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DoD PSYCHOENERGETICS PROGRAM: REPLICATION STUDIES (S)

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(S/NF) DOD PSYCHOENERGETICS PROGRAM--REPLICATION STUDIES (S)

A. DoD Psychoenergetics Program (S)

(S/NF) Major DoD/Intelligence Community interest in assessing the potential of psychoenergetics (ESP) for military/intelligence applications began a little over a decade ago (1972), and has involved a number of agencies and military units as sponsors. The effort was compartmentalized under the code word "GRILL FLAME" in 1978, and in 1981 the various efforts were brought together under single-agency management and coordination (DIA).

(S/NF) The program has involved SRI International as prime contractor, a number of institutes and consultants as subcontractors (e.g., Langley-Porter Neuropsychiatric Institute, University of California; Communications Studies Laboratory, Syracuse University), and has been subject to review by an independent Psychoenergetics Science Advisory Panel composed of Dr. Donald Kerr, Director, Los Alamos National Laboratory; Prof. Fred Zacharaison, Physics Department, California Institute of Technology; and Dr. Ross Adey, V. A. Research Center, Loma Linda, California.

B. Areas of Investigation (S)

(S/NF) Two primary areas of investigation are being pursued in the DoD Psychoenergetics Program. They are:

(1) Remote Viewing (RV)/Extrasensory Perception (ESP). Ability of an individual to access and describe remote geographic sites, or to access and describe concealed data, via undefined transmission mechanisms. Examples include the (mental) viewing of a distant military site or the contents of a secure room.

(2) Remote Action (RA/Psychokinesis (PK). Mental ability to influence physical or biological systems without the use of known physical mechanisms. Examples include perturbation of electronic components or living organisms, such as the behavior of a micro-chip or the growth of a bacterial culture, by a (mental) effort of the will.

C. Replication Efforts (S)

(S/NF) The results generated in the DoD Psychoenergetics Program by the prime contractor (SRI International) in both the remote viewing (RV) and remote action (RA) areas have found wide replication in several other laboratories across the country, notably at Princeton University under the leadership of Dr. Robert Jahn, Dean of the School of Engineering/ Applied Science. (See Appendices A and B for open literature papers on the original SRI work and Princeton replication efforts.) Following is a summary of replication efforts in both the RV and RA areas.

(1) Remote Viewing. A recent survey of the literature on the remote viewing of geographical locations found twenty-eight published formal experimental series. More than half of these (fifteen) were successful, where only one in twenty would be expected by chance. The major successful replicating studies include research efforts at SRI International, Princeton University, Institute for Parapsychology (Durham, NC), Mundelein College (Chicago), and the University of California at Davis. A bibliography of these studies is included as Appendix C.

(2) Remote Action. A recent survey of the literature describing apparent perturbation of electronic-diode- or radioactive-decay-driven random number generators found 48 published papers on 214 formal replication attempts. Of these 214 experiments, 74 were successful, where again only one in twenty would be expected by chance. Major successful replicating studies include, in addition to a large unpublished study by SRI International, research efforts at Princeton University, Mind Science Foundation (San Antonio), Maimonides Medical Center (Brooklyn), Psychophysical Research Laboratory (Princeton), Syracuse University, and Bell Laboratories (Columbus). A bibliography of these studies is included as Appendix D.

The above studies, carried out under a variety of conditions by numerous researchers at a large number of laboratories, indicate that certain of the remote viewing and remote action effects are robust and repeatable phenomena that can be replicated on a broad scale.

Appendix A

A PERCEPTUAL CHANNEL FOR INFORMATION TRANSFER OVER KILOMETER DISTANCES: HISTORICAL PERSPECTIVE AND RECENT RESEARCH

A Perceptual Channel for Information Transfer over Kilometer Distances: Historical Perspective and Recent Research

HAROLD E. PUTHOFF, MEMBER, IEEE, AND RUSSELL TARG, SENIOR MEMBER, IEEE

Abstract—For more than 100 years, scientists have attempted to determine the truth or falsity of claims for the existence of a perceptual channel whereby certain individuals are able to perceive and describe remote data not presented to any known sense. This paper presents an outline of the history of scientific inquiry into such so-called paranormal perception and surveys the current state of the art in parapsychological research in the United States and abroad. The nature of this perceptual channel is examined in a series of experiments carried out in the Electronics and Bioengineering Laboratory of Stanford Research Institute. The perceptual modality most extensively investigated is the ability of both experienced subjects and inexperienced volunteers to view, by innate mental processes, remote geographical or technical targets including buildings, roads, and laboratory apparatus. The accumulated data indicate that the phenomenon is not a sensitive function of distance, and Faraday cage shielding does not in any apparent way degrade the quality and accuracy of perception. On the basis of this research, some areas of physics are suggested from which a description or explanation of the phenomenon could be forthcoming.

I. INTRODUCTION

"IT IS THE PROVINCE of natural science to investigate nature, impartially and without prejudice" [1]. Nowhere in scientific inquiry has this dictum met as great a challenge as in the area of so-called extrasensory perception (ESP), the detection of remote stimuli not mediated by the usual sensory processes. Such phenomena, although under scientific consideration for over a century, have historically been fraught with unreliability and controversy, and validation of the phenomena by accepted scientific methodology has been slow in coming. Even so, a recent survey conducted by the British publication *New Scientist* revealed that 67 percent of nearly 1500 responding readers (the majority of whom are working scientists and technologists) considered ESP to be an established fact or a likely possibility, and 88 percent held the investigation of ESP to be a legitimate scientific undertaking [2].

A review of the literature reveals that although experiments by reputable researchers yielding positive results were begun over a century ago (e.g., Sir William Crookes' study of D. D. Home, 1860's) [3], many consider the study of these phenomena as only recently emerging from the realm of quasi-science. One reason for this is that, despite experimental results, no satisfactory theoretical construct had been advanced to correlate data or to predict new experimental outcomes. Consequently, the area in question remained for a long time in the recipe stage reminiscent of electrodynamics before the unification brought about by the work of Ampere, Faraday, and Maxwell. Since the early work, however, we have seen the development of information theory, quantum theory, and neurophysiological research, and these disciplines provide powerful conceptual tools that appear to bear directly on the issue. In fact, several physicists (Section V) are now of the opinion that these phenomena are not at all inconsistent with the framework of modern physics: the often-held view that observations of this type are *a priori* incompatible with known laws is erroneous in that such a concept is based on the naive realism prevalent before the development of quantum theory. In the emerging view, it is accepted that research in this area can be conducted so as to uncover not just a catalog of interesting events, but rather patterns of cause–effect relationships of the type that lend themselves to analysis and hypothesis in the forms with which we are familiar in the physical sciences. One hypothesis is that information transfer under conditions of sensory shielding is mediated by extremely low-frequency (ELF) electromagnetic waves, a proposal that does not seem to be ruled out by any obvious physical or biological facts. Further, the development of information theory makes it possible to characterize and quantify the performance of a communications channel regardless of the underlying mechanism.

For the past three years, we have had a program in the Electronics and Bioengineering Laboratory of the Stanford Research Institute (SRI) to investigate those facets of human perception that appear to fall outside the range of well-understood perceptual/processing capabilities. Of particular interest is a human information-accessing capability that we call "remote viewing." This phenomenon pertains to the ability of certain individuals to access and describe, by means of mental processes, information sources blocked from ordinary perception, and generally accepted as secure against such access.

In particular, the phenomenon we have investigated most extensively is the ability of a subject to view remote geographical locations up to several thousand kilometers distant from his physical location (given only a known person on whom to target).[1] We have carried out more than fifty experiments under controlled laboratory conditions with several individuals whose remote perceptual abilities have been developed sufficiently to allow them at times to describe correctly—often in great detail—geographical or technical material such as buildings, roads, laboratory apparatus, and the like.

As observed in the laboratory, the basic phenomenon appears to cover a range of subjective experiences variously referred to

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[1] Our initial work in this area was reported in *Nature* [4], and reprinted in the *IEEE Commun. Soc. Newsletter*, vol. 13, Jan. 1975.

end (correct). An airport building also was drawn, and shown to have a large rectangular overhang (correct). The traveler had taken an unplanned one-day side trip to an offshore island and at the time of the experiment had just disembarked from a plane at a small island airport as described by the subject 4000 km away. The sole discrepancy was that the subject's drawing showed a Quonset-hut type of building in place of the rectangular structure.

The above description was chosen as an example to illustrate a major point observed a number of times throughout the program to be described. Contrary to what may be expected, a subject's description does not necessarily portray what may reasonably be expected to be correct (an educated or "safe" guess), but often runs counter even to the subject's own expectations.

We wish to stress again that a result such as the above is not unusual. The remaining submissions in this experiment provided further examples of excellent correspondences between target and response. (A target period of poolside relaxation was identified; a drive through a tropical forest at the base of a truncated volcano was described as a drive through a jungle below a large bare table mountain; a hotel-room target description, including such details as rug color, was correct; and so on.) So as to determine whether such matches were simply fortuitous—that is, could reasonably be expected on the basis of chance alone—Dr. Puthoff was asked after he had returned to blind match the twelve descriptions to his seven target locations. On the basis of this conservative evaluation procedure, which vastly underestimates the statistical significance of the individual descriptions, five correct matches were obtained. This number of matches is significant at $p = 0.02$ by exact binomial calculation.[2]

The observation of such unexpectedly high-quality descriptions early in our program led to a large-scale study of the phenomenon at SRI under secure double-blind conditions (i.e., target unknown to experimenters as well as subjects), with independent random target selection and blind judging. The results, presented in Sections III and IV, provide strong evidence for the robustness of this phenomenon whereby a human perceptual modality of extreme sensitivity can detect complex remote stimuli.

II. Background

Although we are approaching the study of these phenomena as physicists, it is not yet possible to separate ourselves entirely from the language of the nineteenth century when the laboratory study of the paranormal was begun. Consequently, we continue to use terms such as "paranormal," "telepathy," and the like. However, we intend only to indicate a process of information transfer under conditions generally accepted as secure against such transfer and with no prejudice or occult assumptions as to the mechanisms involved. As in any other scientific pursuit, the purpose is to collect the observables that result from experiments and to try to determine the functional relationships between these observables and the laws of physics as they are currently understood.

[2] The probability of a correct daily match by chance for any given transcript is $p = \frac{1}{7}$. Therefore, the probability of at least five correct matches by chance out of twelve tries can be calculated from

$$p = \sum_{i=5}^{12} \frac{12!}{i!\,(12-i)!} \left(\frac{1}{7}\right)^{i} \left(\frac{6}{7}\right)^{(12-i)} = 0.02.$$

Organized research into so-called psychic functioning began roughly in the time of J. J. Thomson, Sir Oliver Lodge, and Sir William Crookes, all of whom took part in the founding of the Society for Psychical Research (SPR) in 1882 in England. Crookes, for example, carried out his principal investigations with D. D. Home, a Scotsman who grew up in America and returned to England in 1855 [3]. According to the notebooks and published reports of Crookes, Home had demonstrated the ability to cause objects to move without touching them. We should note in passing that, Home, unlike most subjects, worked only in the light and spoke out in the strongest possible terms against the darkened seance rooms popular at the time [5].

Sir William Crookes was a pioneer in the study of electrical discharge in gases and in the development of vacuum tubes, some types of which still bear his name. Although everything Crookes said about electron beams and plasmas was accepted, nothing he said about the achievements of D. D. Home ever achieved that status. Many of his colleagues, who had not observed the experiments with Home, stated publicly that they thought Crookes had been deceived, to which Crookes angrily responded:

> Will not my critics give me credit for some amount of common sense? Do they not imagine that the obvious precautions, which occur to them as soon as they sit down to pick holes in my experiments, have occurred to me also in the course of my prolonged and patient investigation? The answer to this, as to all other objections is, prove it to be an error, by showing where the error lies, or if a trick, by showing how the trick is performed. Try the experiment fully and fairly. If then fraud be found, expose it; if it be a truth, proclaim it. This is the only scientific procedure, and it is that I propose steadily to pursue [3].

In the United States, scientific interest in the paranormal was centered in the universities. In 1912, John Coover [6] was established in the endowed Chair of Psychical Research at Stanford University. In the 1920's, Harvard University set up research programs with George Estabrooks and L. T. Troland [7], [8]. It was in this framework that, in 1930, William McDougall invited Dr. J. B. Rhine and Dr. Louisa Rhine to join the Psychology Department at Duke University [9]. For more than 30 years, significant work was carried out at Rhine's Duke University Laboratory. To examine the existence of paranormal perception, he used the now-famous ESP cards containing a boldly printed picture of a star, cross, square, circle, or wavy lines. Subjects were asked to name the order of these cards in a freshly shuffled deck of twenty-five such cards. To test for telepathy, an experimenter would look at the cards one at a time, and a subject suitably separated from the sender would attempt to determine which card was being viewed.

Dr. J. B. Rhine together with Dr. J. G. Pratt carried out thousands of experiments of this type under widely varying conditions [10]. The statistical results from these experiments indicated that some individuals did indeed possess a paranormal perceptual ability in that it was possible to obtain an arbitrarily high degree of improbability by continued testing of a gifted subject.

The work of Rhine has been challenged on many grounds, however, including accusations of improper handling of statistics, error, and fraud. With regard to the statistics, the general consensus of statisticians today is that if fault is to be found in Rhine's work, it would have to be on other than statistical grounds [11]. With regard to the accusations of fraud, the

For Stepanek's run, with $p_i = \frac{1}{2}$, $p_j(j) = 0.619$, and an average time of 9 s per choice, we have a source uncertainty $H(x) = 1$ bit and a calculated bit rate

$$R \approx 0.041 \text{ bit/symbol}$$

or

$$R/T \approx 0.0046 \text{ bit/s.}$$

(Since the 15-digit number (49.8 bits) actually was transmitted at the rate of 2.9×10^{-4} bit/s, an increase in bit rate by a factor of about 20 could be expected on the basis of a coding scheme more optimum than that used in the experiments. See, for example, Appendix A.)

Dr. Charles Tart at the University of California has written extensively on the so-called decline effect. He considers that having subjects attempt to guess cards, or perform any other repetitious task for which they receive no feedback, follows the classical technique for deconditioning any response. He thus considers card guessing "a technique for extinguishing psychic functioning in the laboratory" [32].

Tart's injunctions of the mid-sixties were being heeded at Maimonides Hospital, Brooklyn, NY, by a team of researchers that included Dr. Montague Ullman, who was director of research for the hospital; Dr. Stanley Krippner; and, later, Charles Honorton. These three worked together for several years on experiments on the occurrence of telepathy in dreams. In the course of a half-dozen experimental series, they found in their week-long sessions a number of subjects who had dreams that consistently were highly descriptive of pictorial material that a remote sender was looking at throughout the night. This work is described in detail in the experimenters' book *Dream Telepathy* [33]. Honorton is continuing work of this free-response type in which the subject has no preconceived idea as to what the target may be.

In his more recent work with subjects in the waking state, Honorton is providing homogeneous stimulation to the subject who is to describe color slides viewed by another person in a remote room. In this new work, the subject listens to white noise via earphones and views an homogeneous visual field imposed through the use of Ping-Pong ball halves to cover the subject's eyes in conjunction with diffuse ambient illumination. In this so-called Ganzfeld setting, subjects are again able, now in the waking state, to give correct and often highly accurate descriptions of the material being viewed by the sender [34].

In Honorton's work and elsewhere, it apparently has been the step away from the repetitive forced-choice experiment that has opened the way for a wide variety of ordinary people to demonstrate significant functioning in the laboratory, without being bored into a decline effect.

This survey would be incomplete if we did not indicate certain aspects of the current state of research in the USSR. It is clear from translated documents and other sources [35] that many laboratories in the USSR are engaged in paranormal research.

Since the 1930's, in the laboratory of L. Vasiliev (Leningrad Institute for Brain Research), there has been an interest in the use of telepathy as a method of influencing the behavior of a person at a distance. In Vasiliev's book *Experiments in Mental Suggestion*, he makes it very clear that the bulk of his laboratory's experiments were aimed at long-distance communication combined with a form of behavior modification; for example, putting people at a distance to sleep through hypnosis [36].

Similar behavior modification types of experiments have been carried out in recent times by I. M. Kogan, Chairman of the Bioinformation Section of the Moscow Board of the Popov Society. He is a Soviet engineer who, until 1969, published extensively on the theory of telepathic communication [37]–[40]. He was concerned with three principal kinds of experiments: mental suggestion without hypnosis over short distances, in which the percipient attempts to identify an object; mental awakening over short distances, in which a subject is awakened from a hypnotic sleep at the "beamed" suggestion from the hypnotist; and long-range (intercity) telepathic communication. Kogan's main interest has been to quantify the channel capacity of the paranormal channel. He finds that the bit rate decreases from 0.1 bit/s for laboratory experiments to 0.005 bit/s for his 1000-km intercity experiments.

In the USSR, serious consideration is given to the hypothesis that telepathy is mediated by extremely low-frequency (ELF) electromagnetic propagation. (The pros and cons of this hypothesis are discussed in Section V of this paper.) In general, the entire field of paranormal research in the USSR is part of a larger one concerned with the interaction between electromagnetic fields and living organisms [41], [42]. At the First International Congress on Parapsychology and Psychotronics in Prague, Czechoslovakia, in 1973, for example, Kholodov spoke at length about the susceptibility of living systems to extremely low-level ac and dc fields. He described conditioning effects on the behavior of fish resulting from the application of 10 to 100 μW of RF to their tank [43]. The USSR take these data seriously in that the Soviet safety requirements for steady-state microwave exposure set limits at 10 $\mu W/cm^2$, whereas the United States has set a steady-state limit of 10 mW/cm^2 [44]. Kholodov spoke also about the nonthermal effects of microwaves on animals' central nervous systems. His experiments were very carefully carried out and are characteristic of a new dimension in paranormal research.

The increasing importance of this area in Soviet research was indicated recently when the Soviet Psychological Association issued an unprecedented position paper calling on the Soviet Academy of Sciences to step up efforts in this area [45]. They recommended that the newly formed Psychological Institute within the Soviet Academy of Sciences and the Psychological Institute of the Academy of Pedagogical Sciences review the area and consider the creation of a new laboratory within one of the institutes to study persons with unusual abilities. They also recommended a comprehensive evaluation of experiments and theory by the Academy of Sciences' Institute of Biophysics and Institute for the Problems of Information Transmission.

The Soviet research, along with other behavioristically oriented work, suggests that in addition to obtaining overt responses such as verbalizations or key presses from a subject, it should be possible to obtain objective evidence of information transfer by direct measurement of physiological parameters of a subject. Kamiya, Lindsley, Pribram, Silverman, Walter, and others brought together to discuss physiological methods to detect ESP functioning, have suggested that a whole range of electroencephalogram (EEG) responses such as evoked potentials (EP's), spontaneous EEG, and the contingent negative variation (CNV) might be sensitive indicators of the detection of remote stimuli not mediated by usual sensory processes [46].

Early experimentation of this type was carried out by Douglas Dean at the Newark College of Engineering. In his

class of paranormal perception phenomenon exists. At all times, we and others responsible for the overall program took measures to prevent sensory leakage and subliminal cueing and to prevent deception, whether intentional or unintentional. To ensure evaluations independent of belief structures of both experimenters and judges, all experiments were carried out under a protocol, described below, in which target selection at the beginning of experiments and blind judging of results at the end of experiments were handled independently of the researchers engaged in carrying out the experiments.

Six subjects, designated S1 through S6, were chosen for the study. Three were considered as gifted or experienced subjects (S1 through S3), and three were considered as learners (S4 through S6). The *a priori* dichotomy between gifted and learners was based on the experienced group having been successful in other studies conducted before this program and the learners group being inexperienced with regard to paranormal experimentation.

The study consisted of a series of double-blind tests with local targets in the San Francisco Bay Area so that several independent judges could visit the sites to establish documentation. The protocol was to closet the subject with an experimenter at SRI and at an agreed-on time to obtain from the subject a description of an undisclosed remote site being visited by a target team. In each of the experiments, one of the six program subjects served as remote-viewing subject, and SRI experimenters served as a target demarcation team at the remote location chosen in a double-blind protocol as follows.

In each experiment, SRI management randomly chose a target location from a list of targets within a 30-min driving time from SRI; the target location selected was kept blind to subject and experimenters. The target pool consisted of more than 100 target locations chosen from a target-rich environment. (Before the experimental series began, the Director of the Information Science and Engineering Division, not otherwise associated with the experiment, established the set of locations as the target pool which remained known only to him. The target locations were printed on cards sealed in envelopes and kept in the SRI Division office safe. They were available only with the personal assistance of the Division Director who issued a single random-number selected target card that constituted the traveling orders for that experiment.)

In detail: To begin the experiment, the subject was closeted with an experimenter at SRI to wait 30 min before beginning a narrative description of the remote location. A second experimenter then obtained from the Division Director a target location from a set of traveling orders previously prepared and randomized by the Director and kept under his control. The target demarcation team, consisting of two to four SRI experimenters, then proceeded by automobile directly to the target without any communication with the subject or experimenter remaining behind. The experimenter remaining with the subject at SRI was kept ignorant of both the particular target and the target pool so as to eliminate the possibility of cueing (overt or subliminal) and to allow him freedom in questioning the subject to clarify his descriptions. The demarcation team remained at the target site for an agreed-on 15-min period following the 30 min allotted for travel.[4] During the observation period, the remote-viewing subject was asked to describe his impressions of the target site into a tape recorder and to make any drawings he thought appropriate. An informal comparison was then made when the demarcation team returned, and the subject was taken to the site to provide feedback.

A. Subject S1: Experienced

To begin the series, Pat Price, a former California police commissioner and city councilman, participated as a subject in nine experiments. In general, Price's ability to describe correctly buildings, docks, roads, gardens, and the like, including structural materials, color, ambience, and activity—often in great detail—indicated the functioning of a remote perceptual ability. A Hoover Tower target, for example, was recognized and named by name. Nonetheless, in general, the descriptions contained inaccuracies as well as correct statements. A typical example is indicated by the subject's drawing shown in Fig. 3 in which he correctly described a park-like area containing two pools of water: one rectangular, 60 by 89 ft (actual dimensions 75 by 100 ft); the other circular, diameter 120 ft (actual diameter 110 ft). He incorrectly indicated the function, however, as water filtration rather than recreational swimming. (We often observe essentially correct descriptions of basic elements and patterns coupled with incomplete or erroneous analysis of function.) As can be seen from his drawing, he also included some elements, such as the tanks shown in the upper right, that are not present at the target site. We also note an apparent left–right reversal, often observed in paranormal perception experiments.

To obtain a numerical evaluation of the accuracy of the remote-viewing experiment, the experimental results were subjected to independent judging on a blind basis by an SRI research analyst not otherwise associated with the research. The subject's response packets, which contained the nine typed unedited transcripts of the tape-recorded narratives along with any associated drawings, were unlabeled and presented in random order. While standing at each target location, visited in turn, the judge was required to blind rank order the nine packets on a scale 1 to 9 (best to worst match). The statistic of interest is the sum of ranks assigned to the target-associated transcripts, lower values indicating better matches. For nine targets, the sum of ranks could range from nine to eighty-one. The probability that a given sum of ranks s or less will occur by chance is given by [55]

$$\Pr(s \text{ or less}) = \frac{1}{N^n} \sum_{i=n}^{s} \sum_{l=0}^{k} (-1)^l \binom{n}{l} \binom{i - Nl - 1}{n - 1}$$

where s is obtained sum of ranks, N is number of assignable ranks, n is number of occasions on which rankings were made, and l takes on values from zero to the least positive integer k in $(i - n)/n$. (Table I is a table to enable easy application of the above formula to those cases in which $N = n$.) The sum in this case, which included seven direct hits out of the nine, was 16 (see Table II), a result significant at $p = 2.9 \times 10^{-5}$ by exact calculation.

In Experiments 3, 4, and 6 through 9, the subject was secured in a double-walled copper-screen Faraday cage. The Faraday cage provides 120-dB attenuation for plane-wave radio-frequency radiation over a range of 15 kHz to 1 GHz. For magnetic fields, the attenuation is 68 dB at 15 kHz and decreases to 3 dB at 60 Hz. The results of rank order judging (Table II) indicate that the use of Faraday cage electrical

[4] The first subject (S1) was allowed 30 min for his descriptions, but it was found that he fatigued and had little comment after the first 15 min. The viewing time was therefore reduced to 15 min for subjects S2 through S6.

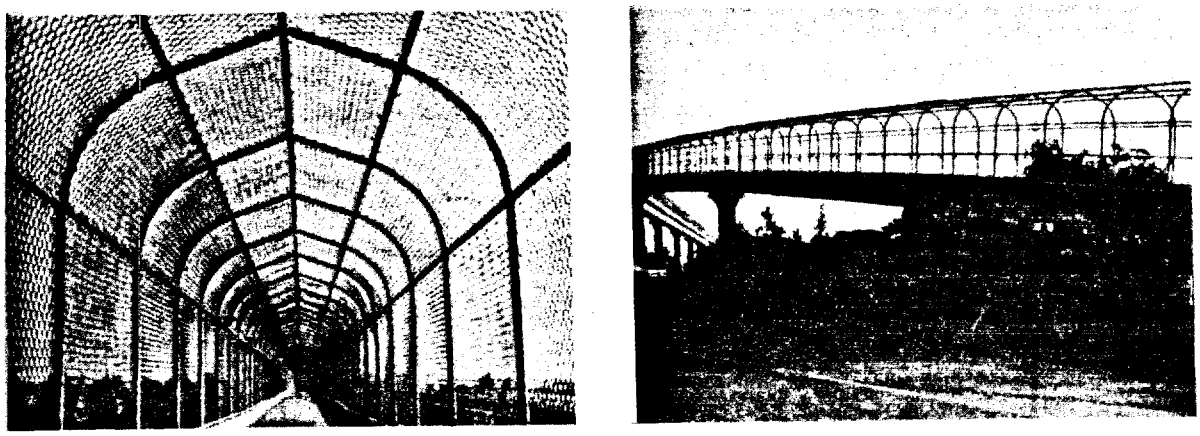


Fig. 4. Subject Hammid (S4) drawing, described as "some kind of diagonal trough up in the air."

TABLE II
DISTRIBUTION OF RANKINGS ASSIGNED TO TRANSCRIPTS ASSOCIATED WITH EACH TARGET LOCATION FOR EXPERIENCED SUBJECT PRICE (S1)

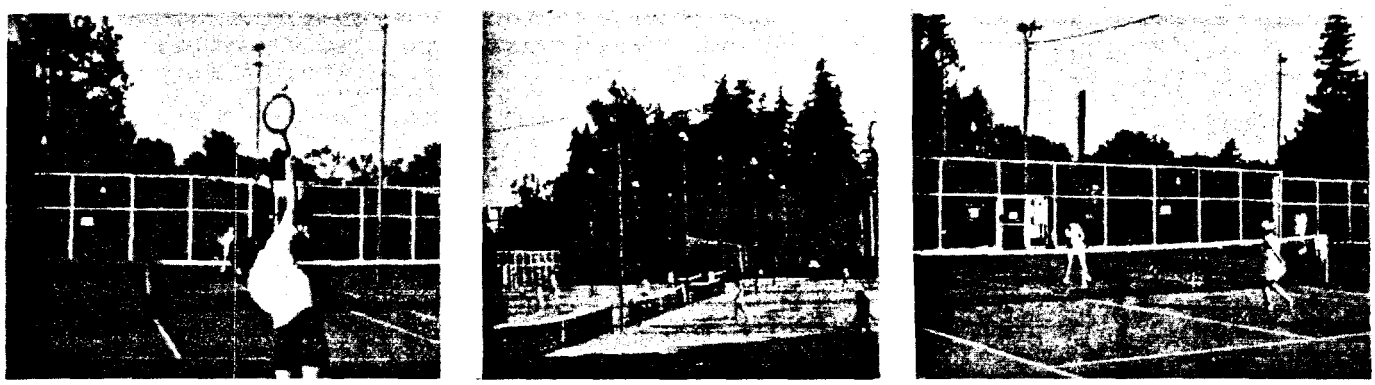
Target Location	Distance (km)	Rank of Associated Transcript
Hoover Tower, Stanford	3.4	1
Baylands Nature Preserve, Palo Alto	6.4	1
Radio telescope, Portola Valley	6.4	1
Marina, Redwood City	6.8	1
Bridge toll plaza, Fremont	14.5	6
Drive-in theater, Palo Alto	5.1	1
Arts and Crafts Plaza, Menlo Park	1.9	1
Catholic Church, Portola Valley	8.5	3
Swimming pool complex, Palo Alto	3.4	1
Total sum of ranks		16 ($p=2.9\times10^{-5}$)

who felt that he used his remote-viewing ability in his everyday life.

In comparison with the latter two, many people are more influenced by their environment and are reluctant under public scrutiny to attempt activities that are generally thought to be impossible. Society often provides inhibition and negative feedback to the individual who might otherwise have explored his own nonregular perceptual ability. We all share an historical tradition of "the stoning of prophets and the burning of witches" and, in more modern times, the hospitalization of those who claim to perceive things that the majority do not admit to seeing. Therefore, in addition to maintaining scientific rigor, one of our primary tasks as researchers is to provide an environment in which the subject feels safe to explore the possibility of paranormal perception. With a new subject, we also try to stress the nonuniqueness of the ability because from our experience paranormal functioning appears to be a latent ability that all subjects can articulate to some degree.

Because of Mrs. Hammid's artistic background, she was capable of drawing and describing visual images that she could not identify in any cognitive or analytic sense. When the target demarcation team went to a target location which was a pedestrian overpass, the subject said that she saw "a kind of trough up in the air," which she indicated in the upper part of her drawing in Fig. 4. She went on to explain, "If you stand where they are standing you will see something like this," indicating the nested squares at the bottom of Fig. 4. As it turned out, a judge standing where she indicated would have a view closely resembling what she had drawn, as can be seen from the accompanying photographs of the target location. It needs to be emphasized, however, that judges did not have access to our photographs of the site, used here for illustrative purposes only, but rather they proceeded to each of the target locations by list.

In another experiment, the subject described seeing "an open barnlike structure with a pitched roof." She also saw a "kind of slatted side to the structure making light and dark bars on the wall." Her drawing and a photograph of the associated bicycle shed target are shown in Fig. 5. (Subjects are encouraged to make drawings of anything they visualize and associate with the remote location because drawings they make are in general more accurate than their verbal description.) As in the original series with Price, the results of the nine-



TARGET—TENNIS COURTS

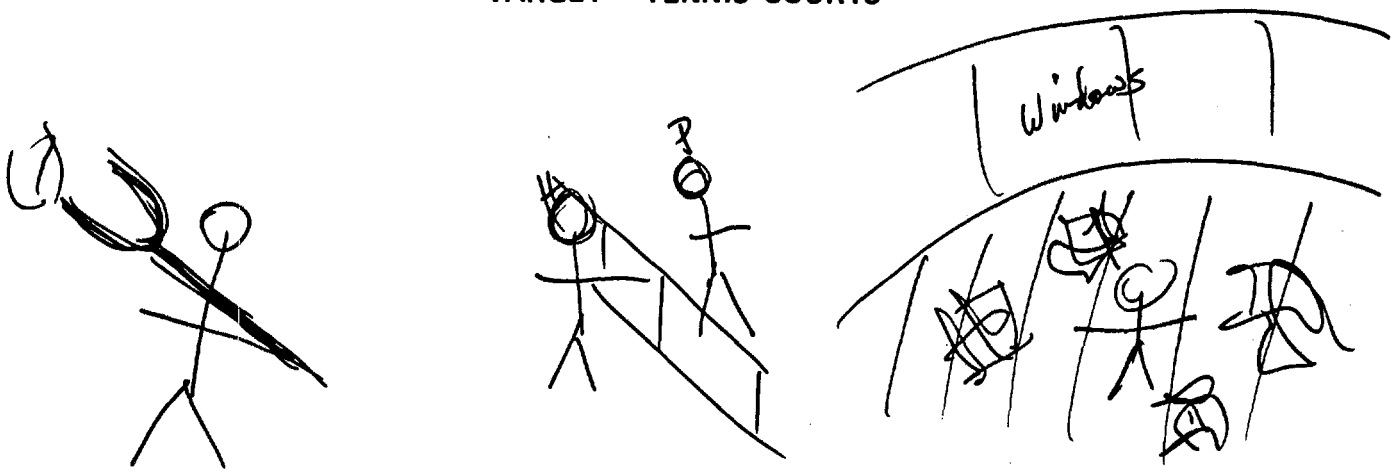


Fig. 6. Subject Elgin (S2) drawings in response to tennis court target.

subject. It was a demonstration experiment for a government visitor who had heard of our work and wanted to evaluate our experimental protocol.

In the laboratory, the subject, holding a bearing compass at arm's length, began the experiment by indicating the direction of the target demarcation team correctly to within 5°. (In all four experiments with this subject, he has always been within 10° of the correct direction in this angular assessment.) The subject then generated a 15-min tape-recorded description and the drawings shown in Fig. 6.

In discussing the drawings, Elgin indicated that he was uncertain as to the action, but had the impression that the demarcation team was located at a museum (known to him) in a particular park. In fact, the target was a tennis court located in that park about 90 m from the indicated museum. Once again, we note the characteristic (discussed earlier) of a resemblance between the target site and certain gestalt elements of the subject's response, especially in regard to the drawings, coupled with incomplete or erroneous analysis of the significances. Nonetheless, when rank ordering transcripts 1 through 8 at the site, the judge ranked this transcript as 2. This example illustrates a continuing observation that most of the correct information related to us by subjects is of a nonanalytic nature pertaining to shape, form, color, and material rather than to function or name.

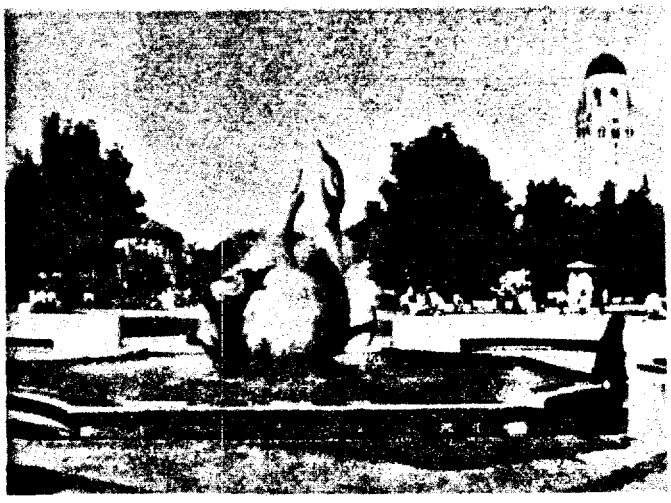
A second example from this group, generated by S3 (Swann), indicates the level of proficiency that can be attained with practice. In the two years since we first started working with Swann, he has been studying the problem of separating the external signal from the internal noise. In our most recent experiments, he dictates two lists for us to record. One list contains objects that he "sees," but does not think are located at the remote scene. A second list contains objects that he thinks are at the scene. In our evaluation, he has made much progress in this most essential ability to separate memory and imagination from paranormal inputs. This is the key to bringing the remote-viewing channel to fruition with regard to its potential usefulness.

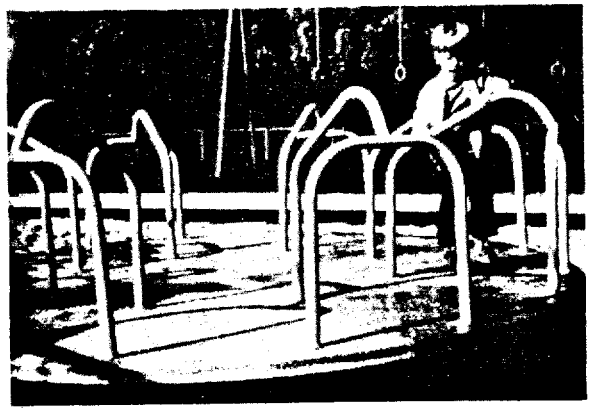
The quality of transcript that can be generated by this process is evident from the results of our most recent experiment with Swann. The target location chosen by the usual double-blind protocol was the Palo Alto City Hall. Swann described a tall building with vertical columns and "set in" windows. His sketch, together with the photograph of the site, is shown in Fig. 7. He said there was a fountain, "but I don't hear it." At the time the target team was at the City Hall during the experiment, the fountain was not running. He also made an effort to draw a replica of the designs in the pavement in front of the building, and correctly indicated the number of trees (four) in the sketch.

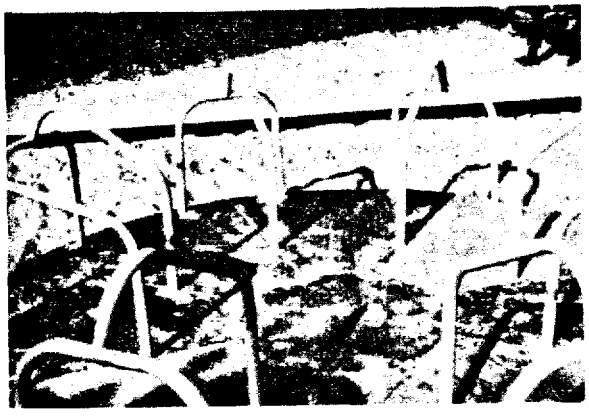
For the entire series of eight, four each from S2 and S3, the numerical evaluation based on blind rank ordering of transcripts at each site was significant at $p = 3.8 \times 10^{-4}$ and included three direct hits and three second ranks for the target-associated transcripts (see Table IV).

D. Subjects S5 and S6: Learners

To complete the series, four experiments each were carried out with learner subjects S5 and S6, a man and woman on the SRI professional staff. The results in this case, taken as a







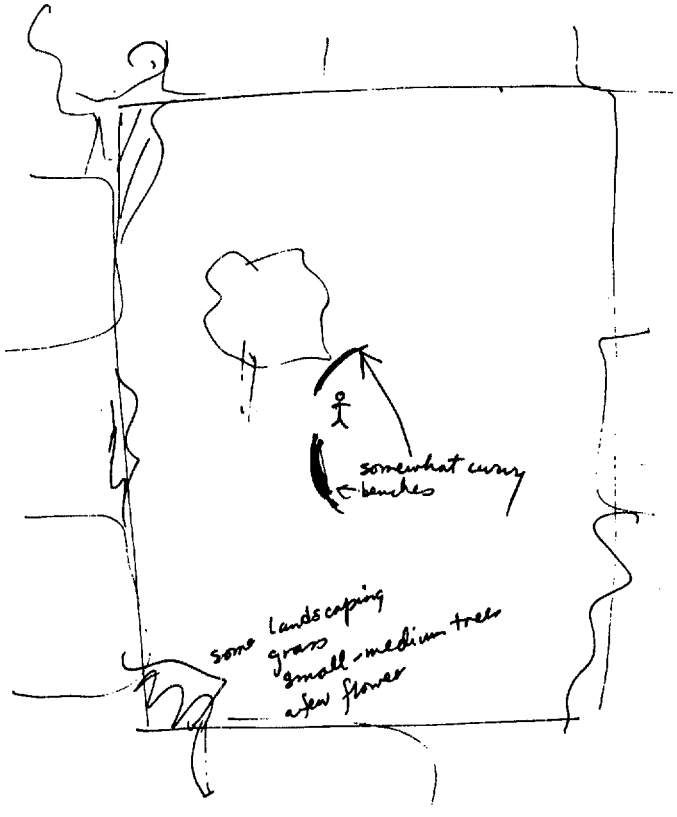
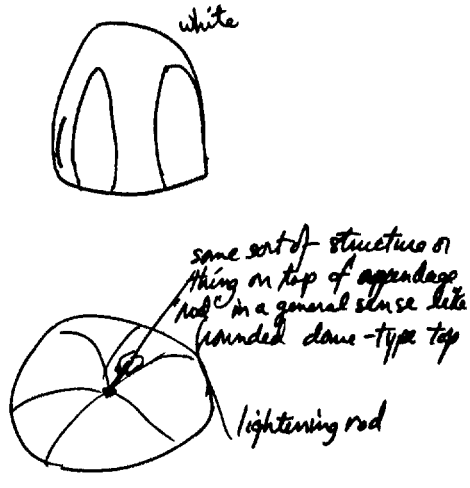
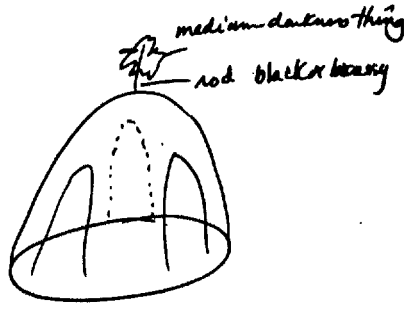


Fig. 8. Subject (S6) drawing of White Plaza, Stanford University. Subject drew what she called "curvy benches" and then announced correctly that the place was "White Plaza at Stanford."



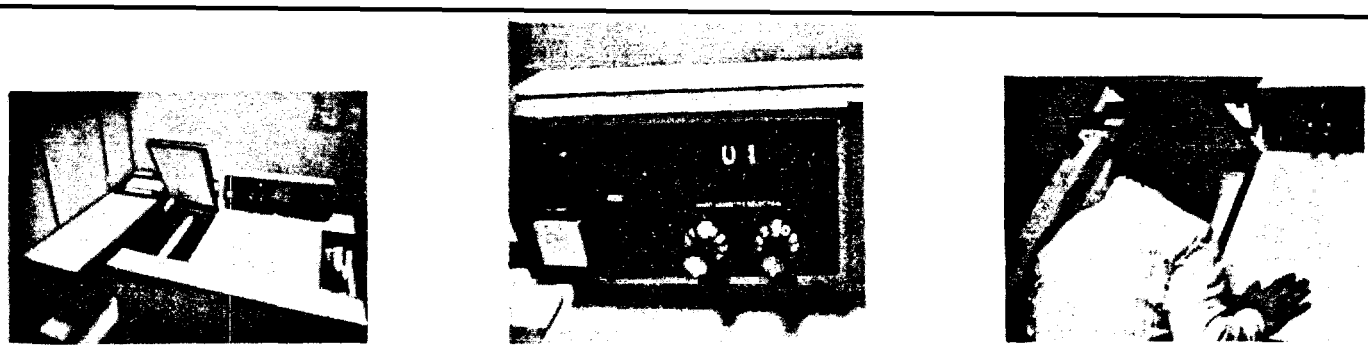


RESPONSES OF VISITING SCIENTIST SUBJECT

Fig. 9. Subject (V1) drawing of merry-go-round target.

Second, when an individual observes a successful demonstration experiment involving another person as subject, it inevitably occurs to him that perhaps chicanery is involved. We have found the most effective way to settle this issue for the observer is to have the individual himself act as a subject so as to obtain personal experience against which our reported results can be evaluated.

The first visitor (V1) was invited to participate as a subject in a three-experiment series. All three experiments contained elements descriptive of the associated target locations; the quality of response increased with practice. The third response is shown in Fig. 9, where again the pattern elements in the drawing appeared to be a closer match than the subject's analytic interpretation of the target object as a cupola.



TARGET LOCATION: XEROX MACHINE (TECHNOLOGY SERIES)

TO ADD INTEREST TO TARGET LOCATION EXPERIMENTER WITH HIS HEAD BEING XEROXED

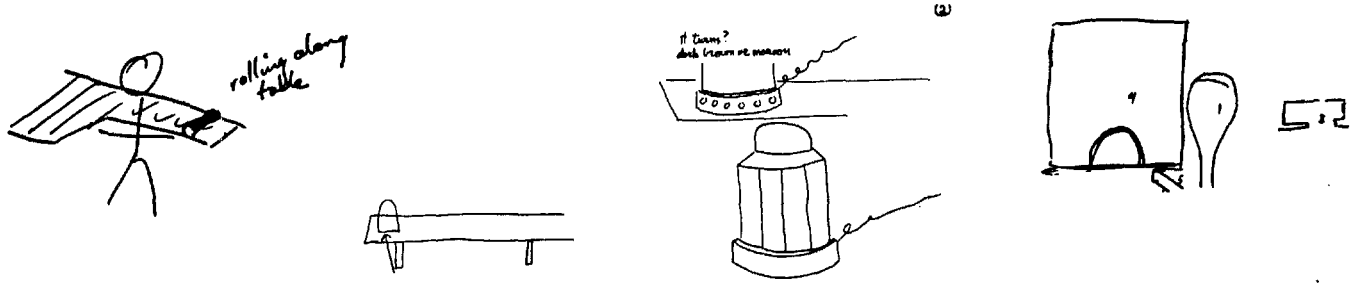


Fig. 11. Drawings by three subjects (S2, S3, and V3) for Xerox machine target. When asked to describe the square at upper left of response on the right, subject (V3) said, "There was this predominant light source which might have been a window, and a working surface which might have been the sill, or a working surface or desk." Earlier the subject had said, "I have the feeling that there is something silhouetted against the window."

Observations with unselected subjects such as those described above indicate that remote viewing may be a latent and widely distributed perceptual ability.

F. Technology Series: Short-Range Remote Viewing

Because remote viewing is a perceptual ability, we considered it important to obtain data on its resolution capabilities. To accomplish this, we turned to the use of indoor technological targets.

Twelve experiments were carried out with five different subjects, two of whom were visiting government scientists. They were told that one of the experimenters would be sent by random protocol to a laboratory within the SRI complex and that he would interact with the equipment or apparatus at that location. It was further explained that the experimenter remaining with the subject was, as usual, kept ignorant of the contents of the target pool to prevent cueing during questioning. (Unknown to subjects, targets in the pool were used with replacement; one of the goals of this particular experiment was to obtain multiple responses to a given target to investigate whether correlation of a number of subject responses would provide enhancement of the signal-to-noise ratio.) The subject was asked to describe the target both verbally (tape recorded) and by means of drawings during a time-synchronized 15-min interval in which the outbound experimenter interacted in an appropriate manner with the equipment in the target area.

In the twelve experiments, seven targets were used: a drill press, Xerox machine, video terminal, chart recorder, four-state random number generator, machine shop, and typewriter. Three of these were used twice (drill press, video terminal, and typewriter) and one (Xerox machine) came up three times in our random selection procedure.

Comparisons of the targets and subject drawings for three of the multiple-response cases (the typewriter, Xerox machine, and video terminal) are shown in Figs. 10, 11, and 12. As is apparent from these illustrations alone, the experiments provide circumstantial evidence for an information channel of useful bit rate. This includes experiments in which visiting government scientists participated as subjects (Xerox machine and video terminal) to observe the protocol. In general, it appears that use of multiple-subject responses to a single target provides better signal-to-noise ratio than target identification by a single individual. This conclusion is borne out by the judging described below.

Given that in general the drawings constitute the most accurate portion of a subject's description, in the first judging procedure a judge was asked simply to blind match only the drawings (i.e., without tape transcripts) to the targets. Multiple-subject responses to a given target were stapled together, and thus seven subject-drawing response packets were to be matched to the seven different targets for which drawings were made. The judge did *not* have access to our photographs of the target locations, used for illustration purposes only, but rather proceeded to each of the target locations by list. While standing at each target location, the judge was required to rank order the seven subject-drawing response packets (presented in random order) on a scale 1 to 7 (best to worst match). For seven targets, the sum of ranks could range from 7 to 49. The sum in this case, which included 1 direct hit and 4 second ranks out of the 7 (see Table VII) was 18, a result significant at $p = 0.036$.

In the second more detailed effort at evaluation, a visiting scientist selected at random one of the 12 data packages (a drill press experiment), sight unseen and submitted it for independent analysis to an engineer with a request for an esti-

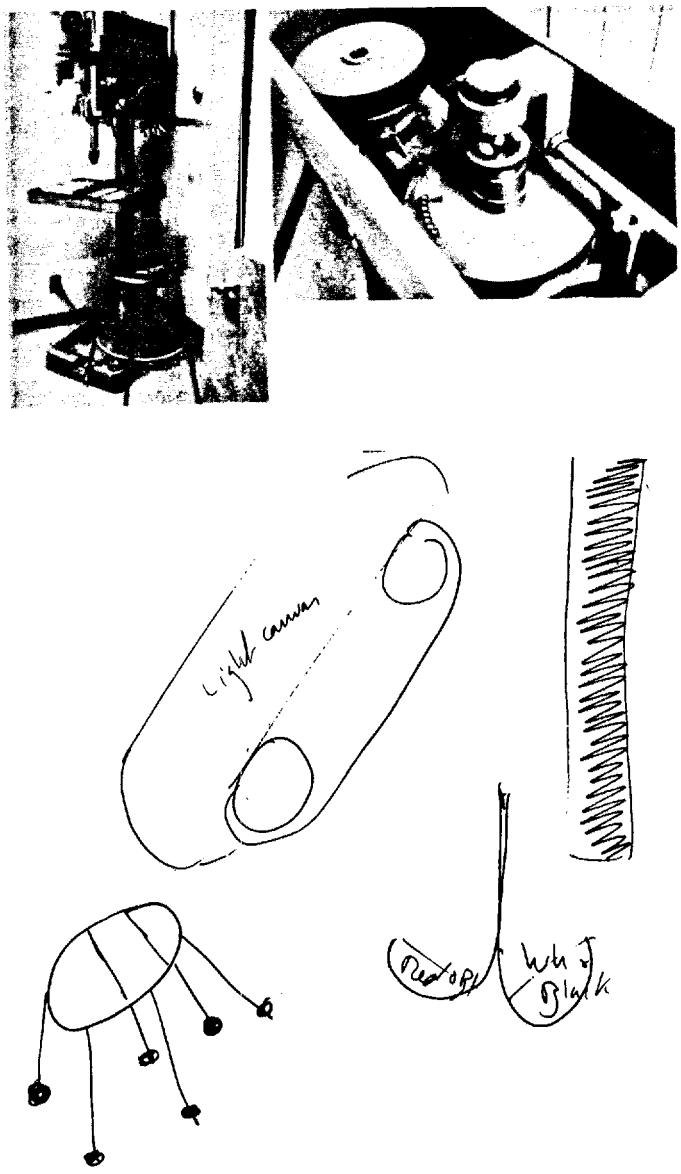


Fig. 13. Subject (S4) drawing of drill press showing belt drive, stool, and a "vertical graph that goes up and down."

Thus the primary achievement of the SRI program was the elicitation of high-quality remote viewing from individuals who agreed to act as subjects. Criticism of this claim could in principle be put forward on the basis of three potential flaws. 1) The study could involve naiveté in protocol that permits various forms of cueing, intentional or unintentional. 2) The experiments discussed could be selected out of a larger pool of experiments of which many are of poorer quality. 3) Data for the reported experiments could be edited to show only the matching elements, the nonmatching elements being discarded.

All three criticisms, however, are invalid. First, with regard to cueing, the use of double-blind protocols ensures that none of the persons in contact with the subject can be aware of the target. Second, selection of experiments for reporting did not take place; every experiment was entered as performed on a master log and is included in the statistical evaluations. Third, data associated with a given experiment remain unedited; all experiments are tape recorded and all data are included unedited in the data package to be judged and evaluated.

In the process of judging—attempting to match transcripts against targets on the basis of the information in the transcripts—some patterns and regularities in the transcript descriptions became evident, particularly regarding individual styles in remote viewing and in the perceptual form of the descriptions given by the subjects. These patterns and the judging procedure are discussed below.

a) Styles of response: The fifty-one transcripts were taken from nine different subjects. Comparing the transcripts of one subject with those of another revealed that each pattern tended to focus on certain aspects of the remote target complex and to exclude others, so that each had an individual pattern of response, like a signature.

Subject S3, for example, frequently responded with topographical descriptions, maps, and architectural features of the target locations. Subject S2 often focused on the behavior of the remote experimenter or the sequence of actions he carried out at the target. The transcripts of subject S4, more than those of other subjects, had descriptions of the feel of the location, and experiential or sensory gestalts—for example, light/dark elements in the scene and indoor/outdoor and enclosed/open distinctions. Prominent features of S1's transcripts were detailed descriptions of what the target persons were concretely experiencing, seeing, or doing—for example, standing on asphalty blacktop overlooking water; looking at a purple iris.

The range of any individual subject's responses was wide. Anyone might draw a map or describe the mood of the remote experimenter, but the consistency of each subject's overall approach suggests that just as individual descriptions of a *directly* viewed scene would differ, so these differences also occur in *remote*-viewing processes.

b) Nature of the description: The concrete descriptions that appear most commonly in transcripts are at the level of subunits of the overall scene. For example, when the target was a Xerox copy machine, the responses included (S2) a rolling object (the moving light) or dials and a cover that is lifted (S3), but the machine as a whole was not identified by name or function.

In a few transcripts, the subjects correctly identified and named the target. In the case of a computer terminal, the subject (V2) apparently perceived the terminal and the relay racks behind it. In the case of targets which were Hoover Tower and White Plaza, the subjects (S1 and S6, respectively) seemed to identify the locations through analysis of their initial images of the elements of the target.

There were also occasional incorrect identifications. Gestalts were incorrectly named; for example, swimming pools in a park were identified as water storage tanks at a water filtration plant (S1).

The most common perceptual level was thus an intermediate one—the individual elements and items that make up the target. This is suggestive of a scanning process that takes sample perceptions from within the overall environment.

When the subjects tried to make sense out of these fragmentary impressions, they often resorted to metaphors or constructed an image with a kind of perceptual inference. From a feeling of the target as an "august" and "solemn" building, a subject (S4) said it might be a library; it was a church. A pedestrian overpass above a freeway was described as a conduit (S4). A rapid transit station, elevated above the countryside, was associated with an observatory (S2). These responses seem to be the result of attempts to process partial informa-

IV. Considerations Concerning Time

If the authors may be forgiven a personal note, we wish to express that this section deals with observations that we have been reluctant to publish because of their striking apparent incompatibility with existing concepts. The motivating factor for presenting the data at this time is the ethical consideration that theorists endeavoring to develop models for paranormal functioning should be apprised of all the observable data if their efforts to arrive at a comprehensive and correct description are to be successful.

During the course of the experimentation in remote viewing (Section III), subjects occasionally volunteered the information that they had been thinking about their forthcoming participation in a remote-viewing experiment and had an image come to them as to what the target location was to be. On these occasions, the information was given only to the experimenter remaining at SRI with the subject and was unknown to the outbound experimenter until completion of the experiment. Two of these contributions were among the most accurate descriptions turned in during those experiments. Since the target location had not yet been selected when the subject communicated his perceptions about the target, we found the data difficult to contend with.

We offer these spontaneous occurrences not as proof of precognitive perception, but rather as the motivation that led us to do further work in this field. On the basis of this firsthand evidence, together with the copious literature describing years of precognition experiments carried out in various other laboratories, we decided to determine whether a subject could perform a perceptual task that required both spatial and temporal remote viewing.

It is well known and recently has been widely discussed that nothing in the fundamental laws of physics forbids the apparent transmission of information from the future to the present (discussed further in Section V). Furthermore, there is a general dictum that "in physical law, everything that is not forbidden, is required" [61]. With this in mind, we set out to conduct very well-controlled experiments to determine whether we could deliberately design and execute experiments for the sole purpose of observing precognition under laboratory conditions.

The experimental protocol was identical to that followed in previous remote-viewing experiments with but one exception. The exception was that the subject was required to describe the remote location during a 15-min period beginning 20 min before the target was selected and 35 min before the outbound experimenter was to arrive at the target location.

In detail, as shown in Table IX, each day at ten o'clock one of the experimenters would leave SRI with a stack of ten sealed envelopes from a larger pool and randomized daily, containing traveling instructions that had been prepared, but that were unknown to the two experimenters remaining with the subject. The subject for this experiment was Hella Hammid (S4) who participated in the nine-experiment series replicating the original Price work described earlier. The traveling experimenter was to drive continuously from 10:00 until 10:30 before selecting his destination with a random number generator. (The motivation for continuous motion was our observation that objects and persons in rapid motion are not generally seen in the remote-viewing mode of perception, and we wished the traveler to be a poor target until he reached his target site.) At the end of 30 min of driving, the traveling experimenter generated a random digit from 0 to 9 with a Texas Instruments SR-51 random number generator; while still in motion, he counted down that number of envelopes and proceeded directly to the target location so as to arrive there by 10:45. He remained at the target site until 11:00, at which time he returned to the laboratory, showed his chosen target name to a security guard, and entered the experimental room.

TABLE IX
Experimental Protocol: Precognitive Remote Viewing

Time Schedule	Experimenter/Subject Activity
10:00	Outbound experimenter leaves with 10 envelopes (containing target locations) and random number generator; begins half-hour drive
10:10	Experimenters remaining with subject in the laboratory elicit from subject a description of where outbound experimenter will be from 10:45-11:00
10:25	Subject response completed, at which time laboratory part of experiment is over
10:30	Outbound experimenter obtains random number from a random number generator, counts down to associated envelope, and proceeds to target location indicated
10:45	Outbound experimenter remains at target location for 15 minutes (10:45-11:00)

Fig. 14. Subject Hammid (S4) described "some kind of congealing tar, or maybe an area of condensed lava . . . that has oozed out to fill up some kind of boundaries."

During the same period, the protocol in the laboratory was as follows. At 10:10, the subject was asked to begin a description of the place to which the experimenter would go 35 min hence. The subject then generated a tape-recorded description and associated drawings from 10:10 to 10:25, at which time her part in the experiment was ended. Her description was thus entirely concluded 5 min before the beginning of the target selection procedure.

Four such experiments were carried out. Each of them appeared to be successful, an evaluation later verified in blind judging without error by three judges. We will briefly summarize the four experiments below.

The first target, the Palo Alto Yacht Harbor, consisted entirely of mud flats because of an extremely low tide (see Fig. 14). Appropriately, the entire transcript of the subject pertained to "some kind of congealing tar, or maybe an area of condensed lava. It looks like the whole area is covered with some kind of wrinkled elephant skin that has oozed out to fill up some kind of boundaries where (the outbound experimenter) is standing." Because of the lack of water, the dock where the remote experimenter was standing was in fact resting directly on the mud.

the corresponding target locations. A long-range experimental program devoted to the clarification of these issues and involving a number of subjects is under way. The above four experiments are the first four carried out under this program.

Currently, we have no precise model of this spatial and temporal remote-viewing phenomenon. However, models of the universe involving higher order synchronicity or correlation have been proposed by the physicist Pauli and the psychologist Carl Jung [62].

> ACAUSALITY. If natural law[5] were an absolute truth, then of course there could not possibly be any processes that deviate from it. But since causality[5] is a *statistical* truth, it holds good only on average and thus leaves room for *exceptions* which must somehow be experienceable, that is to say, *real*. I try to regard synchronistic events as acausal exceptions of this kind. They prove to be relatively independent of space and time; they relativize space and time insofar as space presents in principle no obstacle to their passage and the sequence of events in time is inverted so that it looks as if an event which has not yet occurred were causing a perception in the present.

We shall see in the next section that such a description, though poetic, has some basis in modern physical theory.

V. DISCUSSION

It is important to note at the outset that many contemporary physicists are of the view that the phenomena that we have been discussing are not at all inconsistent with the framework of physics as currently understood. In this emerging view, the often-held belief that observations of this type are incompatible with known laws *in principle* is erroneous, such a concept being based on the naive realism prevalent before the development of modern quantum theory and information theory.

One hypothesis, put forward by I. M. Kogan of the USSR, is that information transfer under conditions of sensory shielding is mediated by extremely low-frequency (ELF) electromagnetic waves in the 300–1000-km region [37]–[40]. Experimental support for the hypothesis is claimed on the basis of slower than inverse square attenuation, compatible with source-percipient distances lying in the induction field range as opposed to the radiation field range; observed low bit rates (0.005–0.1 bit/s) compatible with the information carrying capacity of ELF waves; apparent ineffectiveness of ordinary electromagnetic shielding as an attenuator; and standard antenna calculations entailing biologically generated currents yielding results compatible with observed signal-to-noise ratios.

M. Persinger, Psychophysiology Laboratory, Laurentian University, Toronto, Canada, has narrowed the ELF hypothesis to the suggestion that the 7.8-Hz "Shumann waves" and their harmonics propagating along the earth–ionosphere waveguide duct may be responsible. Such an hypothesis is compatible with driving by brain-wave currents and leads to certain other hypotheses such as asymmetry between east-west and west-east propagation, preferred experimental times (midnight–4 A.M.), and expected negative correlation between success and the U index (a measure of geomagnetic disturbance throughout the world). Persinger claims initial support for these factors on the basis of a literature search [63], [64].

On the negative side with regard to a straightforward ELF interpretation as a blanket hypothesis are the following: a) apparent real-time descriptions of remote activities in sufficient detail to require a channel capacity in all probability greater than that allowed by a conventional modulation of an ELF signal; b) lack of a proposed mechanism for coding and decoding the information onto the proposed ELF carrier; and c) apparent precognition data. The hypothesis must nonetheless remain open at this stage of research, since it is conceivable that counterindication a) may eventually be circumvented on the basis that the apparent high bit rate results from a mixture of low bit rate input and high bit rate "filling in the blanks" from imagination; counterindication b) is common to a number of normal perceptual tasks and may therefore simply reflect a lack of sophistication on our part with regard to perceptual functioning [65]; and counterindication c) may be accommodated by an ELF hypothesis if advanced waves as well as retarded waves are admitted [66], [67]. Experimentation to determine whether the ELF hypothesis is viable can be carried out by the use of ELF sources as targets, by the study of parametric dependence on propagational directions and diurnal timing, and by the exploration of interference effects caused by creation of a high-intensity ELF environment during experimentation, all of which are under consideration in our laboratory and elsewhere.

Some physicists believe that the reconciliation of observed paranormal functioning with modern theory may take place at a more fundamental level—namely, at the level of the foundations of quantum theory. There is a continuing dialog, for example, on the proper interpretation of the effect of an observer (consciousness) on experimental measurement [68], and there is considerable current interest in the implications for our notions of ordering in time and space brought on by the observation [69], [70] of nonlocal correlation or "quantum interconnectedness" (to use Bohm's term [71]) of distant parts of quantum systems of macroscopic dimensions. The latter, Bell's theorem [72], emphasizes that "no theory of reality compatible with quantum theory can require spatially separated events to be independent" [73], but must permit interconnectedness of distant events in a manner that is contrary to ordinary experience [74]–[75]. This prediction has been experimentally tested and confirmed in the recent experiments of, for example, Freedman and Clauser [69], [70].

E. H. Walker and O. Costa de Beauregard, independently proposing theories of paranormal functioning based on quantum concepts, argue that observer effects open the door to the possibility of nontrivial coupling between consciousness and the environment and that the nonlocality principle permits such coupling to transcend spatial and temporal barriers [76], [77].

Apparent "time reversibility"—that is, effects (e.g., observations) apparently preceding causes (e.g., events)—though conceptually difficult at first glance, may be the easiest of apparent paranormal phenomena to assimilate within the current theoretical structure of our world view. In addition to the familiar retarded potential solutions $f(t - r/c)$, it is well known that the equations of, for example, the electromagnetic field admit of advanced potential solutions $f(t + r/c)$—solutions that would appear to imply a reversal of cause and effect. Such solutions are conventionally discarded as not corresponding to any observable physical event. One is cautioned, however, by statements such as that of Stratton in his basic text on electromagnetic theory [78].

[5] As usually understood.

TABLE X
5-BIT CODE FOR ALPHANUMERIC CHARACTERS

E	00000	Y	01000
T	11111	G,J	10111
N	00001	W	01001
R	11110	V	10110
I	00010	B	01010
O	11101	ϕ	10101
A	00011	1	01011
S,X,Z	11100	2	10100
D	00100	3	01100
H	11011	4	10011
L	00101	5	01101
C,K,Q	11010	6	10010
F	00110	7	01110
P	11001	8	10001
U	00111	9	01111
M	11000	.	10000

Note: Alphabet characters listed in order of decreasing frequency in English text. See, for example, A. Sinkov [79]. (The low-frequency letters, *X*, *Z*, *K*, *Q*, and *J*, have been grouped with similar characters to provide space for numerics in a 5-bit code.) In consideration of the uneven distribution of letter frequencies in English text, this code is chosen such that 0 and 1 have equal probability.

dundancy. One efficient coding scheme for such a channel is obtained by application of a sequential sampling procedure of the type used in production-line quality control [80]. The adaptation of such a procedure to paranormal communication channels, which we now discuss, was considered first by Taetzsch [81]. The sequential method gives a rule of procedure for making one of three possible decisions following the receipt of each bit: accept 1 as the bit being transmitted; reject 1 as the bit being transmitted (i.e., accept 0); or continue transmission of the bit under consideration. The sequential sampling procedure differs from fixed-length coding in that the number of bits required to reach a final decision on a message bit is not fixed before transmission, but depends on the results accumulated with each transmission. The principal advantage of the sequential sampling procedure as compared with the other methods is that, on the average, fewer bits per final decision are required for an equivalent degree of reliability.

Use of the sequential sampling procedure requires the specification of parameters that are determined on the basis of the following considerations. Assume that a message bit (0 or 1) is being transmitted. In the absence of *a priori* knowledge, we may assume equal probability ($p = 0.5$) for the two possibilities (0,1). Therefore, from the standpoint of the receiver, the probability of correctly identifying the bit being transmitted is $p = 0.5$ because of chance alone. An operative remote-sensing channel could then be expected to alter the probability of correct identification to a value $p = 0.5 + \psi$, where the parameter ψ satisfies $0 < |\psi| < 0.5$. (The quantity may be positive or negative depending on whether the paranormal channel results in so-called psi-hitting or psi-missing.) Good psi functioning on a repetitive task has been observed to result in $\psi = 0.12$, as reported by Ryzl [31]. Therefore, to indicate the design procedure, let us assume a baseline psi parameter $\psi_b = 0.1$ and design a communication system on this basis.

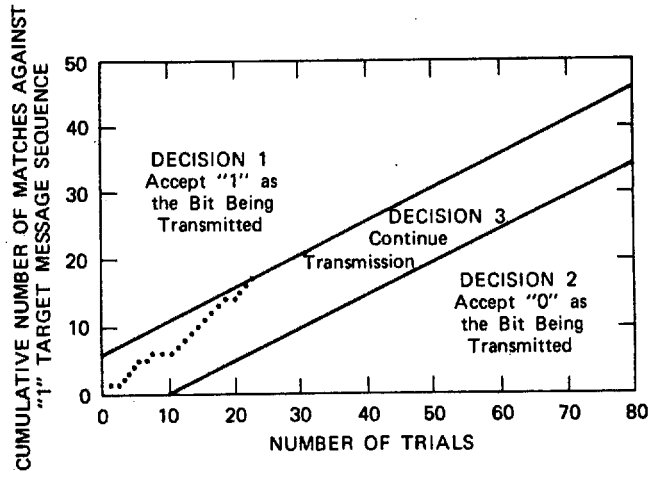


Fig. 18. Enhancement of signal-to-noise ratio by sequential sampling procedure ($p_0 = 0.4, p_1 = 0.6, \alpha = 0.01, \beta = 0.01$).

The question to be addressed is whether, after repeated transmission, a given message bit is labeled a "1" at a low rate p_0 commensurate with the hypothesis H_0 that the bit in question is a "0," or at a higher rate p_1 commensurate with the hypothesis H_1 that the bit in question is indeed a "1." The decision-making process requires the specification of four parameters.

- p_0 The probability of labeling incorrectly a "0" message bit as a "1." The probability of labeling correctly a "0" as a "0" is $p = 0.5 + \psi_b = 0.6$. Therefore, the probability of labeling incorrectly a "0" as a "1" is $1 - p = 0.4 = p_0$.
- p_1 The probability of labeling correctly a "1" message bit as a "1," is given by $p_1 = 0.5 + \psi_b = 0.6$.
- α The probability of rejecting a correct identification for a "0" (Type I error). We shall take $\alpha = 0.01$.
- β The probability of accepting an incorrect identification for a "1" (Type II error). We shall take $\beta = 0.01$.

With the parameters thus specified, the sequential sampling procedure provides for construction of a decision graph as shown in Fig. 18. The equations for the upper and lower limit lines are

$$\sum_1 = d_1 + SN$$

$$\sum_0 = -d_0 + SN$$

where

$$d_1 = \frac{\log \frac{1-\beta}{\alpha}}{\log \frac{p_1}{p_0} \frac{1-p_0}{1-p_1}} \qquad d_0 = \frac{\log \frac{1-\alpha}{\beta}}{\log \frac{p_1}{p_0} \frac{1-p_0}{1-p_1}}$$

$$S = \frac{\log \frac{1-p_0}{1-p_1}}{\log \frac{p_1}{p_0} \frac{1-p_0}{1-p_1}}$$

in which S is the slope, N is the number of trials, and d_1 and d_0 are the y-axis intercepts. A cumulative record of receiver-generated responses to the target bit is compiled until either

Usually at some places there should be a building, large or small that the courtyard is about. Look at the end or the sides of the courtyard. Is there anything to be seen?

I have a sense that there are buildings. It's not solid buildings. I mean there are some around the periphery and I have a sense that none of them are very tall. Maybe mostly one story, maybe an occasional two story one.

Do you have any better idea of what your square was that you saw at the outset?

No. I could hazard different kinds of guesses.

Does it seem part of this scene?

It . . . I think it could be. It could almost be a bulletin board or something with notices on it maybe.

Or something that people are expected to look at. Maybe a window with things in it that people were expected to look at.

What kind of trees do you see in this place?

I don't know what kind they are. The impression was that they were shade trees and not terribly big. Maybe 12 feet of trunk and then a certain amount of branches above that. So that the branches have maybe a 12 foot diameter, or something. Not real big trees.

New trees rather than old trees?

Yeah, maybe 5 or 10 years old, but not real old ones.

Is there anything interesting about the pavement?

No. It seems to be not terribly new or terribly old. Not very interesting. There seems to be some bits of landscaping around. Little patches of grass around the edges and peripheries. Maybe some flowers. But, not lush.

You saw some benches. Do you want to tell me about them?

Well, that's my unsure feeling about this fountain. There was some kind of benches of cement. Curved benches, it felt like.

They were of rough cement.

What do you think Hal is doing while he is there?

I have a sense that he is looking at things trying to project them. Looking at different things and sort of walking back and forth not covering a whole lot of territory.

Sometimes standing still while he looks around.

I just had the impression of him talking, and I almost sense that it was being recorded or something. I don't know if he has a tape recorder, but if it's not that, then he is saying something because it needed to be remembered. *It's 11:33. He's just probably getting ready to come back.*

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Appendix B

THE PERSISTENT PARADOX OF PSYCHIC PHENOMENA: AN ENGINEERING PERSPECTIVE

Appendix C

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(GEOGRAPHICAL SITES)

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Appendix D

BIBLIOGRAPHY: REMOTE ACTION REPLICATION STUDIES
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