# AC Technical Trials: Inspiration for the Target Entropy Concept

by

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## Abstract

Two anomalous cognition trials are presented in which the targets were high–technology directed energy systems. The protocols, fuzzy set analyses, and results are presented in the context of exploration and hypothesis formulation rather than hypothesis testing. The qualitative success of these trials, taken with similar successes throughout the years of the SRI International program, inspired the design of the Shannon entropy experiments that were conducted in the Cognitive Sciences Laboratory in 1993. Potential target confounds are also discussed in the context of these trials.

## Introduction

Hypothesis testing and formulation are the corner stones of modern research methodologies. We have become focused on the former and have become quite proficient. Because of resource limitations and journal and/or grant–proposal restrictions, exploratory or hypothesis–formulation oriented experiments rarely appear in the literature. Discussions of hypotheses are usually restricted to theoretical papers or pilot studies. But the attitude of "Let's try something and see what happens." is one part of a balanced approach to good research.

Our sponsor was interested in determining the degree to which elements of high–technology targets could be sensed by anomalous cognition (AC).* It is in this context that two trials of AC are presented when complex, high–technology systems were used as targets.

During the Cognitive Science Program at SRI International, we were often asked to explore the efficacy of AC in a variety of situations. Contractual agreements rarely allowed for an opportunity to make these widely separated trials into any semblance of a formal experiment. Yet, these trials were not wasted in that they provided insight into data–collection protocols, potential mechanisms, and analysis techniques that have led to formal and publishable experiments.

Two such trials have been selected from our collection to illustrate specific points about the AC process and to present some of the data that inspired the postulate that changes of entropy may be related to target visibility in AC experiments (May, Spottiswood, and James, 1994). No other meaning should be ascribed to the trials in this paper. The analyses were all done *post hoc* and no statistical calculations were performed. The success or failure of the approach can only be assessed by the outcomes of carefully executed experiments that test the concepts that were inspired by the trials shown in this paper. These examples are worthy of public discussion, nonetheless, because the qualitative correspondences of the responses to their intended targets may inspire others to explore different directions, and there may be value in understanding the circumstances that produced the entropy experiments.

In these trials, receiver 372 was targeted on an individual and asked to describe that person's surroundings—not unlike the remote viewing experiments of Puthoff and Targ

* The Cognitive Sciences Laboratory has adopted the term *anomalous mental phenomena* instead of the more widely known *psi*. Likewise, we use the terms *anomalous cognition* and *anomalous perturbation* for *ESP* and *PK*, respectively. We have done so because we believe that these terms are more naturally descriptive of the observables and are neutral in that they do not imply mechanisms. These new terms will be used throughout this paper.



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(1976). The difference was that these targets were complex, high–technology, directed energy systems.

For each trial, the sponsor received a 60–page document describing the protocols, analysis, conclusions, and all the raw data.

In this paper, I summarize the information from these reports, show the qualitative agreement with the targets and demonstrate a *post hoc* application of fuzzy set analysis (May, Utts, Humphrey, Luke, Frivold, and Trask, 1990) to technical targets, all of which were contributing factors that inspired later experiments.

## Method

Between 1987 and 1990, we conducted three trials in which the target systems were pulsed, high–energy systems. The first two trials were analyzed, *post hoc,* by a fuzzy set technique; however, the third and final trial in the series was never analyzed because the contract ended.

### First Trial — May 1987

It is important to specify who knew what and when in this trial. I, as project director, was completely informed about the details of the trial, the identity of the sponsor, and the target system. The receiver (372), an AC–monitor, and the remainder of the SRI staff were blind to all these details. They knew, however, that significant attention was focused on the trial and that the target system was in the San Francisco Bay Area. It was reasonable for the participants to assume that the target might be of a technical nature, given all the attention for the trial. The Bay Area, however, is rich with technical target possibilities. For example, there are many aerospace companies, semiconductor manufacturing facilities, particle accelerators, radar installations, military air fields, and Naval bases. Thus, we felt that the trial was not significantly compromised.

#### Protocol

On 6 May 1987 receiver 372 traveled to Menlo Park in preparation for a 24–hour trial that was to begin at 0800 hours on 7 May.

Receiver 372 and the monitor were told that an individual from the sponsoring organization, who was described by name and Social Security number and who was not known to any of the SRI staff, was in the target area during the AC sessions. In addition, they were told that, as part of the trial, two members of the SRI Cognitive Sciences Laboratory staff who were known to them, would serve as a "beacon" and would be at the specific target of interest between 2200 hours on 7 May and 0800 hours on 8 May.

Four sessions were conducted to provide information at approximately 8–hour intervals. The time and circumstances were as follows:

(1) 0800 Hours. Receiver 372 was asked to describe the geographical area and the gestalt of the area of interest. He was also asked to provide as much detail as possible in real–time (i.e., at 0835) and was targeted upon the sponsor's on–site representative.

(2) 1010 Hours. The receiver was asked to describe the details and activity at the site designated by the sponsor's on–site representative as of 0000 hours 7 May (i.e., the previous night).

(3) 1600 Hours. The receiver was asked to describe, in real–time, the details and activity at the site designated by the sponsor's on–site representative.

(4) 2400 Hours. The receiver was asked to describe, in real–time the details and activity at the site designated by two SRI personnel.

During each session receiver 372's responses were tape recorded, and he was encouraged to draw details whenever possible. The monitor was free to seek clarification of specific points throughout the sessions.

## Analysis Technique

The data were analyzed by a variant of the fuzzy set technique described by May et al. (1990). In this section I provide a review of that procedure and outline the specific application for this trial.

A set is simply a collection if items that share a common property (e.g., the cities that have population over 1,000,000). Descriptor lists, which have been used in AC analyses (Honorton, 1975 and Jahn, Dunne, and Jahn, 1980) are examples of crisp sets. That is, the answer to the question, "Is the target primarily indoors?" must be yes or no. Fuzzy sets are not as restrictive; they were invented to address subjective concepts. For example, an important feature of a target might be "shady." A fuzzy set question for this feature is, "Rate on a scale between zero and one, the degree to which you feel that the concept 'shady' characterizes the target." A target encoder could answer zero for a Sahara desert target or one for a rain forest target or more likely something in between such as 0.6 for a city park target on a sunny day.

May et al. (1990) emphasize that the analysis of AC data with fuzzy sets is quite general. An experimenter is free to chose the type of elements he or she wishes to examine in the target. In their application, May et. al. used visual importance to the target as their measures. In the examples shown in this paper, importance to the technical target of any kind is used instead. The formal definition of a target set and a response set follows below, regardless of the meaning of the specific elements. The universal set of elements is, by definition, experiment dependent.

Target Definition. The target is a fuzzy set $T$ on a universal set of elements, where the *kth* element is characterized by a membership value, $T_k$, and a weighting factor, $w_k$. The membership values are on the closed interval [0,1] and represent the degree to which the *kth* element is a member of $T$. For example, suppose that the element "testing shielding effectiveness" is only apropos to 20% of the total target system. Then the membership value for this element would be 0.2.

The weighting factors, $w_k$, allow for adjusting the elements of $T$ toward trial relevance. In the example, suppose that the sponsor was primarily interested in determining the degree to which AC can be used to sense "testing shielding effectiveness," regardless of its membership value. The weighting factor could be set five times larger than any other weighting factor in $T$ to emphasize this interest.

Response Definition. The response is a fuzzy set $R$ on the universal set of elements, where the *kth* element is characterized by a membership value, $R_k$. The membership values are in the closed interval [0,1] and, differing from their definitions for the target, represent the degree to which an analyst is subjectively convinced that the *kth* element is a member of $R$. For example, declarative statements such as "there is shielding at the target" would receive a membership value of 1.0, while "something massive at the site," might only be assigned a membership value 0.40 for this element.

Universal Set of Elements. The universal set of elements (USE) and weighting factors for this trial were determined *post hoc* by the sponsor and the author, who was blind to the response, and were latter extended by the response elements that were not present in the target. Such elements were assigned a membership value of 0.0 in $T$.

From the response and target fuzzy sets we define:

- Accuracy as the percent of the target that was described correctly in the response:

$$accuracy = \frac{\sum_k w_k \min(T_k, R_k)}{\sum_k w_k T_k}$$

- Reliability as the percent of the response that was correctly identified in the target:

$$reliability = \frac{\sum_k w_k \min(T_k, R_k)}{\sum_k w_k R_k}.$$

The index $k$ ranges over all elements in the USE, and we note that both accuracy and reliability are in the closed interval [0,1]. Clearly, neither of these can be used as a good measure of AC by themselves. After all, a receiver could offer an encyclopedia as a response and guarantee an accuracy of 100% in that all target elements will eventually be described. In this case the reliability would be quite low because of so much incorrect material in the response. Likewise, a single word response such as "outdoors" might yield a reliability of 100% but the accuracy would be quite low.

To address this problem in laboratory experiments, a figure of merit is formed by multiplying accuracy with reliability and is computed for all possible targets in a pool. Thus, to obtain a high figure of merit a reasonable fraction of the target must be correctly described in a relatively error free response. Rank–order statistics are then used to compute p–values and effect sizes. Our qualitative laboratory experience arising from cross match studies provides a "rule of thumb:" for random data, accuracy and reliability are each approximately 1/3 for a figure of merit of 0.111.

In the trials described in this paper, however, there was no *a priori* intent to design a statistically valid measure. Rather, accuracy, reliability and visual and conceptual correspondence with the targets were contributing factors to the design of later statistically-oriented experiments.

### Accuracy and Reliability Calculations

For this and the following trial, the elements in the USE were split into there categories according to whether they described target function, physical relationships among objects, or objects. These categories were assigned weights of 1.0, 0.75, and 0.5, respectively.

Three separate targets were identified depending upon where the beacon person was at the time of the session. The primary target system was the Advanced Technology Accelerator located approximately 15 km from Lawrence Livermore National Laboratory (LLNL). A secondary target was the windmill farm at the Altamont pass, and a tertiary target was the West gate of LLNL. Since the sponsor was mostly interested in the accelerator, these targets were weighted 1.0, 0.50, and 0.25, respectively, to form an average accuracy and reliability for the trial.

Sixty seven individual elements comprised the USE for the accelerator target, and Table 1 shows selected values of $\Omega$, $T$, and $R$ as illustrations. $\Omega$ represent the relative weights within a category so that the $w_k$ in the expressions for the accuracy and reliability are given by the product of the group weight and $\Omega$. For example, $w_k$ for "Tunnel" under Objects is ($\Omega$=2.0) × (group weitht=0.5) = 1.0. The weighting factors and the membership values were assigned *post hoc* by the sponsor and me.

Table 1.

Selected Elements from the USE for the Accelerator

| Elements | $\Omega_k$ | $T_k$ | $R_k$ |
|---|---|---|---|
| Functions (1.0) | | | |
| Directed energy | 5 | 1 | 0.9 |
| Electron accelerator | 3 | 1 | 1 |
| Beam ionizes air | 1 | 1 | 0.6 |
| Testing new form of laser | 1 | 0 | 1 |
| Relationships (0.75) | | | |
| Power source above beam line | 1 | 1 | 0 |
| Linear array of buildings | 1 | 1 | 0.1 |
| E&M radiation < 10 Angstroms | 1 | 0.1 | 1 |
| Pipes into and out of sphere | 1 | 0 | 1 |
| Objects (0.5) | | | |
| External electron beam | 5 | 1 | 0 |
| Tunnel | 2 | 1 | 1 |
| Loud noise | 1 | 0.3 | 1 |
| Hollow polished (internal) sphere | 1 | 0 | 1 |

Table 2 shows the complete target and response sets and their weights for the windmill target. Table 3 shows selected elements from the USE for the LLNL West gate target.

Table 2.

USE for the Windmill Farm

| Elements | $\Omega_k$ | $T_k$ | $R_k$ |
|---|---|---|---|
| Functions (1.0) | | | |
| Wind–powered electricity generation | 2.5 | 1 | 0.9 |
| Relationships (0.75) | | | |
| Poles scattered in hills | 1 | 1 | 1 |
| Poles connected in a grid | 1.5 | 1 | 1 |
| Objects (0.5) | | | |
| Foothills | 1 | 1 | 1 |
| Electrical grid | 1 | 1 | 1 |
| Rotating blades | 1 | 1 | 0.8 |
| Multiple wind generators | 1 | 1 | 1 |

Table 3.

Selected Elements from the USE for the LLNL West Gate

| Elements | $\Omega_k$ | $T_k$ | $R_k$ |
|---|---|---|---|
| Functions (1.0) | | | |
| Multipurpose laboratory complex | 5 | 1 | 0.8 |
| Six–story administration building | 4 | 1 | 1 |
| Relationships (0.75) | | | |
| T–shaped, six–story building | 3 | 1 | 1 |
| Swimming pool Northeast of tall building | 1 | 0 | 1 |
| Large parking lot just west of tall building | 1 | 1 | 1 |
| Segmented 1–story buildings North of tall building | 1 | 1 | 0.2 |
| Objects (0.5) | | | |
| Tall building | 2 | 1 | 1 |
| Parking lot | 1 | 1 | 1 |
| Building with cylindrical shaped roof | 1 | 1 | 0.4 |
| Large mountain | 1 | 0 | 1 |

## Feedback

Receiver 372 was given verbal feedback immediately after the trial and was presented photographic material on the accelerator, the windmill farm, and the West gate approximately six months later.

## Results

Table 4 shows the accuracy and reliability computed from all 67 elements in the USE. The calculations are shown for the separate element categories for the accelerator target and summary data for the other targets.

Table 4.

Accuracy and Reliability for High Technology Trial 1

| Target Type | | Accuracy | Reliability |
|---|---|---|---|
| Accelerator (1.0) | Functions | 0.93 | 0.70 |
| | Relationships | 0.36 | 0.31 |
| | Objects | 0.73 | 0.88 |
| | Total | 0.67 | 0.63 |
| Windmill Farm (0.5) | Total | 0.95 | 1.00 |
| LLNL West Gate (0.25) | Total | 0.85 | 0.95 |
| Combined Total | | 0.77 | 0.78 |

Since the $w_k$ include the category weighting factors, the totals for each target type are linear averages; however, the combined total is a weighted average across target types with the weighting factors shown.

### Samples of Visual Correspondence

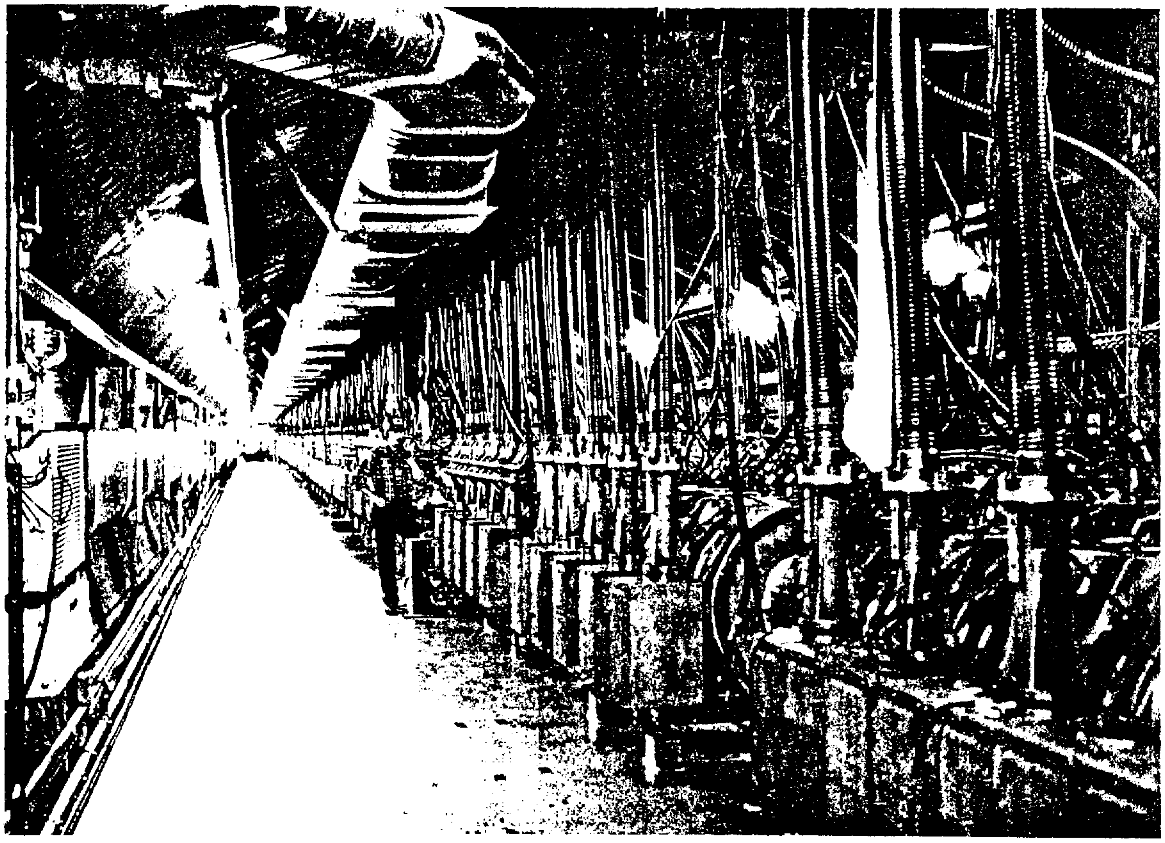
Figures 1–3 show representative samples to illustrate the qualitative correspondence for the accelerator, windmill farm and West gate targets. The accelerator is shown as a partial drawing, but the remaining response are the complete drawings for the targets.

### Discussion

We see from Table 4, that everything that 372 said about the windmill farm was correct (i.e., reliability of one) and almost all of the sponsor–designated target elements were perceived correctly (i.e., accuracy of 0.94). Relatively speaking, however, 372's response to the accelerator contained many matchable elements—at one time in the response he said "...electrons coming down this, this tube..."—this correct information was imbedded in a substantial amount of incorrect material. Perhaps one interesting point is that all the responses to the technical targets were technical and the response to the architectural target (i.e., LLNL West gate) was architectural. I will return to this point in the overall conclusion section below.

The accuracy and reliability for the accelerator relationships are 0.36 and 0.31, respectively. Our experience is that approximately 1/3 of a target is described in cross match studies in the laboratory and approximately 1/3 of a random response matches a given target. Thus, physical relationships appeared not to be sensed beyond what might be expected by chance. Although there is surprisingly high accuracy for functions and high reliability for objects in the accelerator response, the weighted averages of accuracy = 0.67 and reliability = 0.63 better reflect the qualitative correspondence with the drawings. The values for the windmill and West gate targets speak for themselves.

As we will see in the next trial, how to combine or ignore various "interesting" targets near the intended target is problematical. Although we down–weighted the lesser targets, their quality responses inflated the combined averages for accuracy and reliability beyond what might be expected on the bases of the qualitative correspondence alone. In the next example the reverse was true.



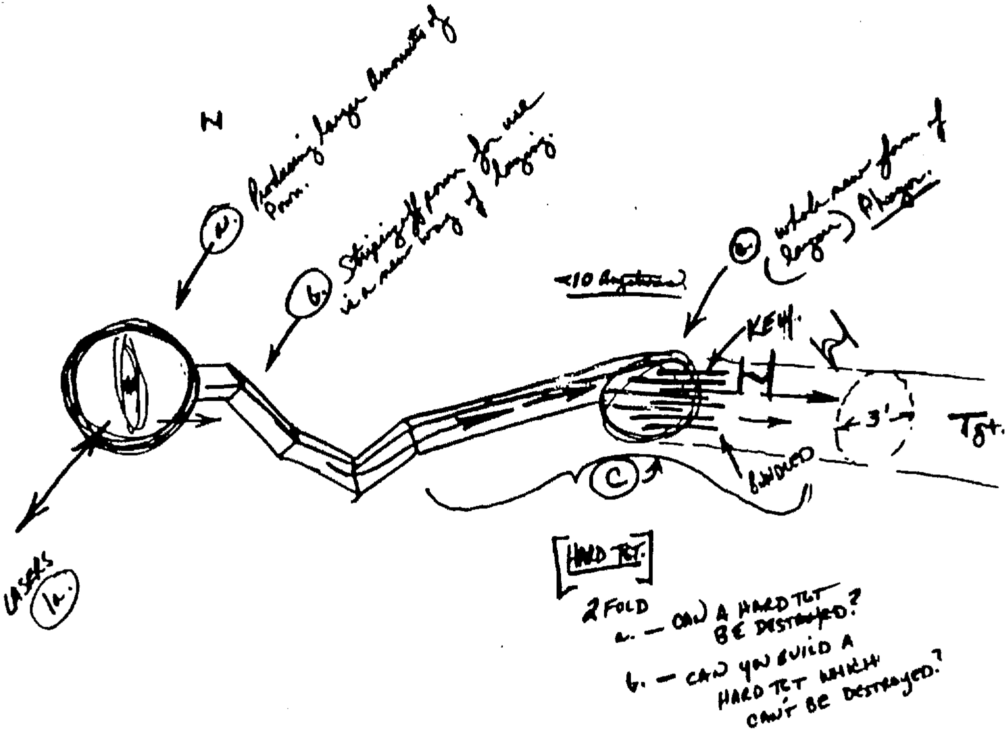



Figure 1. Partial response and the accelerator target.

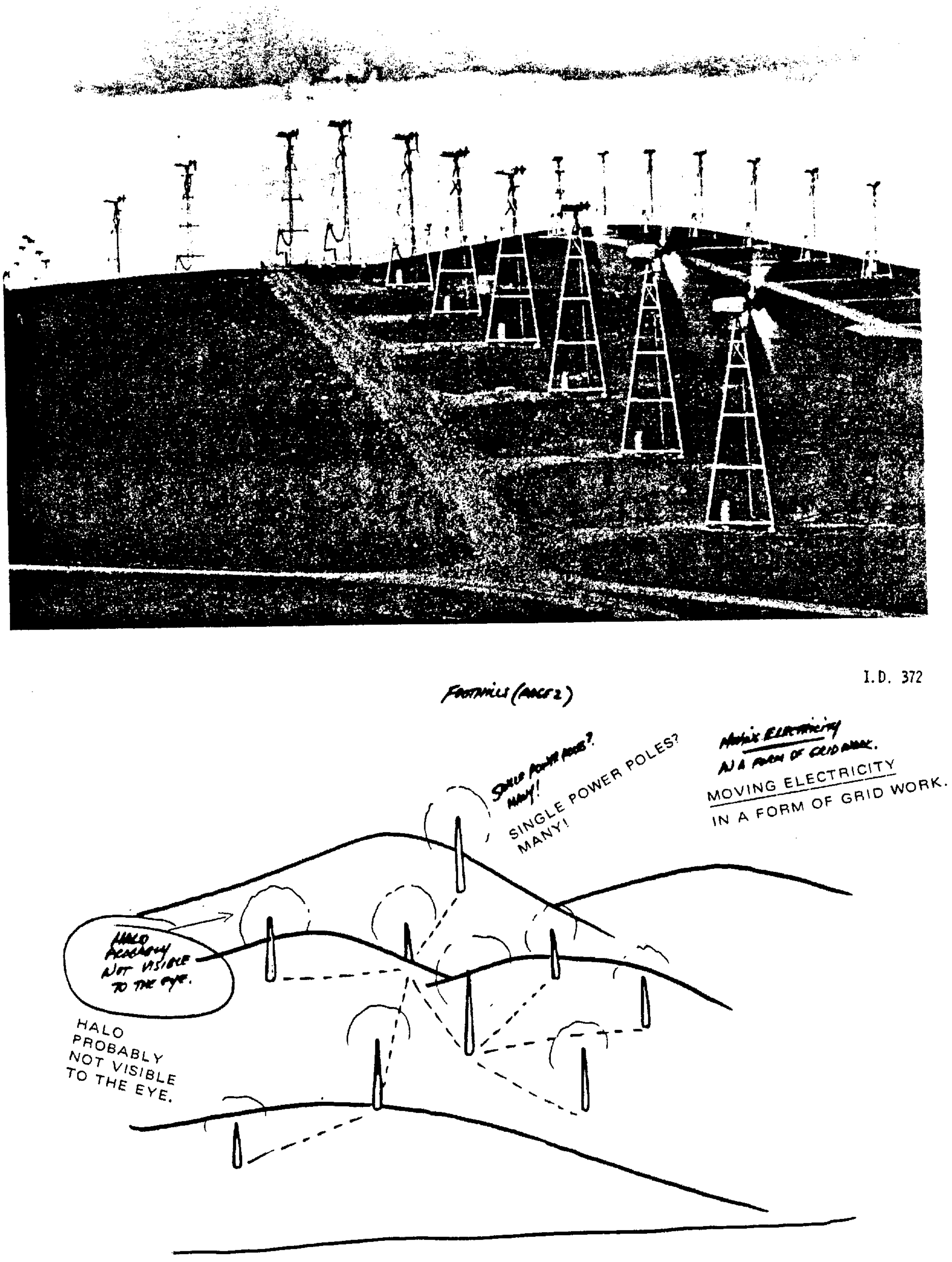



Figure 2. Complete response and the windmill target.

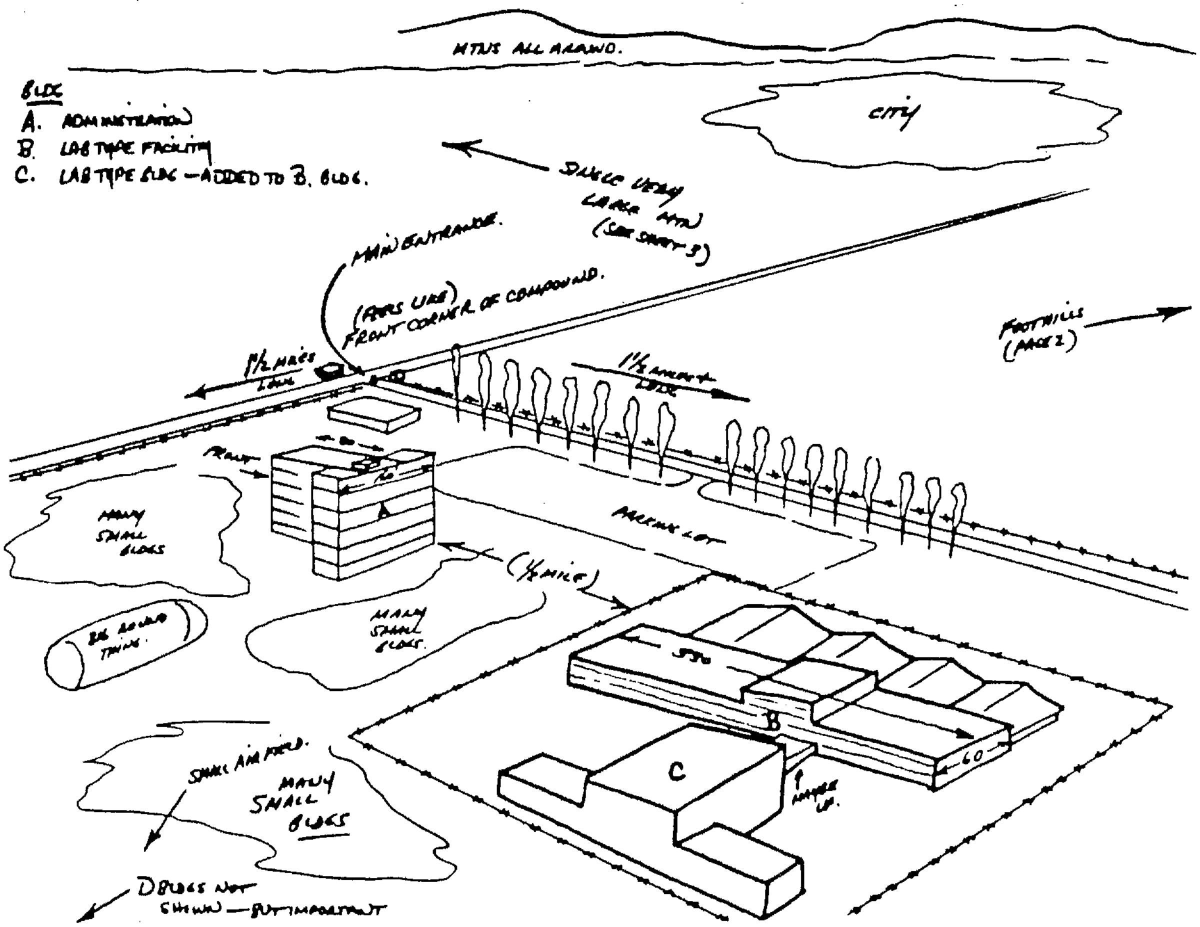



Figure 3. Complete response and the west gate target.

## Second Trial — August 1988

In this trial, the SRI team was completely blind to all details with the exception that we knew that an event was to take place within the continental USA on 24–25 August 1988. As before, we were provided the name and Social Security number of an individual who would be on–site during the event.

### Protocol

On 23 August 1988 an SRI monitor flew to the East coast home of receiver 372 in preparation for the 24–hour trial that was to begin at 1000 hours on 24 August.

Four sessions were conducted to provide information at approximately 8–hour intervals. The time and circumstances were as follows:

(1) 1008 August 24. Receiver 372 was asked to describe the location and details of an event in progress. Details about the pertinent personnel were also requested.

(2) 1500 August 24. Receiver 372 was asked to describe the details and activity at the site demarked by the presence of the sponsor's on–site representative.

(3) 0910 August 25. The receiver was asked to expand his upon his descriptions from the previous day.

(4) 1120 August 25. The receiver was asked to consolidate the information from the previous scans and to provide his concluding remarks.

As before, receiver 372's responses were tape recorded, and he was encouraged to draw details whenever possible. The monitor was free to seek clarification of specific points throughout the sessions.

### Analysis Technique

The analysis technique was similar to the one described above. The USE, however, was reconstructed *post hoc* from the target system and later extended by the response elements.

### Accuracy and Reliability Calculations

For this trial there was only a single target, a high–power microwave generator that was encased in a truck trailer in the New Mexico desert. Table 5 shows selected weighting factors and target and response elements from the USE which contained 72 elements. These were determined *post hoc* by the sponsor and me.

Table 5.

Selected Elements from the USE for the Miçrowave Generator

| Elements | $\Omega_k$ | $T_k$ | $R_k$ |
|---|---|---|---|
| Functions (1.0) | | | |
| High–power microwave production | 5 | 1 | 0.8 |
| Destructive testing of electronics | 2 | 1 | 1 |
| Ground focal area | 1 | 0 | 1 |
| Testing a concept—debugging | 1 | 0.3 | 1 |
| Relationships (0.75) | | | |
| Source enclosed in a trailer | 5 | 1 | 0.7 |
| Energy exit enclosure | 3 | 1 | 1 |
| Large, semicircular shape with block | 1 | 0 | 1 |
| Horn–shape at end of 4_6 cm pipe | 1 | 1 | 0.8 |
| Objects (0.5) | | | |
| Microwave generator (tubular 3 m) | 5 | 1 | 0.7 |
| Incoherent wave front | 3 | 0.1 | 1 |
| Buried sensors | 1 | 0 | 1 |
| Flat desert | 0.5 | 1 | 1 |

## Results

Table 6 shows the accuracy and reliability computed from all 72 elements in the USE. The calculations are shown for the element grouping for the microwave device target.

Table 6.

Accuracy and Reliability for High Technology Trial 2

| Target Type | | Accuracy | Reliability |
|---|---|---|---|
| Microwave Generator | Functions | 0.88 | 0.80 |
| | Relationships | 0.69 | 0.64 |
| | Objects | 0.82 | 0.63 |
| | Total | 0.80 | 0.69 |

## Feedback

One month after the trial, Receiver 372 was taken to New Mexico and allowed to view the device

### Discussion

We notice that the accuracy and reliability for Functions and Objects are reasonably consistent with those shown for the accelerator target. The increase in the totals is a direct result of the doubling of the values for the physical relationships. At this time I cannot account for this increase. Even with all the caveats of *post hoc* analysis, probably biased sponsors and researcher, and consistency of target types between the two trials, the accuracy and reliability values are remarkably consistent over a duration of one year. The increased reliability from 0.63 to 0.80 indicates a reduction of "noise" or incorrect information in the AC response. This is confirmed qualitatively by the increased visual correspondence between target and response.

### Samples of Visual Correspondence

Figures 4 and 5 show representative samples of the response to illustrate the qualitative correspondence to the microwave generator and its details. In this case receiver 372 correctly assessed the function of the target and correctly identified the beam divergence angle of 30 degrees. A reliability of 0.8 for functions also means that the response contained 20% incorrect material. In Figure 5, had 372 illustrated his "wave guide" drawing in units of inches rather than centimeters, he would have been exactly correct.

While some specifics are incorrect, this response, alone, could have guided a skilled analyst to the correct conclusion that the target was a microwave generator device.

## General Discussions and Conclusions

One main property that distinguishes these two targets is that they both represent large changes of energy in a very short period of time. Concomitantly, they represent large changes of thermodynamic entropy as well. These are not two isolated cases. In our database dating from 1972, we have 12–15 similar examples. While some are better than others, we have no cases of a complete miss on such targets. This laboratory anecdote coupled with the quantitative, albeit *post hoc*, analysis of these trials were major contributing factors in the inspiration for our Shannon entropy experiments (May, Spottiswood, and James, 1994) that were designed specifically to test if AC quality is enhanced with large entropy changes in the target.

It may be a significant leap of faith to imply that changes in thermodynamic entropy are in some way equivalent to changes in Shannon entropy; however, such a relationship has been shown to exist in the foundations of entropy theory (*Maxwell's Demon, Entropy, Information, Computing, 1990*).

The two trials in this paper were actually accompanied by a third in 1990. The target was an underground explosion; however, our contract ended before we were able to conduct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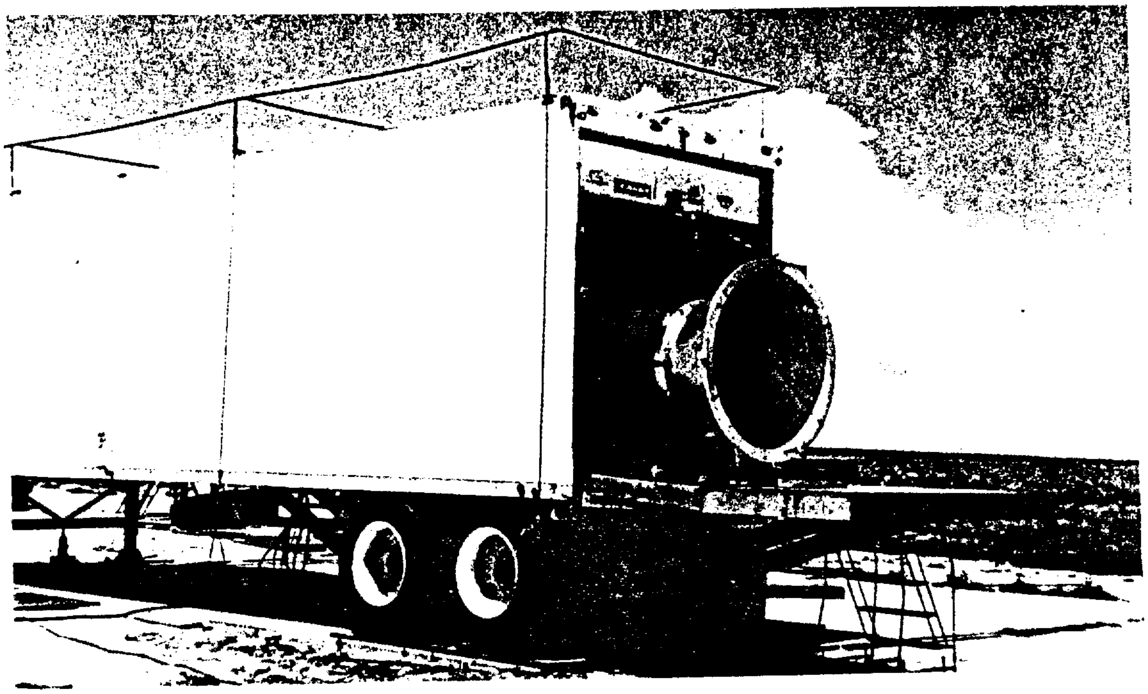
our fuzzy set analysis. We were told by the sponsors that they felt that the qualitative correspondence was as good as the first two trials.

When we were providing experiential feedback for receiver 372 in the microwave trial we drove past a solar power collection research facility. It was operating and presented a spectacular display of sparks and bright flashes of light. The solar collector is characterized by an array of mirrors that focus the sun's energy on the top of a tower. As it so happened, this facility was approximately three kilometers from the microwave device testing area.

I mention this feedback experience because receiver 372's first impression was "ground focal area specifically laid out for 'catching' something evenly." Figure 6 shows 372's sketch and a photograph of the facility. Some of his response elements throughout the second trial were overlaid with mirrors and collection devices. What was particularly interesting, however, was the double lines in Figure 6 and the accompanying words from the transcription, "...getting an impression of a, like a semi–circle that's open over here and there's some kind of a square block or something standing over here. This is really large. I feel like its kinda laid out on the ground in some way." Receiver 372 recognizes later in the session that there is a problem with his first large football size impression. He remarks in the transcript: "Actually this is totally separate. I'll draw a line between the two." This line is shown in Figure 6.

At least for his first impression, receiver 372 was able to parse his internal experiences between target related and target unrelated elements. He was not completely successful at this task in that elements of the mirrors permeate the response. Figure 7 shows an example of this mixing. We are, however, obligated to keep these elements as part of the response, and the resulting reliability is decreased. This again raises questions about target definitions and the degree to which the feedback contributes to the response.



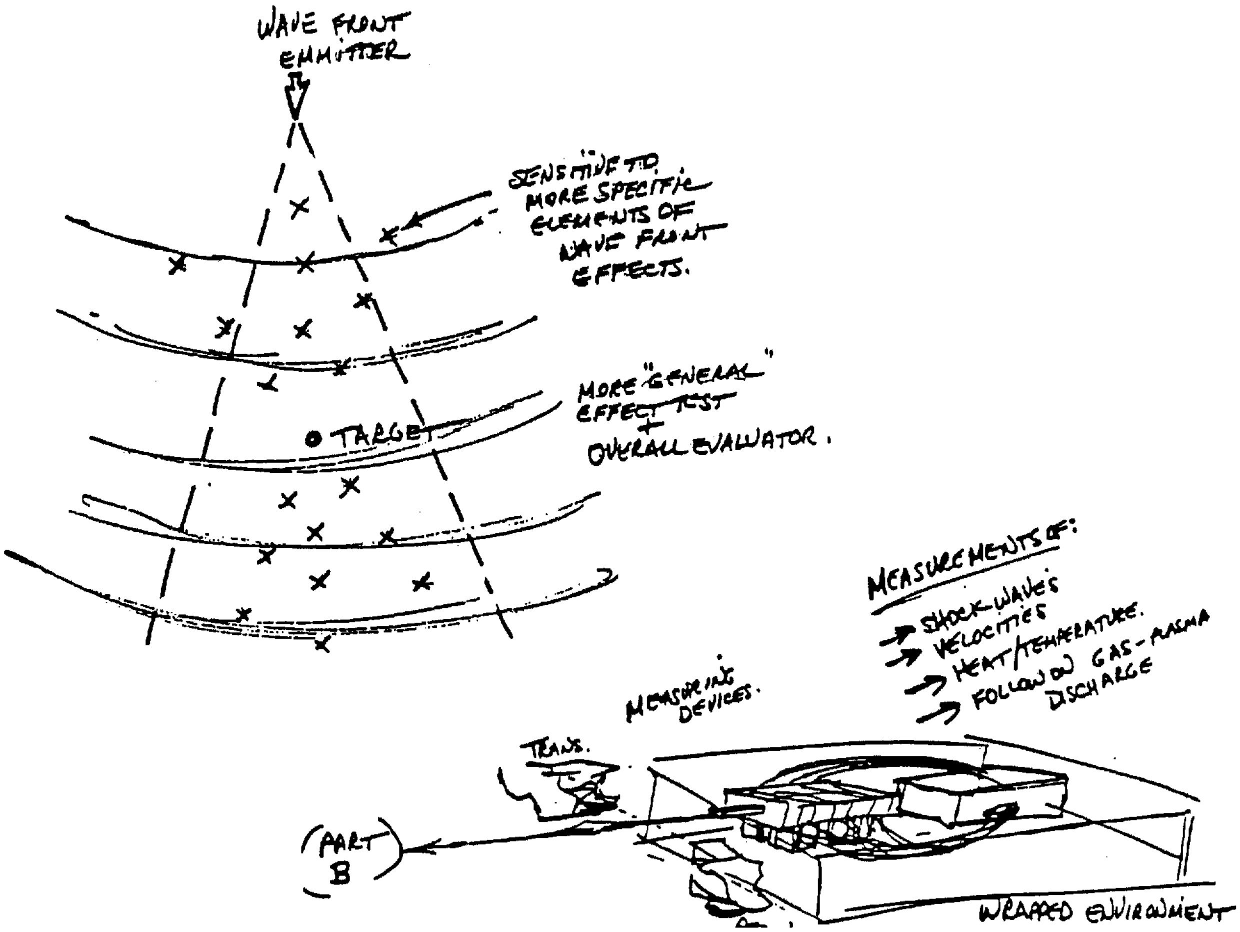
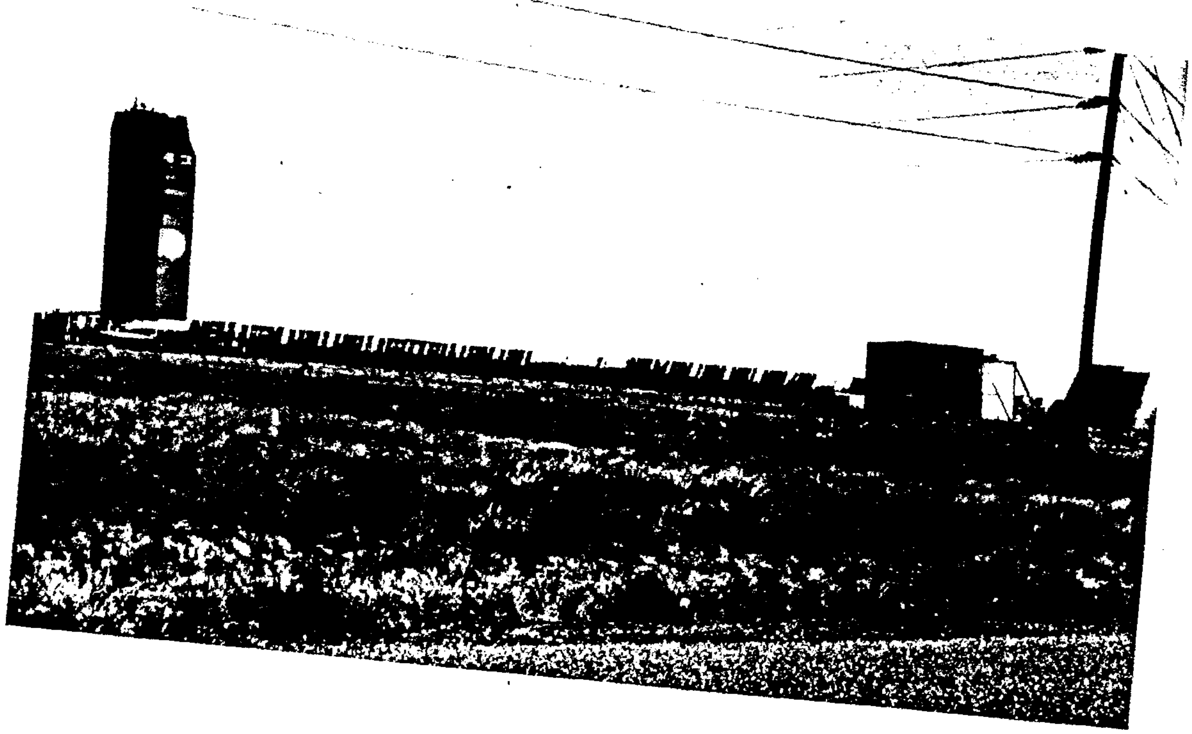



Figure 4. Partial response to the microwave device.



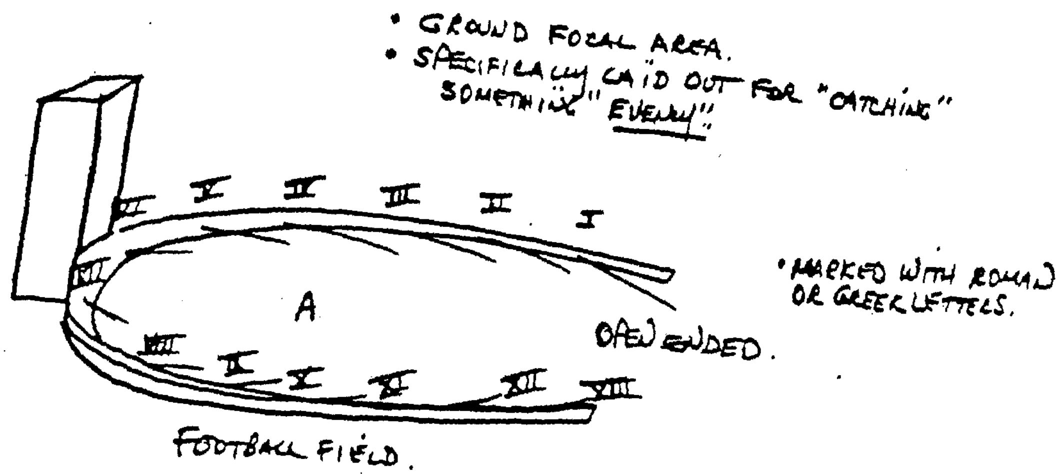
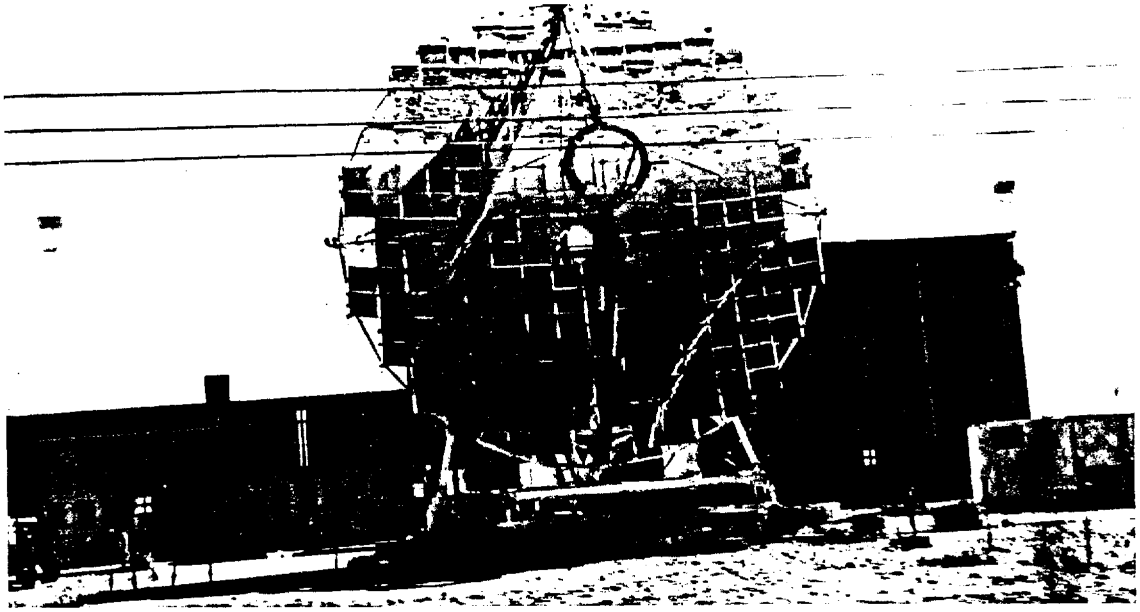
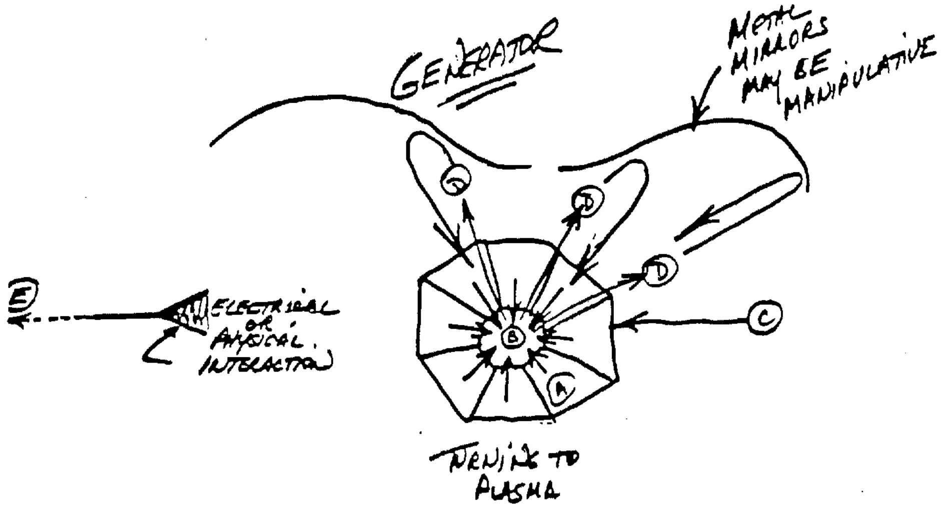



Figure 6. Response to the solar collection facility.






- CONSTANT MIRROR TUNING GOING ON TOP & BOTTOM. BUT INSTANT TO INSTANT.
- KEEP WANTING TO SEPARATE TOP & BOTTOM HALVES

Figure 7. Examples of mirrors in the response to the microwave generator.

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