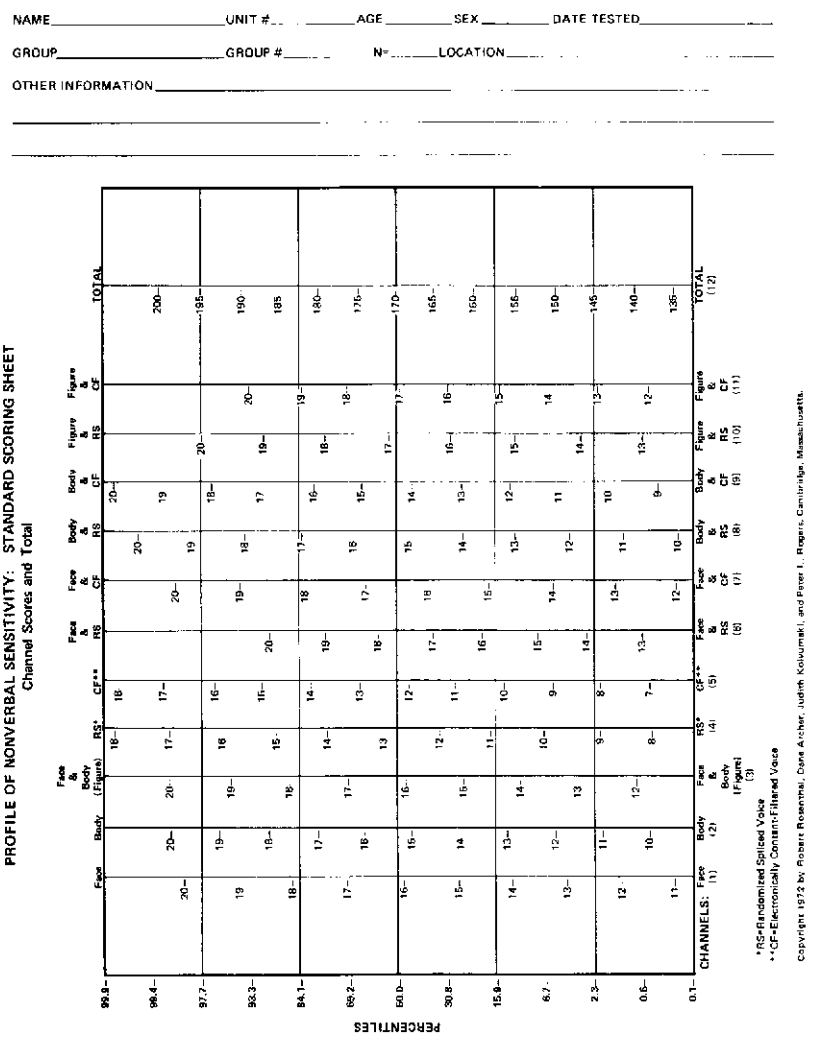


Figure 1

voice. You've got to get rid of the content for some purposes because the world doesn't come in standard speech. If you want to compare the sincerity of presidential candidates, a good way to do that is to remove the content so that you can play it for judges who won't be affected by what the person is saying, but will be listening to pure tone. The problem with the content-filtered speech is that by throwing out the high frequencies, you're losing important affective information. Then

a former student of mine, Klaus Scherer, who is now at the University of Giessen, as a Professor of Social Psychology, developed a randomized splicing procedure as an alternative way to keep all of the tone, but throw out the content. You cut the audio tape into lots of little pieces. Then you get a table of random numbers on the basis of which you randomly rearrange these little clips and splice them together. I now play you some content filtered and random spliced speech.

Before I play the original English of which the following excerpts were transformations of various kinds, did any of you understand any of the statements that were being made there? They're very hard to decipher. Some people do very well in somehow picking out the original English of content filtered speech. There are two kinds of people who do particularly well at that. One is mothers of toddlers learning how to talk. They are constantly getting content-filtered speech at home and they're pretty good at understanding that kind of speech. The other kind of people who are good at doing that are people who work with speech disordered people or with the deaf, and some speech therapists. Sometimes, but not as often, psycholinguists.

Now, I'll play you the four statements by the male and the female speaker before they were transformed. Here are the original versions:

Positive submissive: "I wonder if I could ask you a favor? Could I borrow enough money for lunch?" MALE VOICE
SAME QUESTION REPEATED—FEMALE VOICE
Positive dominant: "Well, hello. I haven't seen you for an age. We should get together more often." MALE
SAME STATEMENT REPEATED—FEMALE
Negative submissive: "Gosh, I'm sorry I borrowed the car without your permission, Dad." MALE
SAME STATEMENT REPEATED—FEMALE
Negative dominant: "Confound it, if that's how it has to be, then you can do it without me." MALE
SAME STATEMENT REPEATED—FEMALE

That's the end of the audio portion demonstration. The video is yet to come. Let me give you just a quick theoretical footnote on the development of the PONS. It was not within the context of psi research that we did all this, but in the context of social psychological thinking. We wanted to be able to do a better job of predicting the outcomes of interpersonal interactions, whether these interactions were teaching interactions or psychotherapeutic interactions or everyday chance encounters of any sort.

What we thought we might be able to do in principle, though it would be difficult, we felt, to do in fact, would be to map out for every person who might encounter any other persons, two kinds of traits having to do with nonverbal transmission and reception. That is, how good they would be in encoding nonverbal cues in different channels and how good they would be in decoding cues in different nonverbal channels. By a channel, I just mean something like seeing the face without looking at the body, or the body without looking at the face, or both together—or randomized spliced speech or content filtered speech. I'm arbitrarily calling those things channels just to make them a handy thing to talk about.

So, we have face or body, and face plus body, random spliced and content filtered speech and various combinations of those. If we knew for any one person how good he was at sending in those channels, how decodable are his messages in those nonverbal terms, and also knew for that person how good he was at decoding those particular messages, we would know something useful that might lead us to improve the predictions of outcomes of psychotherapy, of teaching and of chance encounters. We call it the Diogenes model for no good sound scholarly reason of any sort.

We haven't yet got standardized measures of encoding ability, though we have some people who have been studied intensively from the point of view of encoding ability. Most of our work on the PONS does give us confidence that we know something about how to measure decoding ability in eleven channels of nonverbal communication, and that we can predict things like the outcome of psychotherapy from knowing how good a decoder you are. Not as a patient, but as a therapist.

For example, if you are the average psychotherapist, you are not any better as a decoder of nonverbal cues than your average high school student. But if you are an above average psychotherapist, as judged by your peers and supervisors, you are a better decoder of nonverbal cues than if you are a bad psychotherapist as judged by your peers and by your supervisors. So we can make some useful distinctions with the standardized test called the Profile of Nonverbal Sensitivity.

Let's go back now to the Profile sheet (Figure 1) that I introduced you to a few moments ago. Across the top is a readout of the eleven channels: Face, Body, Face and Body, Random Splice, Content Filtered, Face plus Random Splice, Face plus Content Filtered, Body plus Random Spliced, etc. Those are the eleven basic channels, and the numbers that you see under each of those are the percentiles—for example, under Face, down around the middle of the sheet it says "50"

on the left. That's your fiftieth percentile score. If you got sixteen out of twenty face items right on our test, you would be an average face decoder. This is a standard scored profile sheet. If you got about fifteen items right on the body, you would be an average body decoder. If you got only twelve items right on content filtered; (that's a lot less than face), you would still be an average content filtered decoder. In other words, it's much more difficult to decode content filtered cues than to decode face cues or body cues. In fact, based on several thousand subjects, there's a neat kind of relationship that's linear in the logarithms that goes from tone-to-body-to-face in terms of the amount of information in this test. Not under all circumstances; the ratio is that for one unit of information. One standard deviation's worth of information in tone is what you get by adding tone to the total message. Two standard deviation's worth is what you get by adding body, and four is what you get by adding face. Those are the ratios, not the actual standard deviations. You get more in standard deviation units.

If you turn to Figure 2, you'll see summarized channels. I won't take time with the left half. The right half has four combinations: Positive-Submissive, Positive-Dominant, Negative-Submissive and Negative-Dominant. In addition to the score on eleven channels of nonverbal communication, we also get a score for how good you are at decoding negative affects, positive affects, submissive affects and dominant affects and all combinations of those two dimensions. We find that different people are differentially good at decoding different ones.

One of our most dramatic findings concerns sex differences. Women, in all the societies that we've tested, are very substantially and reliably better than men at decoding nonverbal cues across the board. That was true when we tested American college students and Mexican college students, college students in Israel and England, teachers in Singapore, Indians and Eskimos and New Guineans, Australian aborigines and immigrants. Wherever we go and test—and we've tested pretty much all over—women are better than men. They are most especially better than men at negative affects. And one of our female graduate students has put forward a kind of impression hypothesis that women needed to be better at decoding negative cues, because it was life-saving to be so in eons gone by—and maybe yesterday as well.

One of the things that surprised us when we constructed the test, was that we found that everybody was getting everything right. The original length of the video clips was five and a half seconds. So, just for psychometric reasons, to make a better test, we had to shorten the video clips to make it tougher. We wanted to have an answer sheet that had

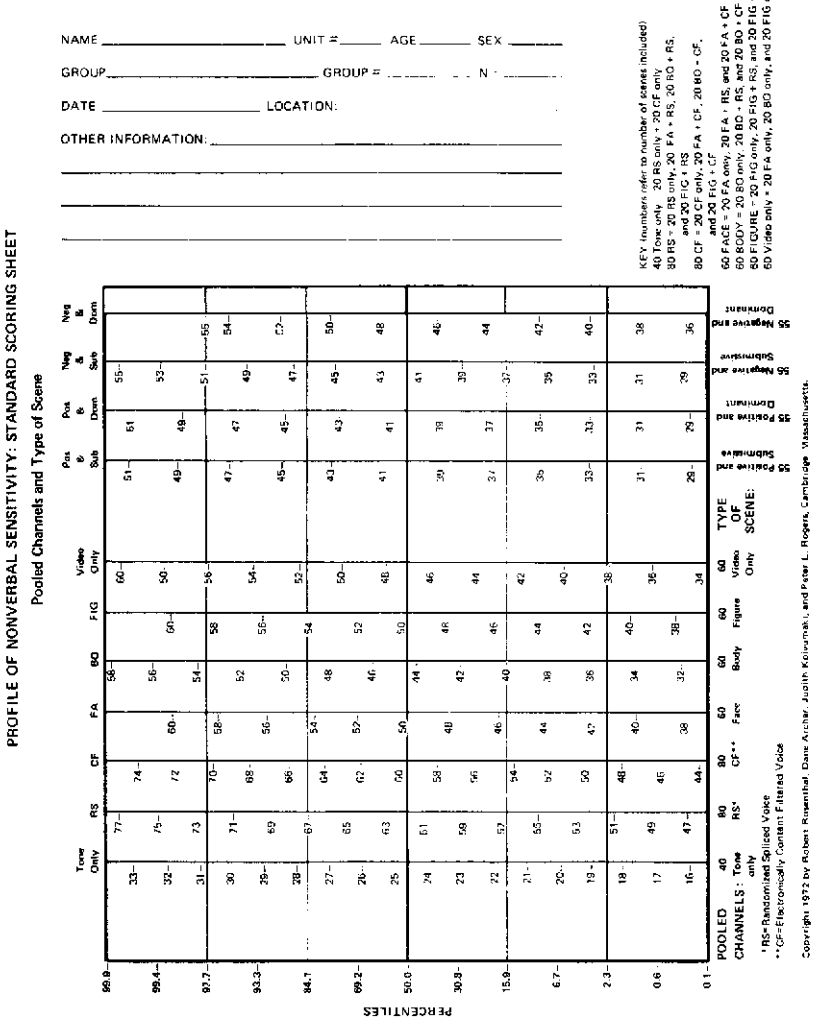


Figure 2

two answers—*A* and *B*. If you pick *A* or *B*, you have a fifty percent base rate; but you'd like to get something where the average accuracy is around seventy-five percent. If the average accuracy were fifty percent, that would just be chance, if you have only two alternatives. If the average accuracy were around one hundred percent, which we had when we first made the test, that's no good, because everybody gets everything and you can't discriminate among people. That's the

purpose of the test—to be able to score people on some trait or characteristic. So we kept cutting down and when we got to two seconds we quit. At two seconds, people were getting about seventy-five percent of the information. That's a lot of information. We wondered how far we could cut things down further. Could we go to one second? Would people still get information from the face and from the body, for example, in one second? How about a half a second? How about an eighth of a second? How about a twenty-fourth of a second, or is that so fast that the subject would think he hadn't even seen it? Figure 3 is a test form called "Nonverbal Communication BP." (BP means Brief PONS.) There is a series of film clips that vary in exposure length from one frame (that's one twenty-fourth of a second) to twenty-seven frames (that's over a second).

The score curves are quite monotonic in the sense that people do very, very well if they have twenty-seven frames; they do quite well if they have nine; they do just about as well if they have three. The big drop is when we go from three frames to one. The interesting research question is—what's the difference between one and three frames? Is it that when you go from one to three frames you introduce movement which you can't have on a single frame, or is it simply that the subject sees more of the same? The experiment that we have planned is to simply take those three frames and then scramble them and see if people will do about as well when they're scrambled. If so, it can't be the movement per se that does it, because if it's backwards, forwards, sideways, you always get about the same accuracy score. It must be just the total amount rather than the movement per se, and that's an experiment that we're planning to do.

I've already mentioned that women are better than men pretty well across the board. There's one interesting thing we call Discrepancy Sensitivity. It is a fifth index of sensitivity to nonverbal communication developed with Bella De Paulo and others at Harvard. That's a test that measures how sensitive you are to discrepancy between tone of voice and body movements or tone of voice and facial expressions. We find that that's a skill only partially related to the skill of decoding face, body and tone cues. It takes to some extent a different kind of skill to be able to detect discrepancies in tone of voice. The importance of discrepancies in psychopathology is given to us by Bateson, Jackson, Haley and others, the formulators of the Double Bind Hypothesis, that sources of psychopathology may reside in childhood, when children get different conflicting cues from their parents in different channels of communication.

Sometimes nonverbal information is not so much sent, but given off,

NONVERBAL COMMUNICATION (BP)

Name _____ Present address _____

Town and country of birth _____ Age _____ Sex _____

Primary language spoken _____ Secondary language spoken _____

Father's occupation _____ Mother's occupation _____

Field of study _____ Average grade in last year of school _____

INSTRUCTIONS: Please circle the letter (A or B) next to the label which best describes the scene you have just seen.

SAMPLE ANSWER: Scene 1. A. admiring a baby
(B) applying for a job

1. A. ordering food in a restaurant
   B. threatening someone
2. A. nagging a child
   B. criticizing someone for being late
3. A. expressing strong dislike
   B. expressing deep affection
4. A. expressing motherly love
   B. threatening someone
5. A. returning faulty item to a store
   B. helping a customer
6. A. talking about one's divorce
   B. returning faulty item to a store
7. A. saying a prayer
   B. threatening someone
8. A. admiring nature
   B. saying a prayer
9. A. talking about one's divorce
   B. trying to seduce someone
10. A. admiring nature
    B. expressing motherly love
11. A. saying a prayer
    B. talking about one's wedding
12. A. talking about the death of a friend
    B. expressing jealous anger
13. A. talking about one's wedding
    B. talking about the death of a friend
14. A. expressing strong dislike
    B. ordering food in a restaurant
15. A. criticizing someone for being late
    B. expressing gratitude
16. A. expressing deep affection
    B. nagging a child
17. A. expressing deep affection
    B. admiring nature
18. A. helping a customer
    B. asking forgiveness
19. A. talking about one's divorce
    B. leaving on a trip
20. A. saying a prayer
    B. nagging a child
21. A. leaving on a trip
    B. nagging a child
22. A. talking about one's wedding
    B. expressing gratitude
23. A. talking about one's divorce
    B. asking forgiveness
24. A. returning faulty item to a store
    B. talking about the death of a friend
25. A. asking forgiveness
    B. nagging a child
26. A. expressing motherly love
    B. asking forgiveness
27. A. returning faulty item to store
    B. expressing strong dislike
28. A. talking about one's wedding
    B. talking about one's divorce
29. A. expressing strong dislike
    B. helping a customer
30. A. threatening someone
    B. expressing strong dislike
31. A. criticizing someone for being late
    B. expressing gratitude
32. A. expressing jealous anger
    B. nagging a child
33. A. expressing motherly love
    B. talking to a lost child
34. A. leaving on a trip
    B. expressing deep affection
35. A. admiring nature
    B. helping a customer
36. A. leaving on a trip
    B. trying to seduce someone
37. A. expressing jealous anger
    B. threatening someone
38. A. nagging a child
    B. talking to a lost child
39. A. ordering food in a restaurant
    B. expressing jealous anger
40. A. trying to seduce someone
    B. talking to a lost child

Figure 3

as Goffman has said—or leaked, as Ekman has said. Face is easiest to control; we feel it leaks the least, though there may be leakage there. Body is easier to control than tone. You can't control Brief PONS because you don't know they're there. And finally, you're least able to control discrepancies among different channels. What has this all to do with the sex differences we've looked at cross-culturally? This—that although across the board women are uniformly better than men, women give up their advantage over men in accuracy of decoding more and more as you get to the leakier and leakier channels. Women are most superior to men at the face. They are next most superior at the body. They are third most superior at tone. They are fourth most superior at the brief PONS, and they are fifth most superior or probably not at all superior at the Discrepant PONS. Our interpretation is that, at least in our culture—and most of this five-level work has been done in our culture—women have adopted a kind of courteous orientation interpersonally, not only in nonverbal communication, but linguistically as well. If you read the face well you can be more assured that you're reading what the person wants you to read—the person that's sending the message. As you move down that, you're getting more and more into leakage. We have some evidence to suggest that if you're very good, for example, at micromomentary display—if you can decode the one twenty-fourth second—that may not be so good for your social adjustment. For example, although social adjustment correlates well if you're a good face/body decoder, if you are a good micromomentary display decoder, that's likely to be slightly negatively correlated with social adjustment. It may be that because of this phenomenon, you may know too much about other people. Like science fiction stories where some people come from another planet and they have a heart of gold but they also have this unfortunate gift of psi, and they know what everybody thinks and nobody likes them because people like their privacy.

Those lower channels are maybe getting closer to psi in the sense that they're more covert, they're more leaked, and therefore they may do you less good in a social sense. Women, having been taught in our culture to do the right and courteous thing, are maybe showing a special kind of courtesy in the avoidance of eavesdropping on nonverbal cues to which they are not supposed to have interpersonal access.

Let me link this to the general literature to point out that generally in the studies that have been done, women have proved to be more supportive in conversations; they laugh at others' jokes more; they listen more; they argue less; they interrupt less. They use less profane

and hostile language. They are more visually attentive. They smile more; they look more pleasant. They intrude less on others' personal space; they even use up less space controlling, for their size, than do men. That is, they shrink up more. So the pattern we get is one, overall, of having women in our culture be more polite, more courteous in their use of nonverbal as well as verbal cues.

Women in our culture, then, seem to have learned that there may be social hazards to knowing too much about others' feelings. This pattern of politeness is consistent with the traditional sex role that has been ascribed to women in our culture—the sex role that is only now beginning to change.

DISCUSSION

MORRIS: On the PONS test—what is the effect of us knowing versus not knowing the set of potential descriptors, and does that interact with the length of the film?

ROSENTHAL: Judy Hall, one of our research group who helped to develop the PONS test—she's at Johns Hopkins University—has done research to test whether you do better if you know the descriptor before you see the clip or not until after. Although most people phenomenologically feel that they will do better if they know the two alternatives (A and B) before they look at it, in fact it doesn't make any difference whether you do it before or after. Then, does it matter as a function of the length of the stimulus? That's not been done. All we've done it for is the full PONS test, which you didn't see any of, and that's two-second clips, and for that it doesn't matter. But that doesn't mean it wouldn't make a difference for these four lengths of one, three, nine, and twenty-seven frames.

MORRIS: I would expect that with the longer clips it might stand a chance of making a difference.

ROSENTHAL: It might.

MORRIS: Since we are talking about the possibility of ESP here, have you thought about trying to imbed some sort of ESP control testing just to make sure that you're not in part testing people's ESP abilities?

ROSENTHAL: Well, for some of these short tests, like the Brief PONS test, we have done what we call ESP controls. But now let me hasten to say that we don't regard those as good tests for ESP. We regard those as

question arrangement on paper problems. That is, it may be that if you give anybody an answer booklet with multiple choice items and have him go through and circle the answer, I don't care if its a third semester course in calculus or whatever it is, if it's multiple choice, you may somehow by the way you have organized the page and by the way you've formed your questions, have the average computer do better than chance. Now, the longer the test, the less likely that is. If you've assigned your alternatives to the correct answer at random and if you've assigned questions to page location at random, then in a long test it's very unlikely to happen. But the shorter the test, the greater the problem. For a forty-item test there's more of a problem than for a two hundred and twenty item test. So we did do these ESP controls. Where you'd expect fifty per cent by chance, under our ESP control conditions, you'd get about fifty-one per cent accuracy. I'm not willing to say that's a test of ESP, although it's statistically significantly better than fifty per cent for the psi sample we used. It could be that that's an effect of the particular answer sheet layout that we had. But we used that to compare accuracy above that "ESP" base rate.

MORRIS: Taking into account individual differences?

ROSENTHAL: Individual differences among items. Each item gets a special ESP correction.

NASH: Dr. Rosenthal, do you think any experimenter effects may be due to psi?

ROSENTHAL: That's a really tough question. I don't know whether any experimenter effects may be due to psi. Rhine didn't think so. I had a long talk with him fairly early in the history of the research project, in 1960 when I was visiting at Ohio State University and he was there on a visit. We discussed it, and it was his feeling that the magnitude of the effect that we were getting in the expectancy studies was inconsistent with the magnitude of the effect that he was getting or that he knew about other people's research. While he certainly would have never ruled it out as a phenomenon, he felt that it was a different order of magnitude of effect. At the time I felt pretty good about that, because I really didn't want to get involved with ESP research; thought it might be detrimental to my health as a young academic. Now I'm old and it doesn't matter. But I think, since having heard some more recent papers on ESP, that I may change my mind on that. I heard some papers at a parapsychology convention a couple of years ago at which people were giving the results of recent experiments of theirs. I did some very quick calculations on the size of the effect shown and the effects were very large, much larger than the average size of the effect

we get in standard social psychological or cognitive psychological, or developmental psychological phenomena. I guess I would hold in abeyance any judgment on it. I certainly wouldn't rule it out.

BYERS: Some years ago I was doing some experiments, when I was teaching photography, on how many frames people can see and what do they get out of it. What I discovered then was one could see very brief frames if they were evenly spaced so that they presented a rhythm that one could eventually learn to relate to. The different ones threw them off. What I want to ask you is, when you were working with the very brief one to three frame clips, were those randomly different lengths, or did you space the one frame to bring three frame clips together?

ROSENTHAL: Is your question when we had a forty-item brief PONS test, where did we put the one frames and where did we put the three frames?

BYERS: Yes—were they randomly distributed?

ROSENTHAL: They were randomly distributed with some blocking, so that a bad luck draw table of random numbers couldn't put, say, all the one framers at the end, so that if everybody did really badly on that, we wouldn't know if it was because they were one frames or if it was a fatigue effect. So we employed a procedure called "blocking," so that within each quarter or fifth of the test, we have fairly equal representation of the four time lengths. It's not one, three, nine, twenty-seven obviously. I mean, there's no fixed order; it's random, but it's blocked so that at least the first half has equally often one, three, nine and twenty-seven, and the last half has equally often one, three, nine and twenty-seven.

MORRIS: What instructions did you give your speakers on the tapes we've heard, and have you thought about varying the instructions to them? I gather that they are acting.

ROSENTHAL: These people were acting, and the young woman that you saw in the Brief PONS was also acting.

MORRIS: You might be in part studying artifacts of what kind of acting they do of their own conceptions, and I was wondering how you perceive that.

ROSENTHAL: We don't really know for any particular senders how different they themselves as senders might be when they've been asked to act or if they were in a spontaneous, everyday life situation.

MORRIS: It would be interesting to give them some of your tests and see how they do.

ROSENTHAL: You mean, how the encoders do as decoders?

MORRIS: Yes.

ROSENTHAL: Well, that's a growing area of research actually. More and more people are now beginning to look at the relationship between encoding and decoding skills, and it's very, very ambiguous. The correlation seems to be small, but positive. If I had to guess, I'd say the correlation based on some fifteen studies is maybe point two. So it's not terribly impressive. Better encoders tend to be better decoders.

ATTENTION AND COMPUTATION IN THE BRAIN

EDWARD F. STORM

"Each of us at any moment of the waking day is a whole bundle of acts simultaneously proceeding. In no case does any other of all the doings of the moment disturb the one focal doing. . . . Should it do so then the pattern changes and the disturbing piece becomes usually the keypiece of a new pattern which supplants the previous. . . . The individual cannot be the seat of two focal acts at once."

Sir Charles Scott Sherrington
Man On His Nature

Introduction

Neither, I believe, can the individual be the seat of two simultaneous acts of focal awareness. There may be other "doings of the moment" which support the object of focal awareness, but that object is always specific, dominant and unitary in form. On the other hand, the object of awareness changes easily in response to events occurring either within or without the brain. We then ask what kind of organization supports the manipulation of awareness, and we seek specific instruments for this manipulation. I will propose here that the attending mechanism has essential computational characteristics. I will also show that at the most familiar level of structure and function, the brain is not a computer. For this observation to be persuasive, it will be necessary to be quite precise about what a computer is. Fortunately, this precision in definition is available from existing studies in the theory of computation.

The variety of applications of computing machines and the metaphors which they provide for abstract processes suggest that computing may be something more than technological innovation, that one may expect to find computational entities at almost any level of organization of reality. While many processes studied in the physical sciences are best idealized in the form of differential equations whose solutions are functions on continuous domains, there appear to be

more abstractly organized activities whose descriptions are best expressed in computational terms. Certain aspects of the structure of human language and of human cognition seem to be organized into finite and discrete categories, and the associated processes are in some cases well imitated by computer programs. At the same time, one may doubt that a complete description of the human personality in important respects can be obtained in computational terms. The issue is to determine the nature of the relation between computation and the human personality. It is therefore both reasonable and sensible to inquire whether there are any computational entities in reality apart from the technological artifacts of human creation and, if there are, to identify them. One may ask, for example, whether interactions among elementary particles have any computational properties. Is the genetic code really a program for a computing process? Is the brain a computer?

In the first section of this study some general remarks provide a perspective for investigating the nature of physical computation. We see, for example, that computation is a physical phenomenon, that it is in principle uninterpreted, and that its relation to causality is problematic. Then in the next section, physical conditions are described which any entity must meet in order to be part of a computation. Then I review the precise definitions for computing and observe that a certain idealized computer must meet the physical conditions specified if it is to behave as defined.

Then follows a brief review of some facts about the membrane properties of neurons and their signal initiation and propagation functions. These structures and functions are seen not to meet the conditions required of computational entities, suggesting the possibility that there are no computational entities of any kind in any biological systems. If this is indeed the case, and if at the same time we believe that our behavior, physical or mental, has computational structure, then we may have to seek the source of biological computation in structures which are not completely characterized in physical terms. For example, if we believe that there are computational structures and processes in the psychological domain, then the preceding observations raise serious difficulties for any psychophysical identity theory. Then I report on my own experience with awareness, focusing on the processes of attending. On the basis of this introspective evidence, I conclude that the form of attending is purely computational, and that the act of attending arises as a result of the emergence of computational forms out of a non-computational

substrate. Finally, the implications of this conclusion are briefly discussed.

The General Concept of Computation

Throughout this study, when I speak of a computer I specifically exclude analog devices from the discussion. Complex assemblies of digital and analog devices are powerful instruments, but they are in general different from purely digital machines or purely analog machines. Subsequent investigation may reveal that such complex assemblies are similar to what we find in living systems, but we must first know what constitutes a digital device occurring in a biological system or as an aspect of a biological system, before we can recognize a hybrid.

If we think that brains and their constituents act as mediators between psychological and physical reality, then we will ask whether a particular level of organization of brain structure and function is appropriate for the psychological realities, however these are specified. We may ask whether the physiological correspondents to cognition, if any, are found at the level of elementary particle interactions, at the level of molecular reactions, at the level at which neurons initiate and distribute signals, at the level of brain waves, or at some other as yet unspecified level. If we determine conclusively that no level supports a computational interpretation, then we may have to recognize the importance of essentially abstract organizing principles at the level of thought, or else discard rational categories from our analysis of thought. Here I will only consider whether brain structure and function at the level of the nerve impulse can be interpreted in computational terms.

Four kinds of entities will figure in this discussion—programs or algorithms, structures, computers and computations. In informal terms, a program is a complete specification of what is required with respect to some particular computational task. A structure is a systematic formal representation of what is to be manipulated by the computer. The computer itself is a physical device capable of "reading" structures, of interpreting programs and of committing the acts specified by them on the structures. A computation is a physical event realizing one complete act committed on some structure. I will use the phrase "computing agent" to refer either to an existing artifact or to a hypothetical biological computer. The distinction is real since it has not yet been shown that there are any biological computers.

All aspects of a computer's structure and function are both finite and discrete. A computer is finite at the abstract level, in that it may not have

infinitely many parts, and may not contemplate infinitely many elementary things. At the concrete level it is, like any other physical object we apprehend, finite in spatial and temporal extent. A discrete or digital character follows from the abstract finitude, but is important enough to receive separate mention. And the mathematical properties of denseness and compactness are excluded from the irreducible objects which computers manipulate. Although computations may be described in abstract terms, a computation itself, as opposed to a description of it or a representation of it, is a genuine physical event involving the time-ordered manipulation of matter and energy in orderly ways. We recognize then that there may be universal principles of physical computing, just as we think there are universal principles of gravitation or of electromagnetic radiation. We may discover that only certain aspects of a biological event are computational. And it may be important to distinguish this phenomenon from that in which physical systems "approximate" computers, itself a very unusual notion. In any case, a computation is a physical process.

Another important observation is that computation consists in the manipulation of pure form. Once we understand this we can appreciate that a computer does not "do" arithmetic. It manipulates forms in such a way that we may reliably interpret those manipulations as arithmetic operations. Specific logical circuits may be designed with arithmetic in mind, but it is entirely possible to construct a digital computer which has no explicit arithmetical capability, just as one could be constructed with no explicit capability to manipulate alphabetic characters. This fact about computation has two important consequences. The first is that if computation occurs in physical reality, then that reality must be able to assume pure form in such a way that it can be computationally manipulated. The second is that computations must in principle be describable entirely without reference to interpretations. If computations are to have substance as well as form, then it will be essential to have a precise specification of what that substance is, what hidden variables determine its character, and some kind of guarantee that it is something other than a selected aspect of form rearranged or disguised. In the same way, computational entities may not be distinguished solely on the basis of interpretation. All general purpose computers can be made to do arithmetic either directly or indirectly, but the ability to do arithmetic does not guarantee that an object is a computer.

In this sense computers do not "play" chess, translate or understand natural languages, identify spectral lines or simulate neural nets. A computer engages in the manipulation of form, a manipulation that we may choose to interpret in a way. In the ordinary situation there is a

prior specification of certain complex forms, a specification of complex acts to be committed upon these forms, and a convenient interpretation which gives the computations significance but never directly influences them. It is really not remarkable that computers can be made to do all this complex form manipulation. The miracle is that matter organized out of organic molecules and living cells has conceived and become conscious of the power of the manipulations of form in the first place.

An even more important issue is that from a theoretical point of view a computer's actions are not causal, at least in any familiar sense of the word. Rather, a computer administers the form of causally described events. A computational scheme specifies that certain pairs of forms are related in such a way that the computer replaces the first form with the second. The persistent iteration of such changes in form is part of the essence of computation. It is difficult to appreciate what kind of causal principle could account for such transformations, whose subject matter is devoid of interpretation. But the fact is that biological systems seem to achieve this manipulation of form and to appreciate that the manipulation of form is an important aspect of physical reality.

Finally, it should be noted that there is no vagueness or indefiniteness about what a computer is. Differing formulations of one or another aspect of the concepts of computation were presented in the early and mid-nineteen thirties, formulations which have been shown to be intimately related, through a well-defined sense of equivalence, and which have stood the test of time in two important respects. The particular and detailed issues associated with computation were specified in those formulations, and these issues are in principle still the foundation of computational practice. And each of these formulations was seen to treat very broad and general issues in a uniform way. Whatever could be achieved within one formulation could be achieved in an exactly specified way in any other formulation. In short, we have exact specifications for what constitutes a computer, an algorithm, a structure or a computation. There is no question of construing the concepts of computation too narrowly or too broadly. If we wish to enlarge the class of computations beyond what was determined by these original theoretical formulations, it must not be at the expense of precision in definition.

Physical Computation

This section begins with a summary of the conditions which a physical event or object must meet in order to constitute a part of a computation. Then a set of formal definitions is given based on

Turing's original treatment,[17] and then there is a review of the physical conditions noting that the formal definitions fail if the physical conditions are not met.

The structures a computer manipulates are either atomic or composite, and the acts a computer commits, its computations, are themselves either primitive or composite. We briefly sketch the conditions on each of these four classes of entities.

All computational structures must ultimately be built out of objects which have no internal structure as far as computation is concerned. These *irreducibles* are computationally invariant, individual and indecomposable. There can be only a finite number of them, but it must be possible to generate an unlimited number of occurrences of any one. These occurrences must yield to inspection, identification, generation and annihilation by the computer without affecting the computer except as specified in an algorithm, and inspection and identification must proceed without affecting the occurrence. These occurrences may appear at any time and place suitable to the computer. And both the objects and their occurrences must be uninterpreted. They must occupy a strictly bounded region of space and time which does not change in any relevant way during the computation except as directed by the computation. By "strictly bounded" I mean that there is a fixed and constant bound on the amount of space and time needed for this storage. No matter which irreducible is stored, these bounds do not change. Any essential geometric properties of an occurrence, such as shape or orientation, must remain fixed throughout the computation, and occurrences of irreducibles must be independent of any particular energetic or temporal factors involved in physical realization. A liter of water at room temperature is an unlikely object to compute with. If it vaporizes, we lose control of its extent altogether. It is difficult to imagine how a computer could deal with the spatially invariant properties of a liter of water vapor freely dispersed. And geometric distortions, for example such as might turn an occurrence of "G" into an occurrence of "Q," must also be excluded. From the fact that the set of irreducibles must be finite in number it follows that they cannot be a dense set, but it is important to appreciate in more detail that a class of irreducibles may not have the denseness property. The distinction is between "discreteness" and "denseness" and depends upon an ordering of the set of irreducibles. The non-negative integers, although infinite in number, are a discrete set because between any two consecutive numbers there are no others. But between any two distinct rational numbers there is always another rational number different from each. Thus there can be processes of mid-point construction that

are endless. Denseness must be explicitly excluded from computational formalisms. It is inconceivable that we can represent any of an infinite number of arbitrarily close objects in such a way that a computer can generate, annihilate, inspect and identify these representations with finite and strictly bounded resources.

A composite computational structure differs from an irreducible in that it has constituents. But it can have only finitely many immediate constituents and this immediate constituency relation must be completely definite in character. If composite forms are to be well-defined, then the immediate constituents of a composite must be decisively distinguishable one from another. And the transitive closure of this constituency relation must provide the conceptual means for a formal counterpart of the idea that one thing "occurs in" another. Composites must be "grounded," in that any progression starting with a composite and stepping only through immediate constituents must always terminate after a finite number of steps with an irreducible. Composites must yield always and decisively to inspection, identification of parts, replication, construction, comparison and disassembly, all by strictly bounded physical means, without affecting the computation in any other way. Arbitrary increase in degree of composition must not in principle alter any computational characteristic of the composite. And composition itself must be expressible in terms of a principle of well-formation, an idea which seems to appeal to the concept of computation for its justification. Finally, composites must be formable with the greatest possible freedom consistent with the stated conditions on well-formation.

In general, the class of computational acts may be divided into a class of operations and a class of judgments. Thus there will be primitive operations, primitive judgments, composite operations and composite judgments. The effects of a primitive act must be definite and predictable in all cases. A primitive act must have a definite beginning and a definite end and the beginning and end must be recognizable by other parts of the computational machinery. A primitive judgment must be able to determine whether a specified object is a computational structure and, if it is an irreducible, there must be a single judgment which can identify it uniquely. There must be primitive judgments to compare irreducibles for sameness or difference. There must be primitive operations to generate new occurrences of irreducibles. There must be primitive acts to discriminate among composite structures, to decompose composites into their immediate constituents and to assemble new occurrences of composites out of given occurrences. In all cases, the resources needed to initiate and conclude

a primitive act must be strictly bounded. There must be a fixed and constant bound on the resources needed for the committing of the primitive act. No matter what arguments are supplied, and no matter when or where the act is committed, its demands on resources never exceed the strict bound. The effect of a primitive act must be independent of the time and position at which it occurs, provided it is admissible at that time and position. Nor may the effect of an act depend on the length of time taken to conclude it, except that each act must be allotted a non-vanishing interval of time for its completion. The resources needed to conclude a primitive act must be independent of the particular structures to which the act is applied, and therefore must be independent of any interpretation that may be placed upon these structures, whether they are irreducible or composite.

Composite acts are specified with reference to occurrences of primitive acts. In general, composition is specified by restricting the order in which primitive acts may be committed. Particular patterns of restrictions on the order of primitive acts are called "control structures." A further restriction is that no primitive act may be initiated until its immediate predecessor in the order has concluded. Such a computer is said to be "synchronous" and one which can initiate an act before its predecessor is concluded is said to be "asynchronous."

Since the principal concern here is with the physical aspects of computing, I have chosen to describe one particular formulation—the Turing machine. There are other formulations of computability theory. The lambda calculus[4] deals with functional abstraction and application of functions to arguments. The equation calculus[8] deals with definition by induction and its extensions. Post's combinatorial systems[12], Markov algorithms[10] and Chomsky's phrase-structure systems[11] all deal with the manipulation of strings. In each case, specification of a machine to realize the required processes leads to exactly the same physical constraints as does the Turing machine treatment. The interpretations that motivate these formulations are both interesting and important, but I will not consider them any further here.

A Turing machine is a physical device which acts upon a strip of tape divided uniformly into adjacent squares. A square may be blank or it may contain an occurrence of some individual symbol chosen from a fixed and finite set of symbols, called the machine's "alphabet." The machine has a tape sensor which in operation attends to exactly one square on tape. The machine can commit certain primitive acts upon this tape. It can shift the tape one square at a time past its sensor in either direction, it can record an occurrence of one of the symbols on

the attended square and it can erase what is already on that square. It can determine if the attended square is or is not blank, and if not blank, it can determine which symbol occurs. A tape configuration is a sequence of marked or blank squares which includes all the marked squares on the tape.

A Turing machine embodies exactly one complex act which can be committed on any of a variety of tape configurations. The act embodied in a Turing machine is realized as a physical event, determined in part by the design of the machine and in part by what occurs initially on tape. A Turing machine can produce different results systematically only by examining and responding to the symbols occurring on its tape in a step-by-step way. In general, the decision to commit a particular act, primitive or complex, is contingent upon the occurrence of a specified configuration of symbols on tape. A general means for expressing arbitrary conditioned complex acts of this kind is achieved in a finite set of commands, each represented by a list (A, B, C, D). The first item, A, is a positive integer identifying the command. B specifies the symbol whose occurrence on the attended square must be recognized. C specifies the act to be committed and D identifies the next command. A command whose fourth member is 0 is a stop command. A set of commands is admissible if and only if no two distinct commands have the same first and second members. Finally, a particular command number is distinguished which identifies a "first" command, the beginning of the algorithm. An admissible set of commands together with an initial state completely determines an algorithm and thereby a Turing machine.

A Turing machine in action is attending to two things—the next command number and the square under its sensor. It advances its activity one step by comparing these two items with the first two members of individual commands, and a successful match determines a primitive act and a next command number. The primitive act is committed and the command number sensor is made to attend to the next command number. Persistent iteration of this stepwise advancement produces a computation.

A particular admissible set of commands completely determines a Turing machine, but further conventions are normally associated with the systematic behavior of all Turing machines. Computers are social tools, and anyone using them must know the social rules. There is first an operational convention designed to prevent the machine from running out of tape before its computation is concluded. We assume that whenever the machine is about to shift the end of the tape past its sensor it suspends operation and emits a signal which is not terminated

until more tape is provided. Further conventions make the machine's behavior uniform in all situations. A strip of tape initially has only a finite number of marked squares, and a left-right tape direction is coordinated with the machine's tape-shifting capability. The left-most marked square relative to this coordination is then positioned under the tape sensor, so that the machine is attending the "first" mark on tape. The other attention aspect of the machine is directed at the initial command number and action is initiated. After the passage of some time the machine stops (perhaps). The result of the computation is the sequence of symbol occurrences whose first is found in the square under the sensor.

Even more conventions are needed if a machine is to commit familiar acts. These conventions are expressed in a systematic scheme by which entities are represented as sequences of symbol occurrences. We bundle up these conventions into a function *rep* such that *rep*(x) is a systematic tape representation for x. In general *rep* cannot be specified without knowing how the commands are to be organized, and the commands are not determined until the details of *rep* are given.

A Turing machine "applied" to a particular *rep*(x) may terminate with its sensor attending to the start of some *rep*(y). If a Turing machine T initiated with its sensor attending the first symbol of A terminates attending the first symbol of B, we write "T:A $->$ B." One of the most important definitions in computability theory can now be stated:

> If f is a function whose arguments are in X and whose values are in Y, then f is *Turing computable* if and only if there is a Turing machine T and a representation function *rep* such that for any x in X and y in Y, f(x) = y if and only if T:*rep*(x) $->$ *rep*(y).

Special attention is called to the fact that the action capabilities of Turing machines are described without reference to the conventions for the systematic use of the machines. We also note that reliance on the results of a Turing machine's computations is measured not only with regard to whether the machine acts physically as specified. Turing computations are determined as well by the simultaneous specification of an admissible set of commands and of a function *rep*. These of course are human activities having both individual and social characteristics. When we say that a certain function is computable, we have inevitably accepted a certain amount of interpretation.

A state of a Turing computation is any complete description of the tape configuration, the tape square under attention and the next command number, together with the admissible set of commands. And

a Turing computation is a finite sequence of states such that the admissible set of commands justifies the machine's transition from any state in the computation to its immediate successor.

It is recognized that an admissible set of commands may itself be expressed as a sequence of symbol occurrences. These sequences may be written on tape and the tape presented to some Turing machine. In fact, a *universal* Turing machine can be specified, one whose initial tape configuration contains a representation of an admissible set of commands determining a Turing machine T, and a representation, *rep*(x), prepared for T. The universal machine, UT, then duplicates the results obtained by applying T to *rep*(x). That is,

$$\text{UT}:(rep(\text{T}), rep(\text{x})) \rightarrow rep(\text{y}) \text{ if and only if } \text{T}:rep(\text{x}) \rightarrow rep(\text{y}).$$

In short, all the facilities which a Turing machine must have in order to scrutinize its commands are already included among the facilities it must have in order to act upon its tape in response to these commands.

The fact that a universal Turing machine can be specified is a significant fact about Turing machines and about computation in general. It means that there is a finite specification in one admissible set of commands which can direct the elaboration of any Turing computation whatever. A universal, or general purpose, Turing machine is a "most powerful" or "maximal" computer. The range of activity of a general purpose machine is as wide as the class of all possible computations. (This is Church's thesis.[3] No one has ever identified an intuitively recognizable computation that lies beyond the power of any Turing machine. But we still have no guarantee that the thesis is a law.)

The notion of a universal machine also provides a standard. A set of primitives and a means for organizing them into composites is adequate for all computations if and only if a universal machine can be specified by their means. Finally, the existence of a universal machine demonstrates that it is an intrinsic feature of algorithms that they are representable in the same way as are the ordinary structures of computation. The capability which a system has when a universal machine can be realized within it is a technical notion that corresponds to the intuitive notion that there is no limit to what the system can realize except what is found in its formal specifications. I think that this is the notion linguists have in mind when they say that the mechanism for language is "creative."

It is easy to appreciate that the physical constraints listed in the beginning of this section are essential for the construction of reliable Turing machines. A Turing machine's symbols are its irreducibles, and

if occurrences of these could change in any way except as directed by the Turing machine, then Turing computation could not be well-defined. In fact, a Turing machine doesn't change these occurrences at all. It detects, recognizes and discriminates among them, without affecting them, and it can generate and annihilate them. But it never changes them. Now, we may not be able to find such absolute invariance, for arbitrarily long periods of time, in the structures which biological systems may use in their computations. I propose that it is necessarily a property of a biological computing agent, if there are any, that it attributes irreducibility *only selectively* to the objects with which it computes. The irreducible elements in a physical computation are irreducible only *relative to* a particular computer. This is a fundamentally important notion in the search for biological computation. Organisms have an interest in other organisms and in organic matter in general. If these are to enter into a living thing's computational habits, then that living thing or its computing organs will have to be able to attribute irreducibility to things which may not have this property at the physical level, even in respects that concern the living thing. It will in fact be advantageous for the living thing to be able to attribute irreducibility in as unrestricted a way as possible. This attribution must be the result of the action of a free, creative and general purpose agent!

The Turing machine's irreducibles must clearly be chosen from a finite repertoire. Otherwise we should have to have a finite tape into whose squares any of an infinite number of distinct symbol occurrences might be placed. Turing computation requires that there be no finite limit to the number of occurrences of its symbols that it may produce. A Turing machine's tape may grow in length without bound in the course of a computation. Any symbol must be writeable into any square, and once written, a symbol occurrence must retain all its properties invariant for as long as the computer may require. Occurrences must be strictly bounded in spatial requirements, else we couldn't build a machine to manipulate the physical tape itself.

In any given state of a Turing computation there are only finitely many marked squares and the smallest sequence of squares including all these and the square under scan may be taken as the machine's composite structure. Its immediate constituents are its individual squares together with whatever occurs in them. Each of the conditions required of a computer's composite structures is satisfied by a Turing machine's tape configuration. The notion of well-formation for a Turing machine's tape may be interpreted either broadly or

narrowly. In the broad sense, the set of well-formed tapes is simply the free semi-group under concatenation with the alphabet of symbols as its generator. Narrowly, it is the set of tapes determined by the function *rep*.

The reader may easily convince himself that the primitive acts of a Turing machine are definite and predictable, have a clear beginning and end, are arrangeable in orderly progression, can recognize occurrences of particular symbols, can generate new occurrences and annihilate old ones, and depend upon the invariance of the machine's tape configuration. A Turing machine's activities are completely independent of the place and time at which they occur, and are also independent of the length of time taken to carry them out. And temporal and energetic factors are clearly irrelevant to the Turing machine's operation.

Furthermore, a computation is a "closed" event. For a Turing machine there are no computationally interesting consequences of a computation anywhere except on its tape. And there are no influences acting upon and determining the course of the computation except those that arise from the admissible set of commands and the precisely specified way in which such sets of commands are executed. As a matter of definition, the communication interface between the machine and all of external reality is restricted to the squares on its tape. In particular, no systematically varying global factors may influence the effects of primitive acts in any computationally interesting way. A computation is an isolated event. People are accustomed to place interpretations on the results of computations, and they are accustomed to attaching other devices to the peripheral equipment surrounding a computer. In the latter case, it is as though we attached a gadget to a particular square on the tape in such a way that each time the machine writes a 0 into that square the gadget in turn commits its act upon external reality. Such an event is, of course, a consequence of a computation, but it is not itself necessarily a computation. As far as the computer is concerned, the gadget needs no other property but this: it must embody a freely initiatable and otherwise orderly event. Alternatively, we may arrange matters so that when a Turing machine reaches a determined point in its activities, it suspends its own activity, "transfers control" to some external agent, one which may even possibly act upon the computer itself, and waits until control is transferred back to it. This is a notion of "relative" computability. It is an interesting notion for natural or biological computation, particularly in nervous systems, but I will not consider it further here.

Is the Brain a Computer?

If computation is to be implicated in any aspect of mental life, we look naturally to the brain for evidence of computational entities. In this section I will indicate that neural processes may not be rigorously interpreted as having computational characteristics. I will assume that neural activity consists of trans-membrane currents arising out of systematic changes in ionic concentrations and other subthreshold processes. Some of these are electrical and others are biochemical. The reader may find these matters discussed in Katz,[7] Shepherd[16] and Kandel.[6] There are of course many aspects of neural activity which cannot be treated here. These include special properties of the afferent systems, spinal mechanisms, the myo-neural junctions, biochemical processes underlying neural behavior, lateral inhibition, feedback loops, metabolic regulation, comparison with the immune system, studies of brain correlates with learning and behavior, ontogenesis, lateralization, and other important and relevant topics. I will refer principally to the "firing" event itself, and to the most important physical manifestations of it, together with the way in which one set of firing events induces another.

The human brain consists of about 1500cc of living tissue, shock mounted and isolated in a bath of cerebrospinal fluid, and protected by a strong bony shell. Day and night, through sleep and waking, this tissue is never quiet, and is never the same from moment to moment. Nor does it ever return to a state it has once occupied. The evidence is decisive that the brain is implicated in consciousness, sensation, intelligence and volition, and no complete study of human behavior or its nonphysical correlates may ignore the neurons in the brain.

The centerpiece of the contemporary picture of neural activity is the impulse, induced by thousands of microscopic excitations and inhibitions, distributed freely but specifically over the membrane of the cell body and its dendritic system. These local currents wax and wane exponentially, and their effects spread according to an exponential and, hence, smoothly graded, functional relationship. Voltages and ionic concentration gradients vary smoothly and systematically. The neuron's threshold responds to sustained excitation by gradually increasing, and is even sensitive to the rate of excitation. "A current of slowly rising strength may be imperceptible and not set up an impulse, even though it may rise gradually to an intensity many times greater than that at which a quickly rising square pulse is effective."[7] Because of this sensitivity to rate of excitation, "sinusoidal alternating current of very low frequency is ineffective because the rate of change of the current intensity is too low. An alternating current of very high

frequency is also ineffective because its half cycles are too brief to displace the membrane potential (the small effect of each half cycle tends to be cancelled by the next half cycle during which current flows in the opposite direction)."[7] The response of a neuron is thus not only determined by extraordinarily complicated graded events, but is even sensitive to the first derivative of those events. At a given point on the membrane an excitation falls exponentially with time and spreads spatially with exponential decrement. Summation of the effects of excitation at various points takes place at the axon hillock where impulse initiation is nonlinear. But the supporting summation itself is adequately described, as far as we know, as a graded process.

Neither can we say that the impulse is the only significant event, and that subthreshold activity is merely its prelude. Perkel and Bullock write that ". . . the role of impulses in the central nervous system in representing and transforming information has seldom been established and is nowhere investigated to a satisfactory degree of completeness. Moreover, several kinds of evidence, although somewhat indirect, point strongly to the importance of other, nonimpulse vehicles for carrying information in the brain according to their corresponding coding schemes; the importance of such nonimpulse codes may well surpass that of the 'classical' nerve impulse."[11] "The suggestion has been made and must be entertained seriously that it is the impulses that are best regarded as the epiphenomena (at least in some parts of the central nervous system) and that only through understanding the properties and interactions of the electrical waves with the anatomical substrate will we arrive at a satisfactory understanding of the higher behavioral and mental processes."[11]

It is experimentally observed that the threshold and the refractory period determine a range of rates or frequencies at which the neuron can discharge impulses. The observable fact is that these rates are selected from a dense set. It is also clear that these rates may be expected to vary incrementally with graded changes in activity at different synaptic sites on the neural membrane. Complex patterns of such graded stimuli may produce complex patterns of variation in firing rates.

In their survey of neural codes, Perkel and Bullock review those classes of neural events that have been observed in the nervous system, or whose occurrence may reasonably be deduced from what is observed, that may constitute neural codes, or may be essentially implicated in the generation, transmission or transformation of coded signals. The labeled line, which identifies the quality and location of the signal source, and the onset, or unit timing code, where the first impulse

is the bearer of information, are the simplest. Principal attention is given, however, to the rate or frequency code and I will try to summarize some of their observations. A particular occurrence of a firing rate may be determined by a single pulse interval or by an average taken over an interval of time. The physical events needed to realize either of these determinations can hardly be the primitive acts of a computing machine.

There may be a background frequency, the increment being the carrier of information, or else the absolute frequency itself may constitute the signal. Rates may vary slowly or rapidly. For a mean rate code, information may be temporally weighted, more recent pulse intervals contributing more to the coded signal. In yet another situation, "both the mean rate and the distribution of intervals in the postsynaptic cell were in some circumstances highly sensitive to the standard deviation of impulse intervals in the synaptic input. This sensitivity was combined with a sensitivity to mean input rate."[11]

The temporal coding of micropatterns without changing mean pulse rate has also been observed to be significant. Certain muscle contractions may be "many times greater for a train of alternately long and short intervals than for one of uniform intervals at the same mean rate."[10] These rate sensitive events are not compatible with a computational interpretation, since they are all continuously varying. In addition, the end result of the action of those neural assemblies implicated, say, with motion, is to control actions that are intrinsically graded. It would indeed be a spectacular situation if these graded phenomena could be controlled and apprehended by a mechanism which was denied any understanding of the concept of continuity.

Perkel and Bullock point out that microstructure codes require extremely precise timing, and that pattern codes may therefore not be so widely used. We may observe that human activities sometimes require extraordinary precision in timing which must originate in the higher brain centers. In addition, the representation, discrimination and manipulation of psychologically significant spatio-temporal events in the brain require a representation of these dimensions, and the nervous system has only anatomical specificity and temporal coding available to it to achieve this spatio-temporal representation. Neocortex, for instance, is a two-dimensional sheet, and so therefore are the motor and somatosensory homunculi that have been identified.

In parallel fibers coordination of impulse patterns becomes an important issue. "The use of systematic delays to encode the desired time relations of the effector action . . . is probably a general principle of parallel line or ensemble coordination."[11] If the coordination of distinct

timing patterns to an arbitrarily fine degree is found to be of significance, we shall have another instance of continuously varying signals arising in the brain.

In almost every respect it is difficult to accept the proposition that the brain is a computer. The capacity of the neuron to fire at arbitrary rates provides elementary units whose occurrences do not constitute a discrete set, let alone a finite set discretely organized. The microstructure of firing patterns is observed to constitute a rich variety of events, and shows considerable structure and regularity.

In addition, neural accommodation and the biochemical events that are believed to subserve learning, make it difficult to believe that neurons have physical invariants of the kind needed to constitute computations. And the difficulties with localization theories make the computational requirement for closure very hard to satisfy in any particular aspect of brain function. The arousal systems in the brain stem and mid-brain reticular formations appear to be so widely connected in the thalamus and cortex that it is difficult to imagine how arbitrarily remote global factors may be excluded from important aspects of brain function.

More broadly, if we try to justify any computational interpretation of neural function, we shall have to explain their precursors in simpler organisms, and show how these computational characteristics are transmitted in ontogeny and phylogeny. Otherwise, we have to understand that computational habits are injected ad hoc. We may say that computation is an "emergent," but this of course has no explanatory value whatever.

We may say that the brain is really a computer whose irreducibles are rate codes. After all, it may be claimed, neurons count integral numbers of spikes. Nothing in this picture is justified. We do not know that neurons, or neural assemblies, in general "count" spikes or anything else. So little is known about the integration of complex neural activity, apart from the fact that it is more often than not graded, that there is no experimental ground to reject the position that firing rates are determining factors at arbitrary levels of neural integration. This observation is reinforced by Perkel and Bullock's statement that "no limit can be set, at least on the dimension that makes important conscious decisions 'high,' to the upper level that single-unit thresholds may be responsible for."[11] If single-unit thresholds can contribute to arbitrarily abstract levels of integration, then so indeed may rate codes and their microstructure, and there is then no basis for assuming that the contribution of membrane activity to brain processes is computational. Those discrete structures and functions that have been

identified may do no more than isolate physically the continuously varying influences that are required for reliable, predictable and repeatable integration into more complex continuously varying processes. Presently available evidence, in short, fails decisively to support the conclusion that the brain is a computer in a well defined physical sense, or that there is any significant physical aspect of brain function that is computational in character.

One may consider that the brain is in fact a device which operates on graded domains in such a way that the results either physically or in consciousness have the form of limits of convergent processes. The brain would be a graded processor that "converges" to a computer. We would then not expect to find computational activity in the brain. Rather, we would look for convergent processes. I cannot consider this alternative any further here except to observe that a theoretical framework for this proposal may be found in the recent studies of Scott[14,15] and others, studies which formulate the basic concepts of computation in terms of approximations, continuity and other topological notions.

Computation and Attention

I will be speaking now about my own personal experience with awareness. I distinguish awareness from attending. Awareness is an experience and attending is an act. One can be aware of the object of an act of attention, but one can also be aware without attending. One cannot, however, attend without being aware. Attention is thus conscious attention.

The central aspect of awareness is the unitary character of the form that attending takes. A particular occasion of attending will normally involve a variety of objects, aspects of these objects, relations among them and so on. But there is a threshold above which some single entity—an object, a feeling, an aspect, for example—is apprehended in a unitary way. In Walker's words[18] consciousness is an onset phenomenon. Below this threshold we cannot truly be said to be attending, although we may well be aware. The object of attention may have constituent structure that I am aware of, but the form the entity takes in my attention has a unitary character that it retains as long as it remains the focus of attention, a character that gives it a prominence in my awareness that no other object simultaneously present to awareness can have. My attention may shift to one of the constituents of that entity, but then that constituent itself becomes the focus of attention. My attention may shift to the fact that such and such is indeed a

constituent. Then that particular constituency relation will assume the unitary focal character.

I may attend to an event that originates in my periphery—my thumb, the position of a limb, my posture, a soothing sound, a bright light. I may attend to yesterday, to tomorrow, to the future, the past, now (with some difficulty), this, that, here, there, me, him, them, a piece of reasoning, a drink of water, an impulse, an image, red, color, an impression, impressions, my dog, dogs. In particular, my attention can fixate on one thing through an interval of time, a peculiarly difficult notion for those who want to find attention in the physical structures in the brain, since we have seen that at least at the level of membrane processes there are no readily detectable invariants. It is then difficult to suppose that these membrane events support the invariants needed to account for our direct experience with attention.

My attending to an entity can become more intensely fixated, and as this intensity increases the entity dominates my awareness more completely. I can attend to an arbitrarily selected point on a homogeneous surface, to a pair of points, to a set of points, to systematic arrays of points, to the idea of a random array of points, (but not perhaps to a particular such random array). I can attend to lines and curves connecting points on this surface, to neighborhoods containing points, to all the points on the surface, and to "no points on the surface." But no matter how diffuse the background details, the form taken by the foreground object of my focal awareness is always unitary, unique and invariant.

The physical shape of the object of awareness may be smoothly graded, as when I contemplate any moving object. But the form of attending is not the same as the substance of what is attended to. This form is an absolute that endures through time, as when I continue to attend to the motion of an object.

I notice that my awareness changes easily. Under suitable excitation my attention transfers abruptly from the cat's fur to the ringing telephone. With guidance it transfers from cat's fur to cat's paw to cat's claw to skin scratch to iodine bottle. Just as easily it shifts from integers to rational numbers to real numbers to vector spaces. But the form of these changes is always abrupt and discontinuous. In shifting from one entity to another my attention does not pass through a graded sequence of stages of attention, each differing but little from its neighbors. A shift in attention is the kind of act a computing agent might commit.

I am on occasion more or less aware of the attending aspect itself of the act of attention, but this aspect does not thrive as I attend more

sharply to the object of attention. On the other hand, I may try to attend to the act T of attending. I can easily do this, but the object of my attention then ceases to be the object of T and comes to be T itself. My new state of awareness has as its object the traces of T. Curiously, I can iterate this shifting of attention to the act of attention as many times as I like, with little effect on my attention. There are aspects of the description of this phenomenon that remain unchanged as I move from one level (of attending to attending) to another level (of attending to attending), aspects that may be expressed in the computational idea of recursion.

There seems to be a substrate out of which my consciousness fetches the focus of attention and its supporting structures. I can feel this substrate, I am aware of it, I know it's there. I am not permitted, however, to attend to its ingredients or its details. It is definitely graded in character. Perhaps, this is why I cannot attend to any differentiated part of it—there is no basis for differentiation. Some unknown process extracts from this substrate the discrete structures that become the objects of my attention and gives them their computational character. The focal entity in the foreground of my attending and its immediate neighbors are individuated, and support each other's definiteness. The stream of awareness is organized in its background as a system of graded processes and relationships. Pribram[13] has made significant suggestions about a possible continuously varying structure which may be related to this background substrate.

Abrupt and dramatic changes in attention may be brought about by discontinuities in the stream of data coming along the afferent pathways, or they may arise as a result of internal disturbance. In such cases, one would not quarrel with the judgment that the changes in the state of attending are discrete. In the more usual situation, temporally consecutive but distinct stages of attending are alike, on the average, except for some small aspect. Such shifts in attention may consist in change from the attended object to another object related to it, a separation of the object into parts or properties, a shift by generalization, a shift to a relation, etc. Each such change seems to me to occur abruptly as far as attention is concerned. Successive stages in awareness are similar to the successive stages in a computation, as far as their foreground structure is concerned. If the background of awareness flows continuously, the foreground lurches forward in saltatory leaps, producing state changes which I can only become aware of by a suppression of the background and a sharpening of my attending to what is in the foreground.

These observations suggest that there is discoverable order and

regularity in attending and in the processes of changing attention. It is proposed here that structures and processes involved in the form of attention and in attention changes are computational—systematic manipulations of pure form.

Indeed, natural computation at an essentially abstract level has already been sought and found. A generative transformational grammar for a natural language is a certain kind of computational specification.[2] It assumes that the production and understanding of language involve the recognition and manipulation of structures having definite form—finite and discrete—and that there are certain kinds of rules that represent relations among these structures. The word "generative" means that these structures, rules and relations are computational, and that the effect of applying rules to structures is managed, at least in part, by computational control mechanisms. The notion of a generative transformational grammar may not survive very far into the future, but at least two aspects of it are of considerable importance. One is that our experience with language may naturally be represented in terms of a finite system of categories which not only classify linguistic objects, but also reflect both their assembly into complex objects and their susceptibility to interpretation. The other is that occurrences of objects belonging to these categories can be organized in such a way that linguistic objects express simultaneously the invariance of certain categorial relations and the free variation of others. "I gave him some soup" and "What did I give him?" have certain meaning relations in common, although syntactic functions are quite distinct. The matter does not end with language. Lenneberg[9] has suggested that "All vertebrates are equipped to superimpose categories of functional equivalence upon stimulus configurations, to classify objects in such a way that a single type of response is given to any one member of a particular stimulus category." He observes that most higher animals have a species-specific and useful capacity for discrimination, and that "Most primates and probably many species in other mammalian orders have the capacity to relate various categories to one another and thus to respond to relations between things rather than to things themselves . . ."[9] Categorization, differentiation and transformation become basic organizing principles for higher animals, and perhaps for living matter in general. The membrane of a neuron, for example, differentiates ions into species according to their potential effects on the membrane, and makes use of this categorization to transform local aspects of its configuration into other configurations with "adaptive value" for the neuron.

It is proposed here that the mechanism that administers attention

organizes its interaction with the subject matter in discrete, finite and unitary ways. And shifts in attention are formally specified as preserving certain relations among these categories, while other aspects of the whole situation are allowed to change. Like cognitive differentiation and language, the pure uninterpreted form of attention is computational, while its substance, its interpretation, is non-computable.

I also notice that there seems to be great freedom in my ability to select objects of focal awareness. It seems that causal laws do not operate at the level at which the attending mechanism manipulates pure form. I may apprehend a great deal of causality in the substance of what I attend to. But the way in which factors outside attention control that attention is as mysterious as the computational form of that attention.

I think it is also true that the discretized and computational structures determining the form of my attending are terminal, or "dead end" in character. The form of what is attended supports a representation, a picture or image. An act of attending is in this respect like an act of measurement. The form of the result is an invariant which constitutes a systematic description to the attender of some specific aspect of what is attended. Once obtained, the form of this description does not change. A new description may appear, sufficiently close to its predecessor to give the illusion of a changing description, but each consecutive description is static and fixed. I attend to the motion of a particle and am aware that it is accelerating. My attending may have been fixed on the particle at one time, but if I know it to be accelerating, then my attending has shifted to its acceleration. From the act of measuring its position I have moved to the act of measuring its momentum. I do not do this in graded stages. It is the form of attending that determines that a measurement will have a definite, unitary and invariant value.

Discussion

In the earlier pages of this essay I took pains to elaborate in considerable detail exactly what it means for a physical process to be a computation, and I then observed that at the level of the nerve impulse nervous tissue cannot be understood to act computationally. Finally, I described my own experience with attention and suggested that when stripped of all interpretation, the forms of the attention mechanism appear to be computational. If, in fact, living systems fail in general to reveal computing mechanisms in their organization, then this fact may have significant consequences for the study of mind.

It is clear from the simple experience of attending to motion or to any other smoothly graded phenomenon that the substance of attention is not in general computable, although its form seems to be describable in computational terms. We may interpret these facts as indicating that computational structures arise exclusively at the interface at which reality manifests itself to awareness, that these computable forms are the instruments of attending, observing and measuring and nothing more. The anatomist's notion of articulation comes to mind. Skeletal structures articulate certain biological forms on which flesh and blood will later be hung. Computable structures articulate certain more general forms, on which reality will eventually be hung.

If these observations are correct, they may have consequences for experimental parapsychology as well. If we postulate a level of organization of reality that is computational and non-physical, we may try to refer paranormal phenomena to this level. For example, it is possible that paranormal communication occurs most easily in connection with the emergence of an act of conscious attention, in the state in which what we are about to attend to is arising from the unattended substrate under the action of forces presently unknown and by processes only faintly perceived. This act of arousing a unitary and attendable object out of the unconscious substrate is similar to the physical process of making a measurement. It may be an important target for parapsychological experiment within the framework proposed here. Griest[5] has already reported that language may affect psi functioning. We do not know whether this effect is due to the substance of language or to its form or grammar.

In addition, computing devices are widely used in experimental parapsychology, where the nature of the experimenter–subject–apparatus interactions is ill-understood or not understood at all. If computational processes are of fundamental and universal significance in the relation of consciousness to reality, then that system of ill-understood interactions may need to be expanded to include the computer, not merely as a piece of apparatus, but as a physical approximation to an abstract mechanism for which the mind may have an absolutely unique affinity. This latter possibility may itself be subject to experimental investigation.

BIBLIOGRAPHY

1. Chomsky, N., "Three models for the description of language," *I.R.E. Trans. on Infor. Theory*, Vol. *IT-2* (1956), pp. 113–124.
2. Chomsky, N., *Aspects of the Theory of Syntax*, M.I.T. Press (1965).

3. Church, A., "An unsolvable problem of elementary number theory." *Amer. Journal of Math.*, vol. *58* (1936), pp. 345–363.
4. Church, A., *The Calculi of Lambda Conversion*, Annals of Mathematics Studies No. 6, Princeton Univ. Press (1941).
5. Griest, W., "Psi speech communication and cognition," in *Extrasensory Ecology: Parapsychology and Anthropology*, edited by J. K. Long, Scarecrow Press (1977).
6. Kandel, E. R., *Cellular Basis of Behavior*, W. H. Freeman (1976).
7. Katz, B., *Nerve, Muscle, and Synapse*, McGraw Hill (1966).
8. Kleene, S. C., "General recursive functions of natural numbers." *Math. Ann.*, vol. *112* (1936), pp. 727–742.
9. Lenneberg, E. H., *The Biological Foundations of Language*, Wiley (1967).
10. Markov, A. A., *Theory of Algorithms*, Translated by the Office of Technical Services, U.S. Dept. of Commerce (1952).
11. Perkel, D. H. and T. H. Bullock, "Neural coding," in *Neurosciences Research Symposium Summaries*, edited by F. O. Schmitt, T. Melnechuk, G. C. Quarton and G. Adelman, M. I. T. Press (1969).
12. Post, E., "Formal reductions of the general combinatorial decision problem," *Amer. Journal of Math.*, vol. *65* (1943), pp. 197–215.
13. Pribram, K. H., *Languages of the Brain*, Prentice-Hall (1971).
14. Scott, D., "Outline of a mathematical theory of computation," *Proc. Fourth Annual Princeton Conference on Info. Sciences and Systems*, Princeton Univ. (1970), pp. 169–176.
15. Scott, D., "Models for various type-free calculi," in *Logic, Methodology and Philosophy of Science IV*, edited by Suppes, P., L. Henkin, A. Joja and G. C. Moisil, North-Holland (1973), pp. 157–187.
16. Shepherd, G. M., *The Synaptic Organization of the Brain*, Oxford Univ. Press (1974).
17. Turing, A. M., "On computable numbers with an application to the entscheidungsproblem," *Proc. London Math. Soc.*, ser. 2, vol. *42* (1937), pp. 230–266. Correction in vol. 43, pp. 544ff.
18. Walker, E. H., "The nature of consciousness," *Mathematical Biosciences*, vol. 7 (1970), pp. 131–178.

DISCUSSION

MORRIS: I would like to hear you comment more on your notion of computation as a physical event. I'm not challenging it. I just would like to hear a little bit more about what's persuaded you over the twenty-five years that it must be a physical event.

STORM: I think it's related to my problem with causality. I have a problem with causality in general and it's fixed, particularly in respect to computation. Computations, as we ordinarily see them, involve submitting one set of structures to a computer; then we run down to the ready room the next day and we get the printout, and we get something very different than we got before. It is, of course, possible in principle, that we could say that we just have pairs of structures and they're computationally related. But the concept of computation for me is the concept of an event—that I have something in my hands today, a column of numbers. We'll take a very simple example because its

paradigmatic. I have a column of numbers, and that's one form and I submit that to a computing machine and I get back the sum. Well, something must happen for me to get back the sum and I don't know how causality figures in determining the sum—it's as though I were making a measurement, I were submitting some numbers and having the computer do something like that for me. I'm saying, "Here are the numbers, and now manipulate, rearrange, reorganize," and the machine comes back and gives me something different and I see that it takes time to do that. It takes expenditure of energy to rearrange things in that way. Rearrangement of form, the spatial and temporal redistribution of form even when it's uninterpreted, takes time and it takes the expenditure of energy and therefore, the expenditure of time. That's what I'm trying to say.

MORRIS: Yes, this is what I thought it might boil down to, that computation must take place in space time. Is that what you're trying to say?

STORM: Yes.

BYERS: Is it possible to have multiple, simultaneous attending at the same level of brain functioning?

STORM: Yes it is. As far as I'm concerned, in my personal experience, it's a problem. I want to use the word "hysteria" in connection with that phenomenon. I don't like that phenomenon when it happens. The next thing that happens when I find myself attending, truly attending simultaneously to more than one thing, I start feeling as if I don't have it all together any more—the question perhaps of parallel processing. I don't know whether the purely abstract apparatus I'm talking about is able to process in parallel. But I know I'm happiest when I feel most together, when it's one thing that I'm dealing with; that my attention is on one thing. Now that's the question of simultaneity. The question of levels is a question of whether I am aware at this level. I'm aware at the present moment. I'm attending to the fact that words are coming out and I'm looking at you and in the background I'm thinking about what you just asked me. But I know that if I peer down underneath there are going to be other subordinate levels of structure down there which I could get at by attending to different things. I could start picking my ideas out, or I could start talking about the color of your coat.

UNIDENTIFIED VOICE: There was some research which I would not try to cite at the moment, but which I read a couple of years ago, about someone who attacked the problem of whether one could do two things

at the same time—in this case, read and write quite different stuff, and found that initially that was not possible. That is, the literature seemed to suggest that was not possible, but he found that with training it was, and the reason that it had seemed that it wasn't was that nobody had ever taken the time to get over the hump of learning to be trained to do that.

STORM: I wonder if that's ever really going to be a matter of attending to two things at once or if we might not find it to be a matter of being able to perform one thing or perform two things and I wonder what the attention experience would be like. My friends tell me that sometimes I act as though I'm attending to several things at once, and I really wonder what it would feel like. I think I could not say that myself. My own personal experience about attending—if you said, "What does it feel like, Edward, to attend to two things simultaneously," that's one place where no matter how bold I felt, I'd have to say I don't know. My own experience is I can do two things at once. I can write out by habit my first name on the paper while I'm talking to you, but that's something different. It's purely formal attending.

MORRIS: Do you envision brain function as a discrete series of events?

STORM: I'm not a physiologist, but from what I have read, I am beginning to elaborate an opinion that we don't know anything about it. I certainly am elaborating the opinion that I am very unhappy about the idea that it's the impulse that's the important thing. I have the greatest respect for neurophysiologists. I think they've got one of the most incredibly difficult physical science tasks of all time, and hats off to everything they try. I think they should be given boundless amounts of money to do it, but I think lots of them are on the wrong track in rigidly fixing their attention on this discrete impulse. I think it's maybe an overstatement for one of those fellows to say that its's an epiphenomenon. I don't think that's reasonable, because a lot of experiments on innervation of muscle tissue and other matters like that, where onset is certainly an important thing, show that an individual neuron's single firing is enough to trigger a wing-beat in an insect, and so you can't say it's an epiphenomenon. But I'm not talking about the operational issue. I'm talking about my mental life and I think at the level of mental life, it might be the case that all the discretizing and digitalizing in the brain is epiphenomenal, that its important feature is that it reflects a continuous and graded base out of which a purely abstract mechanism of some completely unknown kind at the present time fetches up what I'm attending to.

NASH: You have divided consciousness into a series of sensations with a background of awareness. According to Buddhist philosophy, there is only a series of sensations, and the background of continuous awareness is an illusion.

STORM: I think the only fair way I can answer it is to tell you what I personally think and feel, and it is the feelings that matter to me. I would also go this far—this is probably the biggest thing that has attracted me to try to make friends with parapsychologists, and that is it is not the discrete finite and bounded and therefore rational and logical structures that make me feel good and happy and make me resonate with reality and make me get it together. We could determine it on the basis of individual experience, and at the moment, I have no experience with Buddhism. But as far as my own personal experience goes, I think that there is an element of alienation in the discretizing. It can't be foregone. I think I'd be in trouble if I couldn't compute in my mind, but I also think that I get in big trouble if I don't do anything but compute. And I think there are social, educationl, political and cultural consequences of this observation as well. There is a theorem in recursive function theory that intrinsically relates the concepts of deductive logic to computation. If a set of sentences in a form of logic is universally valid, that is, if they all come out true under all interpretations, then there is a Turing machine that will determine that fact in a finite number of steps. That's an absolutely shattering result, I think. For every finite set of sentences which is logically valid, there is a Turing machine which will determine that validity in a finite number of steps. And so if I decide that boundaries have to be put on computation in the human personality, then that's going to mean that boundaries will have to be put on discrete, deductive logic as well.

MORRIS: When I was a graduate student at Duke, I was a subject in a really nasty perception experiment done by Nikolai Khokhlov. They would present to me simultaneously a tone and a colored square, and I was allowed to feel the texture of that colored square for one second. All three pieces of information came at once—tone, color and texture. I was trained along the gradients and asked to make judgments after the end of that second as to which level of stimulus I had just experienced for each of the three sense modalities. In other words, all three sense modalities were activated within that second, and I certainly was trying like hell to attend to all three things. The way I had to solve the problem was simply to store everything quickly and then sequentially process the information consciously afterwards. I think the relevance of this is that it seems to be possible to acquire a lot of

information simultaneously and at least storing it in short term memory. At any given moment you only know you've been attending to something on the basis of what you retrieve from short term memory.

STORM: First of all, with respect to attending and retrieving and storing—on the Turing machine, there's a tiny little amount of memory in the state, but there's a lot of memory on the tape, and when we speak about memory in these regards, I really would like to know where memory is in the brain. And are we really remembering in the sense that we use that word? Does memory mean the same for us as it means for the devices we currently use?

The other remark I want to make in response to your question is that I can't understand anything about perception. I thought I was getting a handle on perception and someone loaned me a book by James Gibson. The psychologists here, I'm sure, know about James Gibson. I read the book and said, I think there's something very right about this and also there's something very wrong about this. James Gibson believes that the experience of perception has constituents. As I put my hand here—that act of perception involves implicitly both things I'm touching—the fingers, my arm, my hands and then all the way up to the brain, and then the signals that come from the brain back down to the arms through to the fingers. As we know now, every time you receive something, signals come from higher brain centers and modify the receptors, so that the information we're getting is constantly being modulated. And it's not clear to me that a good bit of processing and integration, even cross modal information isn't taking place in the peripheral system. One experiment I remember reading about was by Morrell. He had a patient with an open skull, and he found the neuron that responded to certain colors, and changed colors and the neuron responded with a different profile three times. The excitation of the neuron took on a characteristic shape for characteristic colors. And then they found another astonishing thing. If they accompanied the color presentation with sound in different places, the statistical profile of repetitions of the firing pattern changed systematically with the position of the sound source, and this was a neuron that was in the visual system.

NEUTRINO THEORY OF PSI PHENOMENA

MARTIN RUDERFER

The basic element of communication is information. In paranormal communication it is the tenuous, but nonetheless real, product of the neural system—that which we describe generally as thought. Therein lies the whole paradox of parapsychology as a science: Its basic element is undeniably tangible to each of us, yet, unlike the basic elements of any other science, a thought has never been isolated, weighed, measured, seen, tasted, smelled or grasped. It is not surprising that parapsychology has long been regarded as an orphan by the established sciences.

The remarkable irony is that thoughts are the font of the vast knowledge that comprises existing science. Considering man's astounding success in applying the thought process to other phenomena, may we not therefore ask: Can this process be applied to divine its own nature?

Although it is undeniable that we sense our own thoughts, we cannot reliably observe those of others. Despite the bleak outlook for direct measurement, the indisputable reality of thoughts requires that they be a legitimate subject for scientific study. The observability problem merely demands the exercise of caution in formulating testable concepts. To optimize the potential for agreement so necessary for scientific progress, a simple problem-solving technique termed "binary reasoning" is applied here, as follows: *Questions are composed which are answerable from available evidence by only one of two possible choices, such as yes-no, either-or, more-less, etc.*

This is merely a formalization of the essential problem-solving process of the mind as, e.g., tacitly applied by detectives and scientists and employed in games such as the well-known "Twenty Questions." It offers three immediate advantages for scientific theory-building:

(1) Acceptance or rejection of a theory as a whole becomes arbitrary and unrigorous; instead, each binary step is required to be independently evaluated.

(2) A quantitative measure of the validity of a theory is given by 2^n, where n is the number of questions correctly answered. Thus for n = 10 (20), one out of about one thousand (million) theories is affirmed. It is apparent that even a small number of correctly answered questions can provide significant insight into any problem.

(3) Because of the synergistic reinforcement of the answered questions toward a definite solution to a problem, quality of evidence—although always important—is often not critical; in problem solving, a number of little arrows is equivalent to one big arrow for denoting direction.

Binary reasoning is thus a wholistic approach vis-à-vis the usual specialized approach, e.g., of the text-book. In applying binary reasoning to thought and psi phenomena, the main purpose is to delineate the boundary of the forest rather than describe the trees, i.e., to outline a seminal psi theory which is founded on our present knowledge of the universe. Despite the paucity of directly observed data relevant to thought transmissions, a comprehensive psi theory does result. Because of space limitations, the published literature is heavily relied on for details. Although all answers are accorded an above-chance probability by the use of available evidence, direct or indirect, it should be especially borne in mind that no matter how inchoate the discussion or evidence, *further research cannot invalidate the overall theory unless it can change the binary state constituting any answer.* In the theory which follows each question/answer pair is assigned an arabic number.

1. *Is the present body of physical knowledge essential to an understanding of the paranormal?* Yes.

An inviolate tenet of information theory is the association of an energy transfer with every information transfer. Let us apply this to ESP experiments in which above-chance results are obtained indicative of extrasensory information transfer. There are then two extreme interpretations of such experiments:

(a) The skeptic claims there is no perceived energy flow, therefore there is no information transfer; he ascribes the results to hypersensitivity, chance, hoax, error, magic, or some other "normal" explanation.

(b) The believer is prepared to ignore any such theoretical rejection in favor of the elusive, but persistent, findings of psychic research; he stands firm in his faith that some extrasensory process is involved in significant observations.

The net result is an impasse which has long contributed to the general rejection of parapsychology as a veridical science. Yet neither of these interpretations is rigorously justifiable. By denying an energy

transfer, the skeptic presumes he can detect all the possible means of energy transfer in the universe, whereas any believer who indifferently ignores physical theory is trading the solidly based structure of science for a castle in the sky. However, there is a simple solution to this impasse which satisfies both interpretations: We need only explicitly specify that every ESP process is associated with an *unobserved* transfer of energy. Then information theory is not technically violated and the extrasensory interpretation need not be disallowed.

This is more than semantic sophistry, for *no energy* and *unobserved energy* have vastly different connotations. *No energy* is an injunction for all time; *unobserved energy* is only a temporary restriction because it is dependent upon our ability to measure. This ability has been changing rapidly in recent times, for just in the last century several forms of energy have been discovered to which man was oblivious for ages, as radio waves, X-rays, ultrasonics, neutrino radiation and cosmic rays. In light of our still rapidly developing technology it is unreasonable to assume that some form of energy transfer capable of conveying ESP information does not exist. Information theory thereby serves to replace the impasse represented by (a) and (b) and its attendant prolongation of controversy by directing attention to the search for a suitable energy source. In effect, the entire class of psi theories which is in accord with information theory and, concomitantly, with the whole body of present scientific knowledge, is being tacitly selected by a "yes" answer.

2. *Can interaction of a presently unobserved energy source with living things account for the biopsychological properties of psi phenomena?* Yes.

An affirmative answer is provided by the recent theory of Ehrenwald.[1] He initially assumes the excitation of body cells, specifically neurons, by some unknown means and then proceeds to show that given such neural excitation the observed properties of ESP experiments can be accounted for by known biopsychological processes. In brief, he essentially notes that psi-derived information is basically fragmentary, as in subliminal perception and in the perceptions of individuals with damaged left brains, and proposes that all such information is processed via the right brain subject to censorship by the reticular formation, the interest center of the brain. This is substantiated by Dixon's discussion on subliminal perception.[2] By adopting such a theory, we are directed to the nature of the primary unobserved excitation of living cells in the search for the origin of ESP. We may, after Osis and Turner,[3] term this the "ESP channel."

3. *Is there a conventional energy source that is adequate to account for the ESP channel?* No.

Only three of the physical parameters related to ESP information

transfer need be invoked to answer this question: effect of distance, penetrability and required bandwidth. The need for ESP to operate over the largest separation available on earth effectively eliminates all but conventional electromagnetic propagation. The necessity for the ESP channel to penetrate into the body, even when situated in Faraday cages, mines and underwater, further eliminates all but very low frequency electromagnetic radiation. However, this is then eliminated by the need to have available a bandwidth capability of at least 10^{10} Hz, as estimated by Bibbero[4] for telepathic communication. When the extremely low detection efficiency of very low frequency radiation by an antenna the size of the brain is additionally considered, electromagnetic radiation becomes inadequate as a general energy source. Nonetheless, conventional electromagnetic radiation cannot yet be completely excluded as a possible explanation in rare or restricted cases of ESP.

4. *Does physical theory require the existence of forms of energy which are presently unobserved?* Yes.

The zero datum for energy is assigned by convention. In modern physics this is the energy of the vacuum. This question could thus have been alternately posed in the form: Is the vacuum a void of a plenum?

At least three forms of presently unobserved energy which pervade the universe are acknowledged by physical theory to exist: Dirac's infinite energy sea of unobservable electrons,[5] Wheeler's "wormhole" vacuum structure[6] of density $\approx 10^{94}$ g/cm^3 having the characteristic Planck length of 10^{-33} cm, and the neutrino sea. The latter results from neutrinos and antineutrinos which fill the universe from those left over at the formation of the universe, continuously emitted by stellar bodies and radioactive decays, and created in cosmic ray showers. Since 1962, it has been recognized from present observational limits that the energy contained in the neutrino sea may far exceed all the observable energy in the universe.[7] This alone is sufficient to support the vacuum as an energy plenum.

5. *Can any of the unobserved forms of energy in the vacuum interact with matter?* Yes.

Of the three unobserved sources, only one has thus far been directly verified to interact with matter—the neutrinos. There are two known types of neutrino interactions: Inverse beta-decay, in which a neutrino is absorbed by an atomic nucleus thereby transmuting it to another element and Compton scattering between neutrinos and elementary particles, in which there is an exchange of energy but no change in structure. The strength of each interaction is measured as a cross-sectional area.

The presently verified scattering effect, known as the Vector-Axial (V-A) interaction, has a cross-sectional area which increases monotonically with neutrino energy.[8] Because of its verification at high energies, the V-A interaction requires that low-energy neutrinos must have a finite interaction with matter.

6. *Is it possible for neutrinos to couple energetically to living cells?* Yes.

Inverse beta-decay is substantially localized within the atomic nucleus, rather than being directly coupled to the electrochemical forces in living cells. This combined with the restrictions on the high-energy neutrino spectrum makes inverse beta-decay an unlikely candidate for an ESP channel.

In scattering phenomena, relative energy transfer is maximum when the interacting particles have similar energies. Because of the high (low) mass of atomic nuclei (electrons), the relative energy transfer from scattering of neutrinos with high (low) energy is significantly greater with nuclei (electrons). Since the high-energy portion of the neutrino sea is severely restricted by observed limits from past experiments, scattering of electrons by the large number of low-energy neutrinos survives as the most significant coupling between the neutrino sea and matter. Because the electrochemical energy levels of electrons within living cells are correspondingly low, neutrino-electron scattering represents the most eligible energy source for the ESP channel.

7. *Do the properties of neutrino-electron scattering match the properties required for the ESP channel?* Yes.

The essential physical properties—distance, penetrability and bandwidth—are satisfied by neutrino-electron scattering. Neutrinos travel with the speed of light and, because of the low scattering cross-section, are highly penetrating. Thus the potential to couple to living cells anywhere on Earth is inherently satisfied. There is no known effective shield for neutrino radiation.

The problem of bandwidth is less obvious. It is dependent on whether there is a selective factor in the scattering between neutrinos and electrons which, in turn, depends on the structures of neutrinos and electrons. Prevalent theory has very little to offer in this respect. Both particles are now regarded as mathematical points and the conventional V-A interaction provides no selective factor in their scattering. However, there is a characteristic frequency known to be associated with each particle given by

$$E_e = hf_e \qquad E_\nu = hf_\nu/2 \tag{1a,b}$$

where E (f) refers to energy (frequency), $h = 6.63 \times 10^{-27}$ erg-sec is

Planck's constant of action and subscripts e (ν) refer to the electron (neutrino). Thus, a neutrino has the same frequency as an electron of twice the neutrino's energy. If the frequencies associated with the two particles mediate neutrino-electron scattering to affect the intensity of scattering, a resonance factor is introduced in the scattering interaction and the frequency range of neutrinos in the neutrino sea determines the maximum available bandwidth of the energy (and hence information) transfer rate obtainable by scattering. For the typical electron binding energies in living molecules of the order of 0.1 electron-volts (1.6×10^{-13} ergs), the frequency of neutrinos of half this energy is by eq. (1b) of the order of 1.2×10^{13} Hz. This is ample to provide via resonant scattering the high information rate required to account for the most elaborate cases of ESP information transfer.

A physical basis for a resonant interaction is provided by the phasor theory of neutrino, photon and electron structures.[9,10] Phasor language derives directly from Maxwell's equations and has long been successfully applied to macroscopic electromagnetic phenomena. The phasor structure of neutrinos is revealed to be a helical form of electromagnetism; the composite photon is demonstrated to be a resonant interaction of a neutrino and antineutrino; and the electron (positron) is shown to be a resonant interaction of two neutrinos (antineutrinos) in accord with the quantum-electrodynamic description of the electron. The resonant interaction of these particles is further shown to result from the complex Poynting vector, a well-known tool employed in macroscopic electromagnetic interactions.

Because the application of phasor language is rigorously in accord with Maxwell's equations and with known properties of the neutrino, photon, and electron, it cannot be denied as a basis for resonant neutrino-electron scattering. Furthermore, phasor theory delineates the reason why quantum theory has persistently failed to provide a composite photon or a physical structure for the electron: The conventional form of the Schrödinger wave equation is incomplete. Phasor theory demonstrates that the Schrödinger equation derives directly from Maxwell's equations and, in so doing, supplies the missing information. Parenthetically, all prior applications of the quantum-mechanical interpretation of the Schrödinger equation to psi theory are rendered incomplete and, therefore, suspect.

The resonant interaction is manifest only when the left-(right-)hand helicity of the neutrino (antineutrino) matches the left-(right-)hand helicity of the electron (positron) components. The interaction cross-section is maximum when the helical wavelengths are identical

and reverts to the V-A value as the wavelengths diverge. Since electrons predominate in the universe of matter, only resonant interactions of the left-hand neutrino are of primary interest. However, it should be noted that the right-hand antineutrino form may be relevant to interaction with right-hand molecules, as DNA and RNA. Unless otherwise indicated, "neutrino" in the rest of this report refers only to the left-hand form.

8. *Is resonant neutrino-electron scattering supported by observation?* Yes.

Present solar theory requires about two percent of the radiated energy of Sun to be in the form of neutrinos emitted from the core of Sun. Detection of solar neutrinos of the highest energies, those from boron-8 (^{8}B) decays, by the Davis solar neutrino experiment has been underway for some time. From the latest data, only ⅓ of the expected number is being detected.[11] The failure to detect the predicted number has been characterized as a major crisis for present physical theory.

One of the many proposals to account for this crisis is the existence of a resonant neutrino-electron scattering.[12] The required resonant cross-section corresponding to the mean energy of the ^{8}B neutrinos is found to be about nine orders higher than the V-A cross-section *within Sun*. Because of the difficulty of detecting individual neutrinos this is still too small to be presently detected in laboratory experiments. However, due to the high electron energies and the large number of interactions within stellar interiors, sufficient energy is transferred to stellar shells to produce observable consequences. It has been shown[10,12] that this is relevant to a number of heretofore unexplained astrophysical phenomena as stellar evolution, stellar oscillation, the origin of flare energy, and nova and supernova events. These further support the existence of resonant scattering.

9. *Is neutrino-electron scattering intrinsically detectable by living tissue?* Yes.

To answer this question it is necessary to know the total power transfer to living tissue. This is the portion of neutrino energy transferred to an electron per mean scattering event multiplied by the total power flux of the neutrino sea. The former is known to be small, but, although the latter is believed to be large, it has never been measured. However, another more precisely known neutrino source—that from Sun—is available for a more accurate assessment of detectability.

The primary biological effect of solar neutrinos is the random scattering in the brain which produces random noise superimposed on the coherent neural processes. The essential criterion for detectability by living tissue is, then, the noise frequency f in a tissue of active mass

M. This has been determined from existing data to be[13]

$$f/M \approx 3.7 \times 10^{38}\ \sigma\ \text{Hz/g} \tag{2}$$

where σ is the interaction cross-section. For the V-A interaction, f is marginally small, but for the resonant cross-section corresponding to the mean solar neutrino energy of 0.263 Mev from the dominant proton-proton process, $f/M \approx 100$ Hz/g. This is well within the noise detection range of neural systems of reasonable mass. The actual noise power per unit mass is given as

$$P/M \approx 1.5 \times 10^{27}\ \sigma\ \text{erg/g-sec} \tag{3}$$

For resonant scattering, $\sigma \approx 2.8 \times 10^{-37}$ cm^2, so $P/M \approx 4.2 \times 10^{-10}$ erg/g-sec. For a human adult brain of 1300 g, $P \approx 5 \times 10^{-7}$ erg/sec. Such a power is equivalent to the detection, for example, by the eye of $\sim 10^5$ optical photons/sec. This is several orders above the energy detection threshold of living cells, as typified by the sensitivity of the retina. From the standpoint of noise frequency and noise power, it is thus inherently feasible for living things to detect scattering of solar neutrinos with electrons in neural tissue.

10. *Can living things now be applying a solar neutrino detection capability?* Yes.

The study of living things discloses a remarkable ability to utilize all available forms of energy for maximizing survival. Accordingly, the ability of living things to detect solar neutrinos is dependent upon its potential for enhancing the probability of survival.

The detection of random noise in the environment, such as optical, sonic or chemical, is the initial step in the evolution of a corresponding visual, aural or olfactory sense. Since even the most primitive biosystems have such noise-detecting capabilities, the basic processing techniques for detection of neutrino scattering noise already exists. Because solar radiation is directional, electrons scattered by solar neutrinos have a directional anisotropy. Thus, a dual processing system, as employed for the other senses, permits the detection of the instantaneous position of Sun. This is applicable to circadian timing and to navigation, as noted.[13] The primary means by which circadian clocks are synchronized has still not been positively identified. Although numerous cues are used by various species for navigation, the primary reference applied in homing in many species has also not been positively identified. The possibility that detection of solar neutrinos has been applied for such purposes is therefore mandatory.

Scattering of electrons by neutrinos is also demanded in inanimate matter. It has long been observed that associated with electrons is a

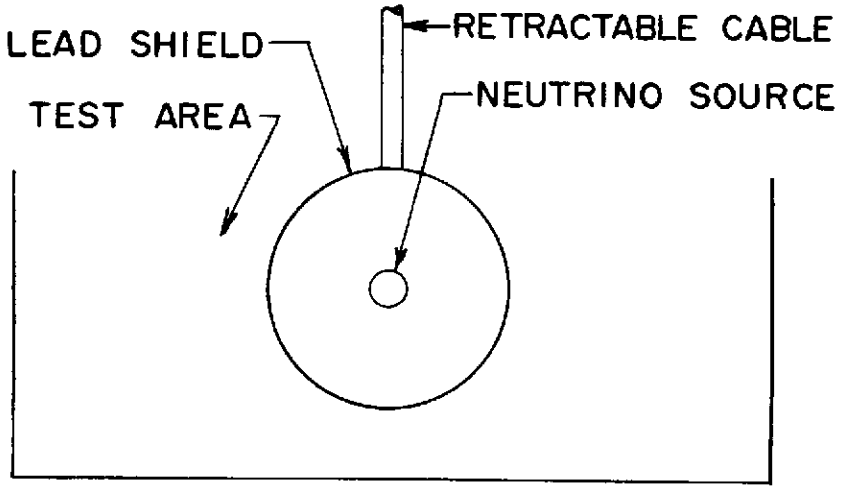


Figure 1. Proposed test for detectability of neutrinos by animate or inanimate matter. The neutrino source is a positron emitting radioactive source capable of producing a neutrino flux just outside the lead shield at least equal to the solar neutrino flux at Earth.

"1/f" electrical noise, wherein, over a considerable range, noise power increases as noise frequency decreases. Such a characteristic is intrinsically required by scattering from the high energy portion of the solar neutrino spectrum, in which the number of neutrinos decreases as energy increases. The existence of a similar 1/f noise characteristic at the Ranvier nodes of frog axons has been measured by Verveen and Derksen.[14] This reinforces the feasibility that biosystems are detecting solar neutrinos.

We are now at a point where the heuristic power of theory asserts itself. By a conceptually simple test it becomes possible to determine whether 1/f noise and/or biological effects are induced by solar neutrinos and, thereby, to affirm all the question/answer sets considered thus far.

The basic design of such a test, as shown in Fig. 1, consists of a source of neutrinos retractably positioned above a test area. The source is an artificially radioactive element of the neutrino/positron emitting type now available from cyclotrons and nuclear reactors. It is encased in a lead shield to reduce the gamma-ray emission associated with such a source. The neutrinos easily pass through the shield producing maximum neutrino flux just outside it. For a source of a few kiloCuries, a neutrino flux is available comparable to that arriving from Sun at Earth's surface—a mean number density of $\sim 10^{11}$ neutrinos/cm^2-sec and a mean power flux of 2.7×10^4 erg/cm^2-sec. The test area may

contain inanimate matter, plants, insects, fish, birds or small mammals to test for 1/f noise, effects on biological rhythm and orientation and any other behavioral reactions. In addition, comparison tests with a second control source producing only gamma rays of intensity equal to that of the neutrino source are also feasible. This allows the diameter of the lead shield to be reduced in some tests to increase sensitivity by increasing the available neutrino flux density closer to the source and measuring the differential effect with and without neutrinos, but with the same gamma-ray background.

The total cost of such a neutrino source is of the order of $500,000. However it is possible to time-share the source, and hence cost, among a number of experiments from different disciplines, e.g., for investigating neutrino scattering with regard to the mystery of the Davis experiment, for which conventional proposals projected to cost millions of dollars are currently being considered.[11] Because living cells are active detectors, they have the added advantage of being able to also test a resonant scattering explanation of the Davis experiment.

Any unusual behavior associable only with the presence of the neutrino flux provides experimental proof of detectability. Such a demonstration, by validating the ten question/answer pairs provides a figure of merit of $2^{10} = 1024$ in support of the theory advanced thus far.

11. *Does use of solar neutrinos also require use of the neutrino sea by living things?* Yes.

The power flux of the neutrino sea differs from the solar flux in three major respects: It is omnidirectional, is projected to be much larger, and has a different energy spectrum.

The neutrino sea flux is unmeasured, but several attempts have been made to estimate it.[15] These have all been based on the *assumption* of Fermi-Dirac statistics only because neutrinos are fermions. However, this assumption has no valid observational or theoretical support: Fermi-Dirac statistics have been verified only for gases of matter, as electrons, and its theoretical application to neutrino gases has been shown to be defective based on Pauli's discussion of the connection between special relativity and statistics.[16] The net result is the admissibility of Bose-Einstein statistics for determining an upper limit to the neutrino sea power flux. Note, especially, that a gravitational limit for massless neutrinos has already been disallowed by general relativity as shown by Davis and Ray.[17]

The total power flux in one direction through a hemisphere with a base of unit area is, from elementary radiation theory,

$$S = c\rho/4 \tag{4}$$

where $c = 3 \times 10^{10}$ cm/sec is the speed of light and ρ is the energy density of the neutrino sea. This also applies in any frequency interval. For the power flux in frequency interval df, the Bose-Einstein upper limit is, as for a photon gas,[18]

$$S_f = \kappa T^4 Z du/df = \kappa T^3 Z h/k \tag{5}$$

where $u = hf/kT$, κ is the Stefan-Boltzmann constant 5.67×10^{-5} erg/cm^2-sec-deg, k is the Boltzmann constant 1.38×10^{-16} erg/deg, T is the temperature in °K, and

$$Z = 15u^3/\pi^4(e^u - 1) \tag{6}$$

The total power flux is the Stefan-Boltzmann law

$$S = \int_0^\infty S_f df = \kappa' T^4 \tag{7}$$

since $Z = 1$ when integrated over all frequencies.

Particle-antiparticle symmetry in the universe demands that S_f be composed of two equal neutrino and antineutrino components. The composite photon required by phasor theory[9] then requires eq. (5) to apply equally to a photon gas and to a neutrino sea obeying particle-antiparticle symmetry. However, the two gases differ in spin properties: Neutrino and antineutrino spins are in the same direction in the photon but are randomly oriented in the neutrino sea. If the latter were not so, the neutrino sea would endow the vacuum with an observable spin contrary to our inability to directly detect any gross property of the vacuum. Thus, it is particle-antiparticle symmetry which effectively determines the appropriate statistics of the neutrino sea. Fermi-Dirac statistics would accurately apply to the neutrino sea only to the extent of its departure from particle-antiparticle symmetry.

Experimental values of S_f are obtained by applying eq. (4) to the upper limits of the observed ρ in the frequency interval Δf, as summarized by Marx[19] and shown in Table 1. These have been doubled to obtain the total value of S_f in accord with the equal neutrino and antineutrino fluxes required by particle-antiparticle symmetry in the universe. Then from eq. (5) the average temperature from the two sets of data is $T = 2.3 \times 10^9$ °K. Application of eqs. (7) and (4) next gives the total values for S and ρ, respectively, as shown in Table 1. The values for the neutrino portion only are $S/2 = 8.0 \times 10^{32}$ erg/cm^2-sec (5.0×10^{38} Mev/cm^2-sec) and $\rho/2 = 1.0 \times 10^{23}$ erg/cm^3 (120 g/cm^3).

Only the negligible portion of ρ and S represented by the high-energy neutrino interactions given by Marx are directly observable. Although ρ may seem high compared to the gross density

TABLE 1

Properties of a Bose-Einstein Neutrino Sea

	Neutrino	Antineutrino	Mean
Observed* neutrino density, g/cm^3	$\lesssim 10^{-25}$	$\lesssim 10^{-24}$	
Energy range of observations,* Mev	0.8 to 3	1.8 to 10	
Δf = frequency range of observations, Hz	5.3×10^{20}	2.0×10^{21}	
ρ_f = total spectral density#, erg/cm^3-Hz	3.4×10^{-25}	9.1×10^{-25}	
Mean of energy range, Mev	1.9	5.9	
S_f from eq. (4), erg/cm^2-sec-Hz	2.5×10^{-15}	6.8×10^{-15}	
T from eq. (5), °K	1.3×10^{9}	3.3×10^{9}	2.3×10^{9}
S from eq. (7), erg/cm^2-sec			1.6×10^{33}
ρ from eq. (4), erg/cm^3			2.1×10^{23}

* Based on data summarized by Marx.[19]

\# Includes doubling of observed values to be in accord with particle-antiparticle symmetry.

of matter in the universe, it is negligible compared, for example, to the unobservable Wheeler-Planck density.

The plot of Z vs. u, which determines the neutrino sea energy spectrum, is shown in Fig. 2. The maximum occurs at $u = 2.80$ corresponding to a neutrino energy $hf/2 = 0.28$ Mev. The mean neutrino energy is $\langle E \rangle \approx kT/2 = 0.10$ Mev. Because these values are so close to the 0.263 Mev mean energy of solar neutrinos, two conclusions follow: (1) The neutrino sea is, or is close to, equilibrium with the neutrino emitting stellar masses distributed throughout the universe so that the Bose-Einstein upper limit becomes an actual estimate. (2) The ability of living things to detect the directional solar neutrino flux demands their ability to also utilize the omnidirectional neutrino sea.

12. *Can the neutrino sea be employed in the chemistry of living things?* Yes.

The neutrino sea power flux obtained from experiment is so high relative to the gross density of matter in the universe that we must regard all matter as embedded in an isotropic neutrino soup that is energetically dense, but dynamically thin. An electron in this neutrino soup slightly interacts simultaneously with a large number flux of mean value $S/2\langle E \rangle = 5.0 \times 10^{39}$ neutrinos/cm^2-sec passing by in all directions. For a perfectly isotropic sea, interactions in opposite directions cancel and there is no net effect on the electron. (This is primarily why a smaller, but directional, solar flux can be detected.) However, to the extent statistical time variations occur, the electron's position fluctuates slightly. In combination with the effect of the directional solar flux, this provides a phenomenal origin of 1/f noise and a physical source of the quantum electrodynamic electron fluctuation measured by the Lamb shift and the anomalous gyromagnetic ratio.

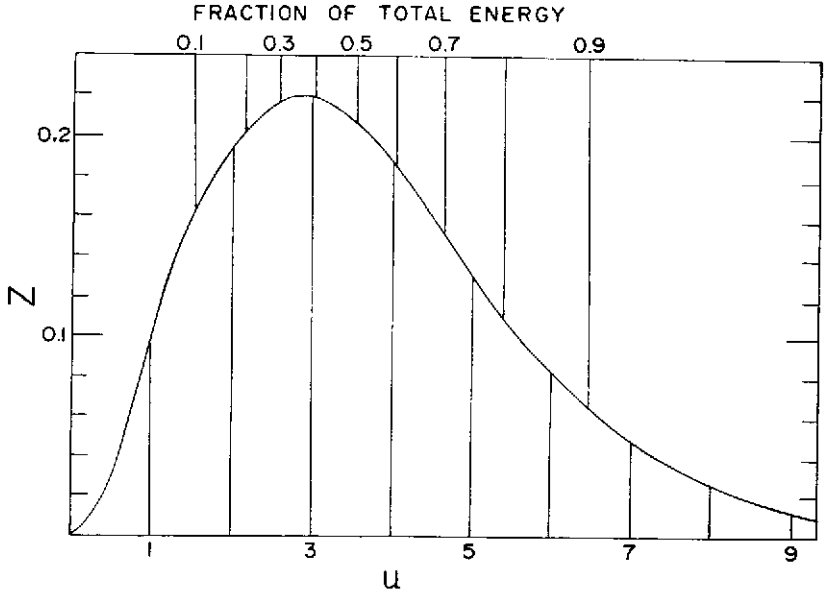


Figure 2. Neutrino sea power spectrum shown in generalized form. The ordinate $Z = 15u^3/\pi^4\ (e^u - 1)$ is proportional to the power flux S_f and density ρ_f per frequency increment. The abscissa $u = hf/kT$ is proportional to neutrino energy and frequency. Absolute values of Z and u are determined by the temperature of the neutrino sea. The upper scale gives the fraction of energy, power, or density remaining in the neutrino sea for all neutrinos with energies less than that of a given u.

Consider, now, an electron in a molecule. Whenever the electron changes state it undergoes displacement, during which it scatters asymmetrically with the passing neutrinos. This induces a corresponding perturbation in the isotropy of the neutrino sea which propagates outward with an intensity that varies inversely as the square of distance. Let an electron transition induce a perturbation having amplitude A/s^2 at the equipotential surface of a sphere of radius s closely surrounding the molecule. At a distance $r > s$ the amplitude is A/r^2. Let there now be within the sphere N identical molecules each having an electron making an identical transition. The total perturbation becomes NA/r^2. This is then sufficient to just excite one electron in an identical molecule at distance r when

$$r \approx N^{1/2}s \tag{8}$$

For N large, *a long-range force results which is not available with normal chemical forces.* Such a long-range force is uniquely applicable to living systems where coherent redundancy in active tissue is widespread. The

example above merely represents one way living things may employ redundancy to make use of the neutrino sea.

13. *Can the neutrino sea be employed in the thought process?* Yes.

Consider, next, a synaptic knob containing vesicules each of which contain N similar neurotransmitter molecules. For the more sensitive synapses, an electrical signal at the knob surface of the order of the energy required to excite one molecule suffices to initiate a synaptic event. An essentially simultaneous change of state in the N molecules of discharged vesicules during the event results in a neutrino sea perturbation capable of exciting a similar nearby synapse. Since $N \approx 5 \times 10^3$ and the vesicule radius is typically $s = 1.5 \times 10^{-6}$ cm, like synapses within a range of $r \approx 10^{-4}$ cm may thereby be excited by a single discharged vesicule. When the simultaneous discharge of m vesicules is required to initiate a synaptic event, $r \approx m^{1/2}\ 10^{-4}$ cm.

The total number of synapses in the human brain is now estimated[20] at 10^{13}. More recent and favorable estimates are 10^{14} and 10^{15}. (See *Sci. Amer.*, Sep. 1979. pp. 46, 221.) For the mean brain volume of ~1300 cm^3, the mean spacing between synapses $\approx 3 \times 10^{-4}$ cm. Since this is of the order of r, a "stepping-stone" excitation of similar synapses throughout the brain *which is independent of the neural network* becomes feasible. This is particularly favorable in regions of the brain where the density of synapses is above average and excitation energies are low, as in the dendritic regions of higher brain function. The sensitivity of such synapses is of the order of one light quantum, which corresponds to the energy sufficient to excite one molecule as assumed above; moreover, in these regions coupling is electrotonic and hence is essentially spikeless.[21] Thus, a long-range neutrino force is probable in at least such regions of the brain. This essentially means that the density of synapses is another independent variable that may be exploited in living systems for facilitating brain function. As noted by Schmitt et al.,[22] density of synapses increases with phylogeny and is highest in man.

Such a long-range force is pertinent to a rather remarkable theory of the consciousness proposed by Walker,[23] in which a long-range "stepping-stone" mechanism in the brain was first postulated. The basic innovation of Walker's theory may be characterized as the existence of a supervisory control over the neural system which operates at the speed of light. For this Walker applied the known quantum-mechanical tunneling effect and showed that, with the assumption of closely spaced "propagator" molecules throughout the brain, similar synapses may be coupled in stepping-stone fashion such that excitation of one results in progressive excitation of others with the velocity of light. The essentially instantaneous excitation of numerous

synapses in the brain is identified by Walker with a state of consciousness.

Walker notes that any suitable long-range force may apply in place of quantum tunneling. The substitution of a long-range neutrino sea force for the tunneling effect has two important advantages: (1) Propagator molecules are not required; each nerve transmitter provides this function. Thus, as many separate such systems as there are transmitter types are available without the need and complexity of added components. (2) There is a one-to-one correspondence between the state of the brain and the perturbation induced in the neutrino sea. Since the neutrino perturbation is not confined to the brain whereas tunneling is, a signature of the state of the brain is impressed on the neutrino sea and is propagated throughout space in all directions. This is obviously suited for psi phenomena.

Walker distinguishes between consciousness and thought. The conscious state results from a simultaneous spatial distribution of excited synapses that may last up to ~0.1 sec, the refractory period of neurons. The number of possible conscious states is then given by n!, where n is the total number of neurons ($\sim 10^{10}$ in humans). On the other hand, the thinking process is identifiable with the software program which determines the switching sequence of synapses and hence neurons. Since the neural network feeds back after a time delay to excite other synapses, the interaction of the neural network with a supervisory long-range control mechanism requires Walker's conscious states to perpetually form and change according to the spatio-temporal pattern of synapse excitation. The characteristic frequency is then $\sim 1/0.1 = 10$ Hz, i.e., of the order of the EEG frequencies. A thought may now be defined as the space-time pattern of synaptic excitation. If only ten percent of the synapses are involved in thoughts as opposed to control and other housekeeping functions, the number of different synaptic excitation combinations available for human thinking is then $\sim 10^{12}! = 10^{x}$, where $x = 6 \times 10^{12}$, and the number of possible thoughts vastly exceeds this by the number of time sequences of these combinations that are resolvable. Such a thought mechanism is supported by the high density and sensitivity of synapses in the higher brain centers, divorces thought from brain structure in accord with observation thus far, accounts for the EEG, and ascribes long-term memory to the ability of software to reproduce a particular spatio-temporal synaptic pattern. Since "mind" is the general term we apply to the thinking mechanism, the neutrino sea in combination with Walker's approach to the consciousness provides a feasible mechanism for the brain-mind interaction.

14. *Is the mind wholly contained within the brain?* No.

The software determines the intelligence content of any computer and must, therefore, be associated with the mind in living computers, whereas the hardware of living computers is defined by the neural structure. Whether the mind and its associated software exists inside or outside the brain structure has already been discussed.[24] It is there concluded that the mind exists independently of the brain for these reasons: (1) The widespread view that the mind is wholly included within the brain structure is an assumption that thus far has no direct observational support. (2) A wholly self-programmed computer represents a closed information system which is consequently required by the Second Law of Thermodynamics to degenerate. (3) A wholly self-programmed computer has never been demonstrated. (4) The existence of a *primordial intelligence* within the microcosm in inherently capable of accounting for all psi phenomena. In addition, the ability to "see" in claimed reports of out-of-body and near-death experiences also requires a separate existence of the brain's software. "Seeing" the results of known computer operations, for example, is accomplished by the (human) software, not the computer hardware.

15. *Is a primordial intelligence pervading the vacuum compatible with physical theory?* Yes.

Information theory requires a correlation between energy and information. In physical terms, all energy is structured and all structures contain information. The existence of a vast unobservable sea of energy in the vacuum thus demands the corollary existence of a vast unobserved information source, and hence intelligence, within the microcosm.

The ubiquitous microscopic quantum of action h is known to have the same value throughout the universe. This is attributable to design rather than coincidence and, therefore, suggests h to be a product of a microscopic intelligence.[25] It may not be fortuitous that existence of a macroscopic quantum of action of living things[26, 27] is the only other type of action quantum known to exist in nature.

It has been further shown[27] that the observed mortality of all known macroscopic systems is demanded by the Second Law of Thermodynamics and that the only practical way to attain physical immortality is by application of repair. Repair is a product of intelligence. The apparent mortality of stable elementary particles and the present belief that they are systems of some kind independently requires existence of a primordial intelligence within the microcosm.[28]

In addition to the general support above by the basic tenets of physics, there is no explicit injunction against the existence of a

primordial intelligence within the microcosm. In physics, what is not strictly forbidden is deemed feasible.

16. *Is existence of a primordial intelligence essential to account for psi phenomena?* Yes.

If the signature of the electrical activity of a brain (region of matter) broadcast by the neutrino sea is detected by a remote brain, telepathy (clairvoyance) results. Since the signal is a modulation superimposed on the neutrino sea power flux, the inverse-square decrease in radiation intensity may be obviated by feedback within a receiver to provide signal reception independent of distance up to the maximum range defined by the sensitivity of the receiver. Such a process is equivalent to the essentially constant reception by radio receivers (equipped with automatic gain control) for distances within the maximum transmitter range; its applicability to ESP has already been noted by Hoffmann.[29] Analogous feedback control of ESP reception is provided by the reticular formation, as in Ehrenwald's theory. However, the maximum range of such a telepathic/clairvoyant mechanism is not clearly defined by available neutrino data, so that it must be provisionally regarded as a feasible, but distance-limited, mechanism.

If motor neurons are activated by the perturbations in the neutrino sea, a dowsing capability becomes explicable. If the energy associated with the transmitted perturbations acts directly on nearby matter, psychokinesis (PK) results. In this case it is the energy of the perturbation, not information per se, that produces the PK effect, so this type of PK is required to decrease rapidly with distance. Such a general relation has been reported in one type of poltergeist case,[30] but, unfortunately, estimates of energy transfer to facilitate comparison with theoretical predictions is not possible, since the weights of the moved objects were not given. Forwald[31] obtained energy estimates for dice moved by PK, but these were about an order of magnitude too high due to an incomplete dynamic analysis.[32]

Nevertheless, extension of such a neutrino-ESP mechanism to the more enigmatic forms of psi phenomena that have been reported, such as precognition, hauntings, map dowsing and the more sophisticated poltergeist cases, is not feasible. The basic problem, as expressed long ago by Richet,[33] is that psi phenomena "are marked off from the physical in that they seem due to an unknown intelligence, whether human or nonhuman." It is, consequently, not surprising that the existence of a primordial supereminent intelligence pervading the microcosm has been proposed as the essential ingredient necessary to account for all psi phenomena.[24] This derives from a "vehicle" model

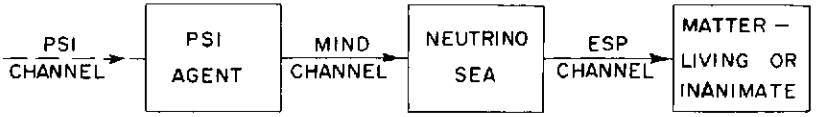


Figure 3. Three stage model of psi phenomena. The psi agent associated with a living thing couples to the neutrino sea via the mind channel and the neutrino sea couples to matter via the ESP channel. Information from external psi agents or sources may couple to the psi agent via the psi channel.

for nonphysical processes in which living things are modeled as systems comprising a physical body and an independent intelligent controller termed the "psi agent," analogous to the combination in our everyday world of a vehicle and driver. The psi agent, which includes the mind, must be regarded as an intelligent system of some kind existing in a microcosmic world in the hierarchy of matter beyond our present observational limits.

This results in a general three-stage model of the paranormal as shown in Fig. 3—a psi agent capable of coupling information and/or energy via the neutrino sea to living systems. The coupling between the psi agent and the neutrino sea is here termed the "mind channel." Although its mode of operation is beyond present observation it must be endowed with the property of an intelligent system to control its environment, such as neutrinos, analogous to the ability of man to control his macroscopic environment. For the primordial intelligence within the microcosm, this is allowed within the constraints of the uncertainty principle at the electromagnetic (elementary particle) hierarchical level. In terms of conventional physics, this may be viewed as a form of a virtual process; there is no violation of energy conservation.

The model in Fig. 3 may be applied in at least three ways:

(1) As a model of the living thing the psi agent is coupled to its associated body analogous to, say, a crew to its ship. The crew (ship) then corresponds to the psi agent (body), the mind channel corresponds to the human software control of the ship by the crew, and the ESP channel corresponds to control of the ship by its electromechanical hardware.

(2) As a model of the limited neutrino-ESP mechanism discussed above, the perturbations broadcast by the neutrino sea from an external source by-pass the body's own psi agent and affect the body directly. This is analogous to control of a space ship from Earth without the intervention of its astronaut crew.

(3) As a general model of psi phenomena in which an external psi source transmits information directly to a psi agent, via the "psi

channel" indicated in Fig. 3, which then couples this information directly via the mind channel to its associated body. This is analogous to the direct communication via radio by the crews of two vehicles, e.g., as in the space meeting accomplished by American and Russian astronauts.

The postulated psi channel between psi agents exists wholly within the primordial energy of the vacuum, so its mode of operation is not directly observable. Since it is not electromagnetic, it is not restricted to the velocity of light. Because it has intelligent properties it is not confined to a form of energy radiation, e.g., as is sound or light propagation. Using our common intelligence based society as a model, we can specify two types of information transfer systems uniquely suited for a psi channel in an energy-rich vacuum pervaded by a microcosmic intelligence.

One model is provided by the common transfer of information via the postal service and telephone. This model is independent of distance—the probability of any human directly contacting any other human anywhere on Earth by these means is independent of location. The existence of an analogous system by which any psi agent may communicate directly with any other, provides a primordial communication means independent of space. Hence an appropriate term for this form of psi channel is the psi "space channel." Since the probability of use of letters or telephone is higher between humans that have some common interest, use of the space channel may be presumed more probable for psi agents that are associated in some way. This is supported by the higher reported occurrence frequency of psi between associated individuals.

A second common source of information in human society is the printed record. By this means all of the conventional wisdom of society is available locally to any individual in libraries. When information on future plans and projections are included in addition to past chronology, this type of information source becomes relatively independent of time. Such a channel must be presumed for a primordial intelligence by which past events and future projections are available locally to all psi agents and hence may be termed the psi "time channel." Coupling of such information via the ESP channel to the biopsychological level provides a feasible model for retrocognition and precognition, as previously discussed.[24, 34]

17. *Can the existence of a primordial psi source and an associated psi channel be tested?* Yes.

Parapsychology deals first and foremost with thought information. Although such information cannot be weighed or otherwise measured as are physical objects, its existence and utility are nonetheless real.

Accordingly, thought information must be evaluated by methods that are suited to such nonphysical entities and, therefore, much different from those of the other sciences. The constant demand for "crucial" psi experiments that must mimic the repeatable measurements of physical objects is an unrealistic imposition that has hampered the development of parapsychology for over a century. Positive proof of the reality of paranormal sources of information may be alternately satisfied simply by a demonstration that information may be obtained when unavailable from any known normal source.

One such type of proof being studied concerns information obtained from out-of-body experiences. These are mostly confined to Earth-bound targets and hence are difficult to render foolproof. To unequivocally satisfy the preclusion of normal acquisition means, extraterrestrial targets are indicated. One class of these is available in astronomical objects within the solar system, wherein psychically derived information may be verifiable by satellites and/or theory. Another class is new information on very remote objects, as quasars, pulsars, and binary systems, that could not possibly be obtained normally in a single lifetime, but which may be amenable to astrophysical verification in various ways.

Another type of remote target is the very small. Besant and Leadbeater,[35] for example, reported results initiated in 1895 of psychic observations within the atom, elementary particles, and beyond. They predicted the existence of isotopes before their discovery and described a composite proton structure which markedly resembles the recent findings of high-energy physics. In particular, they depicted a basic helical structure of the electron which is generally confirmed by the phasor theory of electrons and neutrinos mentioned above.

Implied by the ability to obtain such types of information by psychic means unlimited by space or time is the capability of greatly extending the range of our instrumental capabilities. Although such information does not usually satisfy normal standards of scientific precision, its heuristic value may be inestimable. With experience, statistical and other means may evolve to better evaluate the relevance of such information.

The primary source of the ideas which are the font of man's progress represents another fertile field for investigation. Dreams represent one area in which the existence of telepathy, clairvoyance and precognition has long been recognized by parapsychologists. The history of science is replete with examples of new ideas originating in dreams, such as the process of making lead shot by James Watt;[36–38] discovery of the Bedheilac cave paintings by Joseph Mandemant;[39] an intricate

dissection of a fossil fish by Louis Agassiz;[33,40–42] translation of "Nebuchadnezzer" and the breaking of the Assyrian cuneiform code by Herman Hilprecht;[42–44] discovery of the benzene ring by August Kekulé;[37,45] discovery of the coordination theory of molecular structure by Alfred Werner;[46] discovery of nerve transmitters by Otto Loewi;[37,47] elucidation of atomic structure by Niels Bohr;[37] and invention of the sewing machine by Elias Howe.[37] To assume such previously unknown ideas derive from a brain state where conscious thought processes are suppressed is an unverified extrapolation from known brain research; an alternate source that must be admitted is an outside intelligence.

This is further supported by the appearance of new information in trance and hypnotic states and even in the normal waking state. The widely known use of psychics by police, the Edgar Cayce data, and the recent use of psychics to locate promising archeological sites attest a pervasive nonhuman information source. Reincarnation research and spirit communication are further sources of new potential information not normally obtainable, as on lost languages and customs and verifiable historical facts.

It may not be premature to venture that the present total record already overwhelmingly supports the existence of a primordial intelligence capable of coupling to animate and inanimate matter.

Conclusion

A road has been mapped by which a seminal comprehensive explanation of psi phenomena may be reached which is in general accord with physical theory. This road contains 17 forks. Choice of a direction has been determined by the above-chance probability afforded by experience. Although some of the paths between forks may portray rocky trails, the paramount consideration is that all are sufficiently passable to permit attainment of the destination. The total number of possible directions given by the 17 forks is $2^{17} = 131{,}072$. The actual road mapped represents the selection of just one of these.

No scientific theory answers all the questions we want answered. The value of any theory lies in the questions it *does* answer and in its heuristic value for new tests. It is, therefore, hoped that the theory herein will be useful in further exploring what is undoubtedly the most important unsolved problem in the world today—the nature of the mind of man.

BIBLIOGRAPHY

1. Ehrenwald, J., *The ESP Experience*, Basic, New York, 1978, part 4.
2. Dixon, N. F., *Parapsych. Rev.*, 1979, *10* (3), 1.

3. Osis, K. and Turner, M. E., Jr., *Proc. A. S. P. R.* 1968, *27*, 1.
4. Bibbero, R. J., *Proc. Inst. Radio Engs.*, 1951, *39*, 290.
5. Dirac, P. A. M., *The Principles of Quantum Mechanics*, Clarendon, Oxford, 1958, sec. 73.
6. Wheeler, J. A., *Ann. of Phys.*, 1957, *2*, 604.
7. Pontecorvo, B. and Smorodinskii, Ya., *Sov. Phys. JETP*, 1962, *14*, 173.
8. Bahcall, J. N., *Phys. Rev.*, 1964, *136*, B1164, eq. (16).
9. Ruderfer, M., *Specul. Sci. Tech.*, 1978, 1:29, 147 and 533; *Electron. and Pwr. (JIEE)*, 1965, *11*, 164, and 1972, *18*, 370; *Amer. J. Phys.*, 1971, *39*, 116.
10. ———, *NAPS Document No. 01930*, Microfiche Publications, 440 Park Ave. S., New York 10016, 1972.
11. Hartline, B. K., *Science*, 1979, *204*, 42; *Sci. News*, 1979, 115:103.
12. Ruderfer, M. *Lett. Nuovo Cimento*, 1974, *10*, 393.
13. ———, *Phys. Lett.*, 1975, *54A*, 363.
14. Verveen, A. A. and Derksen, H. E., *Proc. IEEE*, 1968, *56*, 906.
15. Peres, S., *Progr. Theor, Phys.*, 1960, *24*, 149; Weinberg, S., *Nuovo Cimento*, 1962, *25*, 15; *Phys. Rev.*, 1962, *128*, 1457; Zeldovich, Ya. B. and Smorodinskii, Ya., *Sov. Phys. JETP*, 1962, *14*, 647; Morrison, P., *Sci. Amer.*, 1962, *207* (2), 90; Ruderman, M. A. *Repts. Prog. Phys.*, 1965, *28*, 411; Csonka, P. L. and Marx, G., *Nuovo Cimento*, 1966, *43A*, 591; Chiu, H.-Y., *Ann. of Phys.*, 1967, *43*, 1; Ginzburg, V. L., *J. Stat. Phys.*, 1969, *1*, 3; De Graaf, T., *Astron. & Astrophys.*, 1970, *5*, 335.
16. Ruderfer, M., *Lett. Nuovo Cimento*, 1974, *10*, 826.
17. Davis, T. M. and Ray, J. R., *Phys. Rev. D.*, 1974, *9*, 331; *Lett. Nuovo Cimento*, 1975, *14*, 258.
18. Condon, E. U., in *Handbook of Physics*, E. U. Condon and H. Odishaw, eds., McGraw-Hill, New York, 1967, part 6, chap. 6, p. 14.
19. Marx, G., *Nuovo Cimento*, 1963, *30*, 1555.
20. Branscomb, L. M. *Science*, 1979, *203*, 143.
21. Schmitt, F. O., Parvati, D. and Smith, B. H., *Science*, 1976, *193*, 114, see p. 119.
22. ———, p. 116.
23. Walker, E. H., *Math. Biosci.*, 1970, *7*, 131.
24. Ruderfer, M., *Parapsych. Rev.*, 1977, *8*(2), 13.
25. ———, *Proc. Inst. Radio Engrs.*, 1952, *40*, 1734.
26. ———, *Science*, 1949, *110*, 245.
27. ———, in *Physics of Failure in Electronics*, M. F. Goldberg and J. Vaccaro, eds., Office of Technical Services, Dept. Commerce, Washington, 1964, v.2, p. 361.
28. ———, *J. Res. Psi Phen.*, 1976, *1*, 53.
29. Hoffmann, B., *J. Parapsych.*, 1940, *4*, 149.
30. Roll, W. G., *J.A.S.P.R.*, 1968, *62*, 263; Artley, J. L., *Ibid.*, p. 305.
31. Forwald, H., *Mind, Matter and Gravitation, Parapsychological Monograph No. 11*, Parapsychology Foundation, New York, 1969; *J. Parapsych*, 1954, *18*, 219.
32. Ruderfer, M., *NAPS Document No. 02052*, Microfiche Publications, 440 Park Ave. S., New York, 1973, sec. 19.
33. Richet, C. R., *Thirty Years of Psychical Research*, Macmillan, New York, 1923, p. 4.
34. Reference 32, sec. 20.
35. Besant, A. and Leadbeater, C. W., *Occult Chemistry*, Theosophical Society, 1952, obtainable from Health Research, Box 70 Mokelumne Hill CA.
36. Edwards, F., *Stranger Than Science*, Bantam, New York, 1959, sec. 12.
37. Krippner, S., *Psych. Today*, 1970, *4*(1), 40.
38. Edwards, F., *Strange People*, Lyle Stuart, New York, 1961, sec. 35.
39. ———, sec. 37.
40. ———, sec. 48.
41. Stevens, W. O., *The Mystery of Dreams*, Dodd Mead, New York, 1949, p. 37.
42. Krippner, S., *Psychic*, 1972, *3*(6), 44.
43. Reference 36, sec. 11.
44. Reference 41, p. 37.

45. Kekulé, A., *Ber.*, 1890, *23*, 1302. Hein, G. E., in *Kekulé Centennial*, R. F. Gould, ed., American Chemical Society, Washington, 1966, p. 10. Farber, E. *Ibid.*, p. 129.
46. Asimov, I., *Asimov's Biographical Encyclopedia of Science and Technology*, Avon, New York, 1972, sec. 782.
47. ———, sec. 829.

DISCUSSION

RUDOLPH: I must take exception to your statement that "An inviolate tenet of information theory is the association of an energy transfer with every information transfer." This is something that has crept into the literature of parapsychology and it's rather disturbing to me as an information theorist. Now when someone says "information theory," I'm assuming that they're referring to the mathematical theory of communication proposed by Claude Shannon of Bell Laboratories in the late 1940s, in which there is no discussion of energy. I would refer you to one of the best text books on information theory today, Robert Gallagher's, *Information Theory and Reliable Communication*, in which there is no discussion of energy, and also to Shannon's original paper. Information theory is a strictly mathematical theory based on probabilities.

RUDERFER: I think what we're talking about is a difference in semantics as to what we mean by information theory. Shannon's theory was the original spur for modern information theory, but it's gone much further. It's been extended by a number of authors and includes the actual communication process, which is a physical process. Also, we have the fact that when we're talking about communication, we're talking about a physical process and all communication that we are aware of takes place with a transfer of energy. What we are doing is selecting a "yes" answer to Question 1 for a very practical reason; that is, we are assuming that the present laws of science apply and are sticking to that for a very practical reason. We first have to explore what's nearest at hand. If we can't find an answer with that, then we have to look elsewhere.

MORRIS: You mention the fact that certain procedures eliminate "all but very low frequency electromagnetic radiation." And then you say, according to an estimation by Bibbero, you'd need to have a bandwidth capability of at least 10^{10} Hertz, I was wondering if you would comment further on why he estimated that. What was his line of reasoning?

RUDERFER: Bibbero presented that in a series of letters in the *Proceedings of IRE* between 1951 and 1953, discussing telepathic

communication, which unfortunately has been pretty well ignored by parapsychologists. What he stated there was that people, when they see a telepathic image, may very often see in three dimensions and in color. To reproduce such a picture requires a certain number of bits and that's where 10^{10} Hertz comes from. For a 2-D black and white picture, we have an estimate from a television channel of a few megacycles. This is the number that he has given on that basis. He again multiplied by 10^{10} to give each person in the universe his own channel, but this is a questionable added assumption. In any case, for spontaneous occurrences of ESP, some of which are very elaborate, you do require a high information rate and you can't get around that.

BYERS: I'd like to compliment you on that and the most appropriate comment I can think of to make is "Wow!" It seems to me, if I heard you right, we no longer separate man from his cosmic environment.

RUDERFER: I don't think I'm the first one to say that.

BYERS: No, but you're the first one I've heard to give such an elaborate and precise mode of explanation of how that might work. I felt, as you were talking, that the last point I made yesterday from my abstract is that further research will require the recognition of some, perhaps, infinite regressive invisible information bearing contexts. It seems to me that's what you have outlined. Do you agree?

RUDERFER: Yes. I was disturbed by your use of *extrasensory*, but it's a matter of semantics. Extrasensory, as used now, is extra because right now we can't see how it can occur, but if some means is eventually found, which is quite possible due to our developing technology, at that time it would become sensory, so that's the difference. It's a matter of semantics there.

STORM: If information exchange requires expenditure of energy, that means in principle there are going to be unbounded amounts of energy needed for information exchange.

RUDERFER: That's right, because the energy of the universe is infinite.

STORM: Does everyone agree to that? I didn't realize it.

RUDERFER: Well, the observable energy is finite. I don't know if every physicist will agree that it is or is not and I don't think if you take a vote you can decide the issue on that. But most physicists will agree, for example, with Dirac's infinite energy sea of electrons, so there is a basis right there in physics for an infinite energy. It's just that the energy is

not observable. Another thing, energy is a scaler. It has no absolute zero and no absolute maximum. We set the zero energy arbitrarily by fiat, and in physics today they set the zero energy as the energy of the vacuum where there is no observable energy. But if an unobservable energy does exist in the vacuum, it becomes "negative energy," because it's below zero, and that's the only difference. It's just that it's not observable at this time. Then, of course, there's also the Wheeler-Planck density, which is a tremendous density. It's not observable, and, therefore, it doesn't affect the processes that occur in our world as far as we can presently ascertain. It's just a constant amount of energy that underlies the observable energy of our world.

STORM: What specific aspect of the description you just laid out would you identify with my personal conscious experience?

RUDERFER: Well, I use Walker's approach, which is that consciousness is a simultaneous state of a finite number of synapses, a large number of synapses. They are all firing together and they innervate the neurons for a whole tenth of a second so Walker identifies that with a conscious state, and you can't have any other activity for that activated set until the next tenth of a second. And that's what he calls a conscious state. I guess it's a matter of semantics again if you want to call it consciousness or not, but it's a state of the brain that occurs with this type of mechanism, so it's nautral for him to identify it with a physical state, an actual state.

NASH: Is the neutrino sea unobservable because neutrinos and antineutrinos are in balance, and why don't they annihilate each other?

RUDERFER: Well, I'll take the last part first. Neutrinos are left-handed and they're like a left-handed screw and they advance left-handed through the universe. Anti-neutrinos are right-handed, so they don't match, and they can't annihilate. The physicist will say that free neutrinos and antineutrinos do not interact with each other. Now, the first part of your question—is it completely unobservable? No. There is a portion which is observable, which is the high energy portion. This occurs when a neutrino may hit, let's say, a chlorine atom and convert it to argon, which is what is being used in the Davis experiment to detect solar neutrinos. They do detect them, and the anti-neutrino from nuclear reactors was detected in 1956, by Reines and Cowan. So they are detectable when above a certain energy. Now, below that energy we have no means right now of detecting them, but, from the theory, most of the neutrinos are below that energy, so there's a tremendous volume of low energy neutrinos floating around which we can't detect, but they're there.

IRWIN: You describe clairvoyance as "the electrical activity of the region of matter broadcast by the neutrino sea and detected by a remote brain." What is the nature of this electrical activity and how does it encode information such as shape, color, intensity, etc.?

RUDERFER: The neutrinos, as they go through matter, will occasionally interact with an electron or electrons, the electrons that are in a transition of some kind that can disturb the isotropy. It's the resulting anisotropy that's detectable. An isotropic field is not, so as the electrons in a piece of matter vary in their motion, in acceleration, they will induce perturbations which are detectable. Now, to the extent that we can recognize this signature and identify it with some physical object is how we can say what it is. It's very analogous to, say, sound when we hear certain sounds; we know what they mean because of our past learning, so if the brain can detect these perturbations and identify them with some physical objects, that would be the way in which we would be able to use that information. It's a learning process, the same as for the other senses.

IRWIN: Is there any evidence for example, that the electrical activity associated with a square in the ESP cards is different from the electrical activity associated with a circle?

RUDERFER: Well, that's in the processing portion of the brain, and that comes under the heading of Ehrenwald's theory. I am dealing only basically with the input of Ehrenwald's theory, which is the energy channel required. Let me give you a very simple analogy to the whole thing. The whole theory can be described as a telephone conversation. If you're at the receiver end, the noise made by the receiver sound is transferred by your brain into neuron activity which you understand, and that's the portion that Ehrenwald would practically cover in all psi experiments thus far. The sound is created by a physical mechanism—the telephone wire, receiver and transmitter and the neutrino sea would correspond to that. It's just a transmission mechanism. The telephone wires and circuitry do not originate the message. To originate the message you have to have another person or source of information at the other end, and that's the third part of the model which is a psi source and which I call a psi agent. It's a source of psi information, and it's an intelligent source in general. So what you have is a psi source conversing with another psi source or psi agent through the communication medium afforded by neutrinos. It's analogous to a telephone conversation.

MORRIS: I was just wondering about the kinds of predictions you might make to test your theory, especially what kinds of circumstances would be likely to enhance the psi effect?

RUDERFER: I did have two in the report and one is strictly a physical experiment which would be very useful, because it would tell us definitely that we do have a cerebral information-transferring medium. Now, the second one was identifying information that was or is not obtainable elsewhere and this is something that parapsychologists have been trying to do for a long time. Maybe not explicitly for that reason, but that is a basic goal of parapsychology, to identify new information that came from paranormal sources, and if that can be unambiguously demonstrated, then you have proof of psi phenomena. And my personal opinion is that if you take all the experiments and observations of all types and put them together, you find that it's overwhelmingly in favor of the existence of psi phenomena statistically. But we're always looking for the definitive experiment and there you have to get targets that are foolproof. In this respect, parapsychologists haven't gone very far in dealing with the normal, such as out-of-body experiences, which are not really foolproof. I think that there are new sources of information that are foolproof. There is new information that we never knew before and that includes inventions and scientific ideas. This is really an area which demands to be exploited by parapsychologists. Just to investigate the history of where ideas come from would be very relevant. Unfortunately, scientists and the history books don't record that. It is the most interesting aspect, because it's the source of where the ideas come from, and if we're talking about ideas, we're talking about the mind. So, how this kind of new information arises is an excellent area for parapsychologists to investigate.

MORRIS: What would you do next, though? I mean, given the two examples you have there, how would you follow up to really try to assess the very specific ideas you put forth here? Would you have any predictions about factors that would increase or decrease psi success?

RUDERFER: I wouldn't be able to go into it right now because of time, for one thing. But, secondly, it is often difficult for a theorist to do this, because it is the experimentalist who knows what tools he has available; and if he understands the theory he can fit his tools into the theory and find out how he can best verify it. If I were to tell you what to do, I would be designating certain kinds of tools and apparatus you might

not have, and you could discount the whole thing. But, in general, the theory does lead to certain things. For example, this neutrino sea is being perturbed in the vicinity of the body and it's streaming out all the time, so you have a direct possible connection with the aura. We have healing phenomena, where between the hands there is some kind of flow of energy. Could it be a neutrino form of energy? What is the effect of different frequencies of neutrinos on the human body? We don't have a way of detecting low energy neutrinos, but, if we did, then we could directly induce that kind of effects. Potentially, there is a vast area for communications and new energy sources in the neutrino sea if we could ever find a way of utilizing it.

ULLMAN: Of course, many creative scientists pay tribute to intuition as the source of some of their novel ways of looking at the world, and Einstein was perhaps a good example. But are you implying, when a shockingly new insight comes into being, that it's coming from some external source rather than as I've always looked at it, as being in the nature of genius or the nature of creativity to take a look at something that's there for everyone to see, but to see it differently because it's being looked at in a new way, i.e., old facts being rearranged in such a way as to give a different result?

RUDERFER: My view is that intelligence is controlled by the neural system, but creativity is controlled by the external source.

ULLMAN: An external source outside the individual, independent of his personality?

RUDERFER: When you talk about an individual, you're not talking about a physical body, you're talking about a combination of a body and a controller. When you talk about a parked car, you're talking about a physical object. If you're talking about a car moving along the street, you're not talking about a physical thing, you're talking about a combination of a physical thing and an intelligent controller. That moving car has a driver in it, always. When you're talking about an individual, you're talking about a body, but also you're talking about a mind. It appears to me that there's no way that the mind could be just part of the brain itself, a biological thing. It's more than that.

So if there is a controller, an intelligence source, then that is the source of ideas. I don't know what you mean by intuition. I don't think any scientist can define intuition very reliably, but it does show, from some of the history of science, that some of these ideas must come from the outside. At least, you have to entertain that possibility, and that possibility has been pretty well ignored up to now. Now, I guess mainly

it's the arrogance of man; he thinks he himself is the king and that *he* gets the ideas and hence infers that they originate in him. Usually, when people come up against this idea that maybe their ideas come from outside themselves, it shocks them at first. But that doesn't mean it's correct or incorrect. The proper way to find out is scientifically, which is by testing, and what you have to do is, first of all, acknowledge what are the various possibilities. And then test for them. And one possibility is that the brain is the origin for all ideas and the other is that it's not. And you have to first list these without prejudice and then proceed to test them. But this is not done now. One is preferred over the other, unknowingly.

THE PSI CHANNEL CODING PROBLEM

LUTHER D. RUDOLPH

Introduction

Surely the main reason why the laboratory results of parapsychologists have not been widely accepted by the science establishment lies in the elusive nature of psi phenomena. Researchers in extrasensory communication have had to resort to statistical inference in order to demonstrate that communication is actually taking place. Yet Shannon's "noisy-channel coding theorem" states that, for a broad class of channels, if the information rate is kept below the capacity of the channel, then by appropriate design of the encoder and decoder it is possible to reduce the probability of error at the output of the decoder to an arbitrarily small value. This suggests using channel coding to increase the reliability of extrasensory communication to the point where the reality of the phenomena could be verified by direct sensory experience and statistical tests would no longer be necessary. In this paper I consider the question of whether or not Shannon's model applies to extrasensory communication and, if so, what problems must be overcome in order to reap the benefits of channel coding promised in Shannon's theorem.

The primary purpose of this paper is not to solve problems or suggest specific experiments, but to provide a framework in which interesting questions might be asked. The framework is based on Shannon's information theory, which I predict will play an increasingly important role in parapsychological research.

Two characteristics of information theory should be understood at the outset. First, although information theory is couched in signal transmission language, the theory itself does not postulate or depend on any underlying mechanism. Not only is a signal transmission model of communication unnecessary, causality is not even required. That signal transmission language is used throughout this paper is due to long habit, not necessity.

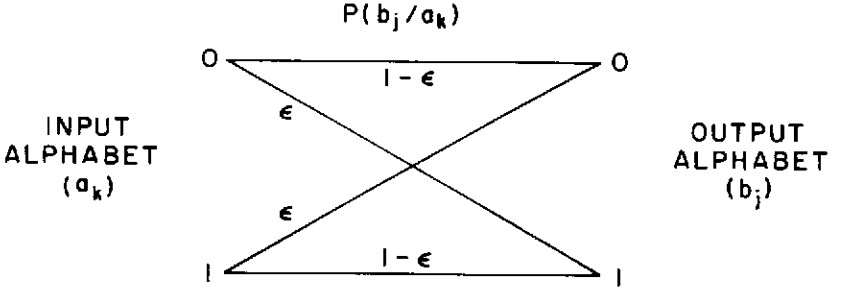


Figure 1. Binary symmetric channel.

Second, a wide range of processes can be modeled as "communication systems," from a radio link to a computer or biological organism. The term "extrasensory communication" is used here in its broadest sense. It applies just as well to a PK task involving a random generator as to a long-distance ESP experiment.

I will first review the fundamental ideas of information theory that relate to channel coding and then consider whether these ideas can be applied to extrasensory communication.

Channel Models and Channel Coding[1]

A channel model requires the specification of the set of possible inputs, the set of possible outputs, and, for each input, a probability measure on the set of outputs. Discrete memoryless channels constitute the simplest class of channel models and are defined as follows: The input is a sequence of symbols from a finite alphabet, $a_1, \ldots, a_K$, the output is a sequence from the same or a different alphabet, $b_1, \ldots, b_J$, and each symbol in the output sequence is statistically dependent only on the symbol in the corresponding position of the input sequence and is determined by a fixed conditional probability assignment $P(b_j|a_k)$.

The simplest non-trivial discrete memoryless channel is the binary symmetric channel (BSC) in which the input and output symbols are binary digits and each digit in the input sequence is reproduced correctly at the channel output with some fixed probability $1 - \epsilon$. The BSC model, which will be used for illustrative purposes later on, is shown in Figure 1.

In order to talk about channel capacity, it is necessary first to define what we mean by "information." In Shannon's theory, this term is used in a highly restricted technical sense to denote a quantitative measure of uncertainty, related to the number of possible outcomes and the probability (i.e. uncertainty) associated with each outcome. Let x

denote the input symbol to the channel and y the output symbol. Let $\{a_1, \ldots, a_K\}$ be the X sample space and $\{b_1, \ldots, b_J\}$ the Y sample space in an XY joint ensemble with probability assignment $P(a_k, b_j)$. We want a quantitative measure of how much the occurrence of $y = b_j$ changes the probability of $x = a_k$ from the à priori probability $P(a_k)$ to the à posteriori probability $P(a_k|b_j)$. The quantitative measure which turns out to be useful is the logarithm of the ratio of à posteriori to à priori probability. This gives the following fundamental definition: *the information provided about the event* $x = a_k$ *by the occurrence of the event* $y = b_j$ *is*

$$I(a_k; b_j) = \log \frac{P(a_k|b_j)}{P(a_k)}. \tag{1}$$

We will take the base of the logarithm to be 2, in which case the numerical value of (1) is the number of *bits* of information.

If we interchange the roles of x and y in (1) and apply the identity $P(y|x)P(x) = P(x|y)P(y)$, it is easily seen that the information provided about the event $y = b_j$ by the event $x = a_k$ is also given by (1). Because of this symmetry, $I(a_k;b_j)$ is called the *mutual information* between events $x = a_k$ and $y = b_j$. Mutual information is a random variable with average value

$$I(X; Y) = \sum_{k=1}^{K} \sum_{j=1}^{J} P(a_k,b_j) I(a_k; b_j). \tag{2}$$

The *capacity* C of the channel is the maxium value of average mutual information per channel use, where the maximum is taken over all input probability assignments $P(a_k)$, i.e.,

$$\begin{aligned} C &= \max_{P(a_k)} I(X; Y) \\ &= \max_{P(a_k)} \sum_{k=1}^{K} \sum_{j=1}^{J} P(b_j|a_k)P(a_k) \log_2 \frac{P(a_k|b_j)}{P(a_k)} \quad \text{bits/symbol.} \end{aligned} \tag{3}$$

(The capacity may, of course, be expressed in bits per second by multiplying C in (3) by the input symbol rate in symbols per second.)

In the case of the BSC, the maximum average mutual information occurs when the à priori input probabilities are $P(0) = P(1) = 1/2$. The capacity of the BSC, as a function of the crossover probability ϵ, is

$$C_{BSC} = 1 + \epsilon \log_2 \epsilon + (1 - \epsilon) \log_2 (1 - \epsilon) \quad \text{bits/binary digit.} \tag{4}$$

This is plotted in Figure 2. Note that the maximum amount of average mutual information that can be conveyed in one use of the channel is

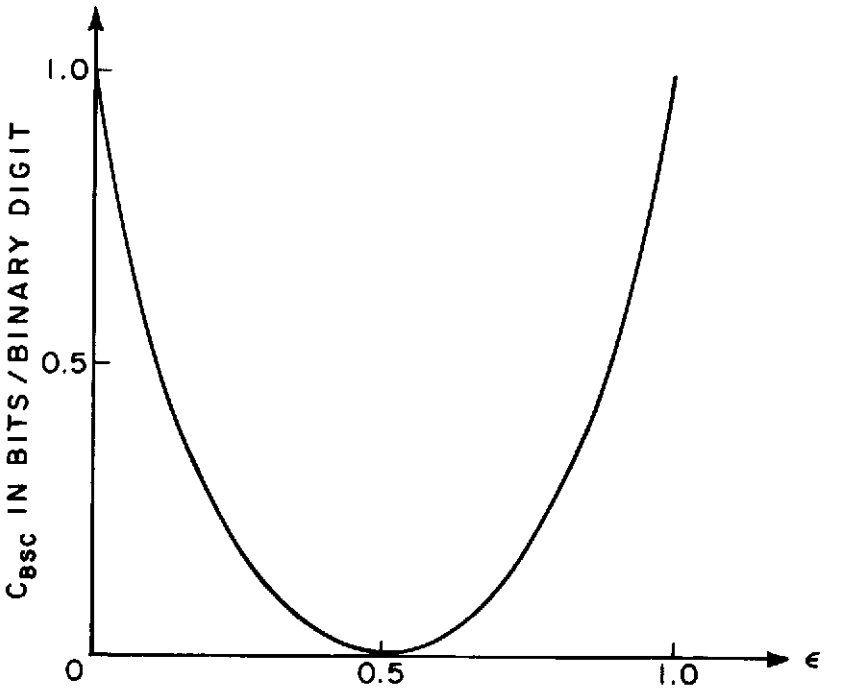


Figure 2. Capacity of the binary symmetric channel.

one bit, and that this occurs either when $\epsilon = 0$ or when $\epsilon = 1$. When $\epsilon = 1/2$, the input and output are statistically independent and the capacity is zero.

It is worth noting at this point that the channel model is completely probabilistic: it depends only on the XY joint ensemble. This means that we need not specify the mechanism which underlies the statistical dependence between channel input and output. In fact, because of the symmetry of mutual information, we need not even say which variable is the input and which the output. Further, nowhere does time enter into the channel model. It is perfectly acceptable for the "output" to occur before the "input." Not only do we not have to postulate some sort of signal energy propagating from a sender to a receiver, we do not even have to postulate a causal relationship between the two, or even think in terms of "sender" and "receiver."

We now turn to the problem of channel coding. Without loss of generality, we will take the input to the channel encoder and the output of the channel decoder to be binary digits, where each digit entering the encoder carries one bit of information (i.e., $P(0) = P(1) = 1/2$). A

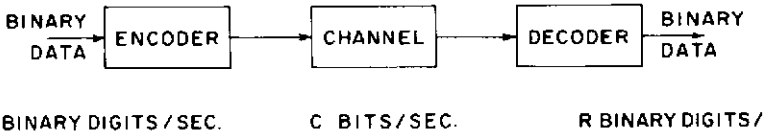


Figure 3. Communication system block diagram.

block diagram of this model is shown in Figure 3. Unlike the channel, which is defined probabilistically, the encoder and decoder are assumed to be deterministic.

The function of the encoder is to produce, for each input data block of binary digits, a unique codeword suitable for transmission over the channel. To combat the effects of the unreliability of the channel, each codeword contains a specified amount of redundancy. The set of all codewords is called an "error-correcting code." The function of the decoder is, given the output of the channel, to determine which codeword was most likely to have been sent. The output of the decoder is then the data block corresponding to this best guess as to the codeword.

The significance of the capacity of a channel (which is here expressed in bits per second) stems primarily from the famous "noisy-channel coding theorem" of Shannon. In imprecise terms, this coding theorem states that, for a broad class of channels, if the channel has capacity C bits per second and if binary data enter the channel encoder at a rate (in binary digits per second) of $R < C$, then by appropriate design of the encoder and decoder, it is possible to reproduce the binary digits at the output of the decoder with as small a probability of error as desired.

Shannon's theorem says that (for long messages) there exists a code which can reduce the probability of error to an arbitrarily small value in spite of the unreliability of the channel. The most obvious way to ensure that a message will get through reliably is simply to repeat it many times and make a decision based on majority vote at the output. However, the repetitive redundancy purchases reliable transmission at the cost of an ever-decreasing transmission rate. The surprising thing about Shannon's theorem is that it promises error-free transmission over an unreliable channel *without further reduction in data rate* given only that the rate is less than the channel capacity.

An example may help to clarify the above. Suppose we are given a BSC with crossover probability $\epsilon = .05$ which accepts binary digits at a rate of 30 binary digits/sec. From (4) we calculate the capacity of this channel to be

$$C_{BSC}(.05) \cong .71 \text{ bits/binary digit}$$

$$= 21.3 \text{ bits/sec.}$$

This means that the data rate going into the encoder must be less than 21.3 binary digits/sec. in order to apply Shannon's theorem. We will choose this data rate to be 10 binary digits/sec. Then for each binary digit which enters the encoder, three binary digits will be sent over the channel. The decoder will in turn produce one binary digit at its output for every three binary digits it receives from the channel. The most common type of code used in this situation is an (n,k) block error-correcting code, where k is the length of the input data block to the encoder and n is the length of the corresponding codeword sent to the channel. The resulting communication system is shown in Figure 4.

The simplest (n,k) code with k/n = 1/3 is the (3,1) code. Here the encoder simply triplicates the digit at its input and the decoder makes a 2-out-of-3 majority decision on the triple it receives from the channel. This code can correct any single error in the transmitted 3-digit codeword and a straightforward counting argument shows that the probability of error at the output of the decoder is $p = (3)(.95)^1(.05)^2 + (.05)^3 \cong .00725$. So the probability of error in the transmission of a data block consisting of one binary digit has been reduced from .05 when no coding is used to .00725 when the (3,1) code is used. Of course, this gain in reliability is paid for by the reduction in data rate from 30 binary digits/sec. to 10 binary digits/sec. We might well question whether it was worth using the code at all. But now Shannon's theorem comes into play. It says that, by going to longer codes with the same k/n = 1/3, we can decrease the probability of error to an arbitrarily small value with no further penalty in data rate. To illustrate this effect, we will now analyze the performance of an (n,k) = (15,5) code.

The encoder for a (15,5) code accepts a data block of 5 binary digits and produces a codeword of 15 binary digits. There are $2^5 = 32$ possible 5-digit data blocks and thus 32 codewords. Again, the simplest approach would be for the encoder to simply triplicate the

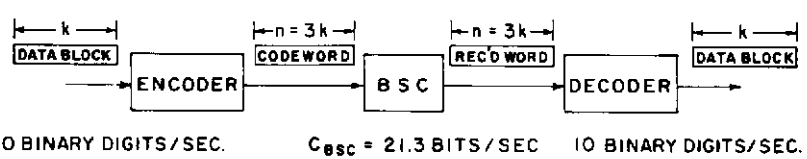


Figure 4. Coded BSC system.

input 5-digit data block and for the decoder to decide which codeword (data block triple) was most likely sent by simple majority vote. A moment's reflection, however, reveals that nothing would be gained over the (3,1) code used previously. In this case, simple repetition is not an efficient way to structure the redundancy. A (15,5) code which has optimally efficient redundancy is shown in Table I. Notice that every possible pair of codewords differs in at least 7 positions, so that the decoder can correctly decode any received word which contains no more than 3 errors. If the received word contains more than 3 errors, the decoder may or may not decode correctly, depending upon the particular error pattern. A more complex version of the counting argument used in the case of the (3,1) code

TABLE 1

(15,5) Error-Correcting Code

Data Block					Codeword														
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
0	0	0	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
0	0	0	1	1	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0
0	0	1	0	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
0	0	1	0	1	1	0	1	1	0	1	0	0	1	0	1	1	0	1	0
0	0	1	1	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0
0	0	1	1	1	1	1	0	1	0	0	1	0	1	1	0	1	0	0	1
0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0	1	0	0	1	1	0	1	0	1	1	0	1	0	1	0	1	0	1	0
0	1	0	1	0	0	1	1	0	0	1	1	1	1	0	0	1	1	0	0
0	1	0	1	1	1	1	0	0	1	1	0	1	0	0	1	1	0	0	1
0	1	1	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0
0	1	1	0	1	1	0	1	1	0	1	0	1	0	1	0	0	1	0	1
0	1	1	1	0	0	1	1	1	1	0	0	1	1	0	0	0	0	1	1
0	1	1	1	1	1	1	0	1	0	0	1	1	0	0	1	0	1	1	0
1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	0	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
1	0	0	1	0	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0
1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
1	0	1	0	0	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
1	0	1	0	1	0	1	0	0	1	0	1	1	0	1	0	0	1	0	1
1	0	1	1	0	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1
1	0	1	1	1	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0
1	1	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
1	1	0	0	1	0	1	0	1	0	1	0	0	1	0	1	0	1	0	1
1	1	0	1	0	1	0	0	1	1	0	0	0	0	1	1	0	0	1	1
1	1	0	1	1	0	0	1	1	0	0	1	0	1	1	0	0	1	1	0
1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1
1	1	1	0	1	0	1	0	0	1	0	1	0	1	1	0	1	1	0	0
1	1	1	1	0	1	0	0	0	0	1	1	0	0	1	1	1	1	0	0
1	1	1	1	1	0	0	1	0	1	1	0	0	1	1	0	1	0	0	1

shows that the probability of error at the output of the decoder is approximately $p_b = .0037$. Of course, this is the probability of a data block error; in order to compare the (15,5) code to the (3,1) code, we need the probability that a single data digit is in error. A conservative assumption is that when the decoder makes a mistake, its output is equally likely to be any one of the 31 incorrect data blocks. In this case, a particular digit in the 5-digit output has about a 50 percent chance of being correct. So the probability of output digit error is $p = .5 \times .0037 = .00185$. Thus the (15,5) code yields a lower probability of error than the (3,1) code at no further penalty in data rate.

The improvement in reliability realized when we moved from the (3,1) to the (15,5) code was not dramatic. This is partly because an increase in code length from 3 to 15 is not large, and partly because the improvement obtainable as a function of code length is dependent upon the initial reliability of the channel. The better the channel, the greater the percent improvement for a given increase in code length. By conventional communication system standards, a BSC with $\epsilon = .05$ is not a very reliable channel. We know that (properly chosen) longer codes with $k/n = 1/3$ will do even better, but very long codes would be required for really reliable communication if the initial channel were a really poor one. (Of course, when we use long codes, the question of whether we can *decode* in a reasonable time and at a reasonable cost becomes important. This problem is treated in the field of coding theory.[2] Suffice it here to say that long codes have been found which can be decoded with relative ease.)

Parapsychologists do not have the luxury of dealing with a channel which has a probability of error of .05 at a data rate of 30 binary digits/sec. The data rate is not unreasonable for certain types of experiments, but the probability of error is more likely to be on the order of .49. The shape of the channel capacity curve near the .50 point warns that this will be a problem. But before considering such practical problems, we must first ask whether, in principle, Shannon's theory can be applied to psi processes.

The Psi Channel

We first ask whether Shannon's channel model is applicable. The answer here is clearly yes. A "channel" in information theory is simply two variables together with the probability measure that relates them. Any psi experiment that lends itself to statistical analysis, therefore, also lends itself to channel modeling.

For example, an ESP card guessing experiment could be modeled as a discrete memoryless channel with a 5-symbol input/output alphabet and assigned probabilities $1-4\epsilon$ for a correct call and ϵ for an incorrect call as shown in Figure 5. The assumptions underlying this model are:

(1) The n^{th} call is statistically dependent only on the n^{th} target symbol.
(2) The probability of an incorrect call is independent of both target and call symbol.
(3) The conditional probabilities do not vary with time.

Are these assumptions reasonable in a card guessing experiment? Clearly not. But they *are* conservative. The equiprobable discrete memoryless channel is a worst-case model in the sense that its capacity is less than or equal to the capacity of any other channel with the same size input/output alphabet and average statistics. Any divergence from equiprobability or independence can only increase the capacity since such divergence constitutes additional information about the channel which can (in principle at least) be used to advantage. The random-error channel is in this sense the most difficult channel to deal with and hence has the lowest capacity. This lower bound on the capacity of the actual channel, however poor the bound may be, provides a basis for applying Shannon's channel coding theorem. As more information about the channel is obtained, better models with higher capacities can be constructed, but in the meantime we can attempt to increase reliability by the use of channel coding based on the worst-case model.

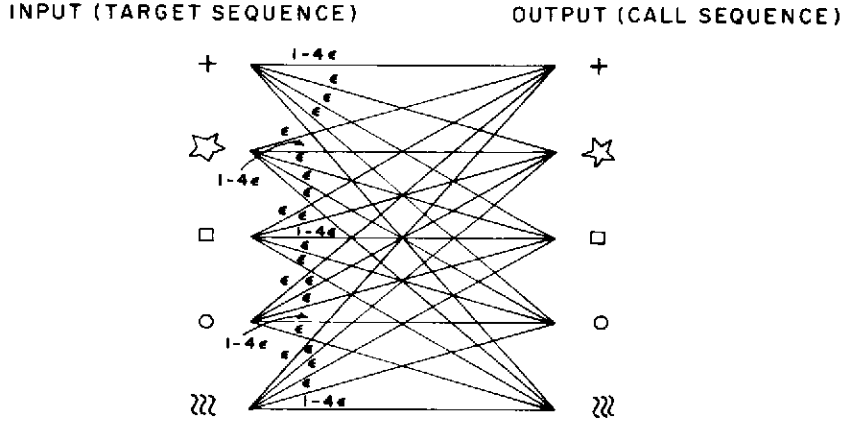


Figure 5. Open-deck card-guessing channel model.

We now turn to the question of whether Shannon's channel-coding theorem can be applied to the psi channel. And here we run into trouble. A channel involves only two variables. The addition of an encoder and a decoder, however, introduces two new variables. Since any two variables constitute a channel, we now have six channels as shown in Figure 6. (The encoder and decoder are the wx and yz channels.) I am assuming here that the auxiliary channels are due to observer effects, not to indeterminacy in the encoder and decoder.

In a conventional communication system we assume that the capacities of these auxiliary channels are zero, but we are certainly not justified in doing so here. If, as is widely believed, psi effects transcend distance and time, then we must allow the possibility of auxiliary channels with nonzero capacities. And this in turn implies the possibility that all attempts to improve the reliability of the original channel through the use of channel coding may be "short circuited" by these auxiliary channels. The addition of the encoder and decoder could thus introduce an "observer effect" which would cancel out the benefits of coding and result in no net gain in reliability.

Only laboratory tests can determine whether or not these auxiliary channels will be a serious problem in practice. However, there are some encouraging indications. First, the use of statistical inference to evaluate the results of experiments consisting of many repeated trials does not cause a complete deterioration of the psi effect. Using statistics to evaluate the results of an experiment consisting of n repeated trials is not unlike the use of an (n,1) repetition code in a coded communication system. That an impressive result such as '$p < 10^{-6}$' can be "observed" by many other researchers (through journal publication, etc.,) without apparent adverse effect, is a hopeful sign. Of course, this does not imply that a similar resistance to observer effects would necessarily obtain if we tried to produce a *physical* output with the same order of reliability, but the reported successes of "majority vote" experiments

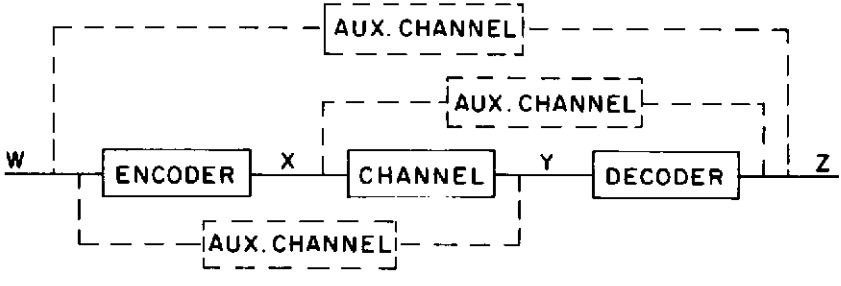


Figure 6. Coded channel with auxiliary channels shown.

gives hope that this might be the case. Stanford[3] and Kennedy[4] have interesting discussions of the majority vote technique.

There is a possible problem, then, in applying Shannon's coding theorem to the psi channel. There are indications that this may not be an insurmountable obstacle, but it is certainly well to be aware of possible observer effects caused by the introduction of channel coding. Who sees what (and how they think about it) may be, and very likely are, important factors. But even if observer effects acting over the auxiliary channels do not wash out our attempts to improve psi process reliability, we still face practical difficulties.

The Data Rate Problem

In this section, we will assume that the capacities of the auxiliary channels are zero. (This is equivalent to what Kennedy[4] has called the "majority vote hypothesis" and is probably much too optimistic.) The problem then reduces to finding a coding scheme that will give the desired performance. To give a feel for the sorts of problems involved, we will consider a simple example.

Suppose we take as our channel model a BSC with $\epsilon = .49$ which accepts binary digits at a rate of ten per second. (This could correspond to a binary random generator experiment with 10 trials/sec. and an average scoring rate of 51 percent.) The capacity of this channel is, from (4),

$$C_{BSC}(.49) \cong .0003 \text{ bits/binary digit}$$
$$= .003 \text{ bits/sec.}$$

In order to apply Shannon's theorem, the k/n for the block code must be less than C_{BSC}, say k/n = .0002. The length of the code word sent to the channel must thus be 5000 times the length of the data block entering the encoder. The information rate into the encoder is then .002 bits/sec., which is also the data rate, in binary digits/sec., assuming that each binary digit entering the encoder carries one bit of information (i.e., P(0) = P(1) = 1/2). The simplest code we could use in this case is the (5000,1) repetition code. The probability that the decoder would correctly decode a 5000-digit received word by majority vote is approximately p = 0.92. To further increase the reliability, we would resort to longer codes with the same k/n as illustrated in the previous section.

In this example, it would take more than eight minutes to transmit one data bit and perhaps several hours to transmit one codeword, if any

code other than the (5000,1) repetition code were used. Aside from the fact that such a low data rate would be of little interest, there are practical problems which make such a rate virtually impossible to sustain. First, there is the very real problem of finding subjects able and willing to serve as part of the "channel." If each channel digit must receive individual attention, as seems likely if a washout of the psi effect due to complexity-independence is to be avoided,[3-5] then the transmission of even one codeword would be an impossibly tedious task. Furthermore, the longer the transmission time for a codeword, the greater the probability that the channel will shift from psi-hitting to psi-missing or otherwise exhibit non-stationary behavior. Therefore, it would seem imperative that we be able to reduce the time required to transmit a codeword. Three approaches come to mind: (1) increase the channel symbol rate, (2) go to a larger channel alphabet or (3) use parallel channels.

Experiments such as those of Schmidt[6] suggest that increasing the channel symbol rate is not the answer. Clearly, if individual attention to each channel symbol is required, then the symbol rate is necessarily limited to human sequential data processing rates. In communication system terminology, we would say that the channel is bandlimited. We might be willing to push the symbol rate beyond the limits of human sequential processing speeds if the strength of the psi effect did not fall off too rapidly. For the BSC, however, the capacity of the channel varies as the square of the deviation from chance for small deviations, which suggests that even a relatively slow fall off of psi strength with increased channel symbol rate would be unacceptable.

The second approach—going to a larger channel alphabet—is the standard approach to increasing information rate over a bandlimited channel. The idea is to increase the amount of information per channel symbol by reducing the á priori probabilities of the symbols. Thus, with the 5-symbol alphabet employed in ESP card guessing experiments, the maximum amount of information that could be conveyed by one channel symbol is $\log_2 5 = 2.32$ bits as compared to $\log_2 2 = 1$ bit in the binary case. (The amount of information contained in one "symbol" of a free-response ESP experiment can be practically unlimited. However, quantifying this information is a difficult problem and the symbol rate is extremely low.) Whether the use of large alphabets will be fruitful or not depends upon the relationship between the à priori probability of a hit and psi strength.[4] At present, all that can be said is that if the use of large alphabets proves to be beneficial, then the channel capacity can be increased and the code length required for reliable communication correspondingly reduced.

The third approach—the use of parallel channels—is closely related to the second approach. Here, too, the idea is to increase the amount of information in one "use" of the channel(s). One use in this case is the simultaneous transmission of one channel symbol (not necessarily the same one) over each of N parallel channels. One could think of using a different subject on each of the N channels, but this is not the most attractive of the possibilities. Better would be a situation in which the attention of a single subject could be distributed over the N channels. A multiple-dice-throwing experiment would be a classical example of this. As a more modern example, a subject might attempt to influence simultaneously N random generators by receiving feedback in the form of a visual pattern, where different parts or aspects of the pattern are controlled by different generators. The use of parallel channels opens up the possibility of coding across channels as well as in time, which in this case could be accomplished by setting a high-aim/low-aim switch on the i^{th} generator according to the value of the i^{th} digit in a binary code-word of length N. The output of the channel would then be an N-vector whose i^{th} component is some measure of the action of the i^{th} random generator. Binary encoding and decoding would be performed in conventional fashion. As far as the subject would be concerned, his task would be the same regardless of what codeword was "transmitted." (I am indebted to Helmut Schmidt for pointing out this implementation of parallel channels.[7]) Of course, the parallel channels approach depends on the ability of the subject to have the same order of effect simultaneously on N channels as he has on one channel. The hope that this might be possible is based on an analogy with human information processing capabilities. Humans are much better parallel processors than sequential processors. Studies of human information processing show that most people can handle only about seven "chunks" of information sequentially without getting confused, but that the complexity of a "chunk" can be varied over a wide range without substantial loss.

Discussion

A coding theorist on first venturing into the field of parapsychology and reviewing the decades of debate over the statistical evidence of a weak psi effect in the laboratory is very apt to ask himself—as I did—why redundancy in the form of channel coding has not been used to provide a reliable and convincing physical demonstration of the existence of the phenomenon.

After a little reflection, it became clear to me that redundancy in the form of a crude channel code, namely, the (n,1) repetition code, had

been used from the very start, first in the form of repeated trials and later in the form of "majority vote" experiments. In almost all cases, however, the redundancy has been used in an attempt to increase statistical significance rather than to provide a convincing physical demonstration. (As Kennedy so aptly puts it, ". . . statistical (rather than practical) significance has become the standard for evaluating psi effects."[8]) The reasons for this seem to me to be: (1) the channel has not been characterized and is therefore unpredictable, (2) the data rates achieved to date are too low to support a real-time physical demonstration and (3) the coding scheme being used is not powerful enought to guarantee reliable results.

On the first point, it must be said that it is extremely difficult to characterize an unknown channel which operates at a very low average signal-to-noise ratio, as does the psi channel. One would hope that channel coding could be used to improve the signal-to-noise ratio and make characterization easier. But one of the fundamental results of information theory is that for reliable and efficient communication, the code must be matched to the channel. And how are we to do this if we know next to nothing about the channel? It is a circular problem which requires that we pull ourselves up by our bootstraps. But as with other situations of this sort, once a little headway is made we can expect very rapid progress.

On the second point, the approach to the low data rate problem which appears most promising to me is increased parallelism. It seems likely that we are dealing with a channel which has a high capacity, but which is severely bandlimited. In this case, the use of parallel channels and/or large channel alphabets is indicated.

On the third point, it is not clear that a more powerful coding scheme will solve the reliability problem. Given a weak but steady statistical effect on a conventional channel, Shannon's theorem guarantees that we can achieve completely reliable communication. But Shannon's theorem may not be applicable to extrasensory communication because of the auxiliary channels created when an encoder and decoder are introduced. An attempt to generalize Shannon's theory to take into account these auxiliary channels would be a most worthwhile undertaking. But even if it turns out that Shannon's theorem cannot be so generalized, the information-theoretic model with auxilliary channels will still provide a useful framework in which to consider such observer-theoretic questions as: who should receive trial-by-trial feedback and who should receive only summary feedback? I will hazard the speculation that the existence of auxiliary channels actually *increases* the overall channel capacity of the system, and that one of the keys to

achieving reliable communication is the use of these auxiliary channels so that they interfere constructively rather than destructively.

I would like to close by sharing a beginner's intuitive feeling about the ultimate reliability of extrasensory communication: either such communication can be made virtually error-free, or else it will never be much more reliable than it is today. It all depends on the nature of the underlying mechanism.

BIBLIOGRAPHY

1. This section borrows freely from R. G. Gallager, *Information Theory and Reliable Communication*, Wiley, New York, 1968.
2. See, for example, W. W. Peterson and E. J. Weldon, Jr., *Error-Correcting Codes*, 2nd Ed., MIT Press, Cambridge, 1972.
3. R. G. Stanford, "Experimental psychokinesis: A review from diverse perspectives," in B. B. Wolman (Ed.), *Handbook of Parapsychology*, Van Nostrand Reinhold, New York, 1977.
4. J. E. Kennedy, "The role of task complexity in PK: A review," *Journal of Parapsychology*, 1978, *42*, 89–122.
5. H. Schmidt, "Comparison of PK action on two different random number generators," *Journal of Parapsychology*, 1974, *38*, 47–55.
6. H. Schmidt, "PK tests with a high-speed random number generator," *Journal of Parapsychology*, 1973, *37*, 105–118.
7. H. Schmidt, private communication, April, 1979.
8. J. E. Kennedy, private communication, July, 1979.

DISCUSSION

MORRIS: How might you attempt to apply these ideas to sender/receiver situations as was talked about in Dr. Byer's paper, in which a lot of information is being simultaneously generated and exchanged, e.g., two opponents in a basketball game. I gather this has been one of the problems with Shannon's theory in general; it's harder to apply in that kind of complex circumstance.

RUDOLPH: Well, I take a very operational view of that. I only consider what shows up in the two variables that I'm looking at. The effect observed may be due to all sorts of influences, e.g. the sharing of common emotional states, as was spoken about yesterday. Nevertheless, if I'm only looking at the two variables, that is the channel. Taking all these other factors into consideration gets us into the area of "how do I get a better channel?" I suspect that this may involve getting constructive rather than destructive interference among all these factors. I've got an experiment in mind which would decouple the sender and receiver from the percipient who is trying to produce the

psi effect. The idea is that an outside observer would provide the information and would receive the information, but the channel capacity would be created by a psi source in a different setting. So that rather than having a pair of percipients try to communicate, I would use one percipient to create the channel and let other people use the channel.

MORRIS: You would then selectively study circumstances in which that would be less likely to occur.

RUDOLPH: Yes.

RUDERFER: How do you define your channel?

RUDOLPH: A channel is simply two variables and the probability assignment that relates them.

RUDERFER: Well, actual channels have to have more than that.

RUDOLPH: I'm talking about the channel model of Shannon. It's a mathematical model.

RUDERFER: So you're talking about mathematics only, a mathematical model only.

RUDOLPH: That's right.

RUDERFER: You're also talking about a noisy channel and so does Shannon. How do you get noise in a mathematical model?

RUDOLPH: That's incorporated into the probabilities.

RUDERFER: Yes, but where does it arise from physically?

RUDOLPH: I don't know. Shannon doesn't consider that. He looks at the effects of noise, but his mathematical model does not address itself to the physical mechanism involved.

RUDERFER: Then if you're excluding all physical phenomena, your statement about energy not applying is not applicable. You're talking about a mathematical equation and its interpretation or a mathematical model and its interpretation; therefore, energy is precluded only because of that, not for any other reason.

RUDOLPH: I'm dealing with a mathematical theory and it's just like applying group theory to crystallography. It is a mathematical theory that is applied to physical channels to improve their reliability. It is used every day. But the theory itself does not require a physical interpretation.

RUDERFER: Which means that when you go into the physical area, you have to add it according to the requirements of the properties of an actual channel.

RUDOLPH: In the design of the encoder and the decoder, you need know nothing about the channel other than its statistics.

ROSENTHAL: Being such an interdisciplinary area, parapsychology focusing on the same problems may forget the sciences of origin they come from. I think the people coming from the physical sciences may not realize how fuzzy and noisy and murky the signal/noise ratio is in the behavioral and social sciences right now, so that for the physical scientists there may be a world of difference between their traditional science and psi phenomena. For the psychologist, for example, or for the sociologist, this is an old problem. My hunch is that the order of magnitude of the size of the effect in some of the psi phenomena may be very much on the order of some of the effects in general psychology. Let me give you an example: Psychiatric diagnosis is notoriously unreliable. We can make it more reliable by adding more psychiatrists and getting a majority of opinions, but I would argue that in a sense that is statistical. That is, rather than increasing the number of patients in our research study who are being diagnosed, what we're doing is increasing the precision of definition of each of the patients, so, in a sense, we are reaping some statistical benefits. I think we've been doing that a long time in the behavioral sciences. I think psi may not be as badly off as people who come from the physical science tradition think it is.

RUDOLPH: I'm thinking of how to get through to the people outside of the field. I'm not comfortable with statistical inference and I know a lot of my colleagues aren't. Suppose something is significant at the five percent level. Nobody I know is really very impressed by that. Yet, if I can have a physical demonstration that works nineteen out of twenty times, they will be impressed and it's the same order of effect. I guess I'm just making a plea to use the redundancy in psi experiments for physical demonstration, just so I can convince my friends and not have to show them statistics which they don't like. But statistics are a very, very useful tool and I don't mean to imply otherwise.

MORRIS: You note that impressive results, such as P less than 10^{-6}, can be observed by many other researchers through journal publications, without apparent adverse effect. I'm not sure that's true. The lore within the parapsychological community is that if you're halfway through a study, don't present the half of your data even to

chums and buddies, because it will plummet at the end. There's even an example of that in the literature. In *Parapsychology from Duke to FRNM*, there is a significant progress report by Rex Stanford of an EEG/ESP study which, when you read the later publication, turns out not to be significant overall. Some people would say that a major portion, perhaps, of parapsychology's replicability problems is that once one announces a result and that therefore one has something to repeat, one has immediately involved a rather large observational community, who may be a little testy about what they observe. I'm not pleased by that interpretation of things, as I like to do the ordinary business of science and generate results for all to observe and utilize.

RUDOLPH: I agree. But there are journal articles that do give impressive results like that.

MORRIS: That I agree with, and the question of asking whether or not the observer effect affects only "not yet" but not "already," I think may re-insert time back into things, because any act of measurement separates the universe into "already" versus "not yet." Even when you say your model is time independent, you sooner or later take an observation separating the universe into "already" versus "not yet." If you're trying to assess a precognition study, all you could say at any given moment was whether or not the precognitive statement had been validated "already" versus "not yet." So time is back in there.

RUDOLPH: Yes. And I share your uneasiness about the assumption of unlimited observer effects, which can certainly cause a lot of paranoia.

PSI INFORMATION AND CULTURE

DAVID READ BARKER

Introduction

The role of culture in the transmission or creation of psi information is an almost empty frontier in parapsychology. Culture, defined briefly as patterns of learned behavior, is the distinguishing characteristic of humans. Psi information is defined as information not apprehended through known sensory channels. The apprehension, commonly termed ESP, occurs during a psi communication. Animals, as well as humans, have demonstrated ESP, indicating that culture is a sufficient, but not necessary requisite for psi experiences. ESP is supra-cultural; humans inherited it through biological evolution.

What is the role of culture? This question has received little attention, in part because of the difficulty of controlling culture as a meaningful experimental variable. Attitudes and personality traits have been studied in relation to performance on tests of ESP, but culture has been too vague and all-inclusive to be susceptible to direct experimentation. However, since the overwhelming majority of the subjects of ESP experiments have belonged to the industrial societies of the West, culture has been effectively treated as a constant.

Since the 1940's a few ESP experiments have employed subjects from non-Western cultures, but the results have not been consistent or dramatic. Accounts of spontaneous psi communications have gradually been collected. Inglis,[1] Long,[2] and Van de Castle[3] have recently contributed valuable bibliographies of these accounts, but their surveys are neither large nor systematic enough to permit a description of the role of culture in psi experiences.

This paper reports a review of the ethnographic literature of a worldwide sample of 68 non-Western societies, undertaken to identify all the authoritative accounts of ESP in these cultures and thereby begin a systematic and cumulative examination of the huge literature of anthropology.

Two important questions for the cross-cultural study of psi were asked more than 30 years ago by Barnouw:[4] Does culture exert an influence upon the incidence of paranormal phenomena? Does it also dictate the forms which such phenomena may assume? In "Paranormal Phenomena and Culture," he demonstrated that culture plays a significant role in the etiology of paranormal phenomena, through the comparison of the emotional ties in a Chippewa poltergeist case with the British spontaneous ESP cases reported in *Phantasms of the Living*. Barnouw also made a close comparison of Siberian Shamanism and Western Spiritualism.[5]

The investigation of spontaneous psi has advanced considerably since the 1940s, primarily through the work of Ian Stevenson[6] and Louisa E. Rhine.[7] The contemporary American equivalent of the nineteenth century British cases is the L. E. Rhine collection in Durham. Between 1951–1969, L. E. Rhine published 20 articles in the *Journal of Parapsychology* analyzing 15,000 self-reported spontaneous (mostly American) psi communications. Her "Case Study Review"[8] is the best entry point into this collection.

One of L. E. Rhine's early studies was of the forms of psi in consciousness.[9] In a group of 1073 ESP cases, 1000 could be typed as one of four subjective forms: intuitive, hallucinatory, unrealistic dreaming, and realistic dreaming. These are the vehicles through which information (including ESP) enters consciousness. ESP, she concluded, has no form of its own.

The ethnographic literature review reported here identified 15 accounts of psi communications in non-Western societies. These accounts will be examined for indications of the prevalence of psi phenomena and their subjective forms in consciousness.

Method

This literature review was intended to be a systematic sampling of authoritative ethnographies of a large sample of non-Western societies worldwide since 1500. I seriously underestimated the time required for the proposed survey; consequently, systematic sampling was not maintained during the last half of the review. The references consulted are biased toward North American societies and away from Circum-Mediterranean societies and are biased toward English-language publications and away from foreign language publications.

If it had been possible to conduct a quantitative analysis of information on psi among non-Western peoples, the methodological defects of this study would have been far more serious than they

presently appear to be. The result of the survey is a collection of accounts of psi communication that is too small and subjective to be usefully analyzed quantitatively.

The Original Societies Sample

The original sample consisted of bibliographic references to ethnographies of 100 societies drawn from the Standard Cross-Cultural Sample (SCCS).[10] The SCCS was originally judged to be the most satisfactory sample universe for this survey for four reasons. First, it is promoted as being a *representative* sample of 186 societies distributed in all of the six major culture areas of the world. Second, it avoids "Galton's Problem" of duplication of societies that share numerous culture traits. Third, it specifies a focus in time and space by indicating both the year and a region (village, section, or whole society) for which the bibliographic citations were chosen. Fourth, it specifies the established authorities on each society and provides a bibliography. The SCCS was chosen over other sample universes such as the Ethnographic Atlas,[11] the World Ethnographic Sample,[12] the Human Relations Area Files, the Probability Sample Files, and the Standard Ethnographic Sample,[13] each of which is deficient in one or more of the four strengths of the SCCS.[14]

Two modifications were made in the SCCS before the original sample was drawn. Of the 186 societies in the SCCS, eight are not included in the Ethnographic Atlas; these were removed from the sample. The SCCS contains four societies with a time focus prior to 1500 A.D. These were also removed, leaving a sample universe of 174 societies from which the original sample of 100 was drawn at random.

Of the 100 societies in the original sample, 65 were included in the Human Relations Area Files.[15] The following HRAF codes[16] were used in the reference search:

75 Sickness: 753 Theory of disease; 754 Sorcery; 755 Magical and mental theory
77 Religious belief: 775 Eschatology; 777 Luck and chance
78 Religious practice: 787 Revelation and divination; 789 Magic
79 Ecclesiastical organization: 791 Magicians and diviners
82 Ideas about nature and man: 828 Ethnopsychology

For the remaining 35 societies for which there were no Human Relations Area Files, bibliographic sources were read completely.

Procedure

Ethnographies were read by the author; by David Howell, Ph.D.; and by two advanced graduate students in the Department of Anthropology at the University of Virginia, Ann Mabe and Alma Gottlieb. The literature review was started with North American societies and progressed to South America, Africa, East Eurasia and the Insular Pacific. The last culture region, the Circum-Mediterranean, was incompletely reviewed under considerable time pressure.

The SCCS bibliography unexpectedly became a second sampling universe. The original intention—to review all the sources in the SCCS bibliographies of the sample societies—was not fully implemented. Some sources are unpublished and unobtainable; others were difficult to locate. There were also sources in the Human Relations Area Files that were not listed in the SCCS bibliography (often because of a different time focus). These were reviewed and included in the bibliography of this survey when the material appeared relevant to psi. Foreign language sources received proportionately less attention than English language sources.

The Completed Societies Sample

The final sample consists of 68 societies of the 100 in the original sample. Table A.1, Appendix A, is a comparison of the original and completed samples, by region. Regional summaries of the number of pages reviewed are shown in Table B.1, Appendix B. Maps C.1–C.6, Appendix C, show the location of the 68 survey societies. The time focus, HRAF number, of sources consulted, and the total pages reviewed are given in Tables C.1–C.6, Appendix C.

The number of pages reviewed for each society ranges from only eight (on the Teda) to 1028 (on the Thonga). For six societies, fewer than 100 pages were read; for ten more societies between 100-199 pages were read. In all, the review covered 26,117 pages in 112 sources.

Criteria for Accounts

We experienced the common difficulty in cross-cultural studies of establishing objective criteria for accounts of psi communication. Normative generalizations and accounts shrouded in legend and myth were rejected with two exceptions, the accounts of the Lengua and Trumai recorded below. A fully-developed account includes: (1) the source of the report, whether rumor, the narration of an informant or firsthand observation by the reporter, (2) the setting, (3) the major

participants, (4) some details of the event and (5) the outcome of the psi communication.

Accounts of Psi Communication in Non-Western Societies

A Kikuyu Prediction

The coming of the white man was a catastrophe for many primitive societies. The late Jomo Kenyatta, himself a Kikuyu and the first President of Kenya, recounted Mogo wa Kebiro's precognitive dream of this event.

"Once upon a time there lived in Gikuyuland a great medicine man known as Mogo or Moro wa Kebiro, his national duty was to foretell future events and to advise the nation how to prepare for what was in store. We are told that one early morning the prophet woke up trembling and unable to speak, his body was covered with bruises. His wives on seeing him were very frightened and in a state of hysteria, not knowing what had happened to their husband, who went to bed in perfect health the previous evening. Horror-stricken, the family summoned the ceremonial elders to his side with a view to offer a sacrifice to Ngai (God) and to inquire what the great man had foreseen that had so frightened him. . . . Soon Mogo wa Kebiro regained his power of speech. . . . In a low and sad voice he said that strangers would come to Gikuyuland from out of the big water, the color of their body would resemble that of a small light-colored frog (*kiengere*) which lives in water, their dress would resemble the wings of butterflies; that these strangers would carry magical sticks which would produce fire. That these sticks would be very much worse in killing than the poisoned arrows. . . . He went on to say that when this came to pass the Gikuyu, as well as their neighbors, would suffer greatly. That the nations would mingle with a merciless attitude towards each other, and the result would seem as though they were eating one another."[17]

A Huron Spark Shaman

People with powers like those of Mogo wa Kebiro are not unique to the Kikuyu. Under many names—medicine man, witch doctor, juggler, conjurer, shaman—these people are reported in all six culture regions. The Jesuit missionaries encountered them during the seventeenth century among the Huron of the Great Lakes of Canada.

"In the *Relation* of 1636, Brébeuf said there were four classes of shamans: first, those who presumed to command the rain and winds; second, those who predicted future events; third, those who found lost

objects; fourth, those who restored health to the sick. They all worked by deception and imagination, according to Brébeuf, but he thought there was some foundation for the belief that the devil occasionally gave them assistance."[18]

Raguenau said that the same men who undertook to discover the whereabouts of lost objects or the perpetrators of thefts also attempted to forecast events connected with warfare. These shamans worked by pyromancy, hydromancy, necromancy, or received the desired information in sweat baths or in frenzies induced in sweat baths or in songs.

An example of pyromancy practiced by a female shaman to learn the whereabouts of seven warriors was given by Lafitau:

"She began first by preparing a space of ground which she cleaned and covered with flour or ashes very well sifted (I do not remember exactly which of the two). She placed on this powder, as it if were a geograpical [sic] map, bundles of sticks, which represented various villages of different nations, observing perfectly their position, and the direction of the wind. She then went into great convulsions during which we saw perceptibly seven sparks of fire come out of the sticks which represented our village, trace a way on this ash or flour and go from one village to the other. After having disappeared during a rather long time in one of these villages these sparks reappeared, nine in number, and traced a new path for the return, until at last they stopped rather close to the village or bundle of sticks from which the first seven came out originally. Then the Indian woman, all the while in a fury, disordered all the piece of ground she had prepared and where this scene had just taken place. Next she seated herself and after having given herself the time to become calm and to recover her senses, she told everything singular which had happened to the warriors, the route which they had kept, the villages through which they had passed, and the number of prisoners they had taken; she named the place where they were at that time and asserted that they would arrive at the village three days later, which was verified by the arrival of the warriors, who confirmed point for point what she had said."[19]

Toda Lifting Stone Diviners

Among the Todas of southern India at the turn of the century, the British anthropologist W. H. R. Rivers reported an instance of possession with GESP.

". . . certain Todas have the power of divination, others are sorcerers, and others again have the power of curing disease by means

of spells and rites. . . . Certain men among the Todas are reputed to have special powers as diviners, and are known as *teuòdipol*, god-gesticulating men, or more commonly as *teuol*. . . . In several cases these men are said to have inherited their powers from some near relative, often a grandfather, but it seems that anyone who showed evidence of the necessary powers might become a *teuol*."[20]

"Each of the *teuol* is believed to be possessed by a special god when he falls into the divining frenzy, and when in this state it is said that the diviner does not, as a rule, speak in his own language, but in some other, most commonly in Malayalam or one of its dialects."[21]

"The *teuol* are consulted whenever any misfortune befalls a Toda. The following are various instances in which I have records of resort to divination; sickness or death of a Toda or his family; . . . loss of a . . . lifting stone. In this last instance the stone at the village of Nidrsi was carried away some years ago by a party of English people who came to picnic near the village while the people were away. They carried the stone for some miles and then threw it down. The Nidrsi people could not find it, and consulted Midjkudr and Mongudrvan [diviners], who were able to reveal where the stone was to be found, and it was restored to the village, where it can now be seen."[22]

Thonga Diviners

The clairvoyant discovery of lost objects while in a state of ecstasy is also reported among the Thonga, a Bantu people living near Lourenço Marques, in southern Africa. The author, Henri A. Junod, was a missionary among them from 1895–1909.

"[The] *divination by ecstasy* . . . is employed by the magician when smelling out wizards. The old men assert that, in former times, there were diviners who could guess anything when in that peculiar psychological state in which the subliminal faculties may develop to a marvelous extent. . . . [One diviner] used to travel all through the land, practising his art in the villages. He was able to describe minutely a goat which he had never seen; or if somebody had buried something in a certain place to test him, he would go straight to the spot and say: 'Dig in the earth here, and you will find it.' . . . I myself heard trustworthy witnesses assert that a certain diviner who had been called into a village . . . actually discovered some pounds sterling which had been hidden by their owner, who was no longer in the country."[23]

"[A] nervous instability may pass away and they may return to their normal state, but it may be that if they possess those strange mental powers, which modern psychology calls subliminal, and which are

more or less dormant in every individual, these faculties will suddenly develop and the exorcised will become a real magician. A faculty of *second sight* may reveal itself. Or he will become a *diviner*, either by ecstasy or by bone throwing. . . . Or he will be a *wonderworker*, a *prophet*, etc. Mholombo, who was an extraordinarily acute woman, had possessed all these gifts. She could discover wizards; one night, crossing the Mabota country, she met one of the indunas of the chief accompanied by two other men, leading his own wife to the marsh, in order to eat her. They were acting in their capacity of wizards."[24]

A Case of Ajie Telepathy

A dramatic example of what appears to be spontaneous telepathy was reported among the Ajie of New Caledonia by Maurice Leenhardt, a French missionary who had lived among them for 25 years.

"[There are three types of diviners. First, he] who has the gift of television. . . .

"The case of the seer Belet, chief of Yengebane but originally of Tipindje, had, at the time, a certain fame in the North of the island. In the course of a great joyous feast, he suddenly plunged himself into despair, announcing that he saw one of his illustrious relatives of Arama agonizing. A canoe was speedily sent to Arama, a three hour trip from there. The chief of Arama had just died."[25]

Lengua Visionaries

There are several reports of clairvoyance among shamans in the New World. W. Barbrooke Grubb, who spent more than 20 years as a missionary among the Lengua of the Paraguayan Chaco, mentioned what appears to be clairvoyance in the context of autohypnosis.

"The training necessary to qualify an Indian to become a witch-doctor consists, in the first place, in severe fastings, and especially in abstention from fluid. They carry this fasting to such an excess as to affect the nervous system and brain. Certain herbs are eaten to hasten this stage. They pass days in solitude, and, when thoroughly worked up to an hysterical condition, they see spirits and ghosts, and have strange visions. It is necessary, furthermore, that they should eat a few live toads and some kinds of snakes. . . .

"It is unquestionable that a few of these wizards understand to a slight degree the power of hypnotism. They appear at times to throw themselves into a hypnotic state by sitting in a strained position for hours, fixing their gaze upon some distant object. In this condition they are believed to be able to throw their souls out—that is, in order to

make them wander. It seems that occasionally, when in this state, they see visions which are quite the opposite of those they had desired."[26]

Trumaí Extra-visionary Shamans

Extra-visionary powers, presumably GESP, were also found among Trumaí shamans of the Upper Xingu River of Brazil to Buell Quain, an anthropologist who lived among them for four months in 1938.

"There is . . . a type of specialist among the Trumaí that is not reported for the Kamayurá and it is to this type that the term shaman is applied in the following description. The Trumaí shaman in this sense, is a man who possessed extra-visionary powers through which he could locate enemy war parties and see the afterworld."[27]

A Cubeo Insect Spirit Shaman

Northwest of the Trumaí, in the Upper Amazon, a Cubeo shaman was reported to have employed an insect spirit, possibly an instance of clairvoyance. The author is Irving Goldman, an American anthropologist who lived among them in 1939.

"The play of the shaman with weather and the river level is only a demonstration of his power and has no sinister motive. Shamanistic power also includes the control of tutelary spirits. Generally, a shaman controls a number of insect spirits who do his bidding, in a minor capacity, however, as scouts and messengers. A shaman on the Cuduiarí once found a little girl who had blundered into the forest and became lost. He claimed he sent an insect to look for her."[28]

Quiche Diviners

Farther north, among the Quiche of the town of Chichicastenango, in Guatemala, belief in clairvoyance is reported by the American anthropologist Ruth Bunzel, who lived with them in 1930–32.

"It is obvious . . . that there is a great deal of suggestion back and forth between the diviner and his client. . . . The process of divination is less a matter of consulting an impersonal oracle than exploring the mind of the patient for hidden guilt and hate and fear. There is nothing extraordinary in the nature of the revelations. It is always the patient who supplies the details. But the diviners insist on the reality of the physiological reactions; their definite sense of what constitutes authenticity in a divination. They believe that they are clairvoyant. Possibly they are. It is still a problem for investigation by someone who is interested in psychic phenomena."[29]

Riffian Sherif Dreamers

The Riffians of the Maghreb of the Mediterranean coast of north Africa ascribe precognition to a magical emanation that functions in dreams. The report is by the American anthropologist Carleton S. Coon, who lived among them in 1926.

"*Baraka*, or *er fthair* is usually confined to supposed descendants of the Prophet [Mohammed], and is dependent upon their possession of a magical emanation supposedly transmitted to them by him. *Baraka* is a force, a power, like the tabu of the Polynesians, and more like the *mana* of the Melanesians. A man possessing it is equipped with supernatural powers; he is able to predict the future, to perform miracles, and to heal or destroy by touch, or, through extension, by employing some object which has been in contact with his body, such as a part of his clothing, a piece of bread, or an egg which he has kissed.

"A client wishing to know his future comes to the sherif at Targuist and presents his problem. On the ensuing night the sherif dreams about it, and in the morning tells his client what the future will contain. The client then pays a fee approximating five dollars and departs. The sherif is not limited to a single dream each night; he dreams as many as are required."[30]

Bella Coola Active Spirits

For the Bella Coola of British Columbia, precognition was believed to be the result of an active spirit. One instance was reported by the anthropologist T. F. McIlwraith.

"The most important part of the human body is the *xix-mänoäs*, spirit. This is small, but of great power, since it belongs to the world of the supernatural; in fact, the spirit of a man is not mortal, but *sint*. Everyone, man or woman, rich or poor, chief or slave, has one; without it, life would be impossible. . . . It is the cause of dreams, which are desired as a means of foretelling the future. Some Bella Coola believe that in sleep it leaves the body and travels, unrestrained by a barrier, to the scene of the dreams; others, that it causes the images to appear. . . . Sometimes an active one can give warning, as in the following instance. A few years ago a chief, when hunting, sat down to rest. While he sat a slide plunged down the mountain-side and swept away the ground where he would have been if he had not stopped. The Bella Coola know that such a fortunate escape is no accident, as foolish white men believe, but is the result of an active spirit. Sometimes it can convey only symbolic hints of what is to happen. . . . A thoughtful person pays great attention to indications such as these, knowing that

his spirit is always striving to pierce the future and obtain information for him, however indefinite. The importance of the supernatural to the Bella Coola can be judged from the fact that they attribute every action and thought to an element of this nature."[31]

Suku Dreamers

The Suku, western central Bantus in Africa, also recognize precognitive dreams, as reported by Torday and Joyce.

"Dreams are considered as presages of events to come; for example, if a man dreams that he kills a leopard and then encounters one the next day, he is sure to succeed in killing it."[32]

Ganda Lubale Spirits

Among the Ganda, of Uganda, in east Africa, precognition was reported to occur during possession. The report is by the British anthropologist Lucy P. Mair.

"The *lubale* are the spirits of persons who gave evidence of supernatural powers during their lifetime, and who manifested themselves after death not only, like other spirits, for their personal ends but also in order to help the living by foretelling the future and by revealing to them magical means of obtaining wealth, fertility, and success in enterprises of all kinds. This they did through the mouths of prophets who, once possessed, were formally dedicated to their service. Two of them were honored by human sacrifice."[33]

Locating a Missing Salteaux Boy

Salteaux conjurers are sometimes called upon to locate missing persons. This report is by the American anthropologist A. Irving Hallowell, who had spent 12 summers with the Salteaux of the Berens River in Manitoba, Canada.

"Sometimes a conjurer was asked to locate lost persons or articles. One of my informants was present at a seance the purpose of which was to discover the whereabouts of a young man who had been missing for a week. His mother was worried and gave a conjurer tea and tobacco amounting to two dollars in order to locate her son. (The narrator commented that the amount given was very small). After the conjuring performance had progressed for awhile the lost man was discovered. Here he is, said the conjurer, and sure enough he spoke to his mother. He told her that he was all right and was camping at such and such a place. Two days later he arrived home. On the night of the seance he

had been camping exactly where he had said he had been. But the performance took place when he was asleep and he did not know that his soul had been called into the conjuring tent."[34]

A Copper Eskimo Shaman's Dream

An apparently clairvoyant dream by the Copper Eskimo shaman Ilatsiak was reported by the Canadian anthropologist Diamond Jenness. The Copper Eskimo live on the coast of the Arctic Ocean in the Northwest Territories, Canada.

"Many of the Shamans' "discoveries" are made in dreams. . . . Ilatsiak asserted that his familiar often visited him in sleep and revealed what was about to happen. . . . [He] entered our house and reported that during the night his spirit had told him that something had gone wrong on our schooner; it was the thing, he said, that made the vessel move. We thought that he must mean the propeller, for we had put a new one on during the winter and had to keep the ice open around it. By a strange coincidence, however, we discovered during the day—what Ilatsiak could hardly have been aware of—that a boom we were using to roof our provision cache had snapped during the night owing to the weight of snow above it."[35]

Psi Information and Culture

The 15 accounts of psi identified in this literature review are too few and incomplete to justify more than a tentative delineation of the role of culture in psi communication. We will cautiously examine two areas: the prevalence of psi, and the forms of psi communication.

The Prevalence of Psi Communication

Superficially, the results of this literature survey indicate "slim pickings" for accounts of psi in authoritative ethnographies. Few of the anthropologists, missionaries or colonial administrators surveyed indicated any familiarity whatever with paranormal phenomena. One anthropologist, Hallowell, had undertaken a full study of the paranormal, *The Role of Conjuring in Salteaux Society*. One other, Bunzel, suggested a specific topic for psychical research, Quiche divination. Those authorities who reported accounts of psi tended to be first-rank anthropologists (Bunzel, Coon, Hallowell, Jenness, Mair, Murphy, Rivers and the Seligmans) or missionaries with over 20 years of contact with the people they described (Grubb, Junod and Leenhardt). This suggests that awareness of paranormal phenomena in non-Western societies requires exceptional fieldwork abilities and/or long exposure.

ESP is probably underreported in non-Western societies because it is so difficult to observe and comprehend.

Of the 68 societies surveyed, 15 (22 percent) were reported to have some experience with paranormal phenomena. These 15 are in all six of the major culture regions. This means that the worldwide prevalence of ESP, by *society*, is at least 22 percent. Improved survey methods should raise the prevalence of reports of psi considerably.

In most of the 15 societies, paranormal phenomena appear to have been institutionalized through stereotyped training (vision quest), roles (diviners, shamans, visionaries) and settings (seances). In these societies, psi communication may be "routine," but no ethnography suggested that ESP was a feature of the daily life of ordinary people. As in our own society, it may be that most non-Western people have no conscious ESP, while others become specialist psychopomps or psychics.

The Forms of Psi Communication

Of the 15 accounts of psi in this survey, five can be readily classed as occurring in dreams; these are the accounts of the Kikuyu, Riffians, Suku, Bella Coola, and Copper Eskimo. Two accounts refer to hallucinations: the Ajie ("he saw") and the Lengua ("they see visions"). In the remaining nine accounts the psychological mechanisms through which ESP reached consciousness cannot be identified. Generally, non-Western people tend not to think of ESP as a "parapsychological" event, but ascribe it to external agents: Bella Coola "active" spirits, Cubeo "insect" spirits and Ganda *lubale* spirits. Culture provides a framework of labels and meanings that extends into the supernatural and paranormal and establishes attitudes and expectations.

Altered states of consciousness apparently facilitate psi communication: the Huron shaman was convulsed, the Toda diviners and Ganda prophets were possessed, Thonga magicians were in ecstasy, Lengua witch-doctors were "thoroughly worked up to an hysterical condition," and the Ajie chief was at a feast. The descriptions of these altered states of consciousness are inadequate to suggest their precise role in selecting the psychological mechanisms of psi communication.

The major roles of culture in selecting the forms of psi communication are positive valuation, training and institutional support of dreaming and altered states of consciousness.

BIBLIOGRAPHY

1. Inglis, Brian, *Natural and Supernatural*, London: Hodder and Stoughton, 1977.
2. Long, Joseph K., *Extrasensory Ecology*, Metuchen, New Jersey: Scarecrow, 1977.

3. Van de Castle, Robert L., "Parapsychology and anthropology," in B. Wolman, Ed., *Handbook of Parapsychology*, New York: Van Nostrand Reinhold, 1977, pp. 667–686.
4. Barnouw, Victor, "Paranormal phenomena and culture," *Journal of the American Society for Psychical Research*, 1946, *40*, pp. 2–21.
5. Barnouw, Victor, "*Siberian shamanism and western spiritualism*," *Journal of the American Society for Psychical Research*, 1942, *36*, pp. 140–168.
6. Stevenson, Ian, *Telepathic Impressions*, Charlottesville: University Press of Virginia, 1970.
7. Rhine, Louisa E., "Research methods with spontaneous cases," in B. Wolman, Ed., *Handbook of Parapsychology*, New York: Van Nostrand Reinhold, 1977, pp. 59–80.
8. Rhine, Louisa E., "Case study review," *Journal of Parapsychology* 1969, *33*, pp. 228–266.
9. Rhine, Louisa E., "Subjective forms of spontaneous psi experiences," *Journal of Parapsychology*, 1953, *17*, pp. 77–114.
10. Murdock, George P., and D. R. White, "Standard cross-cultural sample," *Ethnology*, 1969, *8*, pp. 329–369.
11. Murdock, George P., "Ethnographic atlas: A summary," *Ethnology*, 1967, *6*, pp. 109–236.
12. Murdock, George P., "World ethnographic sample," *American Anthropologist*, 1957, *59*, pp. 664–687.
13. Naroll, Raoul, and R. G. Sipes, "A standard ethnographic sample: Second edition," *Current Anthropology*, 1973, *14*, pp. 111–140.
14. Otterbein, Keith F., "Sampling and samples in cross-cultural research," *Behavior Science Research*, 1976, *11*, pp. 107–121.
15. Murdock, George P., *Outline of World Cultures*, fifth edition, New Haven: Human Relations Area Files, 1975.
16. Murdock, George P., et al., *Outline of Cultural Materials*, fourth revised edition, fifth printing with modifications, New Haven: Human Relations Area Files, 1971.
17. Kenyatta, Jomo, *Facing Mount Kenya*, London: Secker & Warburg, 1938, pp. 41–43.
18. Kinietz, Vernon, W., *The Indians of the Western Great Lakes 1615–1760*, Ann Arbor: University of Michigan Press, 1940, p. 131.
19. Ibid., pp. 133–134.
20. Rivers, W. H. R., *The Todas*, New York: MacMillan, 1906, p. 249.
21. Ibid., p. 250.
22. Ibid., pp. 251–252.
23. Junod, Henri A., *The Life of a South African Tribe*. Volume 2, New Hyde Park, New York: University Books, 1962, p. 538.
24. Ibid., pp. 499–500.
25. Leenhardt, Maurice, *"Notes d'Ethnologie Néo-Calédonienne" Travaux et Memoires de l'Institute d'Ethnologie*, 1930, *8*, pp. 246.
26. Grubb, W. Barbrooke, *An Unknown People in an Unknown Land*, London: Seeley, Service and Company, 1913, p. 146.
27. Murphy, Robert F., and Buell Quain, *The Trumai Indians of Central Brazil*, Seattle: University of Washington Press, 1955, pp. 62–63.
28. Goldman, Irving, *The Cubeo*, Illinois Studies in Anthropology 2 Urbana: University of Illinois Press, 1963, p. 262.
29. Bunzel, Ruth, "Chichicastenango," *Publications of the American Ethnological Society*, 1952, *22*, Locust Valley, New York: J. J. Augustin, p. 149.
30. Coon, Carleton S., *Tribes of the Rif*. Harvard African Studies *9* Cambridge, Massachusetts: Harvard University, 1931, p. 157.
31. McIlwraith, Thomas F., *The Bella Coola Indians*, Volume 1, Toronto: University of Toronto Press, 1948, pp. 94–95.
32. Torday, E., and T. A. Joyce, *Notes Ethnographiques sur les Peuples Communément appelés Bakuba, ainsi que sur les Peuplades Apparentees. Les Bushongo*, Bruxelles, 1910, p. 273.

33. Mair, Lucy P., *An African People in the Twentieth Century*, New York: Russell & Russell, 1965, pp. 229–230.
34. Hallowell, A. Irving, *Conjuring in Salteaux Society*, Philadelphia: University of Pennsylvania Press, 1942, p. 68.
35. Jenness, Diamond, *The Life of the Copper Eskimo*. Report of the Canadian Arctic Expedition *12*, A Ottawa, 1922, pp. 200–201.

APPENDIX A

TABLE A.1

Original and Completed Society Samples, by Region

Region	All Societies			Societies in HRAF*			Societies not in HRAF*		
	Original Sample	Completed Sample	Per Cent	Original Sample	Completed Sample	Per Cent	Original Sample	Completed Sample	Per Cent
Circum-Mediterranean	15	6	40	8	4	50	7	2	29
East-Eurasian	16	12	75	10	10	100	6	2	33
North America	19	17	89	12	12	100	7	5	71
South America	20	15	75	15	11	73	5	4	80
Insular Pacific	16	10	63	11	6	55	5	4	80
Africa	14	8	57	9	5	55	5	3	60

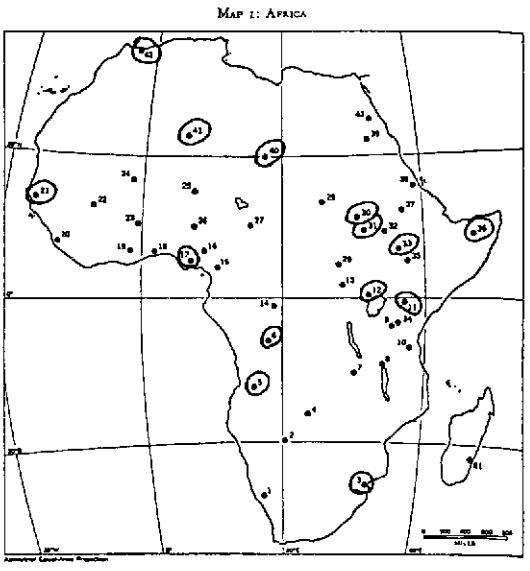
* HRAF is Human Relations Area Files.

APPENDIX B

TABLE B.1

Summary of References Consulted, by Region

Region	No. Societies	No. References	No. Pages	Per Cent of Total Pages
Circum-Mediterranean	6	7	1069	04
East-Eurasian	12	17	3767	14
North America	17	37	9065	35
South America	15	19	4057	16
Insular Pacific	10	14	3734	14
Africa	8	18	4395	17
Totals	68	112	26,117	



REGION:
CIRCUM-MEDITERRANEAN

21. Wolof
33. Kafa
36. Somali
40. Teda
41. Tuareg
42. Riffians

REGION: AFRICA

3. Thonga
5. Mkundu
6. Suku
11. Kikuyu
12. Ganda
17. Ibo
30. Otoro
31. Shilluk

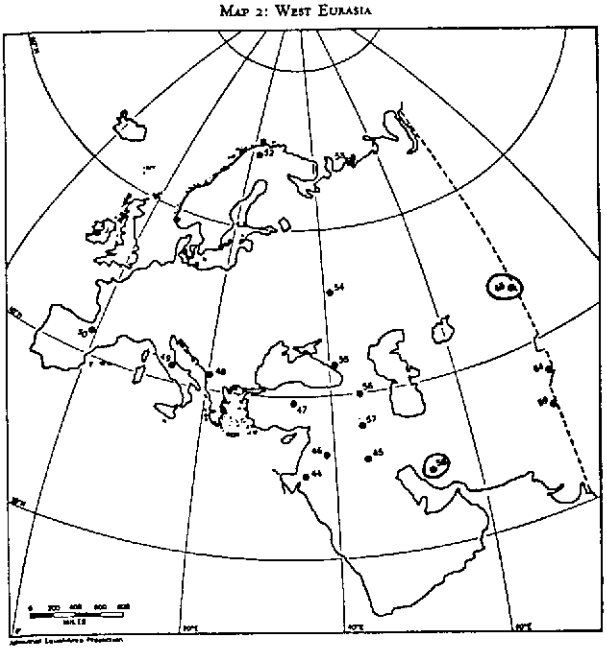
(After Murdock, 1969)

APPENDIX C

TABLE C.1

Africa: Survey Societies

SCCS No.	Society	Time Focus	HRAF No.	No. Sources Consulted	Total Pages
12	Ganda	1875	FK7(a)	2	416
17	Ibo	1935	no file	3	467
11	Kikuyu	1920	FL10(a)	4	699
5	Mbundu	1890	FP13(a)	1	245
30	Otoro	1930	no file	1	447
31	Shilluk	1910	FJ23(a)	4	528
6	Suku	1920	no file	2	565
3	Thonga	1895	FT6(a)	2	1028



MAP 2: WEST EURASIA

EAST EURASIA

58. Basseri
65. Kazak

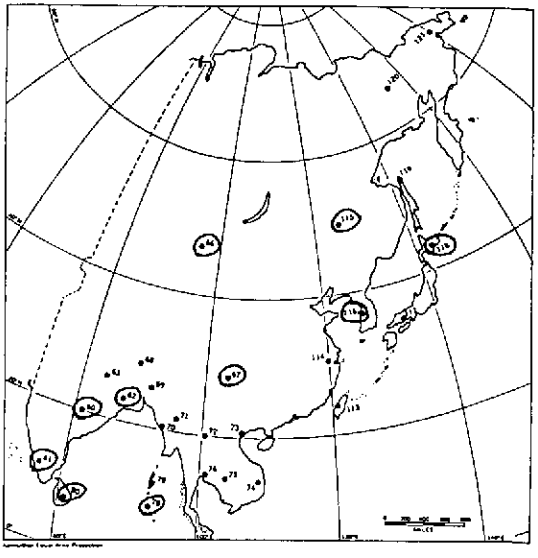
(After Murdock, 1969)

TABLE C.2

Circum-Mediterranean: Survey Societies

SCCS No.	Society	Time Focus	HRAF No.	No. Sources Consulted	Total Pages
33	Kafa	1905	no file	1	57
42	Riffians	1926	MX3(b)	1	417
36	Somali	1900	MO4(c)	2	474
40	Teda	1950	no file	1	8
41	Tuareg	1900	MS25(a)	1	21
21	Wolof	1950	MS30(a)	1	92

MAP 3: EAST EURASIA



REGION: EAST EURASIA

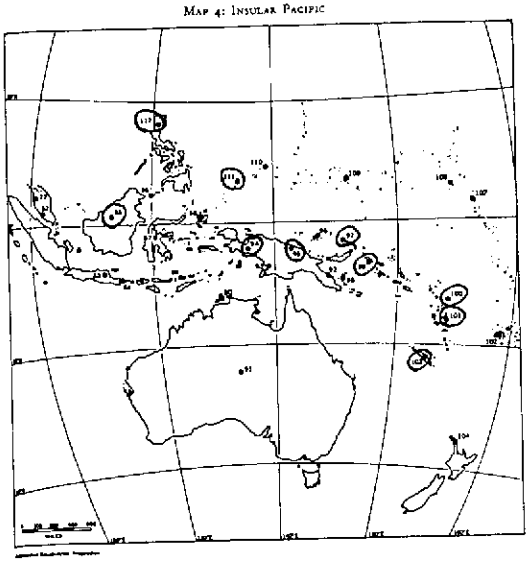
60. Gond
61. Toda
62. Santal
66. Khalka Mongols
67. Lolo
78. Nicobarese
80. Vedda
115. Manchu
116. Koreans
118. Ainu

(After Murdock, 1969)

TABLE C.3

East-Eurasia: Survey Societies

SCCS No.	Society	Time Focus	HRAF No.	No. Sources Consulted	Total Pages
118	Ainu	1880	AB6(c)	2	178
58	Basseri	1958	no file	1	250
60	Gond	1938	AW32(a)	1	427
65	Kazak	1885	RQ2(b)	1	109
66	Khalka Mongols	1920	AH7(b)	1	115
116	Koreans	1947	AA1(a)	1	387
67	Lolo	1910	AE4(c)	1	180
115	Manchu	1915	AG1(a)	1	194
78	Nicobarese	1870	no file	1	276
62	Santal	1940	AW42	2	372
61	Toda	1900	AW60(a)	3	806
80	Vedda	1860	AX5(a)	2	473



Map 4: Insular Pacific

REGION: INSULAR PACIFIC

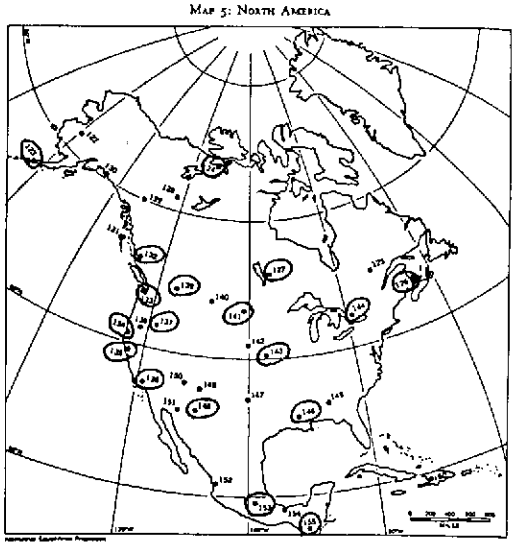
85. Iban
94. Kapauku
95. Kwoma
97. New Ireland
99. Siuai
100. Tikopia
101. Pentecost
103. Ajie
111. Palauns
112. Ifugao

(After Murdock, 1969)

TABLE C.4

Insular Pacific: Survey Societies

SCCS No.	Society	Time Focus	HRAF No.	No. Sources Consulted	Total Pages
103	Ajie	1845	no file	1	340
85	Iban	1950	OC6(a)	3	528
112	Ifugao	1910	OA19(b)	2	458
94	Kapauku	1955	OJ29(c)	2	796
95	Kwoma	1937	OJ13	1	226
97	New Ireland	1930	OM10(a)	1	352
111	Palauans	1947	no file	1	100
101	Pentecost	1953	no file	1	15
99	Siuai	1939	no file	1	534
100	Tikopia	1930	OT11(a)	1	385



REGION: NORTH AMERICA

123. Aleut
124. Copper Eskimo
126. Micmac
127. Salteaux
132. Bellacoola
133. Twana
134. Yurok
135. Pomo
136. Yokuts
137. Paiute
139. Kutenai
141. Hidatsa
143. Omaha
144. Huron
146. Natchez
148. Chiricahua Apache
153. Aztec

REGION: SOUTH AMERICA

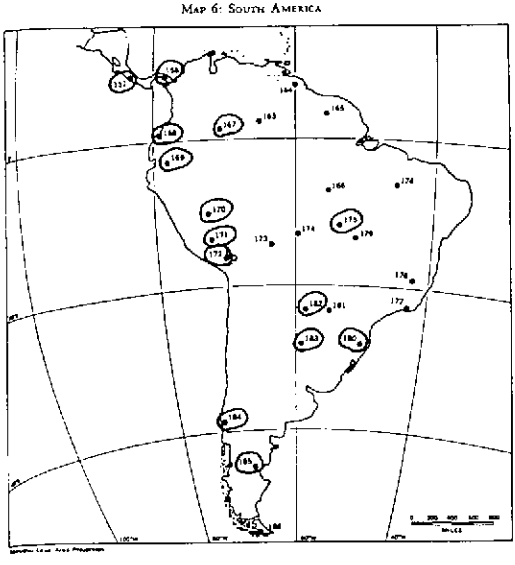
155. Quiche

(After Murdock, 1969)

TABLE C.5

North America: Survey Societies

SCCS No.	Society	Time Focus	HRAF No.	No. Sources Consulted	Total Pages
123	Aleut	1800	NA6(a)	3	600
153	Aztec	1520	NU7(b)	4	765
132	Bellacoola	1880	NE6(a)	1	763
148	Chiricahua Apache	1870	NT8	1	500
124	Copper Eskimo	1915	ND8(a)	2	627
141	Hidatsa	1836	no file	1	528
144	Huron	1634	no file	3	358
139	Kutenai	1890	no file	1	202
126	Micmac	1650	NJ5(b)	4	1019
146	Natchez	1718	no file	1	387
143	Omaha	1860	NQ12(b)	3	995
137	Paiute	1870	NR13(a)	2	194
135	Pomo	1850	NS18(a)	3	495
127	Saulteux	1930	NG6(b)	2	530
133	Twana	1860	no file	1	576
136	Yokuts	1850	NS29(a)	3	415
134	Yurok	1850	NS31(b)	2	111



REGION: SOUTH AMERICA

157. Bribri
158. Cuna
167. Cubeo
168. Cayapa
169. Jivaro
170. Amahuaca
171. Inca
172. Aymara
175. Trumai
180. Aweikoma
182. Lengua
183. Abipon
184. Mapuche
185. Tehuelche

(After Murdock, 1969)

TABLE C.6

South America: Survey Societies

SCCS No.	Society	Time Focus	HRAF No.	No. Sources Consulted	Total Pages
183	Abipon	1750	SI4(a)	1	446
170	Amahuaca	1960	no file	1	40
180	Aweikoma	1932	no file	1	215
172	Aymara	1940	SF5(a)	1	250
157	Bribri	1917	Sa19(a)	4	317
168	Cayapa	1908	SD6(a)	1	476
167	Cubeo	1939	SQ19	1	305
158	Cuna	1927	SB5(a)	1	124
171	Inca	1530	SE13(b)	1	147
169	Jivaro	1920	SD9(a)	1	233
182	Lengua	1889	no file	1	330
184	Mapuche	1950	SG4(c)	1	247
155	Quiche	1930	no file	1	438
185	Tehuelche	1870	SH5(a)	2	381
175	Trumai	1938	SP23	1	108

APPENDIX D
Bibliography, by Region and Society

REGION: AFRICA

GANDA

Fallers, Margaret C., *The Eastern Lacustrine Bantu*, London: International African Institute, 1960.
Mair, Lucy P., *An African People in the Twentieth Century*, New York: Russell & Russell, 1965.

IBO

Forde, Daryll, and C. I. Jones, *The Ibo and Ibibio-Speaking Peoples of South-Eastern Nigeria*, London: International African Institute, 1950.
Green, M. M., *Ibo Village Affairs*, New York: Frederick A. Praeger, 1964; London, 1947.
Uchendu, Victor C., *The Igbo of Southeast Nigeria*, New York: Holt, Rinehart & Winston, 1965.

KIKUYU

Kenyatta, Jomo, *Facing Mount Kenya*, London: Secker and Warburg, 1938.
Lambert, H. E., *Kikuyu Social and Political Institutions*, London: International African Institute, 1956.
Leakey, Louis S. B., *Mau Mau and the Kikuyu*, London: Methuen, 1952.
Middleton, John, *The Central Tribes of the North-Eastern Bantu*, London: International African Institute, 1953.

MBUNDU

Childs, Gladwyn M., *Umbundu Kinship & Character*, London: Oxford University Press, 1949.

OTORO

Nadel, S. F., *The Nuba*, London: Oxford University Press, 1947.

SHILLUK

Howell, P. P., "Observations on the Shilluk of the Upper Nile," *Africa*, 1952, *22*, 97–199; 1953, *23*, 94–109.
Pumphrey, M. E. C., "The Shilluk Tribe," *Sudan Notes and Records 24*(1941): 1–45 (Khartoum).
Seligman, C. G., and Brenda Z. Seligman, *Pagan Tribes of the Nilotic Sudan*, London: Routledge & Kegan Paul, 1932.
Westerman, Diedrich, *The Shilluk People: Their Language and Folklore*, Philadelphia: Board of Foreign Missions of the United Presbyterian Church of North America, 1912.

SUKU

Torday, E., and T. A. Joyce, *Notes Ethnographiques sur les Peuples Communément appelés Bakuba, ainsi que sur les Peuplades Apparentées. Les Bushongo*, Bruxelles, 1910.
Torday, E., and T. A. Joyce, *Notes Ethnographiques sur des Populations Habitant les Bassins du Kasai et du Kwango riental*, Bruxelles: Annales du Musée du Congo belge, 1922.

THONGA

Junod, Henri A., *The Life of a South African Tribe*, 2 volumes, London: MacMillan, 1927; New Hyde Park, New York: University Books, 1962.

REGION: CIRCUM-MEDITERRANEAN

KAFA

Huntingford, G. W. B., *The Kingdoms of Kafa and Janjero*, London: International African Institute, 1955.

RIFFIANS

Coon, Carleton S., *Tribes of the Rif.* Harvard African Studies *9:* 1–417, Cambridge, Massachusetts: Harvard University, 1931.

SOMALI

Lewis, I. M., *Peoples of the Horn of Africa*, London: International African Institute, 1955.
Lewis, I. M., *A Pastoral Democracy*, London: Oxford University Press, 1961.

TEDA

Briggs, L. Cabot, *The Living Races of the Sahara Desert*, Papers of the Peabody Museum of Archaeology and Ethnology *28:* 103–110, Cambridge, Massachusetts, Harvard University, 1958.

WOLOF

Gamble, David P., *The Wolof of Senegambia*, London: International African Institute, 1967.

REGION: EAST EURASIA

AINU

Sugiura, Kenichi, and Harumi Befu, "Kinship Organization of the Saru Ainu," *Ethnology*, 1962, *1,* 287–298.
Watanabe, Hitoshi, "The Ainu: a study of ecology and the system of solidarity between man and nature in relation to group structure," *Faculty of Science, Journal, Section V, Anthropology*, Volume 2, Part 6, Tokyo: University of Tokyo, 1964.

BASSERI

Barth, Fredrik, *Nomads of South Persia*, London: George Allen & Unwin, 1961.

GOND

Grigson, Wilfrid V., *The Maria Gonds of Bastar*, London: Oxford University Press, 1938.

KAZAK

Hudson, Alfred E., *Kazak Social Structure*, Yale University Publications in Anthropology, *20:* 1–109, New Haven: Yale University Press, 1938.

KHALKA MONGOLS

Vreeland, H. H., *Mongolian Community and Kinship Structure,* New Haven: Human Relations Area Files, 1954.

KOREANS

Osgood, Cornelius, *The Koreans and their Culture*, New York: Ronald Press, 1951.

LOLO

Lin, Y. H., *The Lolo of Liang Shan*, New Haven, 1961.

MANCHU

Shirokogroff, S. M., *Social Organization of the Manchus*, Royal Asian Society (North China Branch), Extra Volume *3:* 1–194, Shanghai: Royal Asian Society, 1924.

NICOBARESE

Whitehead, George, *In the Nicobar Islands*, London: Seeley, Service & Company, 1924.

SANTAL

Culshaw, W. J., *Tribal Heritage*, London: Lutterworth Press, 1949.
Datta-Majumder, Nabendu, *The Santal,* Memoir Department of Anthropology, Government of India *2*, 1–150.

TODA

Emerson, M. B., "Toda Marriage Regulations and Taboos," *American Anthropologist*, 1937, *39*, 102–112.
Emerson, M. B., "Language and social forms: A study of Toda kinship terms and double descent," in Spier, Hallowell, and Newman, editors, *Language, Culture and Personality*, Menasha, 1941.
Rivers, W. H. R., *The Todas*, New York: MacMillan, 1906.

VEDDA

Leach, Edmund R., "Did the Veddas have matrilineal clans?" *Royal Anthropological Institute Occasional Papers*, 1963, *16*, 68–78.
Seligman, C. G., and Brenda Z. Seligman, *The Veddas*, Cambridge: Cambridge University Press, 1911.

REGION: INSULAR PACIFIC

AJIE

Leenhardt, Maurice, *"Notes d'Ethnologie Néo-Calédonienne," Travaux et Memoires de l'Institut d'Ethnologie*, 1930, *8*, 1–340.

IBAN

Freeman, J. Derek, *Iban Agriculture*, Colonial Research Studies *18*, 1–148, London: Her Majesty's Stationery Office, 1955.
Freeman, J. Derek, "The Family System of the Iban of Borneo," Cambridge Papers Social Anthropology *1:* 15–52, Cambridge: Cambridge University Press, 1958.

Gomes, Edwin H., *Seventeen Years among the Sea Dyaks of Borneo*, London: Seeley & Company, 1911.

IFUGAO

Barton, Roy F., *Ifugao Law*. University of California Publications in American Archeology and Ethnology, *15*, 1–187, Berkeley: University of California, 1919.
Barton, Roy F., *Philippine Pagans*, London: George Routledge and Sons, 1938.

KAPAUKU

Pospisil, Leonard, *Kapauku Papuans and Their Law*, Yale University Publications in Anthropology, *54*, New Haven: Yale University, 1958.
Pospisil, Leonard, *Kapauku Papuan Economy*, Yale University Publications in Anthropology, *67*, New Haven: Yale University, 1963.

KWOMA

Whiting, John W. M., *Becoming a Kwoma*, New Haven: Yale University Press, 1941.

NEW IRELAND

Powdermaker, Hortense, *Life in Lesu*, New York: W. W. Norton, 1933.

PALAUNS

Barnett, H. G., *Being a Palauan*, New York: Holt, Rinehart and Winston, 1960.

PENTECOST

Tattevin, P. F., "Organisation sociale de Sud de l'île Pentecôte (Nouvelles Hébrides)," *Anthropos*, *23*, 448–463. 1928.

SIUAI

Oliver, Douglas L., *A Solomon Island Society*, Cambridge, Massachusetts: Harvard University Press, 1955.

TIKOPIA

Firth, Raymond, *Primitive Polynesian Economy*, second edition, London: Routledge & Kegan Paul, 1965.

REGION: NORTH AMERICA

ALEUT

Jochelson, Waldemar, *History, Ethnology and Anthropology of the Aleut*, Washington: Carnegie Institute of Washington, 1933.
Shade, Charles I., *Ethnographic Notes on the Aleuts*, Unpublished manuscript, Department of Anthropology, Harvard University, 1948, *Human Relations Area Files*.
Veniaminov, Ivan, *Zapiski ob ostrovax unalashkinskago otdela* [*Notes on the Islands of the Unalaska District*], St. Petersburg: Russian-American Company, 1840; English translation in Human Relations Area Files.

AZTEC

Carrasco, Pedro, "The Civil-religious hierarchy in Mesoamerican communities," *American Anthropologist*, 1961, *63*, 483–497.

Monzon, Arthur, *El Calpulli en la Organization Social de los Tenocha*, Publications del Instituto de Historia, *14*, Mexico: University National Automoma de Mexico, 1949.

Thompson, J. E., *Mexico Before Cortez*, New York, 1933.

Vaillant, George C., *Aztecs of Mexico*, Garden City, New York: Doubleday, Doran, 1941.

BELLA COOLA

McIlwraith, Thomas F., *The Bella Coola Indians*, Volume 1, Toronto: University of Toronto Press, 1948.

CHIRICAHUA APACHE

Opler, Morris E., *An Apache Life-Way*, Chicago: University of Chicago Press, 1941.

COPPER ESKIMO

Jenness, Diamond, *The Life of the Copper Eskimo*, Report of the Canadian Arctic Expedition, *12*, A, 1–277, Ottawa, 1922.

Rasmussen, Knud, *Intellectual Culture of the Copper Eskimo*, Report of the Fifth Thule Expedition, *9*, 1–350, Copenhagen, 1932.

HIDATSA

Bowers, Alfred W., *Hidatsa Social and Ceremonial Organization*, Bulletin Bureau of American Ethnology, *194*, 1–528, Washington: Government Printing Office, 1965.

HURON

Herman, Mary W., "The social aspect of Huron property," *American Anthropologist*, 1956, *58*, 1044–1058.

Kinietz, Vernon W., *The Indians of the Western Great Lakes, 1615–1760*, Ann Arbor: University of Michigan Press, 1940.

Tooker, Elisabeth, *An Ethnography of the Huron Indians, 1615–1649*, Bulletin Bureau of American Ethnology, *190*, 1–183, Washington: Government Printing Office, 1964.

KUTENAI

Turney-High, Harry H., "Ethnography of the Kutenai," *Memoir American Anthropological Association*, 1941, *56*, 1–202.

MICMAC

Johnson, Frederick, "Notes on Micmac Shamanism," *Primitive Man*, 1943, *16*, 53–80.

Le Clerq, Christian, *New Relations of Gaspesia*, edited by W. F. Ganong, Publications Champlain Society, *5*, 1–452, Toronto: Champlain Society, 1910.

Parsons, Elsie C., "Micmac Notes," *Journal of American Folklore*, 1926, *39*, 460–485.

Wallis, Wilson P., and R. S. Wallis, *The Micmac Indians of Eastern Canada*, Minneapolis: University of Minnesota Press, 1955.

NATCHEZ

Swanton, John R., *Indian Tribes of the Lower Mississippi Valley*, Bulletin Bureau American Ethnology, *43*, 1–387, Washington: Government Printing Office, 1911.

OMAHA

Dorsey, J. Owen, *Omaha Sociology*, Annual Report Bureau of American Ethnology, *3*, 205–370, Washington: Government Printing Office, 1884.

Fletcher, Alice C., and F. La Flesche, *The Omaha Tribe*, Annual Report Bureau of American Ethnology, *27*, 17–654, Washington: Government Printing Office, 1911.

Fortune, Reo, *Omaha Secret Societies*, New York: Columbia University Press, 1932.

PAIUTE

Stewart, Omer C., "Northern Paiute," Anthropological Records, *4*, 361–446, Berkeley: University of California, 1941.

Whiting, Beatrice, B., *Paiute Sorcery*, Viking Fund Publications, *15*, 1–110, New York: Viking Fund, 1950.

POMO

Gifford, Edward W., "Clear Lake Pomo Society," University of California Publications in American Archeology and Ethnology, *18*, 287–390, Berkeley: University of California, 1926.

Gifford, Edward W., and A. L. Kroeber, "Pomo," University of California Publications in American Archeology and Ethnology, *37*, 117–254, Berkeley: University of California, 1937.

Loeb, Edwin M., "Pomo Folkways," University of California Publications in American Archeology and Ethnology, *19*, 149–404, Berkeley: University of California, 1926.

SALTEAUX

Hallowell, A. Irving, *The Role of Conjuring in Salteaux Society*, Publications of the Philadelphia Anthropological Society, *2*, 1–96, Philadelphia: University of Pennsylvania Press, 1942.

Hallowell, A. Irving, *Culture & Experience*, Philadelphia: University of Pennsylvania Press, 1955.

TWANA

Elmendorf, W. W., *The Structure of Twana Culture*, Washington State University Research Studies, Monograph Supplement, *2*, 1–576, 1960.

YOKUTS

Driver, Harold E., *Southern Sierra Nevadas*, Anthropological Records, *1*, 53–154, Berkeley: University of California, 1937.

Gayton, Anna H., *Yokuts and Western Mono Ethnography*, Anthropological Record, *10*, 1–302, Berkeley: University of California, 1948.

Gifford, E. W., "California Kinship Terminologies," University of California Publications in American Archeology and Ethnology, *18*, 77–85, Berkeley: University of California, 1922.

YUROK

Kroeber, Alfred L., *Handbook of the Indians of California*, Bulletin Bureau of American Ethnology, *78*, 1–97, Washington, D. C. Government Printing Office, 1925.

Waterman, Thomas T., and Alfred L. Kroeber, "Yurok Marriages," University of California Publications in American Archeology and Ethnology, *35*, 1-14, Berkeley: University of California, 1934.

REGION: SOUTH AMERICA

ABIPON

Dobrizhoffer, Martin, *An Account of the Abipones*, London: John Murray, 1822.

AMAHUACA

Steward, Julian H., and A. Métraux, "The Panoan Tribes of Eastern Peru," Bulletin Bureau of American Ethnology, *143*, iii, 555–595, Washington: Government Printing Office, 1948.

AWEIKOMA

Henry, Jules, *Jungle People: A Kaingáng Tribe of the Highlands of Brazil*, Locust Valley, New York: J. J. Augustin, 1941.

AYMARA

LaBarre, Weston, *The Aymara Indians of the Lake Titicaca Plateau, Bolivia*, Memoir American Anthropological Association, *68*, 1948.

BRIBRI

Gabb, William A., "On the Tribes and Languages of Costa Rica," *Proceedings of American Philosophical Society*, 1876, *14*, 483–602.

Pittier de Fabrega, H., "Folk-Lore of the Bribri and Brunka Indians in Costa Rica," *Journal of American Folk-Lore*, 1903, *16*, 1–19.

Skinner, Alanson, "Notes on the Bribri of Costa Rica," *Indian Notes and Monographs 6*, No. 3, 37–106, New York: Museum of the American Indian, 1920.

Stone, Doris, *The Talamancan Tribes of Costa Rica*, papers of Peabody Museum of Archeology and Ethnology *43:* ii, 1–108, Cambridge, Massachusetts: Harvard University, 1962.

CAYAPA

Barrett, Samuel A., *The Cayapa Indians of Ecuador*, Indian Notes and Monographs, *40*, New York: Museum of the American Indian, 1925.

CUBEO

Goldman, Irving, *The Cubeo*, Illinois Studies in Anthropology *2:* 1-305, Urbana, Illinois: Illinois University Press, 1963.

CUNA

Stout, D. B., *San Blas Acculturation*, Viking Fund Publications Anthropology *9*, 1–124, New York, Viking Fund, 1947.

INCA

Rowe, John H., *Inca Culture at the Time of the Spanish Conquest*, Bulletin Bureau of American Ethnology, *143*, ii, 183–330, Washington: Government Printing Office, 1946.

JIVARO

Harner, Michael J., *The Jivaro: People of the Sacred Waterfalls*, Garden City, New York: Doubleday, 1972.

LENGUA

Grubb, W. Barbrooke, *An Unknown People in an Unknown Land*, London: Seeley, Service & Company, 1913.

MAPUCHE

Faron, Louis C., *Mapuche Social Structure*, Illinois Studies in Anthropology *1*: 1–247, Urbana, Illinois: University of Illinois Press, 1961.

QUICHE

Bunzel, Ruth, *Chichicastenango*, Publications of the American Ethnological Society, *22*, Locust Valley, New York: J. J. Augustin, 1952.

TEHUELCHE

Cooper, John M., "The Patagonian and Pampean Hunters," *Handbook of South American Indians*. Bulletin Bureau of American Ethnology *143*, i, 127–161, Washington: Government Printing Office, 1946.

Musters, George C., *At Home with the Patagonians*, London: John Murray, 1873.

TRUMAÍ

Murphy, Robert F., and Buell Quain, *The Trumaí Indians of Central Brazil*, Seattle: University of Washington Press, 1955.

DISCUSSION

MORRIS: I'm interested in the various kinds of problems of filtering and excluding of data that might have occurred between the original event and your final paper, especially the attitudes toward psi of the various investigators who were mentioned. Can you comment on the levels at which filtering might have taken place in the pathway of the anecdote from when it happened on through to us? Secondly, do you have any feeling for the attitudes of those anthropologists towards psi? Did they report these anecdotes in any kind of context which would allow evaluation of what they thought was going on, or whether they would accept or reject psi phenomena? It's interesting that they're all

fairly famous, I gather, and it's also rather interesting that Margaret Mead isn't one of them, since she gets all the press.

BARKER: To answer your first question, there are almost innumerable filtering stages through which this information has gone from presumably its original experience to its presentation here. We excluded a great many cases—ten times at least this many cases—which seemed not to even meet the minimum kinds of criteria of reasonableness for what's really going on, legends, mythological tales, instances where anthropologists were obviously extremely hostile to the events and were reporting them in a very overtly contemptuous way. I think that everyone would recognize that none of these accounts would measure up to the criteria developed by the SPR researchers for the investigation of a spontaneous psi case, nor would they come anywhere close to the type of research that Ian Stevenson has done. They are typical of the best of the kinds of reports that one finds in the anthropological literature. None of the anthropologists surveyed were interested in psi, as such. I think they were the best—your point is well taken—these are absolutely first rank anthropologists. They reported this because it was part of what they observed, and they put it down because it was there. None of them seemed to have had the slightest interest in following up on it.

With regard to Margaret Mead, aside from her attitudes, which were favorable, she also never took sufficient interest in psi to ever do any research on it, as far as I know.

NASH: On the basis of your study, what percent of ethnographic reports, if examined, would be found to contain instances of ostensible psi. Did you find any quantitative or qualitative differences in psi between the cultures that you could generalize exist, on the basis of the sample you studied?

BARKER: Well, we found a report in slightly less than a quarter of the societies reviewed, and, from that point of view, I was slightly surprised that it was that high. Ten pages of typed script from 26,000 pages of original material is very little, but it's clear that this kind of account is not limited to one particular area of the world; is most definitely not limited to an industrial society. It is geographically distributed all over the world. There simply are not yet enough accounts collected to really be able to analyze them. My hope was that in establishing a general procedure of random sampling from a well defined sample universe, over the course of perhaps the next decade, anthropologists who were interested in psi can begin to systematically and cumulatively work their way into this literature. It's a superhuman job for one team to

undertake at one time. I hope that with the completion of these 112 sources, if my colleagues trust me to have found what's there, they won't need to do that again, that they can go on to other sources. I will say, however, that the material relating to PK outnumbers the material relating to ESP by probably a factor of four or five. I purposely excluded that in this presentation. It's much more difficult to evaluate PK material, for one thing.

POWELL*: With the possible exception of the Quiche, the cultures that you described are, I think, almost uniformly at what we could safely call an archaic stage of cultural development, not industrial, perhaps. Do you have any thoughts on the interaction between the actual stage of development of the culture with respect to the institutionalization of psychopomps and various other functions within their society?

BARKER: These cultures have one common feature in that they are pre-literate. Aside from that major common feature, they vary enormously in their socio-economic structures. Some are very small hunting and gathering bands; others are large, quite complex settled agricultural societies. I think it wouldn't be proper, perhaps, to characterize them as archaic, but they are certainly pre-industrial. Again, this is a start, but there have not been enough of these accounts collected systematically with random sampling techniques to be able to say in what ways geographical or evolutionary forces may play a role. We can turn to some of the work on possession and possession trance, which indicates that there are very important geographical factors in the distribution of these phenomena.

STORM: If, instead of industrialization or literacy versus pre-literacy, you focused instead on organization or a degree of institutionalization, would you find any correlation with the encouragement of psi phenomena? I know that's difficult because then you want to know what do you mean by institutionalization—I mean less structured versus more structured societies.

BARKER: Candidly, I think that the data here are an artifact of the anthropological field work methods. If the anthropology were actually of uniform quality; if all anthropologists were first rank, instead of roughly a quarter of the societies probably a great many of them would have reports of psi. The failure to report these phenomena was not the result of their absence, but of either the inability of the field worker to observe them or the fact that they did not correspond to his theoretical

* Ross Powell, Vancouver, Canada—Observer.

or empirical interest and simply were unreported. There are probably levels of social development that may facilitate or inhibit the experience of psi communication within different cultures, but I don't think we have nearly enough data to be able to pursue that empirically.

MORRIS: I'm curious about how many different cultures may have concepts such as *baraka* which are analogous to psi, i.e., they lump ESP and PK together. Do most cultures tend to compartmentalize those concepts?

BARKER: The tendency seems to be to externalize the phenomenon. It is not a psychological or a parapsychological phenomenon. It is something that is out there that manifests itself through ghosts or spirits or sometimes an external entity. I think we may be at a rather advanced state to associate this phenomenon with something that's part of our basic nature.

MORRIS: But, even so, there's a single term used to describe several powers regardless of where the locus is seen as coming from. It's interesting for a group to conceptually lump them together regardless of what their interpretation of them is.

BARKER: It's not coincidental that the Riffians are an Islamic people and are participants in one of the world's major religions, which has obviously developed itself to a more sophisticated point than some of the other religions that are subscribed to by peoples in this sample.

IRWIN: I'm a little surprised at the lack of apparitional cases in the survey. Were these rejected for any reason, because of mythical overtones, for example? Or did they simply not appear?

BARKER: There were some apparitions, but not many. Again, I think anthropologists are just not accustomed to thinking about them and to describing them.

BYERS: There have been some efforts at doing ethnographic studies in our own societies, such as Middletown or Warner's work. Have there been any reports of this phenomenon in our own society?

BARKER: There have been several very interesting surveys. Greeley has made one. Gallup Poll has made several. They're fascinating reading and the sense that I have from them is that psi is far more common than we, even as parapsychologists, are often led to think.

BYERS: Are these surveys of psychic phenomena in this country? If an anthropologist were to come in and view our country and decided to

write an ethnography about it, would he include psi unless he is particularly focused on it?

BARKER: No, I think not, and that's basically the same explanation. For instance, the British structural functional anthropologists are very greatly under-represented in this paper, not because they were poor anthropologists but because their theoretical interests led them to take note of very different kinds of data. Now, it should be pointed out that there are a great many other accounts in those three bibliographies that I cited. There are probably in total several hundred other accounts to which this is simply an addition.

MORRIS: When ethnographers do confront this kind of society, who do they look at? Do they do ethnographic studies of chartered accountants on Wall Street? Or do they go into Appalachia, which would be more analogous to another cultural system? Or have they fled from it? Secondly, are we being investigated by people from quite different societies? Who is doing us these days?

BARKER: Probably the answer is that there are not many foreign anthropologists trying to study America as such; it's just too big to be handled effectively through the classical ethnographic method, and I don't know of any of them who have concentrated on psi phenomena.

STORM: Can you say anything about the trends and the attitudes of anthropologists through history? I mean, say, prior to the industrial revolution and after it. Did they seem to be more attentive to these matters before 1825 than they were after?

BARKER: If I were going to do this study again, I would first go to the seventeenth century Jesuits, then I would move on to the missionaries, and then last, to twentieth century anthropologists. If I could come up with a list of ethnographies by missionaries who had spent more than twenty years in the field, probably about ninety per cent would contain accounts of psi. These results are also not different from those of Raoul Naroll who discovered that references to witchcraft occurred in ethnographies written by people who had long exposure to the society which they were studying, and who had command of the language.

ROSENTHAL: I was very much interested in the idea that the anthropologists themselves might make a difference, especially their quality. I was wondering if the data that you had were arrayed in such a way that you could change the unit of analysis from the description to the anthropologist, so that you'd compute for each anthropologist—because each anthropologist probably did more than one culture—

what percentage of their cultures did they find psi phenomena in. Then you could run a correlation coefficient between this proportion and their quality as ranked by professors in anthropology. What you might find is the higher the quality of the anthropologist, the higher the proportion of psi phenomena. Then you could statistically correct and get some sort of an estimate. If all the anthropologists were as good as the best, then what would the psi base rate be?

BARKER: My prediction would be that if all were as good as the best, the reporting level would be a great deal higher.

MORRIS: Perhaps one other way of describing the same phenomenon might be that what you were dealing with would not be who are the really good anthropologists, but who are the anthropologists sufficiently highly regarded not to mind having psi appear in their reports?

BARKER: What you're saying is you have to be really good enough to let it hang out.

MORRIS: Yes, that's right.

BARKER: I think that it is the ability to observe closely, minutely and objectively and put it down that is the key, and not to close your eyes to something just because you can't make any sense of it at all. And my own personal experience from field work is that when you start looking at psi in other cultures, you're seeing stuff that just doesn't make any sense at all, and that is very, very frightening.

BYERS: I just wanted to comment about this recurring use of the word "good" anthropologist. Some of our best anthropologists would never acknowledge that there are child rearing practices. It's because their theoretical orientation isn't in that direction. It's not necessarily a matter of being good.

PSI COMMUNICATION THROUGH DREAM SHARING

MONTAGUE ULLMAN

Introduction

While awake, our view of ourselves is one in which we see and stress our autonomy, our individuality, our discreteness. We define our own boundaries and we try to work with them. What I'm suggesting, and which is not at all novel, is that our dreaming self is organized along a different principle. Our dreaming self is more concerned with the nature of our connections with *all* others. There is some part of our being that has never forgotten a basic truth, that in our waking lives throughout history we seem to have continuously lost sight of. The history of the human race, while awake, is a history of fragmentation. It's a history of separating people and communities of people in every possible conceivable way—geographically, nationally, religiously, politically.

Our sleeping self, I am proposing, is connected with the basic truth that we're all members of a single species and that while dreaming our concerns have to do with what has happened in the course of waking experience that interferes with, damages, impedes, obstructs or enhances these connections. While asleep, we seem about to drastically alter the way we experience space and time. While awake, we move through our lives in a sequential, linear moment-by-moment fashion with a point representing birth and another point the present moment. But when we go to sleep and begin to dream we create pictures of what's going on in our psyche from a point that, in terms of space and time, seems to be outside of our waking organization. We are able to recall events going deep into our past. The amount of information that can be gathered from the past is often greater than anything we're able to recall while awake, With this information available we can project more accurately the implications of a present concern. If parapsychological data are valid, this scanning process does not seem to be limited to the individual.

We experience the dream as a series of images that move in relation to each other and seem to develop in some kind of a sequential pattern. Where do these images come from? We have to go back and define how we look upon the substrate. If the substrate has to be broader than the individual, then, to use an analogy, we're talking about some kind of a psychic black hole of highly condensed information about ourselves and others that, under the conditions of sleep, we seem able to tap into and extract what we need to know about ourselves and others that is relevant to our immediate life situation. We have no way of processing that much information as quickly as is necessary under the conditions of dreaming, unless we process some of it all at once in terms of an image, and then process the images sequentially to capture all the information that's available to us. The dream is this first transformation out of an undefined information source. At times we come up on information that we have no right to know about in terms of waking causality, and the natural space and time order of events.

When we awaken, this information undergoes a second transformation into what Shakespeare referred to as "words, word, words." Each of these transformations involves information loss. The dream has no way of capturing all the information in that original source. The waking state has no way of capturing all the information in the dreaming source. It is simply a remembrance, but a rich and significant one. Without going into all of the interesting qualities of our dream life, I'm going to emphasize what I think are the most important.

In the first place the imagery of our dreams comes out of feelings that reflect what is really going on in our lives at that time. Honesty is a quality of the images we create. Secondly, the images are concerned with the issues of connectivity, how human beings are connected with each other. Dreams deal with events that interfere with these connections. They reflect our concerns with maintaining and preserving these connections.

Dreams take as their starting point a recent emotionally intrusive event in our lives. At some time during the night the feeling residue of this event seems to trigger a backward scanning into the deepermost recesses of our remote memory system to retrieve those aspects of our past experience that are emotionally related to the current situation. As we have noted, the pictures that we come up with and that are experienced as our dream are honest reflections of our feelings at the moment and of their connection to events in our past. In effect, we have taken a series of true-to-life photographs of the relational field

we find ourselves in at the time we are dreaming. It is a field that includes much more information about ourselves than is readily available to us in the waking state. The existence of psi in the dream suggests that, under certain circumstances, the scanning process extends beyond our spatial borders to pick up information clairvoyantly or telepathically and beyond our temporal limits to pick up information precognitively.

The pictures we form in our dreams are remarkable in a number of respects. We project ourselves out of our accustomed space-time ordering of events and seem able to view the entire range of our existence from a point outside our waking system. Whatever that perspective is, it is outside space and time as we experience those categories while awake. Furthermore, the images we come up with tend to be metaphorical rather than literal or direct reflections of our situation. While asleep, we transform our primitive imaging capacity into the distinctly human capacity for metaphor. We will refer to the metaphor of the dream image as the oneiric metaphor, in contrast to the metaphor of waking speech. The reason our dream images take this form have been dealt with elsewhere.[1,2] In brief, it derives from the vigilance hypothesis of dreaming, which holds that the dream images we form are primarily self-confrontational and function as emotional regulators of the state of arousal during the REM (rapid eye movement) or dreaming period. While asleep we exist in a state of social isolation. It is important for us while in this state to assess what it is we feel in terms of the relative safety in remaining asleep. Metaphors express feelings and the metaphorical images of the dream mobilize and express a level of feeling appropriate to the nature and importance of the particular issue we are grappling with. The intensity of the feelings aroused by their metaphorical expression determines the outcome of the REM stage. Awakening occurs when the feelings mobilized cannot be contained within the sleep state and necessitate the return of the waking state and the protective social cushioning we experience in that state.

When psi effects occur during dreaming they will influence this monitoring process and if intense enough will produce awakening. Our model suggests that psi can enter the dream by way of metaphorical expression as well as directly.

What follows in this presentation is a consideration of the implications of these features of the dream for psi research. The view of the human condition awake and asleep are quite different and experimental strategies might be more productive if both dimensions

of our existence were taken into account. In this paper I will discuss a beginning investigation along these lines. My other three types of close encounters with psi in dreams (spontaneously, clinically and experimentally) have convinced me of the validity of this approach. Each of these experiences sheds a different kind of light on the paranormal dream but, taken together, they suggest that the properties of the dreaming phase of our existence are largely unexplored in their potential significance for the manifestation of psi. More specifically, the occurrence of psi in dreams suggests experimental approaches that are qualitatively different from those in general use.

Psi events seem to register changes in the same emotional field that the dreamer is preoccupied with. Were the focus of investigation to shift to this field, then efforts might be devoted to identifying and developing a psi favorable field. A psi effect that occurred within such a field would be spontaneous and unpredictable. Subject, agent and target could not be specified in advance. The subject, agent and target status would be identifiable only after the fact and would be derivative factors from an even larger field, all operating beyond the control of any one individual. Psi would then enter the dream as another means at the disposal of the dreamer for learning about and managing the state of his emotional connectedness to significant others. Psi derived imagery, as well as more intrinsically personal imagery, would be set in motion by the existence of the social disconnect that characterizes the dreaming state.

In our dreams we are presenting and transforming imagery. Let us look more closely at the oneiric image and explore some of its features that may have a bearing on the occurrence of psi. Imaging itself is a concrete mode of presentation that relies on form, color and, in general, the transmission of information at a sensory level. The transformation of the simple or literal image into a visual metaphor extends the range and heightens the informational impact of the image at a feeling level. In lower animals, if imagery does occur, and there is some indirect evidence that it does,[3] the literal image probably suffices to monitor the level of arousal during the REM state. In humans, with sources of potential threat arising more in connection with more subtle changes in an emotional field, rather than the recall of actual danger in a physical field, the image transformed into metaphor serves as a more versatile adaptive mechanism for registering such effects. We have generally relied on the literal reflection of psi perceived events in dreams as a mode of detecting them. The possible relationship of psi events to the metaphorical transform is still to be explored.

The attributes of the oneiric image possibly related to psi events include:

(1) The source of the images in feelings. It is our feelings which mobilize the information we need either from our past or, paranormally, from external sources, to shed light on a current predicament. The feelings are then reflected back as metaphorically expressive imagery. The feeling tone now conveyed by these developed images assess emotionally the relevance of the matter before us to our immediate future.

(2) Our dreams are future oriented and serve as indicators of what lies ahead emotionally as a consequence of certain recent events in our life. Psi events, especially as manifest in dreams, seem to have a predilection for future events.

(3) Our dreams are fundamentally concerned with the assessment of damage to, repair of, and enhancement of our connections to significant others. The same concern with connectedness may be said to hold for many manifestations of psi.

Another interesting property of imagery as experienced during sleep that may be relevant to psi is the absolute and unquestioning sense of reality associated with it, regardless of how bizarre or unreal it may seem to us from the vantage point of the waking state. All the images we put to use in our dreams are, in a sense, derived primarily from the "outside." That is to say, they are social in origin and exist somewhere external to ourselves as a kind of pool of available social imagery created by the social habits of human beings. While dreaming, we experience these images in their external, real, outside or objective attributes. At the same time, we experience them as internal, inside and subjective. In fact, the distinction between outside and inside, object and subject seems to disappear. Our relation to the image while asleep enables us to experience it as inside and outside at the same time. We have shifted from dualistic outlook to a non-dual level of experience. Once awake, we experience the image as inside only and also less real. We have assumed a dualistic position which removes us from the feeling of reality formerly connected with the image. The image now strikes us as derived from a memory source and seems like a pale reproduction of some former reality. Perhaps that is not the case at all, but a necessary illusion to maintain our dualistic mode of operating while awake. We drain the images of their objective reality and salvage only those attributes that support our sense of our own discreteness and separateness from the world about us. In our sleep subject-object, observer-observed, inside-outside come together. Perhaps that is a crucial condition for psi effects to occur. Instead of being something

mysteriously different from the ordinary imagery that appears in our sleep, these effects may be of the same order and origin as our visual images but more extended in their spatial and temporal range (as that range is experienced while awake).

In this connection it is of some interest to recall Penfield's experiments in electrical stimulation of the exposed temporal lobe during brain surgery.[4] Under these circumstances there is not simply recall of an earlier memory, but the re-emergence of the memory in its original form as a real experience. It is experienced as "inside" but real ("outside"). A past context reassumes—or perhaps never lost—its realness. It has the flavor of the inside-outside or subject-object unity of the dream, but it occurs while awake and has some of the flavor of the non-dual mode that characterizes dreaming. It is as if the electrical stimulus disrupts the abolute control of the dual mode.

What we are proposing is that the imagery display in our dreams is more complex than the re-emergence of stored memories. The images seem to retain their connection with their source which, in the dual mode, is experienced as external to the bodily boundaries of the individual. They are experienced as real, as existing outside of the dreamer's conception of himself and as defining the relationship independently of the dreamer's wishes. In principle then, psi events would not pose a special problem of transmission or communication, but would simply represent an extension of the imaging process at a larger range of available social imagery than the dreamer usually draws upon. The nature of psi-related imagery suggests that this may occur accidentally or, more often, as a response to considerable emotional turbulence.

There is evidence from clinical and laboratory sources that interest in and a positive orientation to psi interactions favor the occurrence of such events. Our ordinary memory field is also determined by interest and attention. The extension of these attitudes to psi events brings them into what we experience as our memory field. Just as our normal memory is selective for certain events that depend on interest and emotional charge, so is our "memory" for psi events. In both instances an aspect of the source is from outside the self. In a non-dual mode this is not experienced as outside or inside, but as both. In a dual mode memory is experienced as inside and psi events (in the waking state) as outside. Our way of experiencing, of being in the world, is what creates the dilemma that psi poses for our waking orientation. What we experience as a separate and unique kind of event, namely a psi effect, is simply a widening or deepening of an "external" source of available social imagery that can become the building blocks of our dreams.

Together they help us confront ourselves during the cyclically recurring periods of dreaming with pictorial renditions of the emotional cross currents of our lives. This suggests the possibility that, through our interest in and involvement with the psi dimension of reality, we increase the likelihood of our encounter with psi under circumstances in which we move closer to a non-dual existence.

Imagery then appears to be more than a mode of registering, incorporating and recalling new data. Our images never seem to lose their linkage to the outside. Playback during dreams and electrical stimulation of the brain calls our attention to these "outside" or real connections. It is this sense of reality in the dream, for example, that rivets our attention on them and enables them to serve as expressive self-confrontations. While dreaming we are concerned with issues of connection, continuity, affinity and wholeness. The creation and deployment of the visual metaphor is a remarkably powerful way of revealing, at a feeling level, just where we are in relation to these issues and the impact of recent events in our lives upon them. In our dreams we give visibility to the emotional components of the interpersonal fields of greatest importance to us. The potential for psi events is probably intrinsic to this field but hardly ever actualized because of our underdeveloped sense of the reality of psi.

The Use of the Experiential Dream Group as a Psi Facilitating System

Based on the point of view developed above it seemed essential to address the task of working out a waking approach to dreams that could help both to stimulate and to identify psi effects. The goal was to take into account the nocturnal and the diurnal dimensions of human existence and the varying degree of openness to psi that characterized each state. In recent years I have been developing and exploring a small group approach to experiential dream work as a way of bringing people into a close, honest and helpful relationship to the images they create at night. The question to be explored was whether or not, in bringing people closer to their dreams, we could at the same time generate psi effects and bring them closer to their recognition.

The Experiential Dream Group

The process involved in experiential dream group work is given in an addendum to this paper. In brief, it rests on the principle that an interested and concerned social response system is necessary to help the dreamer connect with the images he has created. The group carries out this task by assuming the role of a helping agency, rather than as an outside authority with access to specialized knowledge about the

dream. In its way of functioning the group follows the natural contours of the dream. These include:

(1) Respecting the dreamer's authority over his own dream.

(2) Respecting the privacy of the dreamer and the private realms touched on by the dream.

(3) Respecting the uniqueness of each dream and of the dreamer.

In practice this means:

(1) That the dreamer controls the process and is the final judge of any meanings given to the image.

(2) That the dreamer controls the level of self-disclosure he feels comfortable with and is not pushed beyond that level.

(3) That no a priori categories of meanings are superimposed on the dreamer. Only the meanings felt by the dreamer to be true are true.

Rationale

Experiential dream work generates emotional closeness among the participants. It is expected that this developing rapport in combination with the natural psi facilitating effect of the dream itself, would result in an increasing number of identifiable psi occurrences among the members of the group. It represents, in effect, a two-pronged approach that attempts to generate psi through sharing waking and dreaming experiences. We rely on the orientation and interest of the group in psi to capture psi events in the non-dual mode of the dream state and then to heighten the possibility of interactive psi events among members of the group through experiential dream work and the sharing of dreams. The emotional set of the group and the challenging novelty of each dream heightens the expectancy level to the possibility of psi occurring in dreams and prevents the process from ever lapsing into a stereotyped or repetitive pattern. The procedure lacks any formal experimental design features and maintains an air of challenge, curiosity and spontaneity. At the same time deep and significant motivational patterns are exposed and shared.

Procedure

Every member of the group has had prior exposure to the experiential group approach to dreams as described in the addendum to this paper. Meetings of the group occur weekly for approximately one and a half hours. There has been a nucleus of five*, although at times as many as seven or eight have participated. Dream diaries are kept by each

* The core group currently carrying on this work with me now includes Patrice Keane, Barbara Shelp, Amy Kostant, and Nancy Sandow. I want to acknowledge their helpful suggestions in the preparation of this report.

member. The dreams of each week are typed, copied and distributed at each meeting. Time is set aside to review and compare the dreams of others to his or her own dreams as well as to look for correspondences among the dreams of others. From this point on the process evolves quite informally. It may move into an experiential process around a particular dream or we may begin by pointing up and exploring what strikes us as interesting correspondence. We tend to move into the experiential work with a dream if someone feels some urgency to get help from the group with a particular dream; otherwise, we would be more involved in checking each other's dreams for correspondences, noting any correspondences between the dreams of others and events in our own lives and any correspondences between our dreams and paranormally apprehended events in our own lives.

In the process of exploring such correspondences we might shift into the experiential mode to deepen our understanding of the imagery in question. The experiential work exposes any correspondences at a metaphorical level; the dream sharing any correspondences at a literal or manifest content level, and the dream recording any psi correspondences between the dreaming and waking life of the dreamer. We are engaged in a collective fashion in a process that maximizes the psi retrieval aspects of dreaming. Just as the Toronto group[5] seemed to get physical effects with a table through their collective expectations that, somehow or other, they could get Philip's ghost to produce such effects, so we developed a collective set with regard to the occurrence of ESP effects. A light and informal spirit prevailed and excitement mounted whenever we seemed to be in pursuit of a suggestive correspondence. Our judgments of correspondences remain purely subjective. No blind or objective judging procedure has been introduced. No target is stipulated in advance nor are percipient-agent relationships designated in advance. While this leaves wide open the possibility of reading the likelihood of extra-chance factors into the correspondences, we note it was our hope that some of them would be striking enough or occur often enough to survive this bias. At any rate, at this exploratory stage no design features for blind judging have been introduced.

Results

Since there was no advance structuring of what kind of correspondence to look for, we were using a wide net to capture correspondences along a variety of axes such as, for example:

(1) Correspondences among the dreams of two or more group members.

(2) Correspondences between the dream and the lives of one or more members of the group other than the dreamer.

(3) Correspondences, telepathic or precognitive, between the dream and events in the life of the dreamer.

The correspondences at this stage in the evolution of the group are no more than suggestive. When noted, they would provoke interest and further exploration with the goal in mind, not of pinpointing their evidential value, but as a way of maintaining a high level of excitement about the engagement with work we were doing. We were inviting psi occurrences, so to speak, in a relaxed, playful way, rather than with a quantitative concern with the evidentiality of the data. Our hope is that, if the group can continue to generate enough data, the qualitative results would speak for themselves.

Example I. Dream to dream.

On April 9, 1978, I had the following dream:

"There were preparations for a large scale dinner meal for 150 people. Some people felt the meal would be stereotyped and wanted more variety than could be arranged for so many."

The same night Barabara had this dream:

"Food is laid out on several tables—varied gourmet foods. It seems as though this has been done in Tom's honor. I am there as his guest. I am sampling foods and they are delicious. It occurs to me that this is wasted as far as Tom is concerned as he is a picky eater. I then see an image of Tom with a sort of webbing (iridescent) going out from him all around. This is to symbolize the way his eating pickiness is related to many other areas of his life. I wake up thinking how true this is."

While references to food are not uncommon in dreams, they were not particularly characteristic of Barbara's or my dreams. The suggestive points here are:

(1) The dreams occurred the same night.

(2) They both involve or imply a large scale meal.

(3) In each case there was some kind of complaint or implied complaint.

Example II. Dream to reality involving the group.

In this instance the correspondence was a bit more unusual. It linked a dream occurring on the morning the group met to an unexpected event involving the group later that day.

Barbara's dream of Dec. 1, 1977.

"It was just like a scene. I didn't have the feeling of being inside. There was a man talking to me from behind a counter. There were bare shelves. Nothing was finished off. There were three pair of eyeglasses.

All had the right lens removed, like a monocle. One pair had very small hexagon lenses, down low like Thomas Edison. Also a jeweler's eye piece. There was something about an Oriental who sounded Italian giving an explanation or directive."

Shortly before (half an hour) the group was to come togehter for its regular weekly meeting at the American Society for Psychical Research, I ran into John Cutten, the former Executive Secretary of the SPR. He was visiting and had spent the night at the Society. I hadn't known he was in town. I extended an invitation to join our research group meeting and he accepted. His ears perked up on hearing Barbara recount her dream. He confided that the left lens of his eyeglasses was a dummy so that, in effect, he had only one lens. He also remarked that he had recently given a talk to foreign students, among whom were several Chinese students. One of them asked him why there were more haunted houses in England than anywhere else.

Barbara was listening to his account with growing interest and then commented: "England has always had a certain fascination for me. I feel somehow that their attitude and their history is more connected with psi. I visited England three years ago and it is as if one were surrounded by old souls. Psi is in one's consciousness more than here."

Barbara then amplified some of the elements of her dream: "The man was someone of great wisdom, a guru type with knowledge to give me. The glasses were smoked. You couldn't see very much with them, but it was as if you had second sight. The monocle-like three pair of glasses and the jeweler's eyepiece were all connected. The man could see whatever he wanted to see. I connect the hexagonal lens with Edison, the inventor who shed light."

She added more about England: "I watched the British Jubilee and saw the Queen of England. The old buildings there were revered. I admired the places I visited, places where people had lived so long ago."

Barbara was questioned about the events in her life prior to the dream: "Last night an incident occurred in which I was teased about being a witch. My supervisor said to someone in my presence: 'She dreams of what goes on in your head.' I was very eager to get back to our meetings after the Thanksgiving vacation. Last night I was also thinking about the research on schizophrenia that I'm doing and the relevance of the right brain-left brain work."

In the dream Barbara had no feeling of being in the store, yet she was aware of the counter in front of her and the man on the other side. In the actual situation, as it turned out, Barbara was seated at a table directly opposite Mr. Cutten.

Here, of course, the most striking feature was related to the unusual eyeglasses in the dream and, in reality, with a number of less striking

supporting features. Barbara has been the one in the group most consistently involved in presumptive psi effects.

What follows are a few more examples which, in themselves, may seem trivial but which alerted us to the kinds of correspondences to look for, as well as helped to maintain our level of interest and excitement about the project.

Example III. Dream to dream.

Barbara's dream of March 18, 1979:

"I have to take a driver's test—not the basic operator's test, but an oral one. Jim and I are in my car with him driving to get to the place to take it. We have to cross a sort of bridge onto an island. He drives on but is not square on it and as he leans out the car tips off into the water with him in it. I have just stepped out and am standing on a landing. The car is completely immersed. I wait for Jim to come up (I know he will in a minute) and when he does I give him a hand and pull him out. We have to get someone to get the car out and I still have to take the test. I view all this as more of an inconvenience than a catastrophe. There is a little house with a phone in it and a hen's nest. The phone apparently connects with a house nearby. A sign on the post says: 'For assistance pick up phone and wait for answer. Do not come to main house unless invited. Crotchety old woman. Do not gather eggs.' I pick up the phone and there is recorded music and recorded sounds of a chicken (made by a human being) on it—I am still waiting for an answer as I wake up."

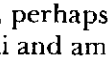
My dream of March 19, 1979:

"Getting back something very valuable, perhaps jewels, and fleeing with someone from pursuers. I find a taxi and am impatient with the person getting out. We help him out. We go to a house. Someone seems to know where we are going. I am afraid he will tell the pursuers. We stop the car because of snow and find ourselves at a crowded bar. There was a screen where porno movies were going to be shown, but none were shown. We were going to start out again. There was something wrong with the brake shoes and someone volunteered to fix them. In the morning I was surprised to find we were on an island."

Both dreams involve an island and trouble with a car.

Example IV. Dream to dream.

Barbara's dream of March 22, 1979:

"Sometime during the night—remembered on the way to work. Woman in the apartment on the second floor has done a painting called 'leg.' It is shaped like this:  Sort of like a ham. It has skin and inside is filled with wires or veins or both. She believes this has some beneficial effect and is trying to influence a woman to try it instead of

psychiatric treatment which I am advising. I am very curious to see it and its purported effects."

My dream of March 22, 1979:

"Something about a Grant Wood painting. Something about a degenerative disease. Going to see the doctor who took Dr. Friedmann's place. He was a stumblebum who had trouble understanding why we were there and seemed confused. There were EEG records when we wanted EKG records."

Both dreams involve the subject of painting in combination with an ailment of some sort.

Example V. Dream to reality event in life of a group member.

My dream of March 28, 1979:

"I'm working as a doctor and examining three patients. I take the first one. She has a sore throat. I examine her chest and have a hard time getting her to breathe right. On percussion there is dullness over left upper lobe. I went to a nurse on the operating room for a prescription blank to give her something like 'phylopenicillin.'

I'm visiting Jesse. He is in his pajamas and so am I. He is practicing medicine and I'm surprised how carefully he has kept notes and has studied pharmacology. Then I leave and his aunt helps me find my coat."

Barbara reported the following events that occurred the night before my dream:

"Tuesday night I received a call from my former mother-in-law whose name is Jessie. She has had great difficulty over the past seven years with chest infections. I had suggested to her in the fall that she take Vitamins C and E. She told me Tuesday night that she had been taking them and that I was right. She hadn't had a chest cold all winter. I did speak with three people that night—Jessie and her two younger sons."

Jesse is an old friend with whom I have not been in touch for a number of years. He had been ill recently. He is not a physician.

The correspondence lies in the name of Jesse and the fact that both Barbara and Jesse were "practicing medicine without a license."

Example VI. Dream to dream.

Barbara's dream of March 13, 1979:

"Nelson Rockefeller and Megan Marshak, they are cousins to each other and cousins to me also. At the time of his death we had an appointment to play basketball. Cartoon 'Doonesbury' has a new character. A very political pig named Rigg."

My dream of March 15, 1979:

"I'm at some camp or resort. Arthur Schlesinger is telling me that he

just played tennis with Jim Terry. I say that I taught Jim how to play. Schlesinger asks who plays better. I say I think Jim can beat me. Barrack scene with three cots, presumably for Schlesinger, Terry and myself. I remember that I forgot to take my travel alarm clock."

Both dreams involve important political personages in connection with a sport and, more specifically, tennis in my dream and a veiled reference to tennis in Barbara's dream (Rigg—Bobby Riggs.)

I have cited correspondences between Barbara and myself, not because they were the only ones that occurred among the dreamers, but because they were illustrative of the tendency for psi linkages to involve particular twosomes in the group. Although the underlying dynamics were not explored, the circumstances suggested that the linkages were related to transferential feelings that were evoked.

Discussion

The approach described is only a beginning in the use of dreams as a psi retrieval mechanism under conditions which are in keeping with the nature of dreams themselves. This involves working along lines that link the dream to waking life and providing the kind of social support system that helps the dreamer get at the meanings embedded in the imagery. Work carried out in this manner results in empathic and intimate bonding among the people involved and creates conditions that stimulate psi interactions among the participants.

Since dream images are metaphorical in intent, it has been of some interest to observe how the psi data relates to the metaphorical structure of the dream images. In the work on experimental dream telepathy there were many examples of how one or another property of the target would find its way into the dream of the percipient in a metaphorically amplified way, e.g., the bronze color of Gauguin's native women appearing in the dream of the percipient as the danger of becoming too sunburned[6] or where the free hand drawing of an acute angle appeared metaphorically elaborated as canes in the shape of hockey sticks in the hands of men attending a cocktail party.[6] In Example II, the single lens and concern with single eyepieces and glasses with one lens were metaphorically conveying a different or second sight way of knowing. In Example V, the name Jesse had different metaphorical connotations for each of the two dreamers.

There are many problems to be overcome before this can be said to be a workable technique. Uppermost is the problem of dealing with the level of complexity of the data that are reviewed each week. This includes the dreams of all the participants during the prior week and the personal disclosures stimulated by the dream sharing. Secondly,

the evidentiality of the data themselves will have to be established on a firmer basis.

In the anecdotal literature there is often evidence of the existence of a highly charged field involved in the psi event. The same is true, but for different reasons, in the field that characterizes the appearance of psi clinically. Working in the laboratory we are generally dealing with low level effects as far as the field is concerned, which is perhaps the reason the data appear so much less striking qualitatively. We have much to learn about the evolution of a psi conducive emotional field and the factors that determine the critical psi event. The approach we have described is one way of integrating the sleeping and waking dimensions of our experience in the interest of generating this field.

Conclusions

Psi has long been considered an unconscious form of communication that often undergoes some degree of distortion before reaching consciousness. There have been efforts to test the notion of unconscious psi effects, but these have generally been designed within the framework of the traditional agent-target-subject test situation. Assuming that psi is not only an unconscious process, but also a field effect, as Murphy and others have proposed, an investigative procedure has been followed in which the emphasis is placed on the generation of a psi facilitating emotional field. Dream sharing and experiential work with dreams in a group setting was used as the means of generating such a field. This paper reports on a pilot study that was designed to explore the use of dream work in a small group setting as a way of establishing natural psi linkages. The group has worked together over the past two years, meeting weekly, sharing dreams of the previous week and working with selected dreams through an experiential process designed by the author. Psi linkages were noted as they occurred spontaneously. Examples of such linkages are given.

BIBLIOGRAPHY

1. Ullman, M., "A Theory of vigilance and dreaming," in V. Zykmund (Ed.) *The Oculomotor System and Brain Function*, London: Butterworth, 1973.
2. Ullman, M., "Dreaming as metaphor in motion." *Archives of General Psychiatry*, 1969, *21*, pp. 696–703.
3. Vaughan, C. J., "The development and use of an operant technique to provide evidence for visual imagery in rhesus monkeys under 'sensory deprivation,' *Dissertation Abstracts*, *26*, 6191, 1966.
4. Penfield, W., *The Mystery of the Mind*, Princeton University Press, Princeton, New Jersey, 1975.
5. Owen, I. M. with Sparrow, M., *Conjuring Up Philip. An Adventure in Psychokinesis*,

Fitzhenry and Whiteside, Toronto, and Harper and Row, New York, 1976. (Also Paper Jacks, Markham, Ontario, 1977.)
6 Ullman, M. and Krippner, S., with Vaughan, A., *Dream Telepathy: Scientific Experiments in Nocturnal ESP*, Macmillan, New York, 1973.

EXPERIENTIAL DREAM GROUPS

A Description of the Process

The Process

The process consists essentially of an interaction between the dreamer and the group, the goal being to help the dreamer experience the felt connections between the imagery of the dream, the life events that triggered the dream, the tensions portrayed, the way that past data are integrated into the present context, the resources and limitation with which the dreamer copes with the issue, and finally, the appreciation of the artistry and creativity with which the entire drama is organized and expressed.

The group is introduced to the process with a few guidelines. These include:

(1) Calling the group's attention to the fact that the dream is the most private and intimate form of communication we are capable of experiencing.

(2) The decision to go public with material of this kind should be optional and be motivated by a genuine desire to share and explore rather than to comply.

(3) Because working on a dream is open-ended, the dreamer has the option of stopping the process at any point when the discomfort of further exploration is too great. This would become the appropriate point for the dreamer to deal with the dream privately in whatever manner he or she chooses (working alone, exploring further in therapy if in treatment, or tabling the issue until he feels better able to cope with it).

Stage I

A participant presents a dream in response to the leader's question: Is there anyone who would like to share a recent dream, preferably one from this morning and preferably not too long? Even though there may be written notes, the dreamer is asked to tell it from memory and then fill in from notes. The group is expected to listen intently, taking notes if they wish. I do encourage note taking if there is any difficulty in recalling the dreamer's verbatim account. The fact that seemingly insignificant details may turn out to be important is pointed out. As the

sessions progress the group becomes more sensitive to the description of the dream and to the relevant qualifying statements that the dreamer may make in introducing the dream.

After the dreamer has finished his account, the leader may repeat the dream if he feels some of the content may have been missed by himself or the group. The others then have the opportunity to question the dreamer in order to clarify the content of the dream. The leader cautions the dreamer not to go beyond the manifest content in his responses.

Stage II

The group now takes over and responds to the question posed by the leader: "You have listened to the dream and have experienced feelings and moods that the dreamer may have evoked. Make an effort to identify those feelings. Try to put them into words. This is an exercise in making you sensitive to the fact that dreams originate in feelings and express feelings. We are not asking for objective comments on the dream and the dreamer. We are asking for your feelings which represent where you are and how the dream affects you. Later we will check them with the dreamer and you will probably be surprised how much similarity there is between the feelings you pick up and those actually felt by the dreamer. In some instances, you will pick up feelings that the dreamer had, but was unaware of."

The dreamer is asked to listen, but not participate during this stage. As much time as is needed is allowed for this part of the process to run its course. When a member of the group starts off by saying: "You must have felt so and so," the leader reminds the group that the concern at this point is with *their* feelings, not the dreamer's.

The group then embarks on a second task in response to the following request from the leader: "Let us now turn to the images contained in this dream. Look at them not as literal portrayals of a particular situation that has come into the dreamer's life, but as the metaphorical expression of the feelings, tensions and movement associated with the situation. In other words, let us look at the images as visual metaphors in much the same way that we would look at poetic metaphors. Our task is to reach out and appreciate the range and intensity of the meaning conveyed by the metaphors. We can do this in the spirit of 'anything goes,' realizing throughout that anything we say is our own projection. These projections represent the meanings we experience around the image. They may or may not have any relevance to the meaning the image has for the dreamer. It is surprising to see how often a good deal of the group's input will not only resonate with

meanings that the images have for the dreamer, but also open up for him the possibility of new meanings he may not have been aware of before, or only dimly sensed."

This discussion is allowed to run its course without any sense of time pressure. The leader intervenes only to prevent anyone from "laying an interpretation" on to the dreamer instead of offering his contribution as a projection of his own subjectivity. The leader also calls the group's attention to any images that were overlooked or received insufficient consideration during the discussion.

The final task is for someone to try to integrate the contributions of the group by reviewing them in the order given in the dream itself. Special attention is paid to the sequence of the images as their natural ordering often gives suggestive clues to their metaphorical content. An image that might be puzzling out of context assumes meaning when examined in the context of the preceding and succeeding images. The recapitulation is not only an organizing event but an all-inclusive one, pulling in details that were overlooked before or not given sufficient attention earlier.

In some instances, the group has done the work so thoroughly that not much recapitulation is needed. The group is now ready to turn to the dreamer, to hear his response to the group input and to hear about his personal relationship to the dream.

Stage III

In bringing the dreamer back into the picture (and sometimes the dreamer has difficulty in staying out of the picture) the group is concerned with two issues. The first is the dreamer's response to the input he has had from the group. The second is the elaboration of the dreamer's personal associations to the images in the dream.

The dreamer's reaction is usually one of surprise at how many feelings and metaphors offered by the group strike a responsive chord. In some cases, the group's contributions mesh with ideas the dreamer had about the dream. More often the dreamer experiences the group input as opening new meanings to the images, meanings he had not thought of, but which now seem plausible to him. When this does occur there is a feeling of excitement and discovery, a true Eureka feeling, a feeling of liberation in dealing with images that had previously mystified him.

The dreamer and the group have more work to do after the dreamer has had a chance to respond. The full sense of identification with the dream—ownership of the dream would be another way of putting it—comes about only when the dreamer is able to answer the question:

What were the specific events in your life that shaped this particular dream to account for the fact that it occurred at that particular time in your life? For this to happen the dreamer, with an assist from the group, must seek to discover and identify the relevant life context. Often this will happen spontaneously as the metaphors suddenly spring to life. However, sometimes the specific context remains obscure and seems to elude any conscious effort by the dreamer to get at it. At this point, specific suggestions can be offered to ferret out the triggering life events. One is to encourage the dreamer to recall thoughts that occurred just before falling asleep. These are often linked to the day residue and the theme of the dream to follow. If this is not successful, it sometimes helps to ask the dreamer to recapitulate the events of the day preceding the dream. What starts off as rote recall is often interrupted by a sudden flash of insight. The Eureka feeling registers and the dreamer's face lights up. The excitement of the discovery outweighs whatever embarrassment or other tensions may have been associated with the original incident.

There still remains some clean up work to do. At this point the group enters into a dialogue with the dreamer about any details of the dream that have not been addressed. Questions are raised about responses that require further elaboration. This process continues until there is a sense of closure that is experienced by both the dreamer and the group.

DISCUSSION

STORM: You spoke of a dream as being an exquisitely personal experience.

ULLMAN: Yes, that's right.

STORM: That comes as a great surprise to me. Why do you say that? Why do you describe them as personal private experiences?

ULLMAN: Our dreams tap into very private aspects of our being. They deal with things we don't ordinarily share in public. They touch on our secrets. They focus on things we're not looking at while we're awake. This is, of course, the basis of both Freud's point of view and Jung's. Freud felt that these things were so taboo and private that they had to be repressed. Jung felt we weren't looking at them, but that our dreams were trying to help us look at them. So I mean private in terms of the nature of their content, not in terms of their ultimate source. To go back to the analogy, I don't know where that psychic black hole

comes from. I don't know where that source is. First we pull out of it whatever has to do with our more immediate personal impinging needs left over from the day before. But that's not all there is in that black hole and as far as I know, it may contain everything there is. There are indications that sometimes strange fragments from someone else's life get into that part of the black hole we're tapping into.

MORRIS: One of the things that I think is most important in what you're doing is that you really are putting together a small group which undoubtedly has a very powerful set of its own group dynamics. Your procedures will be of great interest to the extent that other groups with totally different personnel can also be formed which will function in ways similar to yours. I'm wondering what your thoughts are about "do's" and "don'ts" for such things as initial group composition, factors affecting its maintenance and what happens after termination. How do you prepare folks for life after the group disbands?

ULLMAN: Let me separate that into two parts. Let me talk about this process as applied to dream work and what the "do's" and "don'ts" are. In the first place, it is important to emphasize that dreams were dreamt before psychoanalysts came on the scene. Therefore, it might be that perhaps they had an important purpose for all human beings that we just weren't attending to in our particular culture. It also seemed to me after twenty years of analytic practice, that there wasn't much I was doing with dreams that I couldn't pass on to others. In fact, I came to the conclusion that anyone who had a sense of what a metaphor was could have a sense of what a dream image is. If you can teach children poetry, you can teach them dreams. We don't in our society.

So this process originated as an effort on my part to extend dream work outside the clinical situation. Now, to a society that's been dream-deprived like Western society, you don't just get people to tell each other what their dreams mean. There have to be certain safeguards. The safeguards that I tried to stress have to do with what I call the natural contours of the dream. You've got to structure a non-intrusive group. You've got to let the dreamer move back to the information in the images at his own tempo in his own way. The group only acts as a catalyst, as a supportive agency, as a stimulating agency. Through the play, the gamelike atmosphere actually makes available a richer resource of possible metaphorical meaning for the dreamer. But you never push them onto the dreamer. You never confront him. You never interpret. Those guidelines have to be understood, and if they're understood, then I think anyone can safely and effectively, at least to some degree, help a person with a dream.

Now in terms of the experimental project, that's a little bit too ambiguous and undefined at this point for me to advise others as to how to go about it and get maximum results. But I am convinced, out of my recent three years of working with this process now, that it spontaneously generates psi effects. I've noted that in the teaching groups I've worked with, groups that were not oriented to psi effects, these psi effects came out in a number of ways, as they're now doing in the experimental group. They came out as correspondences between a dream and the life of another person. They came out in terms of or related to natural emotional linkages that were springing up in the group. They came out also in terms of dream-to-dream coincidence, and in a variety of other ways.

RUDERFER: As you stated, it seems to be very difficult to put the dream content into words. Well, the verbal proficiency is confined to one-half of the brain, usually the left half, which indicates then that the dreaming part is the right half. This seems to fit in very well with Ehrenwald's theory of psi originating in the right half. Do you have any comments on that?

ULLMAN: Whatever purpose the dream serves for the sleeping organism, you must remember that the sleeping organism is in a very different state and operating under very different conditions than the waking organism. You have to talk about dreaming at night in the sleeping organism as a recurrent phenomenon that's related to the needs of that sleeping organism. But the remembered dream is a kind of salvaged residue from the experience of dreaming. It's a very valuable residue, because it is coming from that part of our brain that processes things holistically, emotionally in a patterned way. But it's only potentially valuable. The dreamer is too far away from that information generally, when he's awake. But another person can be helpful to a dreamer. It's easier for another person to be honest about a dreamer's dream than it is for the dreamer. The other person doesn't have to live with the implications of that honesty. So that you have a situation where, to reap the maximum benefit from what you've done so effortlessly and spontaneously at night as a consequence of right brain dominance, you need the amplification power of your left brain to transform that potential into a healing reality. You need both.

RUDOLPH: I was in a dream group patterned after your method a year and a half ago, and I can attest the power of this. My question has to do with the play portion—the safeguard against people doing too much interpretation and analyzing. Did I understand you to say that you now discourage any interpretation?

ULLMAN: No. Let's look at the second stage. The dreamer has told a dream. Now the group takes over. The group members respond at a feeling level. In making the dream their own, how does it make them feel? Now, what you're referring to as interpretation, I refer to as trying to translate the metaphor in that image. Not an interpretation! An interpretation is a closed-ended technical therapeutic maneuver of some kind coming out of a theoretical orientation. That's my concept of an interpretation. That's *not* what we're doing. We're saying, there is an image of a woman, a middle-aged woman riding down Main Street on a unicycle. That's the opening setting of a dream. Now don't take that literally. Take that as a visual metaphor. If it were yours; if you created it, what would it mean? That's the problem. You're a group. This is my dream. I'm a middle-aged woman and I'm finding myself riding down Main Street on a unicycle. What am I dreaming about?

RUDOLPH: Being vulnerable.

ULLMAN: Being vulnerable! There are cars all around me and I'm just on this one wheel. Right. What else might it be a metaphor for?

UNIDENTIFIED VOICE: Future life?

ULLMAN: Going into the future . . . O.K. What else?

UNIDENTIFIED VOICE: Having slightly dangerous fun.

ULLMAN: It might be kind of dangerous. It might be exhibitionistic, and so forth. The group, if you give them enough time, will come up with all these possibilities. Not as interpretations, but as metaphorical possibilities. And in this case it was exhibitionistic. She had been at a party that night and she felt a little ashamed at how she had carried on. It was a little painful, but she could face up to her exhibitionistic expression, you see, because she was not forced to, and she didn't have to feed it back to the group if she didn't want to. Now under these conditions people do move closer to the truth.

RUDOLPH: Your description of the dream state reminded me a little bit of Larry LeShan's description of what he called the "Clairvoyant Reality." I wonder if you see any connection?

ULLMAN: I think that, as I indicated in the paper, there are certain characteristics of dream imagery that suggest that we're moving out of the dualistic frame of reference that characterizes our waking state, where you are here and I'm here and there's a space between us, into a kind of non-dual quality to our dream experience. We are the image. We are not the image. There is a different way of experiencing that reality and it's experienced as a reality. I think that has some of the

features of what LeShan is talking about. It is an aspect or dimension that is somehow or other compatible, conducive to psi experience.

BARKER: I was intrigued by your image of the satellite camera. It made me think that, in the overwhelming majority of primitive societies, dreaming is understood to be the result of an entity; a soul or spirit that actually physically leaves the body and goes out wandering, and that there is some real part of a person that is actually perceiving that which is the dream imagery. Do you have any feeling for this? In what way might this correspond to an actual reality of dreaming?

ULLMAN: Well, I think that's a beautiful metaphor for the feeling of transcendence that is conveyed by our dream. Our ancestors do appear and they do appear as real, and we do get information sometimes from them about things at a distance. So there is that quality of transcendence and the traveling spirit is a wonderful metaphor for that phenomenological aspect of a dream.

ROGO*: When in your discussions, as your group is relating dreams and you find a dream that seems to contain a psi component, is the psi component inconsequential or redundant to the overall meaning of the dream? Or have you found that it is directly relevant to the essential message communicated to the dream?

ULLMAN: I'm in a better position to answer that from my own analytic experience, where I was able to look at the motivational factors and the interplay between the dreamer who had the dream and myself. And there I almost always ended up with the feeling that the information that was picked up had some kind of a dynamic significance for the individual and for the situation that he was in.

ROGO: But did it relate to the rest of the dream? Was it topping over the dream or was it relevant to the other meaning communicated in the dream?

ULLMAN: I don't know whether I can generalize, but for the most part it is so worked into the total dream that I don't think I can differentiate.

BONNEAU*: With a number of people I've talked to, often they say they don't recall their dreams unless it's a very significant dream. Periodically, those dreams relate to the future events that are unfolding in their lives. It seems that a large part of the population is, in a sense, unconscious of their own dreams. And I'm wondering in your

* D. Scott Rogo, Northridge, California—Observer.
* Max Bonneau, Vancouver, Canada—Observer.

research, as you spend more and more time with your subjects, as the frequency of their dreams increases, does the proportion of psi phenomena in the dream also increase?

ULLMAN: Dream recall is a complicated subject. About half the people in the world are good recallers and about half are poor recallers and I'm not sure we understand why. There may be reasons at many different levels, including biological differences and so on. In a situation where dreams assume a certain salience or importance, the incidence of recall increases. Therapists often note that when patients come and say they don't recall a dream, if dream work is important to the therapist, they'll begin to remember their dreams. Likewise in the group, poor recallers do begin to recall more. I don't think I have enough experience to say much about how psi develops. My impression is that, in the group, what soon becomes evident are different kinds of emotional linkages—parent/child, sexual linkages—which then become the emotional conveyor of psi responses. There may have been more psi effects between *A* and *B* than between *A* and *C*, and that may be related to these deeper human needs that are operating in the situation.

IRWIN: I want to comment on Martin Ruderfer's point about the linkage between dreams, ESP and functions of the right hemisphere. I think there's something of a misinterpretation of the psychological evidence there. What the evidence suggests is that there is a *relative* specialization of verbal functions in the left hemisphere and a *relative* specialization of spatial functions in the right. I think it is inappropriate to say the right hemisphere is the one that is associated with dreams and ESP.

I also would like to ask about your concept of the "black hole." There is a good deal of neuropsychological evidence to suggest that memories, including unconscious memories, are encoded in the brain. In view of that sort of evidence, why do you find it necessary to posit the source of dreams based on our own personal memories as in the same black hole as that of paranormal dreams?

ULLMAN: I'm not positing its location anywhere with any degree of certainty. I don't know where memory is encoded in the dream and it seems to me that's still an open question. But, as I said before, there does seem to be the ability to remember things that didn't happen to you, a psi event.

RUDERFER: I'm not denying that.

ULLMAN: All right. Then I'm saying that the location of that source is ambiguous. I don't know where it is.

IRWIN: But you are saying the source is the same as that of dreams which have their basis in our own personal memories.

ULLMAN: Yes, I am saying that. Would you clarify what your question is?

IRWIN: I'm not quite sure why you want to do that. Why can't you simply say normal dreams are based on our own personal memories and minds, whereas paranormal dreams have their source elsewhere, namely in this black hole?

ULLMAN: Well, I think you're sort of pushing me into a question of the relationship of mind and brain.

IRWIN: Well, a crucial distinction may be between personal mind and group unconscious.

ULLMAN: Somehow or other the idea of tapping into a single source, wherever it is, seems to me to be closer to what my experience of the phenomenon is.

MORRIS: In response to your comments about the relationship of a psi component to the dream overall, I recall Bob Van de Castle, your prince of percipients, noted that for him, the psi component was likely to be a sudden rather intrusive element quite unrelated to the rest of the dream. For example, he dreamed of lecturing in front of a large hall. Suddenly, Santa Claus and the reindeer came galloping through one of the front doors, galloped up an aisle, exited stage left and were never heard from again in the dream. He had learned that if he had his choice of two target pictures and Santa is on one and a classroom is on the other, go for Santa Claus because that was the intrusive element. At one time you were planning a study to be done with Dr. Cavanna and Hernańdez-Peón which would have involved possible dreaming in spider monkeys. You were going to take sibling spider monkeys and let one go to sleep and keep the other one awake, and wait until the sleeping one was showing some sign of dreaming; then you were going to stimulate the awake one with a little toy spider or a snake and look at what was going on at various levels of the central nervous system of the sleeper. Do you have any comments now on the relevance of dreaming in animals to the kinds of dynamics you've been talking about?

ULLMAN: There is some evidence that animals or monkeys may image. Perhaps, from an evolutionary point of view, the recurrent cycles of dreaming serve some kind of a vigilance function, orienting them to a review of recent experience or an openness to what might be going on in their environment. We never carried that experiment out,

since, as you know, Dr. Hernández-Peón died shortly after we got the grant. If we had been successful, what we were hoping to show is that some kind of vigilance mechanism had an extrasensory component that could be related to natural threats of some kind to the organism. When we're dealing with the human organism, for the most part we have moved beyond the question of concerns with natural threats except under unusual circumstances. And so we seem to have evolved a distinctly human transformation of that imaging potential. We've transformed it into the potential for a metaphor, and we've moved from a concern with natural predators to other human beings as predators, to the state of our social connectedness, the state of our social intactness, etc. I think those are the only differences I can define.

MORRIS: So you would think then that animals don't engage in metaphors.

ULLMAN: Well, I don't know of any poem that an animal ever wrote.

ROUND TABLE DISCUSSION

BYERS: I would like to ask Harvey Irwin to tell us briefly what has happened in the study of ESP among aborigines. I remember years ago encountering some people who were embarking on that and didn't want to talk about it.

IRWIN: Original work on ESP and aborigines was done by the Roses, who were eminent anthropologists in Australia. As far as I know, they did little other than suggest that certain aboriginal individuals have ESP ability. Today the aboriginal people are becoming so westernized that it would be difficult to locate aborigines in an uncontaminated tribal situation if you wanted to look at cultural aspects of ESP in aborigines. As far as I know there are no parapsychologists engaged in any work of that nature.

STORM: Since he brought up memory, I'll address this question to Harvey Irwin. If you have a memory, then you must also have a memory access mechanism. Is there any way at all that we could determine whether the physical brain is the locus of memory or is nothing more than the access mechanism? What experiments might we do to determine that?

IRWIN: My specialty is not in the neuropsychological mechanisms of memory.

STORM: When you asked Monte the question it was as though you thought that something about the brain should be memory.

IRWIN: No, I simply suggested that there was neurological evidence that memories were somehow represented in a neural substrate. This is not to say that in order to get access to memory you do not need to go through something we would call mind. That is quite possible. In my own model I do not pursue the distinction between brain and mind. I deliberately leave the issue open. Thus, while the human information processing system does model the mind, there are acknowledged neurophysiological correlates of processes at certain levels of the system.

BONNEAU: There was a reference made to holograms. Some of the recent work done in certain areas of brain and mind research suggests that possibly information is stored in the mind or in some facsimile of the mind in a hologram structure. In my own views of holograms, they appear to contain time in frozen motion. I wonder how that might relate to some of the psi phenomena we deal with, that have no reference to time as we know it. Psi does seem to have a point of reference, as yet undefined, contained in a hologram structure, and there are a number of points that seem to rotate around that aspect. Does anybody have any ideas on that?

BYERS: I understand the no-space aspect in the hologram very easily. I asked Karl Pribram once how he accounted for time, and he said, which I do not completely understand, that it comes out as amplitude. Maybe that has to be explained further. However, in terms of the storage capacity, there is another interesting point which hasn't come up in this meeting, which intrigues me.

As you know, if you take the physical film hologram, you cut it into any number of pieces and the total information is there, but as the pieces become smaller, the resolution of the image decreases. It was George Leonard's point of view in his book *The Silent Pulse*, that the fuzziness of a psi phenomenon of one sort or another resulted from its being a rather small piece that was available. Although all the image was there, it was not in sufficient resolution.

BONNEAU: In a sense, we keep looking down a very narrow shaft when we go to view psi. We just have a very tiny portion instead of a broad picture or a hologram image.

BYERS: Yes, and also you talk about the entire information being stored in the mind—the mind being a slippery word here. I think the more reasonable explanation here is that it's stored in the entire body or being, in terms of what Pribram has called slow potentials, not localized. Lashley, at the end of his life, trying to find where memory was stored, humorously said that his research seemed to demonstrate that there was no such thing, because no amount of experimental work on the brain itself succeeded in eliminating a piece of memory.

RUDERFER: When you're talking about a hologram, you're looking at something in a frequency domain, and this is an inverse of the time domain mathematically. They're both inversely related, so one may equivalently look at a phenomenon in the frequency or time domain. Which one you want to choose is a matter of convenience. We normally work in the time domain because everything happens to us

sequentially. Now, if we want to work in a frequency domain, we normally do that in a case where, instead of a sequential type of operation, you get a parallel type of operation, and that's more suited for the frequency type of domain. For example, in a hologram, the radiation that passes through a single point goes out in all directions and with all frequencies. It's the same way for every other point you get, all the radiation fanning out from that particular point, so from every point you get some radiation at a particular part of the image. That's why any small part of the image contains all of the information that's in the picture, although with a lower resolution. So really there's no basic difference between a holographic view of the universe and a sequential time view. The frequency viewpoint implies a large number of energy carriers and this fits in with the neutrino sea as an information transmitting medium.

RUDOLPH: I'd also like to comment on the question of the holographic model. A hologram really is a record of a Fourier transform, which is a mathematical transform of whatever coordinates you're looking at. In the case of a hologram it's a transformation of spatial coordinates. In electrical communication engineering, it's the transform of time into frequenices. These are just labels. Mathematically there's no reason why one can't take a Fourier transform of four-dimensional space-time. If you could do that and record that somehow, then at any particular point in the transform domain you would have things from all space and time.

ANGOFF: Our thanks to all of you, participants and observers, for your contributions to this conference. Ladies and gentlemen, this Twenty-Eighth Annual International Conference of the Parapsychology Foundation is adjourned.