

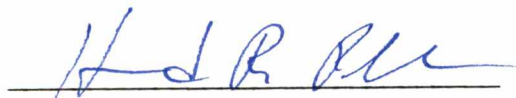
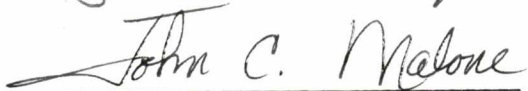
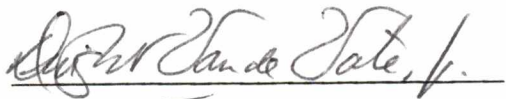
To the Graduate Council:

I am submitting herewith a dissertation written by Paul John Chara Jr. entitled "Visual Imagery in Recall: Seeing and Saying." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Psychology.



William S. Verplanck, Major Professor

We have read this dissertation
and recommend its acceptance:



Accepted for the Council:



Vice Chancellor
Graduate Studies and Research

VISUAL IMAGERY IN RECALL:

SEEING AND SAYING

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Paul John Chara, Jr.

December 1982

3065027

ACKNOWLEDGMENTS

It is with much gratitude that I would like to especially thank Dr. William Verplanck for serving as my committee chairman. The many selfless hours he spent helping to shape the ideas presented in this research proved more of an education to me than any classroom could give. His true excellence as a psychologist has been a constant source of inspiration for me and all those who have had the privilege to work with him.

Thanks also to Drs. John Malone, Howard Pollio, and Dwight Van de Vate Jr. for their invaluable and quality input into this effort. Individually, their commitment to excellence in both research and the presentation of ideas have provided a challenge that I am very grateful to have experienced.

A special thanks to Drs. Kathleen Lawler and Raymond Shrader. I cannot say how much their encouragement and support have meant to me.

Carrie Webb, you're simply a beautiful person! Corena Terral, you're so very special! Thank you both so very much for volunteering to type this dissertation for free. May God's richest blessings reward you in manifold abundance.

Thanks to all the students who took part in this research. Don't ever lose your vision for the future.

I have been privileged with a wonderful family. Thanks to my mother, father, brother, sister and all my relatives whose love and support I profoundly appreciate.

My wife Sheila and sons Symon and Seth have been so patient the last few years. We made it! I love and appreciate my three-fold gift

from God more everyday.

Finally, from the deepest part of my being, thank you to Jesus Christ, my Creator, Savior, and Lord for more than I could ever utter or realize.

ABSTRACT

Both the nature of visual memory imagery and the validity of its measures have been largely uninvestigated through the years. Attention in this research was directed semantically and empirically toward clarifying these two aspects of research on visual memory imagery.

In the first experiment, the validity of Marks' "Vividness of Visual Imagery Questionnaire" (VVIQ) was measured by comparing performance of "good" and "poor" imagers, as derived from scores on the VVIQ, on a test of the recall of a projected slide. Reliability was assessed by comparing participants' responses on the VVIQ twice: once using the original VVIQ rating scale and once using a similar rating scale. The latter additionally had visual analogs developed from the scaling of slides for each rating scale definition. No evidence was found for either the validity or reliability of the VVIQ.

Participants in the second experiment were given one of two forms of the VVIQ or two forms of an "observation" questionnaire containing the same items as the VVIQ but differing in rating scale definitions and instructions, twice, separated by a week. Results demonstrated that participants answered all the questionnaires alike and consistently rated imagery capability better than observation capability.

The third experiment involved the recall of pictorially presented material. Recall was found to be better for certain areas of the picture than others. No statistically significant differences for the effect of either stimulus clarity or gender on subsequent recall were found.

The final experiment investigated the interrelationships among

self-reported visual imagery (as measured on the VVIQ), effectiveness of four directed scanning procedures of a picture, and the recall of pictorially presented material as demonstrated on six performance measures. Scores on the VVIQ were demonstrated to be largely unrelated to any of the recall measures; directed scanning procedures exerted a significant differential effect on visual recall. The evidence in this experiment indicated that the nature of recall was partly visual sense-tied, partly symbolic-verbal, and that recall was more three-dimensional, a "lived-activity", rather than two-dimensional in character.

TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION	1
II. BACKGROUND AND LITERATURE REVIEW	4
Historical Review	4
Defining Imagery	8
Varieties of Visual Imagery Phenomena	12
Methods of Studying Visual Memory Imagery	16
Purpose of Present Research	21
III. EXPERIMENT I: VISUAL IMAGERY, SCALING OF SLIDES, AND VISUAL RECALL.....	24
Introduction	24
Method	28
Results	38
Discussion	44
IV. EXPERIMENT II: IMAGERY AND OBSERVATION QUESTIONNAIRE CORRELATION	51
Introduction	51
Method	52
Results	57
Discussion	61
V. EXPERIMENT III: VISUAL RECALL OF PICTORIALLY PRESENTED MATERIAL.....	64
Introduction	64
Method	65
Results	68

CHAPTER	PAGE
Discussion	72
VI. EXPERIMENT IV: PERCEPTUAL SCANNING STRATEGIES, SELF- ASSESSED VISUAL MEMORY IMAGERY, AND THE RECALL OF PICT- ORIALY PRESENTED MATERIAL	76
Introduction	76
Method	77
Results	83
Discussion	103
VII. DISCUSSION I: IMPLICATIONS FOR SELF-REPORT VISUAL MEMORY IMAGERY QUESTIONNAIRES	109
Properties of the Rating Scale	109
Relationship of the VVIQ to Other Measures	111
The Predictive Value of the VVIQ	111
Imagery Inflation	112
Summary	114
VIII. DISCUSSION II: SOME OBSERVATIONS ON THE RECALL OF PICTORIALLY PRESENTED MATERIAL	115
Differences in Gender and Stimulus Material	115
Scanning Strategies	116
Differential Foci of Recall	117
Effectiveness of Recall Performance	118
Two-Dimensional Versus Three-Dimensional Thinking ..	118
Intercorrelations Among Recall Measures	119
Summary	120

CHAPTER	PAGE
IX. SUMMARY AND CONCLUSIONS	122
REFERENCES	125
APPENDICES	131
APPENDIX A. MARKS' (1973) VIVIDNESS OF VISUAL IMAGERY QUESTIONNAIRE	132
APPENDIX B. VISUAL RECALL QUESTIONNAIRE	135
APPENDIX C. VIVIDNESS OF VISUAL IMAGERY QUESTIONNAIRE: LONG FORM	137
APPENDIX D. OBSERVATION QUESTIONNAIRE: SHORT FORM	141
APPENDIX E. OBSERVATION QUESTIONNAIRE: LONG FORM	144
APPENDIX F. OBSERVATION AND IMAGERY QUESTIONNAIRE	148
APPENDIX G. PICTURE QUESTIONNAIRE	152
APPENDIX H. FIVE FORMS OF THE PICTURE USED IN EXPERIMENT THREE	155
APPENDIX I. SCORING CODE FOR PICTURE QUESTIONNAIRE	161
APPENDIX J. SCANNING DIAGRAMS FOR PICTURE QUESTIONNAIRE IN EXPERIMENT THREE.....	168
APPENDIX K. DIVISIONS OF THE PICTURE IN EXPERIMENT FOUR ...	181
APPENDIX L. OBJECTIVELY VERIFIABLE MEASURES AND TASKS USED IN EXPERIMENT FOUR	184
APPENDIX M. SCANNING INSTRUCTIONS USED IN EXPERIMENT FOUR..	191
APPENDIX N. SCORING CODE FOR POSITION QUESTIONNAIRE.....	196
APPENDIX O. SCORING CODE FOR DEPTH PERCEPTION QUESTIONNAIRE	206
APPENDIX P. RATING INSTRUCTIONS FOR DRAWINGS IN EXPERIMENT FOUR	219

CHAPTER	PAGE
APPENDIX Q. RANKS OF DIVISIONAL UNITS OF PICTURE USED IN EXPERIMENT FOUR VIA FREE RECALL	
ANALYSIS.....	221
VITA	224

LIST OF TABLES

TABLE		PAGE
1.	The Percentage of Ratings Given by Students in Response to VVIQ Items	39
2.	Concordance Percentage of Rating Values Given to VVIQ Items on Two Rating Scales	41
3.	Reliability of Respondents in Distinguishing Between Pairs of Rating Values	43
4.	Number of Participants in Experimental Group Partitions for Experiment II	55
5.	Spearman Rank Order Correlations for Imagery and Observation Questionnaires	58
6.	Wilcoxon Coefficients for Imagery and Observation Questionnaires	60
7.	Group Medians for the Picture Questionnaire	69
8.	Median Scores for Tasks in Experiment Four	84
9.	Spearman Rho Coefficients Between Seven Imagery/Recall Measures	86
10.	Number of Statistically Significant Spearman Rho Coefficients Between the Seven Imagery/Recall Measures in Experiment Four	88
11.	Number of Statistically Significant Spearman Rho Coefficients Between Six Recall Measures in Experiment Four	88
12.	Kruskal-Wallis Coefficients for Questionnaires Comparing Four Directed Scanning Methods	89
13.	Free Recall Analysis: Frequency of Recall by Square	91
14.	Free Recall Analysis: Frequency of Recall by Region	92
15.	Spearman Rho Coefficients Between Different Scanning Strategies and Two Methods of Free Recall Analysis	94
16.	Spearman Rho Coefficients Between Ranks of Median Scores on Drawing Categories and Ranks on Other Measures	97

TABLE	PAGE
17. Spearman Rho Coefficients Between Pairs of Drawing Categories	98
18. Spearman Rho Coefficients Between Ranks of Median Scores on Combinations of Drawing Categories and Ranks on Other Questionnaires	102

LIST OF SYMBOLS

FORM		APPENDIX
VVIQ	Marks' Vividness of Visual Imagery Questionnaire	A
SOS	Scaling of Slides Rating Scale (Experiment Two).....	-
VRQ	Visual Recall Questionnaire.....	B
VVIQ-L	Long Form of VVIQ	C
OQ	Short Form of Observation Questionnaire	D
OQ-L	Long Form of Observation Questionnaire	E
OIQ	Observation and Imagery Questionnaire	F
PQ	Picture Questionnaire	G
FR	Free Recall Measure	L-1
PQ-P	Picture Questionnaire: Positional Questions Only	L-2
POQ	Position Questionnaire	L-3
DP	Depth Perception Questionnaire	L-4
LO	List of Objects Measure	L-5
DW	Drawing of Picture Task	L-6

CHAPTER I

INTRODUCTION

Write the vision, and make it plain
upon tables, that he may run that
readeth it. (Habbakkuk 2:2, 626?BC)

Interest in the understanding and communication of visual imagery is by no means a recent phenomenon. It has only been since the 1960's however, that psychologists have truly "run" with it. With the current climate conducive for the study of visual imagery in psychology and with the development of a "cognitive science" that relies heavily on computer models of the mind, imagery research has currently become a popular scientific topic. The fairly recent development of a journal devoted specifically to the study of imagery, The Journal of Mental Imagery, (1977), attests to the upsurge of interest in visual imagery among other related phenomena.

Just as interest in visual imagery is not a recent phenomenon, so too sharp controversy over imagery phenomena has deep historical roots, especially among psychologists. At the turn of this century there was debate between the elementarism of Titchener, who claimed the vehicle of thought was always the image (Titchener, 1909), and the "Wurzburg school" of imageless thought represented in the United States by Angell (1911) and Woodworth (1906). While such controversy for all practical purposes disappeared with the banishment of the image from psychology by early behaviorists such as Watson (1913), the return of the image to psychology marked so well in a paper by Holt (1964) reopened the door to serious consideration of the role of imagery in thinking.

In recent years, a number of controversies concerning imagery seem to parallel the image versus imageless thought controversy decades earlier. On the one hand, theorists such as Paivio (1971; 1973) and Kosslyn (1981) argue for the position that, "...images are a special kind of representation that depicts information and occurs in a spatial medium..." (Kosslyn, 1981, p. 46). On the other hand, Pylyshyn (1981) and Anderson and Bower (1973) claim that visual images are, "essentially conceptual and propositional, rather than sensory or pictorial in nature" and that, "such representations are more accurately referred to as symbolic descriptions than as images in the usual sense" (Pylyshyn, 1973, p. 3). The arguments may be different from those at the turn of the century but the debate still appears clearly to be between the iconophiles (the believers in the importance of images) and the iconophobes (the skeptics or disbelievers) as so named by Dennett (1978).

Much of the controversy over mental imagery can be seen to stem from problems in two areas. At a semantic level, there is great diversity of opinion as to just what one means by the word imagery. At an empirical level, proof of the validity of "imagery" measures is often strangely absent from the literature. The concept of imagery has been used in a very loose manner. The concept of eidetic image, for instance, is defined by Haber according to "its current or past link to some particular sensory modality" (Commentary on Hilgard, 1981, p. 31). Ahsen (1981) says in the same commentary that "...the eidetic is not just visual but belongs to every department of sense, and above all combines various senses in a single object-like internal structure to provide us with an object experience in the mind which is enriching

and dramatic" (p. 24). Roodin and Gray correctly point out the dissarray at the empirical level by stating; "There has been a paucity of concerns among investigators of imagery with validating their experimental paradigms and techniques" (Commentary on Hilgard, 1981, p. 56). It sometimes appears that imagery researchers have wandered into a vast functionalistic forest, with little attention in how they got there, and with little concern towards finding a clear path through it all. They do, however, keep themselves busy.

This research was an attempt to investigate visual imagery at both the semantic and empirical levels. A particular type of imagery phenomenon, visual memory imagery, was examined in order to determine what the term is supposed to mean and how it is supposed to be identified and measured. In the course of these investigations, attention was gradually directed more towards studying what people are doing when they are supposed to be imaging. In other words, the direction of this research was primarily in a direction opposite that of the majority of imagery research today; more towards the "nature" than the "function" of visual memory imagery.

CHAPTER II

BACKGROUND AND LITERATURE REVIEW

Historical Review

Whether through religion, philosophy, or psychology, imagery has long been an important concept in the search to understand the human world. Since in many ways the early distinctions between these fields were often not clear-cut, to trace the history of the importance of imagery in psychology necessitates a brief review of that concept in both religion and philosophy.

Visual imagistic experiences have played a crucial role in the development of religion. From Genesis, where "God created man in his own image, in the image of God created he him; male and female created he them" (Genesis 1:27), to Revelation, where John was told to; "Write the things which thou hast seen..." (Revelation 1:19), the Bible is full of instances of varied imagistic experiences. In ancient India, Tantrism, which influenced both Buddhism and Hinduism, taught that; "Visualization is the step which precedes actual identification with, and union with, the divinity" (Samuels & Samuels, 1975, p. 23). Central to diverse religions throughout the world was the "graven image", the externalization of "spiritual" experiences. The search for the meaning of existence has often involved the attempt to understand the abstractness of infiniteness with the concreteness of finiteness via the image.

Images also played a role in ancient philosophical writings. Egyptian Hermetic philosophy was an ancient type of philosophical idealism which asserted that, "...thoughts have vibrational levels and

energy levels which bring about changes in the physical universe" (Samuels & Samuels, 1975, p. 21). Aristotle and Plato believed that memories were stored in the form of pictorial patterns, the so-called "wax impression model of memory" (Boring, 1950). The British Associationists such as Hobbes, Locke, and Hume basically subscribed to a version of this theory as the following quote from Hume implies:

"...all our ideas or more feeble perceptions are copies of our impressions or more lively ones" (quote in Herrnstein & Boring, 1976, p. 344). This view was attacked most notably by the Wurzburg school of psychologists who claimed their experiments proved the existence of imageless thought (see Angell, 1911). More recently, Ryle in The Concept of Mind (1963) has assailed the "copy-concept" of imagery by claiming, "In short there are no such objects as mental pictures..." (p. 254). Among more current philosophers, Dennett is perhaps foremost in following in Ryle's footsteps in regard to imagery.

In a more functional vein, visual imagery has played an important role in mnemonic systems. According to Yates (1966), visual imagery was essential in the ancient mnemonic "method of loci" which involved the association of items to be remembered to a succession of familiar locations. During recall, the mnemonist would "mentally walk" past the locations, reconstructing imagistic associations between specific locations and the items to be remembered. Orators such as Cicero claimed that they were able to memorize long speeches by "mentally walking" through a house, each location in the house bringing to mind a different section of the speech (Yates, 1966). According to Buggie (1974) many theaters constructed during the Renaissance era were

decorated with elaborate art work to facilitate actors in remembering their lines, again through the method of loci.

As psychology emerged out of a synthesis of physics, physiology, and mental philosophy (see Chaplin & Krawiec, 1974, p. 7), the scientific, functional study of imagery was made possible. Foremost among the early scientific investigators of imagery were the studies of Sir Francis Galton in the late 1800's. Galton in his book, Inquiries into Human Faculty and its Development (1907), originally tried to demonstrate that, "The visualizing faculty is a natural gift, and, like all natural gifts, has a tendency to be inherited..." (p. 69). The results of his studies with questionnaires such as "Questions on Visualizing and Other Allied Faculties" by his own admission "amazed" him because of the apparent lack of visualizing abilities among "men of science" (p. 58). His reliance on questionnaires and the study of individual differences in imaging ability are still very popular topics in current imagery research.

During the era of Galton's research the dominant school of thought in psychology was known as structuralism. For Titchener, who brought structuralism to America, the image was always the vehicle of thought (Titchener, 1909). Structuralism depended on such introspective methods as Betts' "Vividness of Imagery Scale" (1909), which employed rating scales for the self-assessment of the vividness of visual, auditory and five other types of mental imagery. During the structuralist era, emphasis was placed on identifying more or less pure imagery types among people (see Griffitts, 1927).

The growing prominence of behaviorism in the early 1900's brought

about a shift in psychology towards studying the objective and eliminating the subjective. To Watson, the major early figure in behaviorism, rejecting images was part of the trend toward reducing psychology to physiology (Watson, 1913; 1916). While Skinner (1938) rejected the physiological reductionism of Watson, the emphasis was still placed on objective, observable experiences. Since the study of images depended heavily on subjective methods, until the rise of the cognitive movement in psychology there was little forum for imagery research in experimental psychology.

The cognitive approach developed partly in reaction to the perceived narrowness of the behavioristic point of view (see Neisser, 1967). With the acceptance of the cognitive viewpoint came the concomitant willingness to accept other phenomena, specifically subjective experiences, for scientific study. Holt's paper (1964) entitled, "Imagery: The Return of the Ostracized", was the signal for imagery research to begin anew. It is interesting to note that visual imagery research was primarily revived first by psychologists in British Commonwealth countries (eg., Paivio, 1966; Richardson, 1969; Sheehan, 1967), a reflection of just how overwhelmingly behaviorist-oriented American psychology had become. As psychology increasingly became more receptive to Eastern thought and its emphasis on consciousness and phenomenal experience in the late 1960's and early 1970's (eg., Ornstein, 1972), imagery research also gained much in popularity. In the current popular trend toward the use of computer models of the mind, the so called "new wave of mental modelers" according to Bugelski (Commentary on Hilgard, 1981, p. 29), the study of imagery has found a

new paradigm (see Kosslyn, 1981) and reached new respectability and greater popularity.

Defining Imagery

As noted in Chapter I, there is considerable looseness in the use of the term imagery. Therefore, a profitable, if not necessary step to take before studying imagery empirically is to define as clearly as possible what one is talking about when one uses the word imagery. The first step in defining imagery is to define other related concepts such as sensation, perception, and memory in order to most clearly distinguish what is meant by imagery.

Sensation. According to the Oxford English Dictionary (1933), sensation refers to:

An operation of any of the senses; a psychical affection or state of consciousness consequent on and related to a particular condition of some portion of the bodily organism, or a particular impression received by one of the organs of sense. Now commonly in more precise use, restricted to the subjective element in any operation of one of the senses, a physical 'feeling' considered apart from the resulting 'perception' of an object.

It can be seen that in using the word sensation, there is an emphasis placed on the physical side of knowing the world. The closer an experience comes to being physical in quality, rather than mental, the more likely it is to be termed a sensation. This is aptly pointed out by William James in Principles of Psychology (1980):

The nearer the object cognized comes to being a simple quality like 'hot', 'cold', 'noise', 'pain' apprehended irrelatively to other things, the more the state of mind approaches pure sensation...Sensation, then, so long as we take the analytic point of view, differs

from Perception only in the extreme simplicity of its object or content. Its function is that of mere acquaintance with a fact... A pure sensation is an abstraction; and when we adults talk of our 'sensations' we mean one of two things: either certain objects, namely simple qualities or attributes like hard, hot, pain; or else those of our thoughts in which acquaintance with those objects is least combined with knowledge about the relations of them to other things (pp. 452-453).

Sensation, then is distinguishable from perception and memory by virtue of being an activity closer in relation to the physical world.

Perception. William James in Principles of Psychology (1890) stated:

Perception always involves Sensation as a portion of itself; and sensation in turn never takes place in adult life without Perception also being there...The fuller of relations the object is, on the contrary; the more it is something classed, located, measured, compared, assigned to a function, etc., etc.; the more unreservably do we call the state of mind a perception, and the relatively smaller is the part in which sensation plays...Perception's function, on the other hand, is knowledge about a fact; and this knowledge admits of numberless degrees of complication (p. 453).

Perception then is sensation plus something more.

Oxford English Dictionary (1933) defines perception as: "The taking cognizance or being aware of objects in general; sometimes practically equal to consciousness". In other words, the greater the degree a sensation brings about an awareness the more likely one is to say that perception is occurring.

Memory. A common textbook definition of memory is; "Your store of past experiences, thus the seat of your ability to recreate or reproduce past perceptions, emotions, thoughts, or actions" (McConnell, 1981, p. 424). This definition is very close to the one in the Oxford English

Dictionary (1933); "The faculty by which things are remembered". The problem with this type of definition is the passive nature of memory described. A better definition in Webster's New World Dictionary (1970) is; "the power, act, or process of recalling to minds facts previously learned or past experiences". This is closer in form to what Wundt meant when he described memory as, "a series of processes" (Wundt, 1907, p. 283). That memory is a present experience rather than a stagnant storehouse is clearly pointed out by James in Principles of Psychology (1890); "it (memory) is the knowledge of an event, or fact, of which meantime we have not been thinking, with the additional consciousness that we have thought or experienced it before" (p. 424).

It is further necessary, for purposes to be apparent later in this chapter, to distinguish between two words often used synonymously with memory: recall and recognition. According to Webster's New World Dictionary (1970), to recognize means to, "be aware of as something or someone known before, or as the same as known". Recall according to the same dictionary implies, "...some effort or will to bring back something to mind,...often connoting an imparting of what is brought back..." (see page 1201 for further discussion). There is a matter of degree, then, between recognition and recall, in analogous terms to the distinction between sensation and perception made by James. Recall is, in a sense, "the more fuller of relations" when it comes to memory.

Imagery. The classic definition of the image is given in the Oxford English Dictionary (1933):

A mental representation of something (esp. a visible object), not by direct perception but by memory or imagination; a mental picture or impression; an idea, conception.

The position to be taken here in regard to defining visual imagery avoids both the "scyllic" and "charybdic" extremes and hopefully will avoid their difficulties. More descriptive of this conception of imagery is the position of Wundt in Outlines of Psychology (1907). Wundt retains the idea that there is a close relationship between sensation and imagery, "a special idea referred directly to an earlier impression" (p. 271). Yet, in the same book he asserts that, "The description of these ideas as weaker, but otherwise faithful copies of the direct sense perceptions is as far out of the way as it could possibly be" (p. 282). The reason given was, "...that our ideas are not permanent objects, but processes which can never exactly recur, because the conditions of their occurrence are never twice alike (Wundt, 1901, p. 290). A development of Wundt's position then, would retain the percept-like quality of images, yet reject the assertion of a photographic nature.

Visual imagery as studied in this research is defined as a cognitive experience most clearly identifiable in reference to its perceptual-like quality. Both the strictly literal ("photographic") and figurative ("non-visual") interpretations of this definition are rejected. Visual imagery is assumed to be a certain experience of thinking distinguishable in both kind and quality from other such experiences.

It should be noted here that while the focus of this research is visual imagery, many researchers extend the use of the word imagery to other sense modalities (eg., Betts, 1909; Richardson, 1969). Furthermore, synaesthetic imagery has been investigated by men such as Galton (1907) and Ahsen (Commentary on Hilgard, 1981). To avoid further

complications in this study of visual imagery, all research and discussions here is restricted to the visual sense modality.

Varieties of Visual Imagery Phenomena

Just as the word imagery can be tossed around very loosely, so too the words visual imagery must be further delineated into classes of phenomena in order to avoid further confusion. Through the years psychologists have found it useful to provide classification lists of imagery experiences (eg., Hilgard; 1981, Holt, 1964). The following categorization, while not meant to be a strict, rigid taxonomy, is provided to further clarify the concept of visual imagery.

Afterimagery. In terms of dependence on the manner and conditions of sensory stimulation, the afterimage is the most concrete type of visual imagery phenomenon. It is the consequence of the withdrawal of a sensory stimulus, often of high intensity and brief duration. According to Hilgard (1981), such an image is faithful to the geometry of the prior sense-perception, so that the size of the image roughly follows Emmert's law: that is, "if the image is projected upon a surface, the projected image will increase in size according to the distance of the surface from the eye..." (p. 8). When the afterimage retains the same colors of the sensory stimulus it is termed positive; when complementary colors are seen it is termed negative. The afterimage, unlike other types of images can't be scanned; as the person moves his or her eyes, the image shifts. It is probably the first type of imagery to be scientifically studied as it was mentioned by Fechner in Psychophysik (1890) who, according to James (1890), desired to "work up the subject statistically" (p. 51). Afterimages while primarily retinal, provide

the most compelling evidence for the visual-like quality of images in the fullest sense of the word.

Recurrent imagery. Sometimes a person who spends a prolonged amount of time staring at a certain object or scene has a visual image of the scene immediately after looking at that scene, or sometime later, often while resting his or her eyes. An astronomer who spent hours looking at the moon and then later in the day kept seeing moon craters would be experiencing a recurrent image. According to Samuels and Samuels (1975), "Recurrent images also occasionally occur in people who have taken hallucinogenic drugs. In this case the image may recur long after the drug has worn off"(p. 55). The appearance and disappearance of the recurrent image is usually not under conscious control by the person.

Imagination imagery. According to Richardson (1969); "imagination images tend to be novel, substantial, vividly colored, when in the visual mode, and involve concentrated and quasi-hypnotic attention with inhibition of associations" (p. 94). Imagination images are memory images arranged in novel ways. There are many subvarieties in this class of images.

Dreams, daydreams, and fantasy are the more common forms of imagination imagery, often dealing with a series of images occurring in a chronological order. Twilight state imagery, hypnopompic when it occurs just after waking from sleep but before being fully awake, and hypnagogic when it occurs just before falling asleep, is closely related to dreams, daydreams, and fantasy. These five type of imagination imagery generally are not under conscious control by the person.

Hallucinations or visions are unusually vivid visual images in which a person has most difficulty in distinguishing them from reality because they correspond so closely to the perception of physical objects (Hilgard, 1981). They most commonly occur spontaneously. For all of the above seven types of imagination imagery, the absence of normal sensory stimulation (eg., through drugs, meditation, fasting, sleep, etc.) appears to be a common factor.

A final type of imagery to be included in this category would be creative imagination. According to Hilgard (1981); "When imagination is goal directed towards the production of pleasing, beautiful, useful, socially desirable effects, it is commonly called creative" (p. 10). An architect visualizing a new building may be said to be using creative imagery.

Eidetic imagery. An image that is unusually vivid and persists for relatively long periods of time is called an eidetic image. The term "photographic memory" is often used synonymously with this term. The later work of Haber (1979) demonstrates the falsity of this metaphor for eidetic imagery. According to Richardson (1969, p. 29), while Purkinje is recognized as the first person to give a description of the phenomenon in 1819, the German psychologist Jaensch is credited with coining the term "eidetic" (from the Greek, "eidos" - that which is seen).

Currently, there are two main schools of thought in regard to eidetic imagery. According to Haber (1979); "...research has failed to demonstrate consistent correlates between the presence of eidetic imagery and any cognitive, intellectual, neurological or emotional measure" (p. 583). He stresses the sensory character of such images and a definition

based on accuracy to set it apart from other kinds of imagery (see Commentary on Hilgard, 1981, p. 31). Conversely, Ahsen (1977) proposes a broadly based definition that is not tied to any specific modality. He uses the concept of eidetic imagery as the basis for a form of psychotherapy. The difference between the two views is related to an interpretation of the character of imagery. Ahsen opts for a generalized concept of imagery; Haber for a more specific, sensory-tied definition. While Haber's position is more restrictive, it is more precise, amenable to empirical validation, and less likely to lead to loose, confusing statements about eidetic imagery.

Visual memory imagery. According to Hilgard (1981); "A memory image is a recall with imaginal content deriving from earlier perceptual experience" (p. 8). Richardson (1969) adds that memory images usually, "refer to particular events or occasions having a personal reference" (p. 93). The images that accompany the recall of events from the past (eg., a childhood room), ongoing thought processes (eg., imaging a friend's face while talking over the telephone), or even anticipatory actions for the future (eg., a driver anticipates a sharp curve ahead on a familiar road) are all termed memory images. Memory images, "typically more like a hazy etching, often incomplete and usually instable, of brief duration and indefinitely localized" (Richardson, 1969, p. 43), can be further described in two dimensions: vividness and controllability. If a person can conjure up a detailed image of a Rubik's Cube, but can't mentally manipulate any of the colored squares, then it can be said that person's memory image has a high degree of vividness but a low degree of controllability.

Most of the early work with visual imagery (eg., Betts, 1909; Galton, 1907) dealt with visual memory imagery. It remains the core of imagery research today (eg., Kosslyn, 1981; Richardson, 1977). Most of the self-report imagery questionnaires in use today (eg., Marks, 1973; Sheehan, 1967) are self-styled visual memory imagery questionnaires. Finally, the research presented here deals specifically with visual memory imagery.

Methods of Studying Visual Memory Imagery

There have been diverse experimental methods for studying visual memory imagery. The more popular methods are briefly described:

Self-report questionnaires. Galton (1907) started out with a questionnaire, and current investigators often appear to depend even more on them. The basic strategy employed in self-report questionnaires is to have people rate on various Likert-type scales (Likert, 1932) the vividness or quality of the visual images they get in response to different questions. Among the more popular or important questionnaires are:

1. Galton's Questions on Visualizing and Other Allied Faculties (originally published 1883). According to Galton (1907) the object of the questionnaire was to, "elicit the degree in which different persons possess the power of seeing images in their mind's eye, and of reviving past sensations" (p. 255). He instructed the questionnaire takers to, "...Think of some definite object - suppose it is your breakfast table as you sat down to it this morning - and consider carefully the picture that rises before your mind's eye" (p. 255). Galton's questionnaire was the forerunner of the modern questionnaires and the first of its

kind to be published.

2. Betts' Questionnaire upon Mental Imagery (1909). The Betts questionnaire has been the most prominent of all the adaptations of Galton's questionnaire. The 750 items evaluated imagery in seven sensory modalities via a seven-point Likert-type scale.

3. Sheehan's Betts QMI (1967). Sheehan's questionnaire is a shortened version of Betts' questionnaire. It contains thirty-five items in the seven sensory modalities of Betts' questionnaire.

4. Paivio's Individual Differences Questionnaire (1971). This eighty-six item questionnaire was designed to investigate the visualizer/verbalizer dichotomy, a distinction between cognitive modes. Richardson (1977) has developed a shorter version of this type of test entitled the Verbalizer - Visualizer Questionnaire.

5. Marks' Vividness of Visual Imagery Questionnaire (1973). This sixteen item questionnaire contains five of the items on the Betts' questionnaire, of which it is a close revision. It is currently one of the most frequently used visual memory imagery questionnaires.

6. Gordon's Test of Visual Imagery Control (1949). This twelve item questionnaire deals with the manipulation and control of memory images.

Objective questionnaires. Barratt (1953) asserted that; "Imagery is an important component in the solution of those tasks that involve the 'mental' manipulation of spatial relations" (pp. 160 - 161). Accordingly, scores from such test as "Flags" (Thurstone & Jeffrey, 1956), "Space Relations" (Bennett, Seashore, & Wesman, 1947), and "Space Test" (Thurstone, 1938) have been used, among others to assess

visual memory imagery ability.

Performance measures. Sheppard and Metzler (1971) developed an imagery paradigm which involved the mental rotation of three-dimensional objects. They claimed to have found a linear relationship between how long people say it takes to rotate their images of the objects and the amount of degrees of rotation required to bring the objects into the desired position. Thus, it would take twice as long to rotate an image of an object 180° as to rotate it 90° .

Klapps (1969) has developed a test in which subjects are presented three complex figures arranged in a row for five seconds, then after a five-second delay, they are asked to choose which of five alternatives is identical to one of three previously presented figures.

Psychophysiological measures. Psychophysiological assessment of visual memory can be divided into five main categories:

1. Breathing patterns. A number of studies (Chowdhury & Vernon, 1964; Golla & Antonovitch, 1929; Patterson, 1935; and Short, 1953) have found irregular breathing was associated with the instructed use of verbal/auditory imagery, while visual imagery was associated with more regular breathing patterns. Richardson (1977) proposes that implicit laryngeal and/or tongue movements accompanying "inner speech" are responsible for the distorted breathing patterns.

2. Alpha rhythm. Golla, Hutton, and Walter (1943) first proposed that alpha amplitude EEG suppression is an indicator of visual imaging activity. While supported by Short and Walter (1954), this was unsupported by research by Simpson, Paivio, and Rogers (1967). In terms of alpha frequency EEG, Gale, Morris, Lucas, and Richardson (1972) supported earlier work by Slatter (1960) that contended that visualizing is

accompanied by a higher mean dominant alpha frequency. Paivio (1973), however, argues that the evidence is far from conclusive in this regard also.

3. Electromyography (EMG). Jacobson (1932) reported that EMG activity increased in the arms when a person was asked to imagine throwing a ball; in the eyes when asked to visualize another person throwing a ball. Suinn (1976) has done similar work with skiers.

4. Pupillary reactions. Jaensch (1930) found that children having eidetic imagery showed pupillary dilation when asked to visualize dark objects and, conversely, pupillary constriction when asked to visualize bright objects. In a series of experiments by Paivio and coworkers (Coleman & Paivio, 1969; Paivio & Simpson, 1967; Simpson & Paivio, 1968) the following relationship was reported: Subjects asked to generate visual images to concrete words had less pupil dilation than when asked to generate images to abstract words. Paivio (1966) contended that it was easier to generate images to concrete words (eg., table) than abstract words (eg., truth). A further study (Paivio & Simpson, 1968), however, found no significant relationship between pupillary reaction and imaging ability.

5. Eye movements. Perky (1910) was one of the first investigators to mention that eye movements accompanied visual imaging. Research by Lorens and Darrow (1962) and Deckert (1964) supported this observation; other research (eg., Graham, 1970; Hale & Simpson, 1971) has not.

Two studies (Bakan, 1969; Kocel, Galin, Ornstein & Merrin, 1972) have demonstrated that when verbal-type questions requiring some element of reflective thought were asked of subjects they made more initial right

lateral eye movements, and conversely, when questions of the visual type were asked, more initial left lateral eye movements were made. While Richardson (1977) purports to have demonstrated supporting evidence, questionable levels of statistical significance in some of the studies casts doubt on the quality of such evidence. For instance, a $p < .10$ (two-tailed t-test) level of significance was reported by Bakan (1969) to indicate that left eye movers experience more vivid visual images.

The problem with psychophysiological measures of visual imagery is two-fold: The literature in each case does not present a very consistent picture. Furthermore, it is often assumed that people are visualizing during various experimental paradigms when, in fact, they may not be imaging, per se. At best, psychophysiological measures appear to provide corroboratory evidence of visualization activity. There seems no single measure that is sufficient of itself.

Interviews. After the initial results of Galton's questionnaire "astonished" him (1907, p. 58), he turned to interviews such as the following example for further investigation:

On the other hand, when I spoke to persons whom I met in general society, I found an entirely different disposition to prevail. Many men and yet larger numbers of women, and many boys and girls, declared that they habitually saw mental imagery, and that it was perfectly distinct to them and full of color. The more I pressed and cross-examined them, professing myself to be incredulous, the more obvious was the truth of their assertions. They described their imagery in minute detail, and they spoke in a tone of surprise at my apparent hesitation in accepting what they said. I felt that I myself should have spoken exactly as they

did if I had been describing a scene that lay before my eyes, in broad daylight, to a blind man who persisted in doubting the reality of the vision (p. 59).

There are some problems with interviews: Are people telling the truth about an experience that they may not, in fact, be able to describe accurately? Was Galton's interview above mainly about imagination or memory imagery? Finally, to what degree are people exaggerating, a factor that even Galton later admitted to be involved in such interviews (1907, p. 66)?

Observable studies. The primary basis of science is observation. Three forms of observation provide corroborative support to an assessment of visual memory imagery. The first kind is observation of others; an example of which would be Galton's observance and description of an African Bushman drawing a picture (1907, p. 71). The second kind is self-observation. William James in Principles of Psychology (1890) described his images of soldiers as follows: "My optical images are in general very dim, dark, fugitive, and contracted. It would be utterly impossible to draw from them, and yet I perfectly well distinguish one from another (p. 495). The final kind of observation could be termed "historical/autobiographical observation" - a historical search concerning what different people at different times said about their thinking processes. An example of this type of methodology would be the accounts mentioned by Ghiselin in The Creative Process (1952).

Purpose of the Present Research

There is an underlying problem in much of the current visual imagery research that can be demonstrated in one of the more recent

and important investigations by Finke entitled "Levels of equivalence in imagery and perception" (1980). In this paper he mentions that; "In all studies discussed in this article, vividness of imagery was measured by the Vividness of Visual Imagery Questionnaire...(Marks, 1973)" (p. 121). The problem as mentioned earlier is two-fold: 1. What is meant by the word imagery? By "imagery" does he mean visual-like in a more figurative or literal sense? Is he talking about imagination, eidetic, or memory imagery? 2. Is the measure used a valid measure of visual imagery and specifically, visual memory imagery? According to White, Sheehan, and Ashton's review of imagery tests (including Marks' 1973 questionnaire): "Basically, there is no direct way of knowing factually that the inventories we have reviewed measure imagery and not some other process that is related in function" (1977, p. 163). In other words, what perception is truly "equivalent" to is not properly defined either semantically or empirically.

In order to tackle this problem, effort was made to define as clearly as possible the purpose and avenue of this research. Therefore, the following conditions of study are spelled out:

1. The definition of imagery that provided a starting point for this research was, as mentioned earlier in this chapter: a cognitive experience most clearly identifiable by references to its perceptual-like quality.
2. The perceptual-like quality to be studied was strictly visual.
3. The focus of research was specifically visual memory imagery.
4. The definition of memory imagery given by Hilgard (1981), "a recall with imaginal content deriving from earlier perceptual experience" (p. 8) provided a foundational basis for the experimental

paradigms used in this experiment. In other words, a recall paradigm was the preferred experimental method.

5. A specific methodology, the self-report questionnaire was investigated.

6. One of the most frequently used self-report questionnaires, the Marks' Vividness of Visual Imagery Questionnaire (1973) was investigated in regard to its validity. Since its publication in 1973, there have been fifty-nine citations of this questionnaire according to the Social Sciences Citation Index (1973-1981). Forty-two of the citations have been in the last four years (1978-1981), attesting to its current popularity.

7. Since recall was the key concept in the definition of visual memory imagery, the activity of recall was studied in order to gain insight into the nature of visual memory imagery.

CHAPTER III

EXPERIMENT I: VISUAL IMAGERY, SCALING OF SLIDES, AND VISUAL RECALL

Introduction

While a casual review of recent volumes of the Journal of Mental Imagery will attest to the widespread use and acceptance of Marks' (1973) Vividness of Visual Imagery Questionnaire (VVIQ), a more extensive and intensive literature review has shown that little research on the validity of the VVIQ has been done. What there is falls mainly into two classes: 1) internal correlation through factor analytic studies and 2), external correlation through correlational studies between the VVIQ and the "correlates of its function" (see White, Sheehan & Ashton, 1977, for a review); which are often nothing more than other "imagery" questionnaires. Such studies dealing with internal and external validity address primarily the nature of the questionnaire itself; not the nature of a property that is presumably measured by the questionnaire. With visual imagery the concept of "construct validity" can be directly confronted. The construct validity of the VVIQ has not been demonstrated by other than inadequate correlational methods. This study directly addresses the question of the validity of the VVIQ at two levels: the nature of individual responses to VVIQ items and, the predictive value of the completed questionnaire itself.

The VVIQ is specifically designed to be a test of visual memory imagery, which according to most imagery researchers (eg., Richardson, 1969; Samuels & Samuels, 1975) should be distinguished from other imagery phenomena such as imagination imagery or after-imagery. One

reasonable test of the validity of a visual memory imagery questionnaire then, would be to determine its predictive value for a test of visual recall. According to Marks' (1973) "good visual imagers" as determined from his questionnaire, have significantly better "recall" of pictures than "poor visual imagers" identified by the same questionnaire. The problem with his study, however, is that he used a recognition and not a recall paradigm. Subjects were presented three alternatives and then asked which of the three were previously shown. In other words, they were prompted for recognition, not probed for recall. The important difference between recognition and recall is illustrated in the following example: You have to select for a nature magazine artists who can render accurate illustrations of a mountain scene after they have left the actual site. Would the most satisfactory way of selecting such artists be to show them three photographs of mountains and then ask them which of the three mountains they actually saw, or would it be better to ask them to recall and to reproduce the mountain they saw by sketching or painting it?

If the experience of imagery is something like "seeing", then the best probe for imaging ability would serve to investigate just how much the person has seen, rather than whether or not something is recognized. In a recognition task, whether or not a person is actually imaging is not relevant: he or she is seeing something and asked whether he or she has seen it before. In contrast, in a visual recall task the question of, "what are you imaging?" can be asked. The person can be required to describe and reproduce his or her present experience, and this description or reproduction can be checked against the material originally seen by both subject and experimenter. A visual recall task is therefore a

more appropriate and direct measure of the experience of imaging than a recognition task. Hence, the first way of assessing the validity of the VVIQ is to test its predictive value for performance on a visual recall task. This is singularly appropriate, since the VVIQ questions ask about recall, not recognition--about what one sees, and provides it with its high face value.

The second way of assessing the construct validity of the VVIQ involves investigating the nature and reliability of a person's responses to individual questionnaire items, for these purport to be straightforward self-descriptions. There is little research reporting test-retest data for the VVIQ, and what there is is often of questionable value because of flaws such as the use of small numbers of subjects (eg., McKelvie & Gingras, 1974; Richardson, 1977) or the neglect to report the test-retest interval (Marks, 1973a). Since reliability is a necessary, though not sufficient, test for validity (see Hartman, 1977), the reliability of the numerical rating scores given by people taking the VVIQ is of crucial importance in considering the construct validity of the questionnaire.

Two relevant questions can be asked concerning the reliability of rating value responses given by people to the items of the VVIQ. First, are people consistent in responding to the same items with the same rating values? Second, do the rating values mean the same thing to different people? In other words, does a rating value of "four" represent the same degree of imaging ability as measured objectively on, for instance, a test of the recall of a picture, for one person as it does for another? Questions such as these need to be addressed before

it can be assumed that the VVIQ has the property of equal intervals.

To address such questions about the rating responses given on the VVIQ, in this study the questionnaire was given to the participants twice. At the time of the second administration, the questionnaire takers used a rating scale developed from the scaling of slides projected on a screen. The second rating scale developed from the scaling of slides preserved the five-point numerical rating values and nearly the same verbal definitions for the five rating values of the original Marks scale, but also enabled respondents to accompany these verbal definitions with individualized visual descriptions for each of the five rating values. In other words, each verbal definition of a rating value was accompanied by a picture chosen by each participant to best represent the particular rating value. Thus, two functionally similar rating scales were employed to measure reliability yet limit the probability of participants responding solely on the basis of numbers they see and ignoring the imagery value those numbers are supposed to represent.

If the Marks VVIQ is valid, then the data of both the recall and reliability portions of the research should so indicate. If, however, respondents' scores on the VVIQ are not found to be reliable, or predictive of performance on the visual recall task, then the validity of that questionnaire as a measure of visual memory imagery would be called into question. Furthermore, in that eventuality, the structure of research and theory based on the assumption of its validity must be reassessed.

Method

Participants

Sixty-three undergraduate¹ volunteers randomly selected from an introductory psychology class were administered the Marks VVIQ (1973) in a comfortable, middle-sized classroom during one of three approximately half-hour time periods between 11:00 a.m. and 3:00 p.m. The students, all between the ages of seventeen and twenty-three received experimental credit towards their introductory psychology class grade for participation. Students indicated on the sixteen-item VVIQ how good they thought their visual imagery was for each of the items by choosing a number on a five-point rating scale (see Appendix A). After the resulting numbers on the completed questionnaire were added, the three males and three females reporting the best visual imagery on the questionnaire (mdn = 25 for males; mdn = 20 for females) and the three males and three females reporting the worst visual imagery on the questionnaires (mdn = 44 for males; mdn = 48 for females) were asked to participate in a further research session to be held between ten and fourteen days later for additional class credit; all agreed. The people reporting the best visual imagery on the questionnaire constituted a self-identified "good visual imagers" group; those reporting the worst visual imagery made up the "poor visual imagers" group. Eleven of these selected participants reported having normal, uncorrected vision; one wore corrective lenses. None of the volunteers had participated in

¹Since the subject population in Marks' (1973) study and the overwhelming majority of imagery research studies (see White, Sheehan, & Ashton, 1977) have involved undergraduate students only, the use of undergraduate students as a subject population for this research was particularly appropriate.

a research study dealing with visual imagery before. All sixty-three received experimental credit vouchers after completing the VVIQ.

Experimental Setting and Apparatus

Experimental sessions were conducted in a roomy, well-lighted office with one window. Participants were seated in a comfortable lounge chair during the approximately hour long experimental sessions conducted in the early afternoon. A 35mm slide projector placed about six meters from a screen on a wall was used to project slides (described below) that participants viewed from a distance of approximately five meters from the screen. During slide presentation, a thick blanket over top of a drawn shade ensured a darkened room with nearly equal lighting conditions for all participants in the experiment.

Design and Procedure

The basic procedure used in the experiment was the same for each individual. Each experimental session consisted of four stages:

Stage one: Scale establishment. Each participant was asked upon entering the office to have a seat in a chair facing the projection screen on the wall. When the student was judged to feel comfortable and relaxed through casual conversation, the following instructions were read to each student:

In the first part of the experiment, I want you to be a "photographic judge" for me. I have fifteen slides of the same country scene that I am going to project on the wall. When I project the slides on the screen on the wall, I want you to examine each slide very carefully.

All the slides were taken at the same location and

within ten minutes of each other. These slides vary in clarity and vividness. I want you to rate these slides, indicating which of the slides you think are better or worse than the other slides in terms of how closely each slide provides a detailed representation of the actual scene itself. Indicate your rating for each slide by assigning it a number on a scale of your own choosing. For instance, you may want to give the best slide on your scale a rating of fifty and the worst slide a rating of one, or vice versa. Use whatever numbers you feel comfortable with. What is important is that you indicate the degree to which each slide would most accurately be a detailed representation of the actual scene depicted. Any questions?

After participants stated that they understood the instructions and had no further questions, the fifteen slides were presented and students proceeded to assign a numerical rating value of their choosing to each slide. The student verbally assigned a number to each slide while looking at it. The researcher recorded the response on a sheet hidden from the student's view. At no time did the student receive feedback about the numerical ratings he or she had given to each of the slides. The slides were presented in the same order three times. By the end of three runs, all participants were fairly consistent in ordering the slides. When students were asked later in the experiment to order the slides again, over two-thirds of all the numerical ratings remained the same or deviated by no more than one to the ratings given

on the third run.

A method of fractionation (see Stevens, 1975) was next employed to select five slides in the following manner:

1. The "best" slide. After three runs of the fifteen slides, the three or four slides the students had previously rated the best were presented again to the students who were then asked to assign these slides a number again. The students were this time instructed to look for the best slide of the set. After assigning the slides numbers, the two slides that the students had rated the best were shown again, and the students were asked to choose which of the two slides they thought was the better, more accurately detailed representation of the scene depicted in the slides. The slide chosen was set aside when the student had stated that he or she was sure it was the best slide. All students chose slide number six as the best slide.

2. The "worst" slide. The procedure for choosing the worst slide was directly analogous to the procedure for choosing the best slide. The differences in procedure were that the three or four slides that the students had assigned as the poorest slides were used and, the students were instructed to look for the slide that was the worst, least accurately detailed representation of the scene depicted in the slides. There was unanimous agreement in choosing slide number eleven as the worst slide.

3. The "middle" slide. Students were again shown the remaining thirteen slides and asked to rate them as they had done previously. After they had completed their ratings, they were shown thrice more the best and worse slides they had previously selected. The students were

then told the following:

"I would like you now to choose the slide of this set that would best represent the half-way or mid-point on your scale of accuracy and detailed representation between the best and worst slides you had previously selected."

After the students assured the researcher that they fully understood the instructions, they were presented again the thirteen slides and asked to assign each a number. The five to eight slides that the students had consistently assigned near the middle of their numerical scale during the last three runs were then selected to be shown again to the students. The remainder of the slides were then set aside. The narrowing down procedure used to select the "middle" slide was then the same procedure as employed to select the best and worst slides. A "middle" slide was set aside when the students confidently assured the researcher that the particular slide they had chosen most satisfactorily represented the mid-point on their scale between the best and worst slides. Six different slides were chosen by the students as representing the "middle" slide.

4. The "good" slide. Students were shown the "best" and "middle" slides they had previously selected three more times. They were then shown the four to seven slides they had consistently rated as being the better slides during the earlier scaling runs of the slides and asked to again assign them numbers. Students were instructed to select a slide that they thought best represented the mid-point on their scale between the "best" and "middle" slides. After the narrowing-down procedure

described previously had yielded a slide that the students could confidently assure the researcher best represented the mid-point between the "best" and "worst" slides, it too was set aside. Five different slides were chosen by the students to represent this slide.

5. The "poor" slide. The "middle" and "worst" slides were shown to the students three times. The four to seven slides that the students had previously judged to be the worst of the slides on the earlier scoring runs were then projected on the screen. The instructions to the students were to pick a slide that they thought most adequately represented the mid-point on their scale between the "middle" and "worst" slides. Once the narrowing-down procedure had left a slide that the students felt sure about as most satisfactorily representing the mid-point between the "middle" and "worst" slides, it too was set aside. Seven different slides were selected by the students to represent this midpoint.

Throughout the scaling procedure the researcher was careful not to react to the numerical ratings given by the students. At no time was it suggested that participants might be asked to remember or recall the slides. The instructions proved adequate as all the students quickly grasped the nature of the task and indeed, most of the students found the procedure "interesting" and none found it boring when asked at the end of the experiment about the scaling procedure. The five slides selected by the students via the scaling procedure make up the "scaling of slides" (SOS) scale.

Stage Two: Probe for visual memory images. Each participant was presented the five slides he or she had selected (the SOS scale) once

more in order from the "best" slide to the "worst" slide. The projector was turned off after the five slides were shown and the room lights were turned on. After approximately 60 seconds of informal conversation between the researcher and participant (to guard against possible verbal rehearsal by the participant), each participant in the experiment was handed "the Visual Recall Questionnaire" (VRQ) - six questions about the scene depicted on the slides (see Appendix B). As can be seen by the questions, the VRQ primarily requests the person to recall through description, not recognize through choice. Students were asked to: "think about the "best" slide and using your visual memory, try as best you can to provide written, detailed descriptive answers to the questions you have just received". Students were told to think of the "best" slide since the best projected image should 'logically' yield the best visual memory image. The "best" slide was an obvious and unanimous choice as the best of the set of fifteen slides presented to the students and therefore the number of times it was presented to the students was controlled, thirteen times with an average duration of five seconds per presentation. While there were some slight deviations in the number of times the other fourteen slides were presented to the students, the differences were so minimal that it did not seem to be a disturbing factor in the performance on the VRQ. Participants, once they had finished the VRQ, were again shown the "best" slide and the VRQ questions were asked again while the students were viewing the slide. All participants could provide detailed, correct answers to the questions quite easily with the slide projected.

As mentioned previously, the VRQ was based on a slide of a country scene. The setting of the slide was two cows grazing in a pasture in a valley in the Smoky Mountains. The slides were all taken in the early afternoon on a bright and cloudless day. Such a scene was chosen primarily for three reasons. First of all, since the pastoral scene could readily be described as emotionally pleasant or relaxing, the use of such a scene as a stimulus most likely would not interfere in the subjects' task of scaling the fifteen slides of the scene. Second, the scene did not contain too many objects to distract participants' attention from the scaling of slides procedure, but did contain enough distinct objects to be used as a stimulus probe for the VRQ. Finally, the picture did have an adequate number of "concrete" objects which, according to Paivio (1966) are easier to generate visual images to. Thus, such a scene was deemed a most appropriate stimulus material considering both the nature and demands of the experimental paradigm.

A scoring system for the six VRQ questions was developed from a previous pilot study. For the first five questions, ten points were given for a well-detailed correct answer; five points for a partially correct answer; and no points for a wrong answer or no answer. The veridicality of the answers was based on comparing them to the projection of the "best" slide on the screen. As participants' own comments suggested (see above) the scoring procedure was quite straightforward. For question number six, only one of the six alternative answers was evident in the slide. Ten points were given if the participant indicated the correct alternative (the wire fence) and did not

choose any of the other alternatives. No points were given if none of the alternatives were chosen, and two points were subtracted from the total score for each wrong alternative chosen. A maximum total score of sixty points could therefore be attained. The point totals for each question were added to give what can be loosely termed as a "visual recall score". The VRQ was scored a week after the end of the final experimental session. The questionnaires were shuffled out of order and the student's name was blacked out to prevent bias in the scoring procedure.

Stage Three: Administration of the "Long-form VVIQ". A thirty-item questionnaire was given to participants after discussion of the six VRQ questions was completed. This thirty-item "long-form VVIQ" (VVIQ-L) contained twelve of the sixteen items of the VVIQ randomly interspersed among eighteen additional items (see Appendix C). The eighteen additional items were similar in content and form to the items on the VVIQ. The reasons for the additional items were to guard against participants merely filling in numbers on the basis of habitual ways of filling out the questionnaires (i.e., "ones" for the top items in a category) and to make it difficult for students to respond simply to the items as they had done previously without considering each item independently. Participants upon receiving the questionnaire were given the following oral instructions:

For these items before you, I want you to rate the vividness of your visual memory for each item. In order to rate them, I want you to use the five-point scale that you developed from the scaling of slides

as a guideline. If your visual memory is more like the "best" slide in that it is as "perfectly clear and as vivid as if you were actually and normally looking at the scene", then give it a rating of one. If your visual memory is more like the "worst" slide, in other words "there really isn't anything visually represented that you actually can 'see', you only know that you are thinking of the object or person", then give that item a rating of five. If your visual memory is more like the slide between the "best" and "middle" slides, in other words, "clear and reasonably vivid", then give a rating of two to that item. Give ratings of three and four if your visual memory is more like the "middle", "moderately clear and vivid" slide and the "poorer", "vague and dimmer" slide between the "middle" and "worst" slides, respectively. Try to do each item separately and independently of how you do the other items. Please rate the items as honestly and as accurately as possible.

The five scales (which constituted the SOS scale) each participant had chosen were shown while the instructions were being read, with the appropriate slide projected with the particular description that matched that slide. After the instructions were given, but before the participants would begin to rate the items on the thirty-item questionnaire, the sequence of the five slides of each student's SOS scale was

projected on the projection screen. Rating definitions for each slide (as described above) were also read simultaneously with the presentation of each of the five slides. The slides and accompanying definitions were shown twice more; once after the participant completed ten items of the questionnaire and once after the participant completed twenty items of the questionnaire in order to insure familiarity with both the visual and verbal definitions of the SOS scale.

Stage Four: Discussion with participants. Participants were asked about their impressions of the experiment after the thirty-item questionnaire was completed. In addition to informal discussion of the experiment, students were asked to talk about what their visual imaging experience was like, and how they filled out the VVIQ. Participants left the office with an experimental credit voucher after the purpose of the experiment was described to their satisfaction and they were asked not to discuss the experiment with anybody in a psychology class for one week (the duration of the experiment).

Results

Initial Responses on the VVIQ

The percentage of rating response to each item of the VVIQ is shown in Table 1. It is apparent that there are large differences in the way students answer different items on the questionnaire (e.g., items one and ten). Furthermore, approximately two-thirds of all responses were either ratings one or two on the five-point rating scale. Previous research (i.e., Mark, 1973; Chara, 1977) indicates this high response rate for the first two ratings appears to be a typical pattern. These findings call

TABLE 1
THE PERCENTAGE OF RATINGS GIVEN BY STUDENTS IN RESPONSE TO
VVIQ ITEMS

Rating Given in Response to Questionnaire Item		1	2	3	4	5
Item Number on Marks' Questionnaire	1	61.9	31.7	4.8	1.6	0.0
	2	36.5	31.7	23.8	7.9	0.0
	3	20.6	38.1	17.5	19.0	4.8
	4	39.7	31.7	14.3	7.9	6.3
	5	22.8	36.5	25.4	11.1	3.2
	6	38.1	31.7	19.0	11.1	0.0
	7	39.6	25.4	20.6	7.9	6.3
	8	54.0	34.9	6.3	0.0	1.6
	9	49.2	33.3	17.5	0.0	0.0
	10	11.1	27.0	27.0	30.2	4.8
	11	27.0	41.3	22.2	7.9	1.6
	12	34.9	33.3	25.4	3.2	3.2
	13	20.6	39.6	33.3	11.1	0.0
	14	19.0	36.5	33.3	11.1	0.0
	15	22.2	42.9	31.7	1.6	1.6
	16	25.4	36.5	25.4	12.7	0.0
<u>n</u> ^a		330	348	216	93	21

a

Number of responses of rating values
N = 63 (17 males, 46 females)

into the question the appropriateness of assuming interval and ratio scale properties for the Mark's five-point rating scale and an additivity property for the questionnaire as a whole, in light of the differences between items. In view of these considerations, it was deemed more appropriate that non-parametric statistical methods be employed for analysis.

The Correlation Between the VVIQ and SOS Rating Scales

The calculated rank of the twelve students on the twelve items selected from the VVIQ for later use in the VVIQ-L reflected equivalent ranks of those students on the sixteen item VVIQ as a whole ($n = 12$, $r_s = .976$, $p < .001$). In comparing the use of the two rating scales for the twelve items, the Spearman rank order correlation coefficient was low and statistically insignificant ($n = 12$, $r_s = .290$, $p > .05$). Given the apparent similarity between the two rating scales this was somewhat surprising. There were no statistically significant rank order correlations between the two rating scales in partitions of the students into males, females, "good" or "poor" visual imagers (as determined from initial scores on the VVIQ) only. The differences between the use of the two rating scales is highlighted by the following fact: the percentage for each of the five rating values that remained numerically equivalent for both rating scales never exceeded thirty percent (see Table 2).

The statistical measure Kappa was used to analyze the reliability of participants in distinguishing between pairs of rating values given to VVIQ using the two rating scales. Kappa, a measure of the interobserver reliability of categorical data, was used to determine whether students

TABLE 2
CONCORDANCE PERCENTAGE OF RATING VALUES GIVEN TO VVIQ ITEMS
ON TWO RATING SCALES

Original Marks' Rating Scale Value

	SOS Rating Scale Value					<u>n</u> ^a
	1	2	3	4	5	
1	27.3	34.6	32.7	3.6	1.8	55
2	24.3	29.7	24.3	16.2	5.4	37
3	7.1	42.9	21.4	21.4	7.1	28
4	10.0	10.0	45.0	30.0	5.0	20
5	0.0	25.0	50.0	0.0	25.0	4
<u>n</u> ^a	28	45	44	20	7	144

Notes. 1. Percentages calculated on the basis of the number of particular rating responses given via the SOS scale divided by the total number of rating responses given via the original Marks' rating scale.

2. All ratings were given to the twelve selected items of Marks' VVIQ (see main text).

^a Total number of rating value responses

N = 12

were consistent in maintaining the same difference between pairs of scores on the two rating scales. In signal detection terms, the reliability of students in responding to the same item with two similar rating scales was calculated considering both "hits" (the occurrences of, for example, "ones" or "twos" on one scale that are the same on the other scale) and "misses" (the times, for example, when a one or two on one scale is the opposite number on the other scale). As can be seen in Table 3, when pairs of scores considered were either one or two rating value units apart, there was no statistically significant evidence that students were consistent in maintaining distinctions between these rating values for the two rating scales. This finding provides further support for the notion that participants do not have a clear idea of the distinctions between the rating scale values used in the VVIQ.

Comparison of Scores on the Twelve Item VVIQ Using the Original Marks' and the SOS Rating Scales with Scores on the VVIQ

If the VVIQ does test visual memory imagery, as it purports to do, then a strong predictive relationship should exist between scores on the VVIQ and the VRQ- -a simple "test" of visual memory. Such a relationship was not found in this study. The probability of a significant relationship between scores on the selected VVIQ items using either rating scale and the VRQ appears close to zero: the Spearman rho correlation coefficient was insignificant for scores on the VVIQ and the VRQ using both the Marks' ($n = 12$, $r_s = .028$, $p > .05$) and SOS ($n = 12$, $r_s = .086$, $p > .05$) rating scales. No rank order correlation coefficients approached statistical significance for any of the possible partitions

TABLE 3
RELIABILITY OF RESPONDENTS IN DISTIGUISHING BETWEEN
PAIRS OF RATING VALUES

Rating Pair	<u>n</u> ^a	Kappa Coefficient ^b
1, 2	54	.139
1, 3	41	-.089
1, 4	25	.717*
2, 3	38	-.093
2, 4	25	.369
3, 4	27	-.125

- Notes.
1. All ratings were given to the twelve selected items of Marks' VVIQ (see main text).
 2. The original Marks' VVIQ rating scale and the SOS rating scale were compared.
 3. There were not enough occurrences of rating value 5 to warrant valid calculations.

^aNumber of occurrences of the pair.

^bThe lower the Kappa Coefficient, the lower the ability of respondents to make reliable distinctions between pairs of rating values.

* $p < .001$

N = 12

of students into males, females, "good" or "poor" imagers (determined from scores on the VVIQ using each rating scale) only. Finally the median scores for performance on the VRQ for those selected on the basis of scores on the original sixteen-item VVIQ as "poor visual imagers" ($mdn = 25$) was nearly identical to that of people similarly selected as "good visual imagers" ($mdn = 27.5$).

Discussion

Evidence Against Accepting the VVIQ as a Valid Imagery Test

No evidence in this experiment suggests that the VVIQ is a reliable, valid, or even an adequate test of visual memory imagery. On the contrary, there are three different considerations that form a basis for concluding that a score on the VVIQ may be related weakly to visual memory imagery at best. These considerations are presented below:

1. Properties of the rating scale. A little more than two-thirds of all responses on the VVIQ were either rating value "one" or "two" (see Table 2); a fact that previous research (e.g., Marks, 1973; Chara, 1975) indicates is a common occurrence. It is very likely that the high percentage of rating values "one" and "two" given in response to VVIQ items may be more the result of people not using the five-point rating scale accurately than most people having very good visual memory imagery for a number of reasons.

First of all, in this study the mean total scores for the six "good visual imagers" and six "poor visual imagers" on the twelve selected VVIQ items were 16.8 and 35.2, respectively. When visual analogs (slides) were added to the rating value definitions, the mean total scores for

the "good visual imagers" dropped 9.4 points to 26.2 while the mean total score for the "poor visual imagers" changed very little, 34.8. It is interesting that the same kind of differential shift can be found in Marks' (1973) study. In the second experiment reported by Marks in his article concerning pictorial memory and the VVIQ, the individual mean numerical rating value response of "good visual imagers" selected for the experiment to items on the VVIQ was 1.53; the individual mean numerical rating value response of "poor visual imagers" was 3.15. When these same people were asked to rate the vividness of their visual imagery for pictures using the same VVIQ rating scale, the mean value response of the "good visual imagers" dropped 1.15 points to 2.68 (a drop of one whole rating value on the five-point scale); the mean rating value response for "poor visual imagers" changed slightly to 3.26 (see Marks, 1973, Table 4). In other words, in both cases the rating values for "poor visual imagers" changed very little when they actually could see a picture that accompanied their self-assessment of visual imagery ability. Moreover, for the "good visual imagers" the accompaniment of a more objective measure, a picture, with the subjective rating scale was seen to result in a striking deflation of self-rated imagery ability. Thus, the subjective ratings given by "poor visual imagers" appear much more reliable than the self-assessments given by "good visual imagers".

Secondly, the rating value judgments by "good visual imagers" given in response to VVIQ items are further clouded by the following observation: not one "good visual imager" when asked to first look out the office window and then turn around and face the door and describe their present imaging experience reported that they had an experience like

"normal vision"- -part of the definition for a rating of "one". In fact, the more students were probed about the VVIQ items they had rated "one", the less likely they were to continue in saying they had an imaging experience "clear and reasonably vivid"- -part of the definition of a rating value of "two"- -much less like "normal vision". In conjunction with the fact that there was very little difference in performance on the visual memory task (VRQ) between "good" and "poor" visual imagers determined from the VVIQ, it appears then that many of the people who report a high percentage of rating values "one" and "two" either overrate the vividness of their visual imagery or employ some unexplicated criterion in checking rating scale values.

Finally, there are two further types of evidence on the meaning of the rating scale definitions that indicate that the rating scale used in the VVIQ is misleading at best and of little value as an accurate measure of visual memory imagery. First, people were asked at the conclusion of the experiment; "What does a rating of "one" mean to you?" A sample of some of the diverse answers received were: "If I see that person or thing mentioned in the questionnaire often, I give it a rating of "one"; If I recently saw the object or person, I give the item a rating of "one". Most of the students did not even mention the word imagery in their explanations, and those who stayed closest to the actual definitions given in the rating scale, in their interpretations of how they used the rating scale were mostly those people who rated their visual imagery as "poor". Words such as familiar, frequent, and recent were used more often than words such as image, picture, or see by participants in describing how they went about judging what rating value

to use. Second, while there was unanimous agreement in choosing the "best" and "worst" slides (because they were obvious choices) during the scaling of slides procedure in this experiment, there was considerable disagreement among the subjects as to what other three slides should be in the rating scale they individually constructed. In fact, on several occasions the same slide was used by different students to represent different positions (the "good", "middle", or "poor" slide) in individual five-slide scales. If people can not agree (mean the same thing) on the relative rating value given to a slide projected directly in front of them, why should we expect them to agree on what relative rating values to assign their own "visual memory images"? The ratings seem to have a unique meaning to each individual; their judgments seem to be governed by disparate considerations. There is little sound reasoning to justify lumping a group of individualistic responses together and expect that anything approaching a stable, "objectively verifiable" measure of visual memory imagery will result.

In sum, the evidence points rather toward the need to treat VVIQ items as "unlikes" than to classify and count them together as additive "likes". With such differences between items, it is doubtfully reasonable to add up the numerical ratings given to each item and assume that a unitary "visual imagery" factor is obtained that represents something other than an invalidated computate.

2. Unreliability of responses to the VVIQ using two functionally similar imagery rating scales. Through systematic experience in observing images, both projected and recalled, it was found that significant changes occurred in participants' responses to VVIQ items. Responses

and scores of participants in this study when responding to the same items twice with the original Marks and SOS rating scales were found to be very unreliable. For example, students responding with a rating of one using Marks' rating scale on the first administration of the twelve selected items of the VVIQ were more likely to respond with a rating of "two" or "three" on the second administration of the same items, using the SOS scale. Although the definitions given for each rating scale are very similar, only about twenty-seven percent of the "perfectly clear and as vivid as normal vision" ratings (rating one on Marks' rating scale) remained a rating of "perfectly clear and as vivid as if you were actually looking at the scene" (rating "one" on the SOS scale) with an accompanying slide on the second administration of the scale.

To the degree a questionnaire asks a person to report on an increasingly subjective or ill-defined experience, that is, one for which he or she has had little opportunity for sharing with others in an ordinary discourse that which "objectifies" private events, one may expect a similarly increasing reliance by questionnaire takers on number and position habits in filling out the questionnaire. Thus the fact that the SOS rating scale does, in a sense, "objectify", self-ratings of visual memory imagery becomes more meaningful. Participants' responses are seen to be statistically unreliable as the self-assessment of visual imagery is more "objectified". Since reliability is a necessary though not sufficient condition for the validity of a test, a basic requirement for the construct validity of the VVIQ is particularly questionable.

3. Scores on the VVIQ do not predict performance on a visual recall task. Perhaps the strongest evidence against accepting the valid-

ity of the VVIQ is the fact that three of the people selected for the experiment on the basis of being "poor visual imagers" according to the VVIQ, demonstrated better visual recall on the VRQ than did any of the "good visual imagers" similarly selected for the experiment. If a person reports on the VVIQ that he or she has outstanding visual memory imaging capabilities, then one would certainly expect those capabilities to be manifested elsewhere than on the VVIQ; and certainly a visual recall task represents an appropriate performance measure where the "good visual imagers" could demonstrate the ability they identified when they took the VVIQ. One would certainly question the meaning, if not the truthfulness of an artist who asserts that he or she has outstanding visual memory imagery, but who can not paint or draw anything memory yet, in fact, relies totally on sketch books or photographs. Similarly, when scores on the VVIQ do not directly predict performance on a visual memory recall task (and such scores on the VVIQ supposedly measure this visual memory ability) then, one must question the meaning and veridicality of scores on that questionnaire.

Summary

The construct validity of the Marks VVIQ was addressed in three basic areas: 1) the properties of the rating scale employed in the questionnaire, 2) the reliability of responses to questionnaire items, and 3) the predictive value of the VVIQ on a test of visual recall. The results of investigation into all three areas were very consistent: little, if any, evidence was demonstrated that indicated that the VVIQ is a valid measure of visual memory imagery. This leads to two questions:

1) Could imagery questionnaire takers actually be responding to the questionnaires largely on the basis of concepts other than imagery?

2) What better ways are there to investigate visual memory imagery?

The next experiment addresses the first question, the latter two will address the second.

CHAPTER IV

EXPERIMENT II: IMAGERY AND OBSERVATION QUESTIONNAIRE CORRELATION

Introduction

One of the more interesting findings of Experiment I was the way participants reported they used the Marks' (1973) VVIQ rating scale. When participants were asked, "What does a rating of one mean to you?", it was found that not only was there a wide diversity of opinion, but that the majority of people seemed to be basing their judgments on concepts other than imagery, per se. Words such as familiar, frequency, and recent appeared more important in their explanations than words dealing specifically with visual memory such as image or picture. In other words, when respondents refer to sharp and vivid images of some remembered or imagined event, they may be referring more to the frequency and context in which they have observed it in the past than "seeing" a presently occurring image. Indeed, it is questionable whether scores on the VVIQ are more indicative of self-assessed visual memory imagery or the frequency and context of observation; if, the two can even be distinguished on a self-report questionnaire.

The purpose of Experiment II was to investigate the relationship between self-assessed observation and imagery capability. Specifically, the correlations between scores on observation and imagery self-report questionnaires were examined. In the first part of the experiment participants were randomly given one of the four observation or imagery questionnaires twice; in the second part, participants were given a questionnaire that included observance and imagery instructions.

Method

Subjects

Part I. Participants were 141 undergraduates enrolled in Introductory Psychology at the University of Tennessee, Knoxville. More females ($n = 87$) than males ($n = 54$) took part in the study. All participants received experimental credit toward their final Psychology 2500 grade for their participation. Credit was given only after each student completed two questionnaires.

Part II. Thirty-two undergraduates (eleven females and twenty-one males) enrolled in Introduction to Psychology 2500 at the University of Tennessee, Knoxville, participated in the second part of the experiment. They, too, received experimental credit toward their final class grade for participation. These students, however, took only one questionnaire.

Questionnaires

Five different questionnaires were used in the experiment. In Part I "short" (VVIQ, Appendix A) and "long" (VVIQ-L, appendix C) form imagery questionnaires in addition to short (Appendix D) and long (Appendix E) form observation questionnaires were employed. The items on the two short forms were the same, as were the items on the two long forms. The instructions for the short form Observation Questionnaire (OQ) and the long form Observation Questionnaire (OQ-L) were identical, as were the instructions for the two forms of the imagery questionnaires. The long forms included twelve of the sixteen items of the short form randomly interspersed among eighteen additional items of similar content as a check against students basing their responses primarily on number and position habits.

The Observation and Imagery Questionnaire (OIQ, Appendix F) used in Part II of the experiment consisted of the same rating scale and items of the VVIQ with the addition of the rating scale used in the OQ. Respondents were asked to rate independently the questionnaire items on both scales.

Design and Procedure

Part I. The experiment was conducted in two phases. In the first phase, students agreeing to participate in the experiment were asked to come to a classroom at one of the three times (10:15 a.m., 11:15 a.m., and 1:15 p.m.) in order to fill out a questionnaire. Students were not informed as to the nature of the questionnaires or that there were four different questionnaires to be handed out. After all students were seated (with a male next to a female as much as possible to control gender bias in questionnaire administration) in the comfortable, well-lighted classroom, the following instructions were verbally given:

You are about to receive a questionnaire. Once you get your questionnaire, leave it face down on the table in front of you until you are told to turn it over. Once you receive permission to turn the questionnaire over, please read the instructions carefully before answering the questions. Do not look at the questionnaires of the people around you. Please answer the questionnaire items as honestly and as accurately as possible. When you have completed the questionnaire please turn it face down again and remain quietly seated until you are given permission to turn in your questionnaire. Again do not look on the

questionnaires of those people around you. You may read a book or paper after you have finished your questionnaire. You will be given further instructions after the questionnaires are handed in, so please remain seated until you are given permission to leave. Any questions?

After all questions, if any, were answered to the students' satisfaction, an equal number of the four questionnaire forms were handed out. No two students sitting next to each other received the same questionnaire. Once all completed questionnaires were collected, the participants were reminded to come back exactly one week later to the same room at the same time to participate in Phase Two of the experiment. Students were not told they would be asked to fill out another questionnaire. They were asked not to discuss the questionnaire they took with anybody else in their psychology class for one week. Each experimental session lasted approximately forty minutes.

Phase Two of Part I commenced exactly one week later for each of the three experimental sessions. The procedure followed quite closely that used in Phase One. The major difference was that eighty-four students received a different questionnaire from the one they took in Phase One. Table 4 gives the number of subjects in each of the sixteen permutations resulting from the two administrations of the four questionnaires. Since a number of participants did not show up for the second questionnaire administration, the number of students taking each questionnaire was unequal. Participants in the earlier sessions were asked not to discuss the experiment with those people in the other sessions. Participants in the afternoon session were told the purpose of the experiment; those in

TABLE 4

NUMBER OF PARTICIPANTS IN EXPERIMENTAL GROUP PARTITIONS FOR
EXPERIMENT II

Questionnaire Administered Second Time

Questionnaire Administered First Time		VVIQ	OQ	VVIQ-L	OQ-L	TOTALS
	VVIQ	14(10/4)	5(4/1)	6(4/2)	7 (5/2)	32 (23/9)
	OQ	8(4/4)	14(9/5)	5(3/2)	6 (4/2)	33 (20/13)
	VVIQ-L	8 (4/4)	9(6/3)	14(8/6)	6 (3/3)	37 (21/16)
	OQ-L	8 (5/3)	9(5/4)	7(4/3)	15 (9/6)	39 (23/16)
	Totals	38(23/15)	37(24/13)	32(19/13)	34(21/13)	141 (87/54)

Note. Total number of participants within each partition is listed first. In parentheses, females are listed first; males second.

the earlier sessions were told they could find out about the purpose of the experiment after 2:00 p.m. that day. Again, each experimental session lasted approximately forty minutes. Students were given their experimental credit vouchers upon being dismissed.

Part II. Students agreeing to participate in the second part of the experiment were asked to come to a comfortable classroom in the early afternoon. After all the students were quietly seated, the following instructions were given verbally:

You are about to receive a questionnaire. Once you receive your questionnaire you may immediately begin to read as carefully as you can the questionnaire instructions. After you have read the instructions please turn your questionnaire face down on the table in front of you.

After all questionnaires were turned face down in front of the students, they were asked if they had any questions about the instructions. Since none of the students had any questions, they were told to begin answering the questionnaire and to turn it face down in front of them after they had completed it, and to remain quietly seated until they received permission to hand in the questionnaire.

Students were told the purpose of the experiment after all the completed questionnaires were handed in. The participants were given their experimental credit vouchers and dismissed following answers to all of their questions about the experiment. The duration of the session was approximately forty-five minutes.

Results

Two statistical measures were used to analyze the relationships among (Part I) and within (Part II) the questionnaires. Spearman rank order correlation tests were used to assess respondent reliability; Wilcoxon tests were used to assess item reliability.

Part I

Table 5 presents the Spearman rank order coefficients between the various combinations of the four imagery and observation questionnaires. Spearman correlation coefficients for half of the sixteen combinations of the four questionnaires were statistically significant. In examining Row E of Table 5, higher reliability is seen between students taking only short or long forms of the questionnaires than students taking a combination of the two--an unexpected result. An examination of column V of Table 5 shows perhaps the most interesting finding: while all the correlation coefficients are statistically significant, indicating high reliability among students taking the questionnaires, the highest correlation coefficient (Row C) is for those people who took an imagery questionnaire first and an observation questionnaire second. That is, they are answering the second, on "observation", as they answered the first, on "imagery". Whether students took only imagery (Row A) or observation (Row B) questionnaires both times or were administered one imagery and one observation questionnaire for the two sessions appears to have made little difference to the students. The median between Rows A and B in Column V ($mdn = 71$) is almost identical to the median between Rows C and D in the same column ($mdn = 71.5$). Observance and imagery seem to be dealt with similarly by

TABLE 5
SPEARMAN RANK ORDER CORRELATIONS FOR IMAGERY AND OBSERVATION
QUESTIONNAIRES

		Form of Questionnaire				
		I	II	III	IV	V
		Short (1) Short (2)	Long (1) Long (2)	Short (1) Long (2)	Long (1) Short (2)	Short and Long Combined
Type of Questionnaire	A Imagery (1)	$r_s = .72^{**}$	$r_s = .90^{***}$	$r_s = .54$	$r_s = .76^*$	$r_s = .73^{***}$
	Imagery (2)	(n = 14)	(n = 14)	(n = 6)	(n = 8)	(n = 42)
	B Observation(1)	$r_s = .87^{***}$	$r_s = .88^{***}$	$r_s = .41$	$r_s = .17$	$r_s = .69^{***}$
	Observation(2)	(n = 14)	(n = 15)	(n = 6)	(n = 9)	(n = 44)
	C Imagery (1)	$r_s = .70$	$r_s = .94^*$	$r_s = .54$	$r_s = .86^{**}$	$r_s = .77^{***}$
	Observation(2)	(n = 5)	(n = 6)	(n = 5)	(n =)	(n = 27)
	D Observation(1)	$r_s = .80^*$	$r_s = .17$	$r_s = .10$	$r_s = .62$	$r_s = .66^{***}$
	Imagery (2)	(n = 8)	(n = 7)	(n = 5)	(n = 8)	(n = 28)
	E Imagery and Observation Combined	$r_s = .80^{***}$ (n = 41)	$r_s = .83^{***}$ (n = 42)	$r_s = .40$ (n = 24)	$r_s = .67^{***}$ (n = 34)	N = 141

^a Number in parentheses indicates whether questionnaire was administered the first (1) or second (2) session.

* $p < .05$
 ** $p < .01$
 *** $p < .002$

by the participants in this regard.

The direction and strength of the Wilcoxon coefficients (Table 6) reveals two interesting trends. In examining Table 6, a negative coefficient means the ratings given to the second questionnaire are lower--the second time of administration. A positive coefficient means the self ratings given the first time are better than those given the second time. The first trend of interest is seen by looking at Rows A and D. In all eight cases where an imagery questionnaire was given the second time, respondents' ratings to the same items indicated a better imagery ability. Only half of the eight times when an observation questionnaire was given the second time did a similar finding occur; the other half of the times the opposite result occurred. This trend towards an inflation in imagery self-assessment on the second questionnaire administration is further borne out in Column V of Table 6; the two statistically significant Wilcoxon coefficients are for those instances where an imagery questionnaire was administered the second session.

A second trend involves the interaction between self-assessments on imagery and observation questionnaires. In examining Rows C and D of Table 6 it can be seen that all the Wilcoxon coefficients for the time when an imagery questionnaire was followed by an observation questionnaire were positive; while for the opposite occurrence, all the coefficients were negative. This trend also is borne out in Column V, although the coefficient for Row C is not statistically significant. In other words, for the same items students have a penchant for rating their visual memory imagery better than their ability in observing the same

TABLE 6
WILCOXON COEFFICIENTS FOR IMAGERY AND OBSERVATION QUESTIONNAIRES

	Form of Questionnaire				
	I	II	III	IV	V
	Short (1) ^a Short (2)	Long (1) Long (2)	Short (1) Long (2)	Long (1) Short (2)	Short and Long Combined
A	Imagery (1)	T = -44	T = 31.5	T = 2*	T = 231*
	Imagery (2)	(n = 14)	(n = 14)	...	(n = 39)
B	Observation (1)	T = -42	T = 18.5**	T = -12	T = -362
	Observation (2)	(n = 13)	(n = 15)	...	(n = 40)
C	Imagery (1)		T = 10	T = 10	T = 18
	Observation (2)	...	(n = 6)	(n = 7)	(n = 8)
D	Observation (1)	T = -2*	T = -10	T = -1.5*	T = -61***
	Imagery (2)	(n = 8)	(n = 7)	...	(n = 25)
E	Imagery and Observation Combined	T = 295.5 (n = 38)	T = 275 (n = 39)	T = 104.5 (n = 20)	T = -110*** (n = 32) N = 141

Notes.

1. In categories without a coefficient n, there was an insufficient number of subjects to conduct a Wilcoxon test.
2. Ties in item rank differences are not counted for Wilcoxon tests, so the number of subjects reported is less than the actual number who took the questionnaires in some cases.

^a Number in parentheses indicates whether questionnaire was administered the first (1) or second (2) session.

* p < .05
** p < .02
*** p < .01

things in the first place.

Part II

An analysis of the OIQ provided further support for the findings of Part I. The Spearman rank order correlation for participants between the imagery and observation scale ratings of the same items was statistically significant ($r_s = .68$, $p < .002$). Furthermore, nearly twice as many people reported better imagery ratings for the same items as observation ratings (nineteen vs eleven; two no difference). The Wilcoxon coefficient, although indicating this trend, was marginally insignificant ($T = 158$, $p > .05$).

Discussion

Interpretation of Three Trends

Three significant trends appeared from the analysis of the data of this experiment. Each trend reveals something important about the way people treat the concept of imagery on self-report questionnaires:

1. The concepts of imagery and observation are dealt with very similarly. Imagery or observation instructions made very little difference in regard to the correlation of ranks of participants in this experiment. In terms of rank order correlation there is very little distinction between imagery or observation. This finding can be interpreted in at least two ways: On one hand, observation and imagery can be seen as very closely related concepts and very predictable (in terms of self-rated ability) of each other. On the other hand, "imagery" and "observation" can be seen to be such fuzzy concepts that questionnaire takers respond

primarily on the basis of concepts or factors other than "imagery" or "observation" per se. Questionnaire taking behavior, such as number and position habits in filling out questionnaires, may be more responsible for the high correlations. The results of Experiment I (especially in terms of the rating scale properties) appear to provide more support for the second contention.

2. Self-rated imagery ability seems to improve over time. Participants demonstrated a consistent tendency to rate their imagery capability better the second time they took an imagery questionnaire (Row A, Table 6). This follows a trend evident in Experiment I in which people seem consistently to overrate their imagery capability. If imagery was a stable concept for questionnaire takers, one would expect the scores on these questionnaires to be more stable. The fact is that there is a widespread trend toward imagery scores getting "better". There may be motivational factors present toward overrating imagery capability.

3. Imagery capability is rated better than observation capability. Participants consistently assessed their memory imagery of things to be better than their observation of those things in the first place. In strict perceptual terms, the direction of the relationship is quite contrary to what should be expected. The ratings for observation and imagery are so similar (see Appendix F) that this finding does not appear to be a mere artifact of rating scale discrepancies. Again, this relationship between imagery and observation points toward an overestimation of self-reported imagery ability.

Summary

This analysis of scores on five imagery and observation questionnaires has yielded a pattern of results which suggests that visual memory imagery is at best an unstable, fuzzy concept for respondents to the self-report questionnaires. Since self-report questionnaires appear to be an inadequate means of assessing visual memory imagery ability, the next two studies were designed to investigate more objective means of assessing visual memory imagery ability.

CHAPTER V

EXPERIMENT III: VISUAL RECALL OF PICTORIALLY PRESENTED MATERIAL

Introduction

The first two experiments demonstrated that subjective-report questionnaires are not an adequate means of assessing visual memory imagery. Such questionnaires are clearly not rooted in a solid phenomenological ground. It is quite evident that there is a need for basic research emphasizing objectively what people are recalling more than subjectively what people say they are recalling in the ill-defined terms of self-report imagery questionnaires.

The purpose of this experiment was to investigate visual memory imagery in a more objective fashion. By "objective", it is meant that participants' responses on a measure of imagery ability are amenable to verification by both the participant and experimenter. The imagery measure used was a questionnaire following closely in logic and form to the VRQ used in Experiment I. The Picture Questionnaire (PQ, Appendix G) is a visual recall test that presents respondents with questions that are based on a picture (see Appendix H-3) and are readily verifiable by comparison to it.

There were three main objectives of this experiment:

- 1) To investigate gender differences in visual recall.
- 2) To investigate the effect of stimuli varied in clarity on subsequent visual recall of that stimuli.
- 3) To examine the nature of visual recall; specifically, what aspects of the picture are primarily recalled or forgotten.

Method

Subjects

Participants were 171 undergraduates enrolled in Introductory Psychology at the University of Tennessee, Knoxville. More males ($n = 93$) than females ($n = 78$) took part in the study. All participants received experimental credit toward their final Psychology grade for their participation.

Materials

Picture. A picture by Peggy Burrows entitled "The Magic Mountains" taken out of Childcraft - The How and Why Library (1976) provided the stimulus material for this experiment (see Appendix H-3). This picture was chosen because of its emotionally neutral content and the high number of diverse, easily labeled objects in it. Since such "concrete" objects are supposedly easier to generate visual images to (see Paivio, 1966), this type of picture was deemed a more appropriate stimulus for a visual recall experiment than a picture of more abstract content. Five copies of the picture were made: 1) a very light copy (Appendix H-1); 2) a light copy (Appendix H-2); 3) a "good" normal copy (Appendix H-3); 4) a dark copy (Appendix H-4); and 5), a very dark copy (Appendix H-5).

Questionnaire. The questions on the PQ (Appendix G) were based on Burrow's picture. There were two types of visual recall questions on the PQ. The first were termed "positional" questions (questions 1-6; 11-16). These questions dealt with directional, spatial relationships and requested respondents to identify objects in relationship to other

objects. The other eighteen questions were termed "class" questions and requested respondents to recall from three to six objects related to each other in some fashion (questions 7-10; 17-30).

Procedure

Students who participated in the experiment were requested to come to a large classroom in the early afternoon. They were asked to be seated with males in the odd-numbered rows and females in the even-numbered rows to provide a balanced number of each gender to receive each of the five forms of the picture. After all students were properly seated the following instructions were spoken to them:

You are about to receive a picture. After receiving your copy keep it face down in front of you. Please do not turn it over until you are given permission to do so. After you turn over your picture you will have two and a half minutes to examine the picture. You will be asked questions about the picture later. Are there any questions?

Since there were no questions, the five forms of the picture in a random order were subsequently handed out. The pictures were handed in after two and a half minutes from the time students began to look at the picture were expired. Students were not told that the experiment dealt with visual recall or imagery.

Once the pictures were collected, all students received a questionnaire containing twenty questions about moral values that also provided space for detailed comments in regard to each topic. This questionnaire took an average of twenty minutes to complete. It was

used as a diversionary tactic to prevent short-term memory verbal rehearsal of the picture material. The questionnaire was collected after all students had completed it.

The PQ was handed out face down in front of the students after all the questionnaires about moral values were collected. Students were told to read the directions and answer the questions to the best of their ability after they received permission to turn the PQ over. They were also told not to look at anybody else's questionnaire and to turn their questionnaire back over after they were finished. From the time the pictures were turned over and collected to the time participants received permission to begin on the PQ, exactly thirty-five minutes transpired.

The PQ's were collected after all students were finished with it. It took approximately twelve minutes before all students were finished answering the questions. After all the PQ's were handed in, students were informed about the purposes of the experiment. The students were subsequently given their experimental voucher forms and dismissed.

Scoring of the PQ

For the "class" questions, five points were given for each correct answer; no points for an incorrect answer. The scoring procedure for the "positional" questions was more elaborate (see Appendix I). For each question, a unique scoring system was devised based on both direction and distance from a key object (e.g., the kite, for questions one through four) for each question. Concentric circles provided point totals for distance (one to four points, with four for the closest distance); a straight line provided an additional point if the

respondent's answer was in the right direction (e.g., for question one, an extra point was given if the answer was to the left of the line dividing the picture into right and left sections around the kite). The concentric circles and straight lines were arbitrarily drawn to divide the picture into sections in which individual objects would be dissected least.

Results

For purposes of clarity, the results of the data analysis are presented in three sections corresponding to the three main objectives of this experiment:

Gender Differences in Visual Recall

While the medians for females ($mdn = 33$) were slightly higher than those for males ($mdn = 30$) on both the positional and class questions ($mdns = 70$ and 65 , respectively), median tests demonstrated that the differences for both the positional ($df = 1$, $\chi^2 = .715$, $p > .05$) and class ($df = 1$, $\chi^2 = .298$, $p > .05$) questions were statistically insignificant. Since the positional and class questions were basically different, the PQ was not assumed to have an additive property, composed of both types of questions and total scores were not computed. Because the gender differences were small and statistically insignificant, scores of males and females were combined for further analyses.

Group Form Differences in Visual Recall

Table 7 presents the medians for each of the five groups that received a picture copy of varied clarity. Again, both the median tests

TABLE 7

GROUP MEDIANS FOR THE PICTURE QUESTIONNAIRE

Picture Form	Number in Group	Positional Questions	Class Questions
1	35	29	65
2	34	30	70
3	34	33	70
4	34	33	65
5	33	35	70
Total	171	31	70

for the positional ($df = 4$, $\chi^2 = 7.07$, $p > .05$) and the class ($df = 4$, $\chi^2 = 2.06$, $p > .05$) questions were statistically insignificant. Therefore the descriptive analysis of the questions combined all five forms of the picture.

Descriptive Analysis of the PQ Questions

Since the main objective in analyzing the questions was to examine what is recalled, a brief description of the pattern of response for each question will follow (see Appendix J for accompanying diagrams):

Positional Questions

Question One: "What flying object is to the immediate left of the kite?" Response relative frequency: 1) Hot air balloon (.306); 2) Jet plane (.171); 3) Magic carpet (.159); 4) Parachute (.100) and Stork with baby (.100). No response rate: .082. Eighty-four percent of the responses were to the left of the kite.

Question Two: "What flying object is to the immediate right of the kite?" Response relative frequency: 1) Flying saucer (.253); 2) Witch on a broom (.176); 3) Helicopter (.153); 4) Stork with baby (.094). No response rate: .112. Sixty-two percent of the responses were to the right of the kite.

Question Three: "What object is closest above the kite?" Response relative frequency: 1) Jet plane (.318); 2) Stork with baby (.141); 3) Flying saucer (.124); 4) Hot air balloon (.094); 5) Tram car (.088). No response rate: .106. Seventy-three percent of the responses were above the kite.

Question Four: "What is the object directly below the kite?" Response relative frequency: 1) Stork with baby (.147); 2) Hot air

balloon (.141); 3) Witch on a broom (.082); 4) Ocean liner (.065).

No response rate: .188. Forty-nine percent of the responses were below the kite.

Question Five: "What is directly above the castle?" Response relative frequency: 1) Magic carpet (.218); 2) Flag (.076) and Moon (.076); 4) Sky (.065); 5) Clouds (.053). No response rate: .318.

Question Six: "What is directly to the left of the moon?" Response relative frequency: 1) Helicopter (.159; 2) Stars (.106); 3) Witch on a broom (.076); 4) Flying saucer (.071); 5) Jet plane (.047). The no response rate (.394) was the highest of all the PQ questions.

Question Eleven: "What is immediately to the left of the mushrooms?" Response relative frequency: 1) Two bugs/beetles (.500); 2) Tree trunk/root (.041); 3) Boy flying kite (.035); 4) Girl fishing (.018) and People skiing (.018). No response rate: .265.

Questions Fourteen through Sixteen: "Describe the three objects in the topmost part of the picture that are most centered from the left and right hand sides of the picture." Response relative frequency: 1) Jet plane (.186); 2) Kite (.110); 3) Flying saucer (.104); Stork with baby (.073); 5) Hot air balloon (.055); 6) Moon (.041); 7) Helicopter (.039). No response rate: .180.

Class Questions

Questions Seven through Ten: "Name four objects on the road." Response relative frequency: 1) Sports car convertible (.201); 2) Girl on bicycle (.159); 3) Truck (.135); 4) Car with camper (.100); 5) Rickshaw (.063). No response rate: .207.

Questions Seventeen through Twenty-one: "Name five kinds of

animals." Relative response frequency: 1) Dog (.113); 2) Whale (.101); 3) Penguins (.089); 4) Stork with baby (.084); 5) Two bugs/beetles (.082). No response rate: .199.

Questions Twenty-two through Twenty-seven: "Name six different types of buildings." Response relative frequency: 1) Castle (.142); 2) Ski Challet (.126); 3) "Houses" (.105); 4) Cafe/Gas station (.082); 5) Log cabin (.075); 6) Church (.059). No response rate: .212.

Questions Twenty-eight through Thirty: "Name three objects in the water." Response relative frequency: 1) Ocean liner (.271); 2) Sail boat (.253); 3) Whale (.180); 4) Mermaid (.035); 5) Lighthouse (.024). No response rate: .129.

Discussion

Gender and Group Form Differences

Although females did better than males on the PQ, the difference was small. It does not appear, at least in the terms of this experiment, that in regard to visual memory imagery that separate analyses for the two genders is required. Obviously, in view of the fact there there is a small difference, precautions should be taken to insure a balance of males and females in experimental groups.

While participants did better on the PQ with the best, most clear, copy of the picture, again the differences among all five forms of the picture were statistically insignificant. The clarity of the stimuli did not have a significant functional effect on subsequent visual recall.

Some Observations on Responses to the PQ

Positional Questions

The first four positional questions dealt with objects in four directions around a focal point: the kite. The percentage of correct response and of no response for each of the four directions produces an interesting pattern. Participants demonstrated the following order of correct direction response rate: 1) left (84%); 2) above (73%); 3) right (62%); 4) below (49.5%). Exactly the same order was observed for the no response rate: 1) left (.082); 2) above (.106); 3) right (.122); 4) below (.188). This order is especially interesting in that it corresponds closely to the way a typical American college student learned to read: Start at the left and at the uppermost word or sentence (above); then proceed to the right; upon the end of the line, go below and repeat the sequence. It appears that the participants' scanning for examining the picture used in this study could have been influenced by reading habits.

There are several other observations regarding the positional questions that are worthy of note. The most appropriate response for question three would be the tram car. However, it was mentioned in less than nine percent of the responses. Participants seemed to focus on the flying objects in the sky, while the non-flying tram car was less noticed. A similar finding was observed for question four where less than seven percent of the responses mentioned the ocean liner, which in two-dimensional terms is clearly the most appropriate response. Again, flying objects dominated the attention of participants in terms of their response rate. The word "kite" may have served as a key for the recall

of a class of "flying objects" for the participants.

Questions five, six and eleven which directed respondents' attention to objects in three extreme corners of the picture, had the three highest rates of no response. Of these questions perhaps the most interesting observation comes from question eleven. The first two highest percentage response rates for the bugs and tree trunk were very appropriate answers to the question. However, the next highest rate of response was for the boy with the kite, almost clear on the other side of the picture. In other words, a large section of the picture, the ice pond scene, was largely overlooked. Since the three highest rates of response belong to objects in the foreground, it appears that depth perception may have come into play for question eleven.

The response rates for questions fourteen through sixteen were quite good. A sixty degree arc from the base of the kite extending to the left edge of the jet and the right edge of the saucer enclosed over fifty percent (.502) of the objects named in response to the questions.

Class Questions

There are two observations of interest concerning the class questions. The six buildings with the highest rate of response for questions twenty-two through twenty-seven were those on the two mountains (with the possible exception of "houses", which still could refer to the houses on the slopes of the wooded mountain on the left side of the picture). Only eighteen percent of the responses included buildings from the middle or foreground of the picture. The percentage of responses to questions twenty-eight through thirty also reveals a differential focus of attention. Only five percent of the response

includes objects in the pond (left foreground). With both classes of questions, participants' focus of attention appears to be to certain areas of the picture to the exclusion of others with a fairly high degree of consensus.

Summary

An experiment was designed to investigate the nature of visual recall. It was found that both differences between gender and the clarity of the stimulus material were minimal and statistically insignificant. An examination of the patterns of responses to the PQ revealed several trends regarding what was recalled/observed. The responses to the PQ provide a measure of visual recall that appears to be on the surface, a more accurate measure than the VVIQ. The relationship between the PQ and VVIQ and further examination of visual recall is dealt with in Experiment IV.

CHAPTER VI

EXPERIMENT IV: PERCEPTUAL SCANNING STRATEGIES, SELF-ASSESSED VISUAL MEMORY IMAGERY, AND THE RECALL OF PICTORIALY PRESENTED MATERIAL

Introduction

The previous experiments lead to three primary conclusions:

1) Self-report visual memory imagery questionnaires such as Marks' VVIQ are inadequate measures of the purported abilities. 2. Objectively verifiable questionnaires such as the PQ may be a more dependable means of investigating visual recall. 3. It may be possible to learn more about visual recall by examining scanning patterns. This experiment combines elements of the three previous experiments to investigate possible interrelationships between self-assessed visual memory imagery, different perceptual scanning strategies, and visual recall.

The objectives of this experiment were as follows:

- 1) To examine the relationship between performance on the VVIQ and other measures of recall.
- 2) To examine the interrelationships among six other measures of recall.
- 3) In a follow-up from Experiment III, to determine the effect of different strategies of directed scanning of a picture on the subsequent performance of recall of that picture on various measures of recall.
- 4) To investigate the effect of two-dimensional and three-dimensional recall directions on subsequent recall and the

relationship between such directions to other measures of recall.

- 5) To examine more closely the nature of the recall of a picture.

Method

Subjects

Participants were sixty-six undergraduates enrolled in Introductory Psychology at the University of Tennessee, Knoxville. Forty-one females and twenty-five males took part in the study. All participants received experimental credit toward their final psychology grade for their participation.

Materials

Picture. A picture by Peggy Burrows taken out of Childcraft - The How and Why Library (1976) chosen for the reasons given in Experiment III, provided the stimulus material for this experiment (Appendix H-3). In addition to the untouched copy of the picture, two other modifications of the picture were used. The first modification had a grid superimposed over the picture (see Appendix K-1). The second modification had dark outlines superimposed on the borders of different regions in the picture (see Appendix K-2). The modifications were made to assist students in following the particular scanning instructions they received. No number or letters were on the pictures participants received. The numbers in the pictures of Appendix K were added later for statistical analyses.

Imagery/recall measures. Seven indices of imagery and/or recall ability were used:

- 1) The Marks VVIQ: A self-report visual memory imagery questionnaire (Appendix A).
- 2) A Free Recall measure (FR). Respondents were simply asked to list all of the things they remembered in the picture (Appendix L-1).
- 3) The twelve positional questions of the Picture Questionnaire (PQ-P): Questions require respondents to identify objects in particular directions from other objects (Appendix L-2).
- 4) A two-dimensional Position Questionnaire (POQ): Questions require respondents to identify objects in particular directions from other objects in terms of how objects appear in the flat, two-dimensional space of a picture (Appendix L-3).
- 5) A Depth Perception questionnaire (DP): Questions are similar to those of the PQ-P and POQ except that answers are based on how the objects in the picture would appear in "real-life", three-dimensional space (Appendix L-4).
- 6) A List of Objects measure (LO): Respondents are required to list:
 - a) all the different types of animals in the picture they remember,
 - and b) all the different types of modes of transportation in the picture they remember (Appendix L-5).
- 7) A Drawing of the picture (DW): Participants were asked to sketch the picture (Appendix L-6).

Scanning Directions. Four different sets of instructions for directed scanning were used:

- 1) Scan A: Vertical scanning directions (Appendix M-1).
- 2) Scan B: Horizontal scanning directions (Appendix M-2).
- 3) Scan C: No scanning directions (Appendix M-3).

4) Scan D: Regional scanning directions (Appendix M-4).

Procedure

Students who participated in the experiment were requested to come to a large classroom in the early afternoon. They were asked to be seated with females in the odd-numbered rows and males in the even-numbered rows to insure a balanced number of each gender for the four sets of scanning instructions to be handed out. After all students were properly seated the following instructions were spoken to them:

You are about to receive a questionnaire. When you receive your questionnaire you may begin to answer the questions. Please try to be as accurate and as honest as you can be in answering the questions. When you are finished please turn over your questionnaire, be quiet, and wait until you are instructed to hand the questionnaire in. Any questions?

Since there were no questions, the Marks VVIQ was handed out. Students were given eight minutes to fill it out before handing it in.

After all of the VVIQ's were handed in, each student was given a sealed folder that contained a picture with one of four scanning instructions inside and six other recall measures. Students were not allowed to unseal and open the folders until after the following instructions were spoken:

The folder you have in front of you contains different articles. The first article is a picture that you are to carefully examine. Stapled on top of the picture is a green sheet with specific instructions for scanning the picture. When you receive permission to remove the

picture and instructions out of your folder you may immediately begin to read the instructions. Do not, however, unstaple the instructions and look at the picture until you are given permission to do so. Read the instructions very, very carefully. When you have finished reading the instructions, look up. Any questions?

Since there were no questions, students were allowed to remove the picture and instructions out of the folder and read the scanning instructions. When all students had completed reading the directions by a show of hands, they were instructed to re-read the instructions. After the second reading was completed by all students, again by a show of hands, students were allowed to unstaple the instructions and scan the picture underneath. The participants were given exactly one minute to look at the picture, which previously could not be seen underneath the instruction sheet. After one minute had expired, students were instructed to replace the picture and instructions in the folder and to remove a second packet which contained six recall measures stapled together. Seventeen students each received scanning instructions A or B, and sixteen students each received scanning instructions C or D.

After all students had removed the recall measure packet from the folder, they were asked to keep it face down in front of them. The following instructions were then spoken:

The second packet contains six tasks for you to complete. You will have a certain amount of time to complete each task. Once you have finished one

task, do not go on to another task or look at any other tasks. You will be told how much time you have for each task. When you finish a task, please remain quiet so that you do not disturb others. When you are given permission you will have ten minutes to complete the first task. Any questions?

Students began the FR measure immediately after a question was answered. The participants were given the following amounts of time for each task in the following order.

- 1) FR: Ten minutes
- 2) PQ-P: Five minutes
- 3) POQ or DP: Five minutes (half of the students received the POQ and half the DP first).
- 4) POQ or DP: Five minutes
- 5) LO: Six minutes
- 6) DW: Ten minutes

Upon completion of the drawing, students were instructed to replace the recall task packet back in the folder with their picture and scanning instructions. Experimental voucher forms were handed out to the students after all folders were handed in and discussion of the experiment was finished.

Scoring of Tasks

All materials in each folder were identified by the same number. Immediately after the experiment was completed all recall tasks and VVIQ's were put into separate piles corresponding to each task and then all sheets

were shuffled within each stack. Thus, scoring of the sheets, begun a week later, was accomplished without knowledge of gender or scanning direction differences. After all tasks were scored they were identified as to the specific scanning directions that were used.

A description of the scoring procedure for each task is presented below:

- 1) VVIQ: Rating values were added as usual. The lower the score, the better the self-reported imagery ability.
- 2) FR: A count was made of all the things itemized by the respondent. The "things" listed fell into three classes: a) objects- -something that fits into one or two grid "squares" (see Appendix K-1); b) regions- -anything listed that was larger than two squares but fit into one region as diagrammed in Appendix K-2; c) descriptive concepts- -anything listed that was too big or inappropriate for a regional category (e.g., "Springtime").
- 3) PQ-P: The scoring procedure developed in Experiment III was used (Appendix I).
- 4) POQ: A similar scoring procedure as used for the PQ-P was employed (Appendix N).
- 5) DP: A scoring procedure similar to those used for the PQ-P and the POQ was employed (Appendix O).
- 6) LO: The number of animals and modes of transportation listed were added individually and combined. As with the FR, PQ-P, POQ, and the DP, the higher the total score the better the measured recall.
- 7) DW: Five independent judges were asked to rate on a one-to-five

rating scale each drawing in five categories: (See Appendix P for a complete description)

- a) Category I - The artistic quality of the drawing (Quality).
- b) Category II - How well the topography of the picture was preserved (Topography Preservation).
- c) Category III - How much of the picture was represented (Quantity Representation).
- d) Category IV - How many left vs right errors were made (Horizontal Preservation).
- e) Category V - How many up vs down errors were made (Vertical Preservation).

Since over seventy-five percent of the scores in categories IV and V were identical and the others varied by only one, these two categories were subsequently combined into one Category IV with the median of all ten ratings serving as the new rating score.

Scores for each category were arrived at by taking the median score of the five judges' ratings for each picture. Scores for combinations of more than one category were arrived at by taking the median of the median scores for each category for each picture.

Results

Scores on Performance Tasks

The median scores of performance on the various tasks in this experiment are presented in Table 8. An obvious consistent trend is apparent in examining the different directed scanning procedures: Students using scanning procedures A or C do consistently better on the

TABLE 8

MEDIAN SCORES FOR TASKS IN EXPERIMENT FOUR

	Free Recall: Objects Named	Free Recall: Regions Named	Free Recall: Descriptions Named	Free Recall: Total Sum	Mark's WJQ Sum	Picture Questionnaire Sum	Position Questionnaire Sum	Depth Perception Questionnaire Sum	List of Objects: Animals Named	List of Objects: Modes of Transportation Named	List of Objects: Total Sum	Drawing I: Artistic Quality	Drawing II: Topography Presentation	Drawing III: Quantity Representation	Drawing IV: Vertical and Horizontal Errors	Number of Participants
Scan A Vertical Instructions	18	3	3	25	33	31	18	32	2.5	8.5	11	4	4	3	2	17
Scan B Horizontal Instructions	14.5	3	4	20	35	25	15	26	2	7	10	5	4	4	2	17
Scan C No Instructions	23	3	3.5	31	32.5	29.5	17.5	33.5	3.5	10	13.5	4	4	3.5	2	16
Scan D Regional Instructions	17	2.5	4	23.5	31.5	23.5	12.5	25.5	2.5	8	10.5	5	3	4	2	16
Overall Median	17.5	3	4	24.5	34	27.5	16	29	2	8	11	4	4	4	2	

tasks than those using scanning procedure B or D. This trend is supported by calculating the ranks of the median scores for each scanning procedure within each task category (not including the VVIQ) and then adding them for each scanning procedure. The sum of the ranks for each scanning procedure groups is as follows: 1) Scan C, sum of ranks = 26; 2) Scan A, sum of ranks = 28.5; 3) Scan D, sum of ranks = 39.5; 4) Scan B, sum of tanks = 46. Those students who received no specific scanning instructions did best overall, followed in order by the vertical, regional and horizontal scanning procedure groups. A chi square analysis comparing the sum of ranks for Scans A and C to those of Scans B and D demonstrated that the differences in ranks was statistically significant ($df = 1$, $\chi^2 = 6.78$, $p < .01$).

It is interesting that in comparing self-reported imagery ability as measured on the VVIQ and performance on subsequent tasks, there are large discrepancies in the ranks of individuals. The rank order for scanning procedure groups according to median scores on the VVIQ would be: 1) Scan D; 2) Scan C; 3) Scan A; 4) Scan B. Only with the scanning procedure group B is the rank the same as observed for the recall tasks. Thus, levels of performance on visual recall tasks appear to be more predictable by type of scanning procedure than degree of self-reported imagery ability, as measured on the VVIQ.

Comparison of Questionnaires

Table 9 represents the Spearman rank order correlations among the six questionnaires used in this experiment. Perhaps the most striking observation in the table is the high degree of correlation among the six objectively

TABLE 9

SPEARMAN RHO COEFFICIENTS BETWEEN

SEVEN IMAGERY/RECALL MEASURES

		Measure					
	Scan	Marks	Picture	Position	Depth	Free Recall	List
Marks	A	-	.201	.583*	.428	.119	.307
	B	-	.265	.509*	.255	.252	.332
	C	-	.316	.431	.311	.257	.218
	D	-	-.213	-.494	-.199	-.263	-.235
Median		-	.233	.470	.283	.186	.262
Picture	A		-	.458	.676**	.703*	.403
	B		-	.787***	.142	.506*	.667**
	C		-	.246	.526*	.434	.191
	D		-	.800***	.641**	.731***	.551*
Median			-	.623*	.583*	.605*	.477
Position	A			-	.743***	.549*	.637**
	B			-	.237	.487	.746***
	C			-	.459	.406	.552*
	D			-	.639**	.824***	.493
Median				-	.549*	.513*	.613*
Depth	A				-	.568*	.700**
	B				-	.610*	.746***
	C				-	.658**	.683**
	D				-	.568*	.555*
Median					-	.589*	.692**
Free Recall	A					-	.557*
	B					-	.671**
	C					-	.744***
	D					-	.530*
Median						-	.614*

Note. Significance levels for all medians based on n=16.
* p < .05
** p < .01
*** p < .002

verifiable measures and the low degree of correlation between the Marks VVIQ and all other measures. This observation is further highlighted by two types of evidence. First, nine of the ten medians across all scanning groups among the six objectively verifiable measures were significant, while none of the five relevant medians involving the VVIQ were significant (Table 9). Second, the number of significant correlations for all specific scanning procedures for the Marks questionnaire was slight in comparison to other questionnaires (see Tables 10 and 11). The significance of this difference is supported by Chi Square analyses. The number of significant correlations is significantly different between the Marks and: the PQ-P ($\chi^2 = 5.83$, $p < .02$); the POQ ($\chi^2 = 7.29$, $p < .01$); the DP ($\chi^2 = 10.67$, $p < .01$); the FR ($\chi^2 = 10.67$, $p < .01$); and the LO ($\chi^2 = 12.60$, $p < .001$). (One degree of freedom for all chi square values.) By contrast, the highest chi square value between any of the objectively verifiable measures (LO and PQ-P) was low and statistically insignificant ($df = 1$, $\chi^2 = .94$, $p < .05$).

A Kruskal-Wallis analysis of variance was used to assess differences between scanning procedures in terms of a total score for each measure. As Table 12 shows, significant differences between scanning procedures were found for the DP, FR, and LO. The lowest coefficient was for the VVIQ. The Kruskal-Wallis coefficients demonstrate the degree to which the different total scores are sensitive to differences in scanning techniques. It can be seen that the FR is most sensitive while the VVIQ is least sensitive (as indeed should be expected).

TABLE 10

NUMBER OF STATISTICALLY SIGNIFICANT SPEARMAN RHO COEFFICIENTS
BETWEEN THE SEVEN IMAGERY/RECALL MEASURES IN EXPERIMENT FOUR

Statistical Significance	Marks	Picture	Position	Depth	Free Recall	List
Yes	2	10	11	13	13	14
No	18	10	9	7	7	6

Note. For detailed values see Table 9.

TABLE 11

NUMBER OF STATISTICALLY SIGNIFICANT SPEARMAN RHO COEFFICIENTS
BETWEEN SIX RECALL MEASURES IN EXPERIMENT FOUR

Statistical Significance	Picture	Position	Depth	Free Recall	List
Yes	10	9	13	13	13
No	6	7	3	3	3

Note. For detailed values, see Table 9.

TABLE 12

KRUSKAL-WALLIS COEFFICIENTS FOR QUESTIONNAIRES
 COMPARING FOUR DIRECTED SCANNING METHODS

Questionnaire

Marks	Picture	Position	Depth	Free Recall	List
.434	2.965	4.882	11.235*	14.600**	8.103*

Note. 1. Degrees of freedom was three for all questionnaires.

* $p < .05$

** $p < .01$

Free Recall Analysis

Analyses of the FR task indicate that there are some important patterns of recall in the picture. The recall of specific areas of the picture was more closely examined by the following procedure:

- 1) The picture was divided into squares and regions (see Appendix K).
- 2) The total number of objects within each area, wholly or in part, was calculated.
- 3) The total number of objects mentioned in the FR that corresponded to each area of the picture was counted for each area.
- 4) The number in step 3 was divided by the number of participants in each group.
- 5) The quotient in step 4 was divided by the number of objects within each area (step 2). This quotient then was used as an indicator of focus of recall. Table 13 presents these quotients for divisions of the picture into squares, Table 14 for regions.

There were a few significant differences between directed scanning procedures and relative frequency of recall for divisions of the picture into specific areas. In divisions into squares (for location, see Appendix K-1) there were four significant differences:

- 1) Square 2: Students using scanning instructions A and C did significantly better than those using B and D ($df = 1$, $\chi^2 = 6.70$, $p < .01$). Because of differences in numbers of students in the four scanning groups, all χ^2 's used calculations where the cross-product numbers of subjects were equivalent.
- 2) Square 10: Students using scanning procedures A and C did significantly better than those using B and D ($df = 1$, $\chi^2 = 4.26$,

TABLE 13
FREE RECALL ANALYSIS: FREQUENCY
OF RECALL BY SQUARE

Scanning Instructions

Square	Number of Objects in Square	A		B		C		D		Median
		Observed Frequency	Relative Frequency	Observed Frequency	Relative Frequency	Observed Frequency	Relative Frequency	Observed Frequency	Relative Frequency	
1	8	33	.243	26	.191	18	.141	23	.180	.186
2	10	28	.165	15	.088	28	.175	15	.094	.130
3	5	29	.341	24	.282	36	.450	22	.275	.312
4	6	14	.137	11	.108	15	.147	17	.177	.142
5	6	6	.059	8	.078	8	.078	7	.073	.076
6	9	15	.098	15	.098	22	.144	17	.118	.108
7	5	6	.071	2	.024	5	.059	11	.138	.065
8	8	13	.096	3	.022	8	.063	9	.070	.067
9	7	11	.092	11	.092	9	.076	9	.080	.086
10	8	33	.243	26	.191	45	.352	27	.211	.227
11	8	1	.007	2	.015	5	.039	2	.016	.016
12	6	8	.078	9	.088	14	.146	9	.094	.091
13	5	0	.000	0	.000	0	.000	0	.000	.000
14	21	27	.076	23	.064	26	.077	16	.048	.070
15	16	10	.037	7	.026	34	.133	6	.023	.032
16	15	3	.012	7	.027	10	.042	5	.021	.024
17	14	5	.021	8	.034	9	.040	5	.022	.028
18	6	14	.137	16	.157	17	.177	14	.146	.152
19	14	33	.139	11	.046	24	.107	29	.129	.118
20	15	22	.086	8	.031	21	.088	22	.092	.087
21	19	19	.059	12	.037	26	.086	20	.066	.063
22	19	14	.043	15	.046	29	.095	17	.056	.051
23	8	10	.074	8	.059	9	.070	15	.117	.072
24	7	9	.076	4	.034	6	.054	9	.080	.065
Total 245		363	-	271	-	424	-	326	-	-
Median -		-	.076	-	.053	-	.087	-	.086	

Note.

1. Relative frequency computed by dividing the observed frequency for each square by the number of objects in that square and that quotient by the number of participants ($n = 17$ for A & B; $n = 16$ for C & D).
2. All medians derived from the relative frequencies listed for the particular row or column.
3. See appendix for location of specific squares.

TABLE 14
FREE RECALL ANALYSIS: FREQUENCY OF RECALL BY REGION

Scanning Instructions

REGION	Number of Objects in Region	A		B		C		D		MEDIAN
		Observed Frequency	Relative Frequency	Observed Frequency	Relative Frequency	Observed Frequency	Relative Frequency	Observed Frequency	Relative Frequency	
A	12	82	.402	70	.383	80	.417	69	.359	.381
B	4	15	.221	11	.162	8	.125	14	.219	.191
C	10	30	.176	13	.076	24	.150	15	.094	.122
D	13	39	.176	35	.158	35	.168	32	.154	.163
E	7	15	.126	16	.134	22	.196	15	.134	.134
F	19	37	.115	32	.099	28	.092	32	.105	.102
G	7	24	.202	18	.151	58	.518	16	.143	.177
H	15	6	.024	8	.031	18	.075	5	.021	.028
I	5	17	.200	17	.200	22	.275	18	.225	.213
J	10	18	.106	5	.029	17	.106	17	.106	.106
K	13	32	.145	29	.131	35	.168	37	.178	.157
L	7	6	.050	3	.025	9	.080	3	.027	.039
M	8	16	.118	11	.081	14	.109	22	.172	.114
N	10	45	.265	20	.118	26	.163	36	.225	.194
O	11	12	.064	11	.059	17	.097	13	.074	.089
TOTALS	151	394		299		413		344		
MEDIAN			.145		.118		.150		.143	

Notes.

1. Relative frequency computed by dividing the observed frequency for each region by the number of objects in that region, and that quotient by the number of participants (n=17 for A & B, n=18 for C & D).
2. All medians are derived from the relative frequencies listed for the particular row or column.
3. See Appendix for location of specific regions.

$p < .05$).

- 3) Square 15: Students using scanning directions A and C did significantly better than those using B and D ($df = 1$, $\chi^2 = 9.28$, $p < .01$).
- 4) Square 19: Students using scanning instructions A and D did significantly better than those using B and C ($df = 1$, $\chi^2 = 4.29$, $p < .05$).

In divisions of the picture into regions (for location, see Appendix K-2) there were three significant differences:

- 1) Region C: Students using scanning procedures A and C did significantly better than those using B and D ($df = 1$, $\chi^2 = 6.88$, $p < .02$).
- 2) Region G: Students using scanning directions A and C did significantly better than those using B and D ($df = 1$, $\chi^2 = 13.43$, $p < .001$).
- 3) Region N: Students using scanning instructions A and D did significantly better than those using B and C ($df = 1$, $\chi^2 = 9.59$, $p < .01$).

While there were some differences between the directed scanning procedures in terms of some specific areas of the picture, the overall pattern in regards to ranks that results of all scanning procedures are closely correlated (see Table 15). Some interesting patterns develop by combining the four scanning procedures and looking at the ranks of the overall medians for specific areas. In examining ranks in the regional analysis (see Appendix Q-1), the regions in the valley between the mountains (regions H, J, O, and L, see Appendix K-2) and the mountain partly obscured by a large tree in the foreground (region F) evidently are less recalled than other regions of the picture.

TABLE 15

SPEARMAN RHO COEFFICIENTS BETWEEN DIFFERENT SCANNING

STRATEGIES AND TWO METHODS OF FREE RECALL ANALYSIS

Analysis Method	A - B	A - C	A - D	B - C	B - D	C - D
Regional	.828	.796	.852	.817	.812	.713
Squares	.776	.785	.862	.807	.758	.739

Note. All coefficients significant beyond the .002 level (p < .002).

A further statement on recall can be made by examining the pattern of ranks in the square analysis of the picture. In summing ranks for rows and columns in the square analysis (see Appendix Q-2), recall is greater for objects in the top half of the picture (sum of ranks for rows one and two = 111.5) than for the bottom half of the picture (sum of ranks for rows three and four = 188.5). This discrepancy is not seen in dividing the picture into left and right halves (sum of ranks 145.5 and 154.5 for left and right halves, respectively). Furthermore, a chi square analysis of the ranks of the square analysis as a whole reveals that there are significant differences in regards to the recall of specific squares of the picture ($df = 15$, $\chi^2 = 46.95$, $p < .001$). This finding, however, may be more the result of the properties of the picture than recall strategies on the part of participants.

A final point to be made concerns the form of the lists made by students in filling out the FR task sheet. Thirty-one of the thirty-four students in scanning groups A and B wrote their FR lists in a vertical manner (one object underneath the other), while three students wrote their lists in a paragraph form. However, for scanning groups C and D, thirteen of the thirty-two students used a paragraph form and nineteen a vertical list form. A chi square analysis revealed that this difference was statistically significant ($df = 1$, $\chi^2 = 7.43$, $p < .01$). It is interesting to note that students using scanning directions A and B used a picture with a grid to help guide their linear scanning procedure, while students in scanning groups C and D did not have a grid superimposed on the picture to guide a linear scanning procedure. It seems that the scanning procedure had a subsequent effect on the form of the written lists in the FR

questionnaire: a linear procedure (scans A and B) was more likely to lead to a written linear list.

Drawing Analysis

The medians for the drawing categories and the VVIQ in Table 8 provides an interesting contrast. The overall median of thirty-four for the VVIQ divided by the sixteen questions would leave an item score of about two, a self-assessed visual memory imagery ability of "clear and reasonably vivid". In other words, the majority of the students reported having fairly good visual memory imagery. Conversely, the medians for the first three drawing categories which were ratings of what really was recalled were all rating value four. In other words, the independently assessed performance on the drawings was rated quite poor. In fact, of the 990 ratings given by the five judges to the sixty-six students on the three categories, only forty-one ratings of two were given and only six of one. Thus, while self-ratings of recall ability were good, independent ratings of recall performance as indicated by drawings were poor, a striking contrast.

Table 16 presents the relationship between drawing categories and imagery/recall measure scores. There is a complex interrelationship among three variables: drawing category, imagery/recall measure, and scanning instructions. For the sake of clarity, each variable will be dealt with individually before a more molar picture is presented.

1. Analysis of the drawing categories. Table 17 presents the correlation coefficients among the four categories. It can be seen that across the four scanning procedures (see the column medians) there are two statistically significant relationships. Topography Preservation (II)

TABLE 16

SPEARMAN RHO COEFFICIENTS BETWEEN RANKS OF MEDIAN SCORES ON DRAWING
CATEGORIES AND RANKS ON OTHER IMAGERY/RECALL MEASURES

Drawing Category	Scanning Instructions	Marks	Picture	Position	Depth	Free Recall	Libt	Median
I	A	.211	.108	.031	.135	-.112	-.092	.070
	B	.165	.099	.011	.316	.458	.200	.183
	C	.496	.357	.486	.333	.347	.044	.352
	D	.160	.525*	.596*	.543*	.494	.258	.510*
	Median	.188	.233	.294	.325	.403	.122	-
II	A	.107	.198	.183	.536*	.225	.351	.212
	B	.011	-.072	-.171	.444	.338	-.018	-.004
	C	.446	.376	.703**	.601*	.536*	.618*	.569*
	D	-.127	.237	.518*	.304	.085	.408	.271
	Median	.059	.218	.351	.490	.282	.380	-
III	A	.149	.413	.651**	.483	.721***	.516*	.500*
	B	.295	.581	.386	.477	.676**	.406	.442
	C	.057	.518*	.257	.644**	.690**	.628*	.573*
	D	-.190	.135	.388	.483	.465	.262	.365
	Median	.103	.466	.387	.483	.683**	.461	-
IV	A	.023	.178	.048	.134	-.125	-.183	.036
	B	-.148	.043	.030	.210	.016	.074	.037
	C	.621*	.533*	.008	.310	.460	.301	.385
	D	.482	.053	.046	-.087	-.110	-.059	.053
	Median	.253	.116	.038	.172	.047	.067	-

Note. 1. Medians are derived from each particular row or column (n = 17 for A & B; n = 16 for C & D).

2. Significance levels for all column medians based on n = 16.

* p < .05

** p < .01

*** p < .002

TABLE 17

SPEARMAN RHO COEFFICIENTS BETWEEN PAIRS OF DRAWING

CATEGORIES

Drawing Category Pair

Scanning Instructions	I,II	I,III	I,IV	II,III	II,IV	III,IV
A	.526*	.123	.461	.446	.351	.235
B	.644**	.171	.478	.534*	.595*	.214
C	.503*	.399	.494	.526*	.453	.457
D	.376	.312	.283	.857***	.002	-.103
Median	.515*	.356	.470	.530*	.402	.225

Note. 1. Significance levels for all column medians based on $n = 16$

Key I = Quality of drawing
 II = Topography preservation
 III = Quantity representation
 IV = Vertical and horizontal errors

* $p < .05$
 ** $p < .01$
 *** $p < .002$

is significantly correlated with Quality of the Drawing (I) and Quantity of Representation (III). Vertical and Horizontal Errors (IV) is the only category across the four scanning procedures that is not significantly related with another category.

A median test was performed using the correlation coefficients of Table 16 (overall mdn = .279) comparing the four drawing categories. It was found that a statistically significant difference existed among the four drawing categories ($df = 3$, $\chi^2 = 12.33$, $p < .01$). In other words, there was a significant difference between the drawing categories in terms of number of correlation coefficients above and below the overall median. Further chi square analysis identified the primary source of variance as between categories III and IV ($df = 1$, $\chi^2 = 10.08$, $p < .01$). No other chi square analyses between the drawing categories reached the .05 level of statistical significance.

2. Analysis of relationships to other measures. Comparing the other measures to the drawing categories reveals that certain measures are more closely related to certain drawing categories. For Quality of the Drawing (I), the FR measure is most closely related (column mdn = .403, $p .05$). The DP measure is most closely related to the Topography Preservation (II) (column mdn = .490, $p .05$). The FR measure is most closely related to Quantity of Representation (III) (column mdn = .683, $p .01$). While the VVIQ has the highest correlation coefficient for Vertical and Horizontal Errors (IV) (column mdn = .253, $p .05$), the coefficient is very weak and below the overall median of Table 16 (mdn = .279). Clearly the best conclusion to be drawn in regard to the measures and drawing category IV is that no relationship

appears.

A median test was done comparing the six measures' correlation coefficients in Table 16 (overall mdn = .279). No statistically significant difference was found among all the measures in terms of differences in correlation coefficients above and below the overall median ($df = 5$, $\chi^2 = 8.25$, $p > .05$). However, a chi square analysis revealed that a statistically significant difference did exist between the VVIQ and the DP ($df = 1$, $\chi^2 = 4.52$, $p < .05$) with the DP having significantly more correlation coefficients above the overall median. No other such chi square analysis comparisons among other measures reached the .05 level of significance.

3. Analysis of the scanning procedures. There are differences in scanning procedure groups within each drawing category. While for drawing category III all the row medians of Table 16 are above the overall median of .279 for all scanning procedures, for all other drawing categories only scanning procedure C is above the overall median with the exception of scanning procedure D for drawing category I. Since the row medians include Marks' VVIQ, the majority of the medians would actually be higher if the VVIQ were eliminated.

An overall median test comparing the four scanning procedures analogous to those used for comparing the drawing categories and other measures revealed significant differences among the scanning procedures ($df = 3$, $\chi^2 = 12.33$, $p < .01$). Further chi square analyses revealed that the primary source of variance involved scanning procedure C. It was found that scanning procedure C was most significantly different in regard to relationships to drawing categories from scanning procedure A

(df = 1, $\chi^2 = 5.83$, $p < .02$). No other chi square comparisons reached the .05 level of statistical significance.

4. The overall pattern of interrelationship. Collapsing the drawing categories provides a way of analyzing the overall relationship of scanning procedures and questionnaire scores to drawing performance. Taking the median of the medians for the four drawing categories and comparing it to the measures and scanning procedures reveals that the DP (column mdn = .441, $p > .05$) is most closely related to overall drawing performance (Table 18). Since the correlation coefficients for drawing category IV in Table 16 were basically quite low, a further analysis in Table 18 was done involving only drawing categories I, II, and III. It can be seen that the POQ (column mdn = .519, $p < .05$) has joined the DP (column mdn = .494, $p > .05$) and the FR (column mdn = .584, $p < .05$) as the indices most closely related to overall drawing performance.

Finally, drawing categories II and III are the best categorical measures of pure recall performance. An analysis done with only these two categories (Table 18) reveals that the DP (column mdn = .526, $p < .05$) and the FR (column mdn = .647, $p < .01$) measures are most closely related to recall as indicated by drawing performance. The POQ (column mdn = .418, $p > .05$) is next best.

Also of interest is a comparison of the relationship between scanning procedures. Scan C has the most high correlations in all three analyses in Table 18. In the analysis using the best indicators of visual recall (drawing categories II and III) Scans C and A are by far the most closely related. Since, as shown in Table 8, students did

TABLE 18
SPEARMAN RHO COEFFICIENTS BETWEEN RANKS OF MEDIAN SCORES ON COMBINATIONS OF DRAWING CATEGORIES
AND RANKS ON OTHER QUESTIONNAIRES

Drawing Category	Scanning Instructions	Narks	Picture	Position	Depth	Free Recall	List	Median
I - IV	A	.132	.297	.333	.452	.166	.127	.232
	B	.000	.068	-.227	.281	.297	-.085	.034
	C	.563*	.708**	.385	.650**	.729**	.514*	.607*
	D	-.201	.271	.540*	.420	.579*	.238	.350
	Median	.066	.284	.359	.441	.438	.183	—
I - III	A	.061	.256	.509*	.510*	.298	.342	.320
	B	.185	.140	-.036	.455	.592*	.154	.170
	C	.521*	.586*	.604*	.613*	.686**	.454	.595*
	D	-.174	.224	.529*	.477	.576*	.294	.386
	Median	.123	.240	.519*	.494	.584*	.318	—
II - III	A	.186	.331	.682*	.540*	.653**	.599*	.570*
	B	.076	.377	.091	.511*	.640**	.223	.300
	C	.336	.530*	.455	.727**	.675**	.682**	.601*
	D	-.241	.132	.381	.346	.487	.106	.239
	Median	.131	.354	.418	.526*	.647**	.411	—

- Note. 1. Drawing category ranks are derived from the medians of the medians for each individual category.
 2. Medians are derived from each particular row or column ($n = 17$ for A - B, $n = 16$ for C - D).
 3. Significance levels for all column medians based on $n = 16$.
 * $p < .05$
 ** $p < .01$

better overall in performance on the recall measures using these two scanning procedures, this relationship to recall in terms of drawing performance is not unexpected, and further corroborates the evidence that suggests that scanning strategies significantly affect subsequent recall in a variety of ways.

Discussion

The results of this experiment have some important implications for the study of visual memory imagery. For the sake of clarity, these implications will be discussed in terms of the objectives of this experiment.

The Relationship Between Performance on Marks' VVIQ and Other Indices of Recall

Once again the VVIQ has been demonstrated to be a less than adequate measure of visual memory imagery. On the face value of the VVIQ, it would seem apparent that it should be predictive of performance on other measures of recall. As seen in Table 8, the VVIQ has little predictive value on the other measures of recall. The evidence for the construct validity of the VVIQ in this experiment is quite lacking.

Since the VVIQ lacks construct validity, it is not surprising that in all the correlative analyses done in this experiment taken as a whole, the VVIQ was least related to other measures of recall performance than any other questionnaire or measure (see Tables 9, 10, 16 and 18). The strength of the correlations indicate that it is safer and more accurate to conclude that the VVIQ has little to do with visual recall than to assume that it does. The overall pattern of relationship between the

VVIQ and other measures of recall is one of low correlation.

The Relationship Among the Other Measures of Recall

As can be seen in Tables 9 and 11, there is a fairly high degree of correlation among the five other recall measures in this experiment. Furthermore, Tables 16 and 18 demonstrate that there is a fair degree of correlation among these measures and drawing performance, most particularly for the FR and DP. Considering that the scoring procedures involved for the most part were anything but straightforward, the degree of correlation is important.

The correlations among these six measures of recall indicate two things: 1) There may be some recall ability that is tapped better by these, more objective measures, than the subjective measure VVIQ. 2) It is possible that these more objective measures have some predictive value concerning visual recall. Although this type of relationship was not specifically established, the evidence certainly favors such a case more than for self-report questionnaires as the VVIQ.

Generally speaking, the objectively verifiable tasks tapped diverse, yet related recall abilities. The relationship between the FR and DP is particularly interesting in this regard. A person could theoretically score very well on the FR without any visual memory imagery per se. The DP, on the other hand, appears to require a strong visual memory of some sort. When it comes to the best indicators of recall performance through a drawing (Categories II and III), these two measures are most closely related to performance (Table 18). Two implications of this are that free recall may be strongly visually mediated or that a "good", "visual"

recall is facilitated or mediated by some basically non-visual labelling operations.

The Effects of Different Directed Strategies of Scanning Material on Subsequent Recall of That Material

Dramatic differences in recall performance were seen as the result of different directed strategies for scanning the picture. While the fact that students were instructed to follow certain methods of scanning does not insure that they actually did, the differences observed in this experiment certainly indicate that the directions had important effects on students' later ability to perform on various recall tasks. The no instruction (Scan C) and vertical instruction (Scan A) groups were clearly superior to the regional (Scan D) and horizontal (Scan B) groups. In terms of sums of ranks in Table 8, Scan C was best, followed in order by Scans A, D and B.

It is interesting to note a relationship between the effectiveness of the four scanning strategies and an observance in Experiment III. In that experiment it was noted that participants' recall for objects around the kite in the picture was best for those to the left of the kite, then in order, above, below and to the right of the kite. In other words, a sort of 1) left, 2) above, 3) below, 4) right "rule of effectiveness" was observed. Looking at the nature of the scanning procedures used in this experiment (see Appendix M), there is a relationship between effectiveness of scanning procedure and degree of violation of the so-called "rule of effectiveness" (RE), Scan C was the most effective procedure towards subsequent recall performance, and with no instructions had no directed

violations of the RE. Scan A was next most effective and it can be seen that the scan starts in the left and proceeds up then to the right and down. The Scan A directions have left to right and above to below components in them, with minor violations of right before below three times in the top fourth of the picture and right before above twice in the bottom fourth of the picture. In general, the overall scanning directions are in agreement with the RE. Scan D is third most effective. Its scan begins to follow the RE of left - above but then the rule is violated because the scan skips the middle of the picture and goes to the right - above before back to the left - below. This is a more serious violation of the RE than with Scan A. Finally, Scan B contains serious violations of both the horizontal and vertical components of the RE. First of all, the scanning directions in the top part of the picture depart from the left, quicker than Scans A and D. Second, steps 2 and 4 of the instructions violate quite clearly the left - right "rule". Lastly, the movement directed is all downward away from the top of the picture (above "rule").

The RE is, of course, very conjectural and may be a mere artifact of the properties of the picture used. The effectiveness of the different scanning strategies and their degree of departure from this RE does, however, indicate one thing: Different strategies of scanning are more effective than others, and part of the degree of effectiveness may be due in part to how closely they follow certain established cognitive/perceptual operations.

Differences in Recall of the Picture Between Two-Dimensional and Three-Dimensional Mediated Thinking

Participants scored almost twice as well on the DP than the POQ. In other words, their recall was better with three-dimensional thinking than with two-dimensional thinking. Furthermore, as can be seen in Tables 16 and 18, scores on the DP are more closely related to recall via drawing performance than on the POQ. These findings indicate that visual recall may be more three-dimensional than two-dimensional in nature, at least in respect to the type of picture used in this experiment. In other words, visual recall is not simply a passive experience, but more like an active interpreting visual experience.

Some Final Comments on the Nature of Visual Recall

Analyses of the FR paint a picture of the nature of the recall of Burrows' picture. In terms of ranks of recall for both the regional and square analyses of the FR responses (Appendix P) recall is worst for the valley between the mountains (except the bridge) and the mountain on the left partly hidden by a large tree in the foreground. In regions where objects are allowed to stand out the most (e.g., the sky, sea, white snowy ski slope, front - left foreground) recall is best. Visual search is easiest in these regions, where the "figure" is most discrepant from the "ground". There may be than also a "gestalt" nature to visual recall.

In conclusion, these final remarks can be made about the nature of visual recall:

- 1) Visual recall is greatly affected by scanning strategies whose effectiveness may be strongly influenced by certain established cognitive/perceptual operational "rules".

- 2) Visual recall is more three-dimensional than two-dimensional in nature.
- 3) Good visual recall may require non-visual labelling components.
- 4) A "figure-ground" principle appears to be in operation in visual recall.
- 5) In terms of performance on the tasks, there seems to be a wholesale overrating of visual recall capability among people.

Summary

An experiment was designed to investigate the interrelationships among self-reported visual memory imagery, different perceptual scanning strategies, and performance on various objectively verifiable recall measures. It was found that while there was a strong relationship between different scanning strategies and performance on subsequent recall measures, relationships between subjective reports of imagery and recall performance were very weak and primarily statistically insignificant. The results seriously question the validity and adequacy of the Marks' VVIQ, a purported measure of visual memory imagery. In contrast, several more objective measures were shown to have more merit of varying degrees. Analyses of the patterns of recall performance provided a promising means of gaining a more accurate knowledge of the nature of visual memory imagery.

CHAPTER VII

DISCUSSION I:

IMPLICATIONS FOR SELF-REPORT VISUAL MEMORY IMAGERY QUESTIONNAIRES

The results of this research conclusively demonstrate that Marks' VVIQ does not provide an adequate measure of visual memory imagery ability if visual imagery is conceived as related to behavioral measures of recall and reproduction. Several different research findings provide the reasons for arriving at the conclusion that one must reject the validity of the VVIQ. A summary and discussion of this evidence is presented in this chapter.

Properties of the Rating Scale

Many problems with the rating scales used in the VVIQ are most clearly demonstrated in Experiment II. First, the high percentage of response of rating values one and two (over 67%, Table 1) indicated that most college students judged their imagery as "quite good". When participants were questioned about such an ability, however, it became apparent that they were not using the scale consistently with themselves or others. Subjects restated scale definitions to themselves in diverse ways before responding. Not only did a rating of one mean different things to different people, but when participants were asked to demonstrate an imagery ability of "one" by describing in detail what they had just seen out a window, they were unable to do so consistently. To confuse the picture further in regard to the rating scale, when rating scale values were "objectified" by the addition of slides in the SOS rating scale, participants demonstrated little ability

to use the same rating value on a very similar SOS rating scale for the same items previously rated using the VVIQ rating scale (see Table 3). In other words, as the rating scale became more objective, the subjectively reported differences between "good" and "poor" imagers attenuated. "Imagery" theorists would seem to be writing more and more about less and less.

The problem with taking subjective ratings of a cognitive ability as definitive is highlighted by the following: There was wide disagreement among participants in judging the relative rankings to be given to the slides used in the SOS rating scale. If there is such disagreement in rating visual objects projected before the person's eyes, how much more disagreement should be expected in the relative ratings assigned subjective visual experiences? To take such ratings as a basis for serious research is an obvious error.

It is often assumed that the VVIQ has interval and ratio scale properties. The differences in the type of things to be "visualized" in the questionnaire, and the way people rate these items (see Table 1) together with the distribution of scores show no evidence that this assumption can be made. Attribution of the additive property for the VVIQ is a most unsound assumption. Those who do research embodying this assumption are playing games with numbers.

Finally, the close relationship between the imagery and observation questionnaires in Experiment II indicates that position and number habits of students in filling out self-report questionnaires become more important determiners of response as the experiences to be rated in self-report questionnaires become increasingly "subjective" and less

defined consensually. The fact that the VVIQ correlated quite highly with subjective questionnaires (Experiment II) but very little with more objective measures (Experiment IV) of visual recall suggests that VVIQ scores, and others similar to them, are influenced strongly by position and number habits.

Relationship of the VVIQ to Other Measures

While the VVIQ was correlated quite significantly with the self-report questionnaires in Experiment II, the results of Experiments I and IV indicated that the VVIQ is largely unrelated to more objective measures of visual recall of novel scenes. This finding indicates that scores on the VVIQ may be more influenced by habitual ways of filling out questionnaires than the "possession" presumed abilities. The VVIQ was largely unrelated to the VRQ in Experiment I (Appendix B), and the FR, PQ-P, POQ, DP, and LO (all in Appendix L) in Experiment IV (see Table 9). Furthermore, little evidence was demonstrated indicating that VVIQ scores were significantly related to ratings of performance on the drawing task in Experiment IV (see Tables 16 and 18). If VVIQ scores were valid measures of "visual memory imagery", then it should be expected that the VVIQ is significantly related to other, more evaluable measures of recall ability. The overall picture is that the VVIQ is unrelated to visual recall measures, at least those used in this research. This, despite the fact that its questions relate to present descriptions of a presumed scene.

The Predictive Value of the VVIQ

In Experiment I "good" and "poor" visual imagers as defined by

scores on the VVIQ were indistinguishable in performance on the VRQ, a recall measure. Evidence presented in Experiment IV fully supports this finding; correlations between the VVIQ and verifiable measures of recall were weak and for the most part, statistically insignificant. More specifically, while different scanning procedures were closely related to performance across all recall measures, scores on the VVIQ were not predictive of performance on these same measures (see Table 8). In addition, while people reported primarily "good" visual imagery ability according to ratings given on the VVIQ, their performance in reconstructing scenes in Experiment IV was rated by others as quite poor. Similarly, the maximum attainable total score on the Picture, Position, and Depth Perception questionnaires was seventy. Yet, none of the median scores across the four scanning groups reached half of that total (see Table 8). What people believe about their visual imagery ability and how well they perform on recall tests which should depend on that ability have little relationship to one another. The Bible clearly states the case: "Even so faith, if it hath not works, is dead, being alone" (James 2:17).

"Imagery Inflation"

Present evidence indicates that many people overestimate their visual memory imagery abilities on the VVIQ. Three studies on the VVIQ show a consistent trend toward rating visual memory imagery ability better than it actually may be.

In Experiment I, over two-thirds of the responses on the VVIQ were rating values one and two, which means the scores were not distributed normally on the five-point rating scale. When imagery ratings were

accompanied by a picture in both this experiment and Marks' (1973, see Table 4), the "good" visual imagery ratings dropped while the "poor" visual imagery ratings remained approximately the same. This, with the fact that "good" and "poor" imagers according to VVIQ scores showed little difference in performance on a recall task indicates that "good" self-reported visual memory imagery is largely an exaggeration.

In Experiment II, every time an imagery questionnaire was given a second time, Wilcoxon coefficients indicated that the scores on the second administration were lower (see Table 6) indicating visual memory imagery ability seems to improve on retest. No such movement was observed for the observation questionnaires. It was further found that when students took both an imagery and observational questionnaire they rated their visual memory imagery better than their observations of the same items (see Table 6). This trend was replicated in the second part of the experiment with the OIQ. Thus, considering comparisons of "subjective" ratings only, there were strong indications of a movement toward an overly high opinion of visual memory imagery ability on the part of the subjects.

Finally, in Experiment IV, while VVIQ ratings of visual memory imagery ability were distributed heavily toward the "good" end of the scale, ratings by independent judges of recall performance on the drawing task were distributed quite heavily toward the "poor" end of a five-point rating scale. Thus, whether comparing objective and subjective ratings (Experiment I), subjective ratings only (Experiment II), or subjective and basically objective ratings given by independent judges (Experiment IV), the result was the same: a trend toward

exaggerating visual memory imagery ability.

Summary

The results of this research are damaging, not only to the validity of the VVIQ itself, but also to the research that depends on its validity (e.g., Finke, 1980). From a definitional point of view (see Hilgard, 1981, p.8), the fact that VVIQ scores are largely unrelated to recall ability indicates that the VVIQ is at best a superficial test of visual memory imagery ability. Its use would appear to lead to research of equally superficial value. More generally, the validity of similar self-rating imagery questionnaires should be carefully examined.

CHAPTER VIII

DISCUSSION II:

SOME OBSERVATIONS ON THE RECALL OF PICTORIALLY PRESENTED MATERIAL

Assuming that the nature of the recall of pictorially presented material is closely related to the nature of visual memory imagery- -as it should be according to definition (see Hilgard, 1981, p. 8)- -then examining the nature of such recall should assist in developing a scientifically useful ("valid") concept of visual memory imagery. While all the recall of visually presented material cannot be assumed to be visual in nature, operationally, the visual recall paradigm should contribute to an understanding of the nature of visual memory imagery. This chapter will summarize the nature of the recall of a particular picture.

Differences in Gender and Stimulus Material

Although females performed slightly better on the recall task in Experiment III, differences were not statistically significant. So too, differences in recall based on the quality of the pictures used in the experiment were statistically insignificant. In light of the effect of different scanning strategies on recall performance in Experiment IV, it appears that how a person looks at objects may be more important than the clarity of the objects themselves in terms of the recall of those objects. It seems it is the mode of interaction of the individual with the objects, rather than the objects themselves, that determines how much will be recalled.

Scanning Strategies

One of the most important results of Experiment IV was the effect of different procedures in directed scanning of a picture on the subsequent recall of that picture. Results in Table 8 indicated that those students who received no scanning instructions³ (Scan C) did slightly better than those students using vertical scanning instructions (Scan A), and much greater than those using regional (Scan D) and horizontal (Scan B) scanning instructions, in that order.

There were more significant correlations involving those instructed by Scan C than for those with any other scanning strategy (see Tables 16 and 18) between performance on the drawing task and on other measures. No scanning instructions appears to be the best condition for investigating such interrelationships; subjects do best when they do "what comes naturally" to them, and surely there are individual differences in how one looks at different scenes, whether pictures or objects.

Differential scanning instructions not only affected recall performance, but also affected the form of recall as indicated in the Free Recall analysis. Students using Scans A and B wrote their lists primarily in vertical lists, while those using Scans C and D demonstrated a much greater tendency to write their lists in paragraph form. This difference was statistically significant and demonstrates that mode of recall behavior is particularly relevant to the activities that precede it.

³This is an exploratory study, so it was neither advisable or possible to record the scanning methods used, as by photographing eye movements. Such a technology exists, and measures to be made during both the period of observing and recall are needed.

A "rule of effectiveness" is suggested by Experiment III. Students showed best recall for objects in the following positional order around a central point: left, above, right, below. In Experiment IV, the more effective scanning strategy was that which yielded fewer violations of the "rule" sequence. While no attempt will be made to extend this "rule" to the recall of different stimuli, this finding does indicate that the effectiveness of different scanning procedures on the subsequent recall of a picture or scene is strongly influenced by the content and character of that picture or scene and possibly by certain habitual cognitive/perceptual operations.

Differential Foci of Recall

In Experiment III it was mentioned that the ice pond scene was largely ignored in question eleven, as was the pond with rafts in questions twenty-eight through thirty (PQ, Appendix G). This was confirmed in Experiment IV where in the Regional Free Recall analysis, recall was seen to be poorer for the valley (which includes the two ponds) between the two mountains. Recall was also better for the top half of the picture in terms of the Square Free Recall analysis (Experiment IV) than for the bottom half. Little difference was observed between the right and left halves of the picture. This finding supported the observation in Experiment III that recall for the buildings appeared to proceed from top to bottom.

Recall was better for objects that stood out from the background (figure/ground effect) as indicated in Experiment IV. Also, in questions three and four of Experiment III, non-flying objects were poorly recalled when the focal point of the question was a flying object.

Thus, recall of objects was greatly affected by where the object was located and the other objects around it; important, perhaps, in the labelling feature of visual memory imagery.

Effectiveness of Recall Performance

Performance on the verifiable recall measures was not very good. These subjects did not remember much of what they had looked at. Five measures used in this research had a maximum attainable score: VRQ (60), PQ (positional questions only, Experiment III, 70), PQ-P (70), DP (70), and POS (70). Not once did the overall median score for any of these questionnaires exceed more than half of the total possible score. The overall medians for each questionnaire are as follows: VRQ (26), PQ (31), DP (29), POS (16), and PQ-P (27.5). These scores plus the poor performance on the drawing task (Table 8) demonstrate that for those tasks that by nature involve visual, spatial recall abilities, recall performance for the picture was not very good considering what it possibly could be.

Two-Dimensional Versus Three-Dimensional Thinking

In Experiment IV, participants performed nearly twice as well on a questionnaire requesting responses in language referring to three-dimensions (DP, mdn = 29) than one requesting statements in two-dimensional terms (POS, mdn = 16). Eighteen of the twenty-eight correlations between the performance on the DP and performance on the drawing task were higher than those with the POS. Students recalled objects in the picture more as they would in "real" life than as they would be in a flat picture. Visual recall for the picture used in this

experiment may be considered as more "three-dimensional" than "two-dimensional". This is reminiscent of Wundt's description of images as not being faithful copies (1907, p. 282), but rather active processes (1901, p. 290). Their recalling responses indicated that students perform as if they put themselves into the picture than as being detached observers. Those who conceive of images as "faded xerox copies" are as likely to be in error as those who dismiss the visual-like experience totally, in terms of Experiment IV.

Intercorrelations Among Recall Measures

Table 9 demonstrates that the five objectively verifiable recall measures in Experiment IV were, in the main, quite closely interrelated. Among the drawing categories, Topography Preservation (category II) was significantly related to both Quality of the Picture (category I) and Quantity of Representation (category III) (see Table 17). The Free Recall measure was most closely related to the Quality (I) and Quantity (III) categories, while the Depth Perception measure was most closely correlated to Topography Preservation (II) and the three combinations of categories in Table 18. The overall picture then, is quite different than with the VVIQ. While the VVIQ is largely unrelated to other measures of recall, the objectively verifiable measures show a fairly high degree of interrelationship. Considering the diversity of the more objective measures, the results indicate that factor-analytic studies will yield a limited number of factors. Since all the objectively verifiable measures dealt with the recall of pictorially presented material, one such factor might be termed "visual memory imagery".

Summary

Performances on the recall tasks were not exceptional, and even very disappointing, in comparison to what they could have been. Analyses of such performances indicate, however, that a specifiable type of thinking is occurring. To term that kind of thinking as propositional, in other words, not fundamentally different from other kinds of verbal behavior, does not fully describe these activities. The differential effects of scanning operations on the kind, quality, and quantity of recall strongly imply that the recall of certain pictorially presented material is more than abstractly connected with visual mechanisms. The relationship is not as straightforward as with afterimagery, but the recall is, to a degree, visual-bound; the "syntax" of eye movements enters into the propositions. The close relationship of the Free Recall and List of Objects measures to the more visual recall measures (PQ-P, POS, DP, and DW) indicates that students' recall additionally involved a more symbolic labelling feature. Visual memory imagery, by nature, may require basically non-visual linguistical features. Furthermore, visual memory imagery appears to be a more "lived-experience" even from retrospect: Students had an easier time with a three-dimensional questionnaire than a two-dimensional one, an indicator that "visual memory images" may be thought of as mapping onto the "real world" than onto the two-dimensional projections of pictures.

In sum, the picture painted of visual memory imagery in this research is:

1. An active visual-like experience.
2. Visually-bound to varying degrees, at least in part through eye movements.

3. An experience that is interpreted symbolically to greater, yet to varying degrees, based on labelling or naming that occurs on initial observation.

4. An experience that the person projects him or herself into- -a more three-dimensional "lived experience" of the person.

5. An experience that may be best described not as the world minus a quality (e.g., "faded copy") but, as the world plus the person's own unique interactional history.

Since much of this research was based on the recall of a specific stimulus, the generality of these findings must be restricted to stimuli of the type used in these studies until further research with a wider range of different stimuli is conducted. Investigations involving pictures, objects, or scenes of more abstract and/or emotional quality are needed. Furthermore, there is an obvious need for studies involving participants other than college undergraduates.

CHAPTER IX

SUMMARY AND CONCLUSIONS

The purpose of this research was two-fold. The first focus of investigation was an assessment of the validity of Marks' Vividness of Visual Imagery Questionnaire (1973). Evidence from all the studies taken as a whole is contrary to the proposition that the VVIQ is a valid or meaningful measure of visual memory imagery. The structure and validity of research depending on the Marks questionnaire and similar measures must be seriously reexamined.

The second focus of investigation was the nature of the recall of certain pictorially presented material. The results of these studies strongly indicated that both the "faded photographic copy" and the propositional conceptions of visual memory imagery are false if they are taken as antithetical, incompatible views. A "visual-like" conception of visual memory imagery as a "lived", visual sense-related, experience that is also symbolical (verbal) to varying degrees is proposed as a better conception, more faithful to the phenomena, as based on the present research.

Much can be said of imagery research based on the experience of this research project. In general, imagery research is characterized by a lack of precision, both semantically and empirically. Semantically, the word imagery is bandied around very loosely, although in discussions, impressively. There can be no end to the "functions and "measures" of such a fuzzy and unverifiable phenomenon. The term often seems to be used as a "salt" by current psychologists: Sprinkle it on any research and

its flavor is enhanced. But since both the nature of visual memory imagery and the validity of its supposed "measures" have been largely uninvestigated through the years, it remains a tasteless variety. The qualities that distinguish between the "real thing" and a substitute are greatly needed.

As should be expected, empirically the results are equally fuzzy. The self-report questionnaire is the cornerstone of imagery research, as it has been since the time of Galton in the late 1800's. Even Marks' questionnaire can be seen as little more than a revision of Betts' questionnaire (1909) sixty-two years previously. For a field where creativity is written about so much in connection with imagery (e.g., Forisha, 1981), it is ironic that there is so little original thinking on imagery. Furthermore, very little of the imagery research to date would stand up to even superficial operational analysis; "construct validity" is absent. Granted that imaging is not the easiest set of phenomena to pin down, nevertheless, more care must be taken to define as clearly as possible the experimental paradigms that are used, and to relate them to verification independent of "tests". Not enough effort has been made in this regard.

There are several steps that imagery research must take to become both semantically and empirically sound:

1. A consistent, experimentally verifiable, operational definition of visual memory imagery must be established in the research findings through a convergence of operations (see Garner, Hake, & Eriksen, 1956).

2. Reliable, operationally distinguishable delineations of types of imagery phenomena need to be established.

3. Visual imagery measures need to be carefully assessed in regard to their validity.

4. More emphasis should be placed on research into the nature, that is, the meaning and character of visual imagery, rather than the functions of visual imagery, if such "functions" are to be meaningful.

5. In general, the direction of imagery research should be toward the establishment of a coherent, consistent, valid overall picture of visual imagery rather than toward a "functional" diffusion of effort.

REFERENCES

REFERENCES

- Ahsen, A. Eidetics: An overview. Journal of Mental Imagery, 1977, 1, 5-38.
- Angell, J.R. Imageless thought. Psychological Review, 1911, 18, 295-323.
- Bakan, P. Hypnotizability, laterality of eye movements and functional brain asymmetry. Perceptual and Motor Skills, 1969, 28, 927-932.
- Barratt, P.E. Imagery and thinking. Australian Journal of Psychology, 1953, 5, 154-164.
- Bennett, G.K., Seashore, M.G., & Wesman, A.G. Differential aptitude tests. New York: The Psychological Corporation, 1947.
- Betts, G.H. The distribution and functions of mental imagery. New York: Teachers College, Columbia University, 1909.
- Boring, E.G. A history of experimental psychology (2nd Ed.). New York: Appleton-Century-Crofts, 1950.
- Buggie, S.E. Imagery and relational variety in associative learning. Unpublished doctoral dissertation, University of Oregon, 1974.
- Chaplin, J.P. & Krawiec, T.S. Systems and theories of psychology (3rd Ed.). New York: Holt, Rinehart, and Winston, Inc., 1974.
- Chara, P.J. Visual imagery and individual differences. Unpublished masters thesis, Montana State University, 1977.
- Childcraft - The how and why library. Chicago, Illinois: Field Enterprises Educational Corporation, 1976, 13, 74-75.
- Chowdhury, K.R. & Vernon, P.E. An experimental study of imagery and its relation to abilities and interests. British Journal of Psychology, 1964, 55, 355-364.
- Coleman, F.D. & Paivio, A. Pupillary response and galvanic skin response during an imagery task. Psychonomic Science, 1969, 16, 296-297.
- Deckert, G.H. Pursuit eye movements in the absence of a moving visual stimulus. Science, 1964, 143, 1192-1193.
- Dennett, D.C. Brainstorms. Montgomery, Vermont: Bradford Books, 1978.
- Finke, R.A. Levels of equivalence in imagery and perception. Psychological Review, 1980, 87, 113-132.

- Forisha, B.L. Patterns of creativity and mental imagery in men and women. Journal of Mental Imagery, 1981, 5, 85-96.
- Gale, A., Morris, P.E., Lucas, R., & Richardson, A. Types of imagery and imagery types: An EEG study. British Journal of Psychology, 1972, 63, 523-531.
- Galton, F. Inquiries into human faculty and its development. New York: AMS Press, Inc. 1973 (reprint of 1907 edition).
- Garner, W.R., Hake, H.W., & Eriksen, C.W. Operationalism and the concept of perception. Psychological Review, 1956, 63, 149-159.
- Ghiselin, B. The creative process. New York: New American Library, 1952.
- Golla, F.L. & Antonovitch, S. The relation of muscular tonus and the patellar reflex to mental work. Journal of Mental Science, 1929, 75, 234-241.
- Gordon, R. An investigation into some of the factors that favor the formation of stereotyped images. British Journal of Psychology, 1949, 39, 156-167.
- Graham, K.R. Eye movements during visual mental imagery. Paper presented to the Eastern Psychological Association, Atlantic City, April, 1970.
- Griffitts, C.H. Individual differences in imagery. Psychological Monographs, 1927, 37, (No. 172).
- Haber, R.N. Twenty years of haunting eidetic imagery: Where's the ghost? Behavioral and Brain Sciences, 1979, 2, 593-630.
- Hale, S.M. & Simpson, H.M. Effects of eye movements on the rate of discovery and the vividness of visual images. Perception and Psychophysics, 1971, 9, 242-246.
- Hartman, D.P. Considerations in the choice of interobserver reliability estimates. Journal of Applied Behavior Analysis, 1977, 10, 103-116.
- Herrnstein, R.J. & Boring, E.G. A source book in the history of psychology (5th Ed.). Cambridge, Massachusetts: Harvard University Press, 1976.
- Hilgard, E.R. Imagery and imagination in American Psychology. Journal of Mental Imagery, 1981, 5, 5-66.
- Holt, R.R. Imagery: The return of the ostracized. American Psychologist, 1964, 19, 254-264.
- Jacobson, E. Electrophysiology of mental activities. American Journal of Psychology, 1932, 44, 677-694.

- Jaensch, E.R. Eidetic imagery (Trans. by Oscar Oeser). New York: Harcourt, Brace & Company, 1930.
- James, W. The principles of psychology, Vols. I & II. Chicago: Great Books of the Western World, Encyclopedia Britannica, Inc., William Benton, pub., 1971 (reprint of 1890 edition).
- Klapp, S.T. Individual differences in nonverbal memory for visually presented material. Unpublished doctoral dissertation, University of California (Berkley), 1969.
- Kocel, K., Galin, D., Ornstein, R., & Merrin, E.L. Lateral eye movements and cognitive mode. Psychonomic Science, 1972, 27, 223-224.
- Kosslyn, S.M. The medium and the message in mental imagery: A theory. Psychological Review, 1981, 88, 46-66.
- Likert, R.A. A technique for the measurement of attitudes. Archives of Psychology, 1932, No. 4.
- Lorens, S.A., Jr. & Darrow, C.W. Eye movements, EEG, GSR, and EKG during mental multiplication. Electroencephalography and Clinical Neurophysiology, 1962, 14, 739-746.
- Marks, D.F. Visual imagery differences in the recall of pictures. British Journal of Psychology, 1973, 64, 17-24.
- McConnell, J.V. Understanding Human Behavior (3rd Ed.). Holt, Rinehart, & Winston: New York, 1980.
- McKelvie, S.J. & Gingras, P.P. Reliability of two measures of visual imagery. Perceptual and Motor Skills, 1974, 39, 417-418.
- Neisser, U. Cognitive Psychology. New York: Apleton-Century-Crofts, 1967.
- Ornstein, R.E. The psychology of consciousness. San Francisco: W.H. Freeman and Company, 1972.
- Oxford English Dictionary (Edited by Murray, J.A.H., Bradley, H., Craigie, W.A., & Onions, C.T.). London: Oxford University Press, 1933.
- Paivio, A. Latency of verbal associations and imagery to noun stimuli as a function of abstractness and generality. Canadian Journal of Psychology, 1966, 20, 378-387.
- Paivio, A. Imagery and verbal processes. New York: Holt, Rinehart, and Winston, 1971.
- Paivio, A. Psychophysiological correlates of imagery. In F.J. McGuigan & R. A. Schoonover (Eds.) The Psychophysiology of thinking. New York: Academic Press, 1973.

- Patterson, A.S. The respiratory rhythms in normal and psychotic subjects. Journal of Neurological Psychopathology, 1935, 16, 36-53.
- Perky, C.W. An experimental study of imagination. American Journal of Psychology, 1910, 21, 422-452.
- Pylyshyn, Z. What the mind's eye tells the mind's brain: a critique of mental imagery. Psychological Bulletin, 1973, 86, 1-24.
- Richardson, A. Verbalizer - visualizer: A cognitive style dimension. Journal of Mental Imagery, 1977, 1, 109-125.
- Ryle, G. The Concept of Mind. London: Hutchinson & Company, Ltd., 1963, (reprint of 1949 edition).
- Samuels, M. & Samuels, N. Seeing with the mind's eye. New York: Random House Bookworks, 1975.
- Simpson, H.M., Paivio, A. & Rogers, T.B. Occipital alpha activity of high and low visual imagers during problem solving. Psychonomic Science, 1967, 7, 49-50.
- Simpson, H.M. & Paivio, A. Effects on pupil size of manual and verbal indicators of cognitive task fulfillment. Perception and Psychophysics, 1968, 3, 185-190.
- Sheehan, P.W. A shortened form of Betts' Questionnaire Upon Mental Imagery. Journal of Clinical Psychology, 1967, 23, 386-389.
- Shepard, R.N. & Metzler, J. Mental rotation of three-dimensional objects. Science, 1971, 171, 701-703.
- Short, P.L. The objective study of mental imagery. British Journal of Psychology, 1953, 44, 38-51.
- Short, P.L. & Walter, W.G. The relationship between physiological variables and stereognosis. EEG and Clinical Neurophysiology, 1954, 6, 29-44.
- Skinner, B.F. The behavior of organisms. New York: Appleton-Century-Crofts, 1938.
- Slatter, K.H. Alpha rhythms and mental imagery. EEG and Clinical Neurophysiology, 1960, 12, 851-859.
- Social Sciences Citation Index. Philadelphia, Pennsylvania: Institute for Scientific Information, Inc., 1973-1982.
- Stevens, S.S. Psychophysics: Introduction to its perceptual, neural, and social prospects. New York, N.Y.: John Wiley & Sons, 1975.

Suinn, R.M. Body thinking: Psychology for Olympic champs. Psychology Today, 1976, July, 38-42.

Thompson Chain-Reference Bible (King James Version). (F. C. Thompson, Ed.) Indianapolis, Indiana: B.B. Kirkbride Bible Company, Inc., 1964.

Thurstone, L.L. & Jeffrey, T.E. Flags: A test of space thinking. Chicago: Industrial Relations Center, 1956.

Thurstone, L.L. Primary mental abilities. Psychometrika Monographs, 1938, No. 1.

Titchener, E.B. Lectures on the experimental psychology of thought-processes. New York: MacMillan, 1909.

Watson, J.B. Psychology as the behaviorist views it. Psychological Review, 1913, 20, 158-177.

Watson, J.B. The place of the conditioned-reflex in psychology. Psychological Review, 1916, 23, 89-116.

Webster's New World Dictionary of the American Language (2nd. Ed.) (D.B. Guralnik, Editor in Chief). New York: The World Publishing Co., 1970.

White, K., Sheehan, P.W., & Ashton, R. Imagery assessment: A survey of self-report measures. Journal of Mental Imagery, 1977, 1, 145-169.

Woodworth, R.S. Imageless thought. Journal of Philosophy, 1906, 3, 701-708.

Wundt, W. Human and animal psychology. New York: Swan Sonnenschein & Co., 1901.

Wundt, W. Outlines of Psychology (trans. by C.H. Judd, Yale University). Leipzig, Germany: Alfred Kroner, 1907.

Yates, F.A. The art of memory. Chicago: University of Chicago Press, 1966.

APPENDICES

APPENDIX A

MARKS' (1973) VIVIDNESS OF VISUAL
IMAGERY QUESTIONNAIRE

VIVIDNESS OF VISUAL IMAGERY QUESTIONNAIRE

INSTRUCTIONS FOR DOING TEST:

THE AIM OF THIS TEST IS TO DETERMINE THE VIVIDNESS OF YOUR VISUAL IMAGERY. THE ITEMS FOR YOUR CONSIDERATION WILL BRING CERTAIN IMAGES TO YOUR MIND. YOU ARE TO RATE THE VIVIDNESS (HOW STRONG, CLEAR, INTENSE, BRIGHT, ECT.) OF EACH IMAGE BY REFERENCE TO THE ACCOMPANYING RATING SCALE, WHICH IS SHOWN BELOW. FOR EXAMPLE, IF YOUR IMAGE IS VAGUE AND DIM YOU WILL GIVE IT A RATING OF 4. RECORD YOUR ANSWER BY WRITING THE NUMBER OF THE RATING YOU WOULD ASSIGN EACH ITEM ON THE LINE PROVIDED PRECEDING EACH ITEM. BEFORE YOU PROCEED TO THE ITEMS BELOW, FAMILIARIZE YOURSELF WITH THE DIFFERENT CATEGORIES ON THE RATING SCALE. THROUGHOUT THE TEST, REFER TO THE RATING SCALE WHEN JUDGING THE VIVIDNESS OF EACH IMAGE. TRY TO DO EACH ITEM SEPARATELY, INDEPENDENT OF HOW YOU MAY HAVE DONE THE OTHER ITEMS. PLEASE DO THE TEST AS HONESTLY AND AS ACCURATELY AS POSSIBLE.

.....

RATING SCALE:

- RATING 1 PERFECTLY CLEAR AND AS VIVID AS NORMAL VISION.
 - RATING 2 CLEAR AND REASONABLY VIVID.
 - RATING 3 MODERATELY CLEAR AND VIVID.
 - RATING 4 VAGUE AND DIM.
 - RATING 5 NO IMAGE AT ALL, YOU ONLY KNOW THAT YOU ARE THINKING OF THE OBJECT.
-

ONCE YOU HAVE UNDERSTOOD THE INSTRUCTIONS, YOU MAY TURN THE PAGE AND USING THE RATING SCALE ABOVE, INDICATE THE VIVIDNESS OF YOUR VISUAL IMAGERY IN TERMS OF EACH ITEM.

A FRIEND OR RELATIVE WHOM YOU FREQUENTLY SEE (BUT IS
NOT WITH YOU AT PRESENT):

- _____ 1. The exact contour of face, head, shoulders and body.
- _____ 2. The characteristic poses of head, attitudes of body,
etc.
- _____ 3. The precise carriage, length of step, etc., in walking.
- _____ 4. The different colors worn in some familiar clothes.

A RISING SUN:

- _____ 5. The sun rising above the horizon to a hazy day.
- _____ 6. Clouds with a storm blowing up, with flashes of light-
ening.
- _____ 7. The sky clearing and surrounding the sun with blueness.
- _____ 8. A rainbow.

A STORE WHICH YOU OFTEN GO TO:

- _____ 9. The overall appearance of the store from the opposite
side of the road.
- _____ 10. A window display including colors, shapes and details of
items for sale.
- _____ 11. You are near the entrance. The color, shape and details
of the door.
- _____ 12. A counter in the store. The counter assistant serving
you with money changing hands.

A COUNTRY SCENE WHICH INVOLVES TREES, MOUNTAINS AND A LAKE:

- _____ 13. The contours of the landscape.
- _____ 14. The color and shape of the trees.
- _____ 15. The color and shape of the lake.
- _____ 16. A strong wind blows on the trees and on the lake causing
waves.

APPENDIX B

VISUAL RECALL QUESTIONNAIRE

VISUAL RECALL QUESTIONNAIRE

Instructions: Answer the following questions to the best of your ability

1. Describe the tree that is dead center in the picture foreground. Imagine yourself to be at the bottom of the slide and directly centered from each side of the slide. As you are walking straight into the slide towards the back, there is a tree directly in front of you. Describe it on your answer sheet.
2. Describe the tree directly to the right and the tree directly to the left of the above tree. Include in your description on the answer sheet colors, shape, type of tree and relative height in comparison to the tree described in question number one.
3. Describe in as much detail as you can what was in the lower right-hand corner of the picture. Be specific on your answer sheet.
4. Describe in as much detail as you can what was in the lower left-hand corner of the picture. Be specific on your answer sheet.
5. Describe the sky on your answer sheet. Make note of anything you saw in the sky; if anything. Was it clear, cloudy, etc.
6. Which of the following (if any) were in the slide?
 - a) A deer.
 - b) A dog.
 - c) A wire fence.
 - d) A person.
 - e) A stonewall.
 - f) A stream.

APPENDIX C

VIVIDNESS OF VISUAL IMAGERY

QUESTIONNAIRE: LONG FORM

VIVIDNESS OF VISUAL IMAGERY
QUESTIONNAIRE

INSTRUCTIONS FOR DOING TEST:

THE AIM OF THIS TEST IS TO DETERMINE THE VIVIDNESS OF YOUR VISUAL IMAGERY. THE ITEMS FOR YOUR CONSIDERATION WILL BRING CERTAIN IMAGES TO YOUR MIND. YOU ARE TO RATE THE VIVIDNESS (HOW STRONG, CLEAR, INTENSE, BRIGHT, ETC.) OF EACH IMAGE BY REFERENCE TO THE ACCOMPANYING RATING SCALE, WHICH IS SHOWN BELOW. FOR EXAMPLE, IF YOUR IMAGE IS VAGUE AND DIM YOU WILL GIVE IT A RATING OF 4. RECORD YOUR ANSWER BY WRITING THE NUMBER OF THE RATING YOU WOULD ASSIGN EACH ITEM ON THE LINE PROVIDED PRECEDING EACH ITEM. BEFORE YOU PROCEED TO THE ITEMS BELOW, FAMILIARIZE YOURSELF WITH THE DIFFERENT CATEGORIES ON THE RATING SCALE. THROUGHOUT THE TEST, REFER TO THE RATING SCALE WHEN JUDGING THE VIVIDNESS OF EACH IMAGE. TRY TO DO EACH ITEM SEPARATELY, INDEPENDENT OF HOW YOU MAY HAVE DONE THE OTHER ITEMS. PLEASE DO THE TEST AS HONESTLY AND AS ACCURATELY AS POSSIBLE.

.....

RATING SCALE:

RATING 1 PERFECTLY CLEAR AND AS VIVID AS NORMAL VISION.
RATING 2 CLEAR AND REASONABLY VIVID.
RATING 3 MODERATELY CLEAR AND VIVID.
RATING 4 VAGUE AND DIM.
RATING 5 NO IMAGE AT ALL, YOU ONLY KNOW THAT YOU ARE THINKING OF
THE OBJECT.

.....

ONCE YOU HAVE UNDERSTOOD THE INSTRUCTIONS, YOU MAY TURN THE PAGE AND USING THE RATING SCALE ABOVE, INDICATE THE VIVIDNESS OF YOUR VISUAL IMAGERY IN TERMS OF EACH ITEM.

COUNTRY EXPERIENCE

You and a companion at a park in the country

- _____ 1. The woods along a hiking path.
- _____ 2. The color and shape of the trees.
- _____ 3. The contours of the landscape.
- _____ 4. The rustling of the leaves as the wind blows.
- _____ 5. The sky darkening.
- _____ 6. Clouds with a storm blowing up with flashes of lightening
- _____ 7. Your companion running for shelter as rain is falling.
- _____ 8. The rain slackening and wind dying down.
- _____ 9. The sky clearing and surrounding the sun with blueness.
- _____ 10. The hiking path filled with puddles and the trees
dripping after a hard storm.

CITY EXPERIENCE

You and a companion walking together in a city

- _____ 11. The signs of the different stores along a city street.
- _____ 12. The sun rising above the horizon to a hazy sky.
- _____ 13. A traffic light at the end of the street.
- _____ 14. A "SALE" sign in the window of a store across the street.
- _____ 15. The overall appearance of the store including shape of
the building as you approach it.
- _____ 16. A window display including colors, shapes and details of
items for sale.
- _____ 17. The different colors and styles of clothes in the window
display.
- _____ 18. The different colors worn in some familiar clothes of
your companion.
- _____ 19. A city park full of trees, benches, hills and a lake.
- _____ 20. The color and shape of the lake.

SCHOOL EXPERIENCE

You and a companion walking around together on a school campus

- _____ 21. The street in front of a bookstore.
- _____ 22. The overall appearance of the store from the opposite side of the road.
- _____ 23. You are near the entrance. The color, shape and details of the door.
- _____ 24. The entrance to your room. The color and shape of the door.
- _____ 25. The shapes, colors, and details of things in your room.
- _____ 26. The face of your companion as he/she is standing or sitting next to you.
- _____ 27. The characteristic poses of head, attitudes of body, etc. of your companion.
- _____ 28. Your companion opening the door.
- _____ 29. The precise carriage, length of step, etc. of your companion in walking.
- _____ 30. The precise stature of your companion as he/she is standing with his/her back towards you.

APPENDIX D

OBSERVATION QUESTIONNAIRE:

SHORT FORM

WHAT KINDS OF THINGS ARE YOU MOST OBSERVANT OF?

Instructions for doing test:

The aim of this test is to determine how closely you have looked at different people and things. You are to consider the items presented below and then, using the accompanying rating scale, rate how carefully you have observed each item. For example, if you have observed something carefully and reasonably well, then you would give the item a rating of 2. Record your answer by writing the number of the rating you would assign each item on the line preceding each item. Before you precede to the items below, familiarize yourself with the different categories on the rating scale. Throughout the test, refer to the rating scale when judging how carefully you have observed each item. Please do the test as honestly and as accurately as possible.

Rating Scale:

- Rating 1....Observed very carefully and as perfectly well as possible.
Rating 2....Observed carefully and reasonably well.
Rating 3....Observed moderately well and somewhat carefully.
Rating 4....Observed in only a vague fashion and not very carefully.
Rating 5....Haven't really observed, you only know that the object (or such a possibility) exists.
-

YOU MAY NOW TURN THIS PAGE OVER AND INDICATE VIA THE ABOVE RATING SCALE WHAT KINDS OF THINGS YOU ARE MOST OBSERVANT OF.

A FRIEND OR RELATIVE WHOM YOU FREQUENTLY SEE (BUT IS
NOT WITH YOU AT PRESENT):

- _____ 1. The exact contour of face, head, shoulders and body.
- _____ 2. The characteristic poses of head, attitudes of body,
etc.
- _____ 3. The precise carriage, length of step, etc., in walking.
- _____ 4. The different colors worn in some familiar clothes.

A RISING SUN:

- _____ 5. The sun rising above the horizon to a hazy day.
- _____ 6. Clouds with a storm blowing up, with flashes of light-
ening.
- _____ 7. The sky clearing and surrounding the sun with blueness.
- _____ 8. A rainbow.

A STORE WHICH YOU OFTEN GO TO:

- _____ 9. The overall appearance of the store from the opposite
side of the road.
- _____ 10. A window display including colors, shapes and details of
items for sale.
- _____ 11. You are near the entrance. The color, shape and details
of the door.
- _____ 12. A counter in the store. The counter assistant serving
you with money changing hands.

A COUNTRY SCENE WHICH INVOLVES TREES, MOUNTAINS AND A LAKE:

- _____ 13. The contours of the landscape.
- _____ 14. The color and shape of the trees.
- _____ 15. The color and shape of the lake.
- _____ 16. A strong wind blows on the trees and on the lake causing
waves.

APPENDIX E

OBSERVATION QUESTIONNAIRE:

LONG FORM

WHAT KINDS OF THINGS ARE YOU MOST OBSERVANT OF?

Instructions for doing test:

The aim of this test is to determine how closely you have looked at different people and things. You are to consider the items presented below and then, using the accompanying rating scale, rate how carefully you have observed each item. For example, if you have observed something carefully and reasonably well, then you would give the item a rating of 2. Record your answer by writing the number of the rating you would assign each item on the line preceding each item. Before you precede to the items below, familiarize yourself with the different categories on the rating scale. Throughout the test, refer to the rating scale when judging how carefully you have observed each item. Please do the test as honestly and as accurately as possible.

Rating Scale:

- Rating 1....Observed very carefully and as perfectly well as possible.
Rating 2....Observed carefully and reasonably well.
Rating 3....Observed moderately well and somewhat carefully.
Rating 4....Observed in only a vague fashion and not very carefully.
Rating 5....Haven't really observed, you only know that the object (or such a possibility) exists.
-

YOU MAY NOW TURN THIS PAGE OVER AND INDICATE VIA THE ABOVE RATING SCALE WHAT KINDS OF THINGS YOU ARE MOST OBSERVANT OF.

COUNTRY EXPERIENCE

You and a companion at a park in the country

- _____ 1. The woods along a hiking path.
- _____ 2. The color and shape of the trees.
- _____ 3. The contours of the landscape.
- _____ 4. The rustling of the leaves as the wind blows.
- _____ 5. The sky darkening.
- _____ 6. Clouds with a storm blowing up with flashes of lightening
- _____ 7. Your companion running for shelter as rain is falling.
- _____ 8. The rain slackening and wind dying down.
- _____ 9. The sky clearing and surrounding the sun with blueness.
- _____ 10. The hiking path filled with puddles and the trees
dripping after a hard storm.

CITY EXPERIENCE

You and a companion walking together in a city

- _____ 11. The signs of the different stores along a city street.
- _____ 12. The sun rising above the horizon to a hazy sky.
- _____ 13. A traffic light at the end of the street.
- _____ 14. A "SALE" sign in the window of a store across the street.
- _____ 15. The overall appearance of the store including shape of
the building as you approach it.
- _____ 16. A window display including colors, shapes and details of
items for sale.
- _____ 17. The different colors and styles of clothes in the window
display.
- _____ 18. The different colors worn in some familiar clothes of
your companion.
- _____ 19. A city park full of trees, benches, hills and a lake.
- _____ 20. The color and shape of the lake.

SCHOOL EXPERIENCE

You and a companion walking around together on a school campus

- _____ 21. The street in front of a bookstore.
- _____ 22. The overall appearance of the store from the opposite side of the road.
- _____ 23. You are near the entrance. The color, shape and details of the door.
- _____ 24. The entrance to your room. The color and shape of the door.
- _____ 25. The shapes, colors, and details of things in your room.
- _____ 26. The face of your companion as he/she is standing or sitting next to you.
- _____ 27. The characteristic poses of head, attitudes of body, etc. of your companion.
- _____ 28. Your companion opening the door.
- _____ 29. The precise carriage, length of step, etc. of your companion in walking.
- _____ 30. The precise stature of your companion as he/she is standing with his/her back towards you.

APPENDIX F

OBSERVATION AND IMAGERY
QUESTIONNAIRE

OBSERVATION AND IMAGERY QUESTIONNAIRE

Instructions for doing questionnaire:

The purpose of this questionnaire is two-fold: 1) to determine how closely you have looked at different people and things; 2) to determine the vividness of your visual imagery. You are to consider the items below and then, using the accompanying rating scales, 1) rate how carefully you have observed each item and 2) rate the vividness (how strong, clear, intense, bright, etc.) of your image of each item. For example; if you have observed something "carefully and reasonably well", then you would write the letter "b" in the space provided for the item. If your image is "clear and reasonably vivid", then you would write the number "2" in the space provided for the item. Before you proceed to the items below, familiarize yourself with the different categories on the two rating scales. Remember, you must have a letter and a number before each item. Try to do each item separately, independent of how you may have done the other items. Furthermore, try to do each item distinctly, independent of how you have used the other rating scale. Throughout the test, refer to the rating scale when judging your rating for each item. Please do the questionnaire as honestly and as accurately as possible.

OBSERVATION RATING SCALE:

Rating A.....Observed very carefully and as perfectly well as possible
Rating B.....Observed carefully and reasonably well
Rating C.....Observed moderately well and somewhat carefully
Rating D.....Observed in only a vague fashion and not very carefully
Rating E.....Haven't really observed, you only know that the object
(or such a possibility) exists.

Rating 1.....Image perfectly clear and as vivid as normal vision
Rating 2.....Image clear and reasonably vivid
Rating 3.....Image moderately clear and vivid
Rating 4.....Image vague and dim
Rating 5.....No image at all, you only know that you are thinking of
the object

OBSERVATION IMAGERY

_____ 1. The exact contour of face, head, shoulders and body.

_____ 2. The characteristic poses of head, attitudes of body, etc.

_____ 3. The precise carriage, length of step, etc., in walking.

_____ 4. The different colors worn in some familiar clothes.

_____ 5. The sun rising above the horizon to a hazy sky.

_____ 6. Clouds with a storm blowing up, with flashes of lightening.

_____ 7. The sky clearing and surrounding the sun with blueness.

_____ 8. A rainbow.

_____ 9. The overall appearance of the store from the opposite side of the road.

_____ 10. A window display including colors, shapes and details of items for sale.

_____ 11. You are near the entrance. The color, shape and details of the door.

_____ 12. A counter in the store. The counter assistant serving you with money changing hands.

Page 3

A COUNTRY SCENE WHICH INVOLVES TREE, MOUNTAINS AND A LAKE:

- _____ 13. The contours of the landscape.
- _____ 14. The color and shape of the trees.
- _____ 15. The color and shape of the lake.
- _____ 16. A strong wind blows on the trees and on the lake causing waves.

APPENDIX G

PICTURE QUESTIONNAIRE

PICTURE QUESTIONNAIRE

Picture Form Letter: _____

Sex: _____

Name: _____

Age: _____

.....

INSTRUCTIONS: ANSWER THE FOLLOWING QUESTIONS TO THE BEST OF YOUR ABILITY

.....

For questions one - four, focus your attention on the kite in the middle of the picture:

1. What flying object is to its immediate left? _____
2. What flying object is to its immediate right? _____
3. What object is closest above it? _____
4. What object is directly below it? _____
5. What is directly above the castle? _____
6. What is directly to the left of the moon? _____

For questions seven - ten, describe four different objects on the road:

7. _____
8. _____
9. _____
10. _____

11. Describe what is immediately to the left of the mushrooms:

Picture Questionnaire (cont.)

Describe two things immediately to the left of the girl on the bicycle:

12. _____

13. _____

Describe the three objects in the top-most part of the picture that are most centered from the left and right hand sides of the picture:

14. _____

15. _____

16. _____

Name five different kinds of animals in the picture (excluding people):

17. _____

18. _____

19. _____

20. _____

21. _____

Name six different types of buildings that are in the picture:

22. _____

23. _____

24. _____

25. _____

26. _____

27. _____

Name the three objects floating in the water:

28. _____

29. _____

30. _____

APPENDIX H

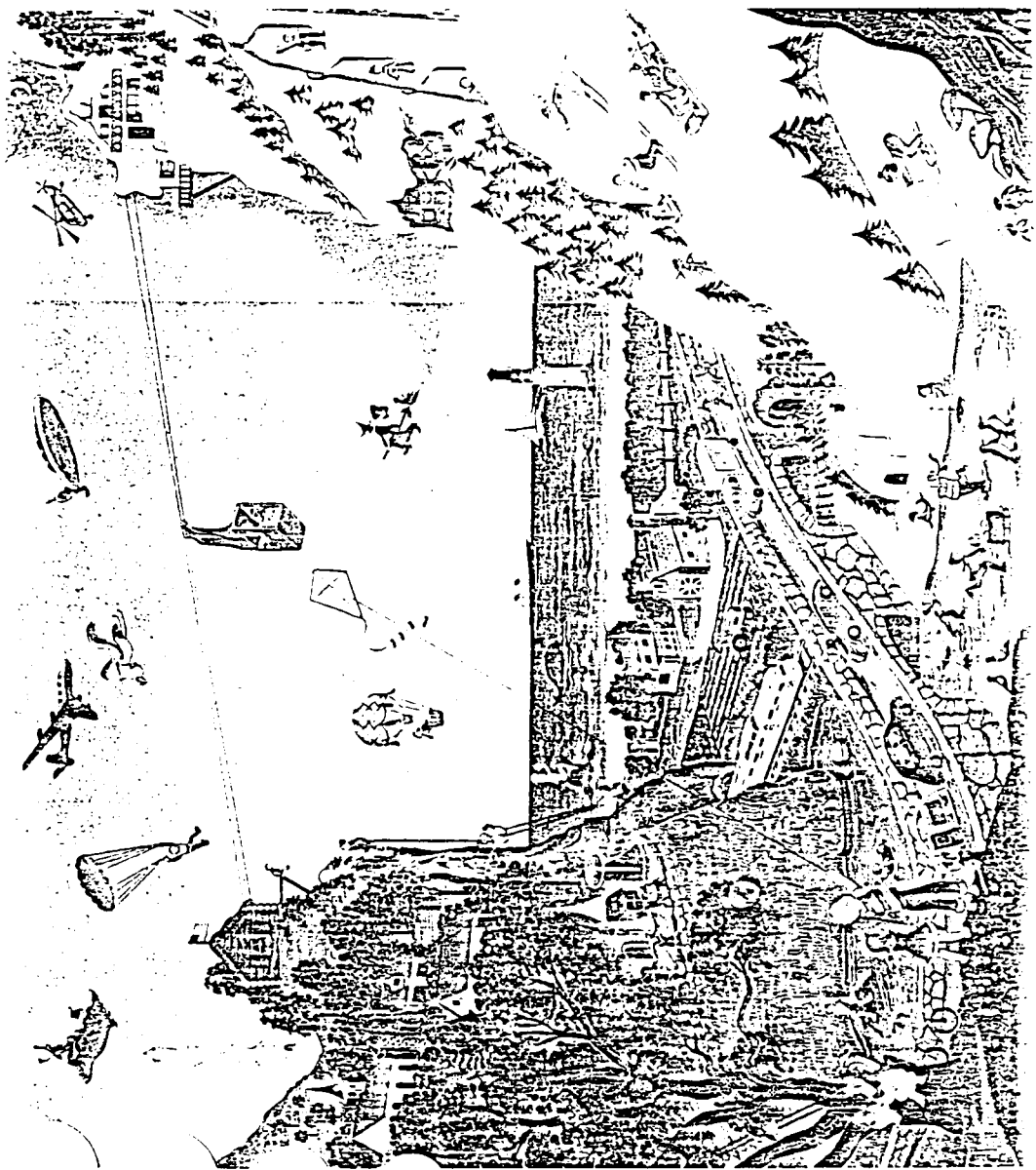
FIVE FORMS OF THE PICTURE USED IN

EXPERIMENT THREE

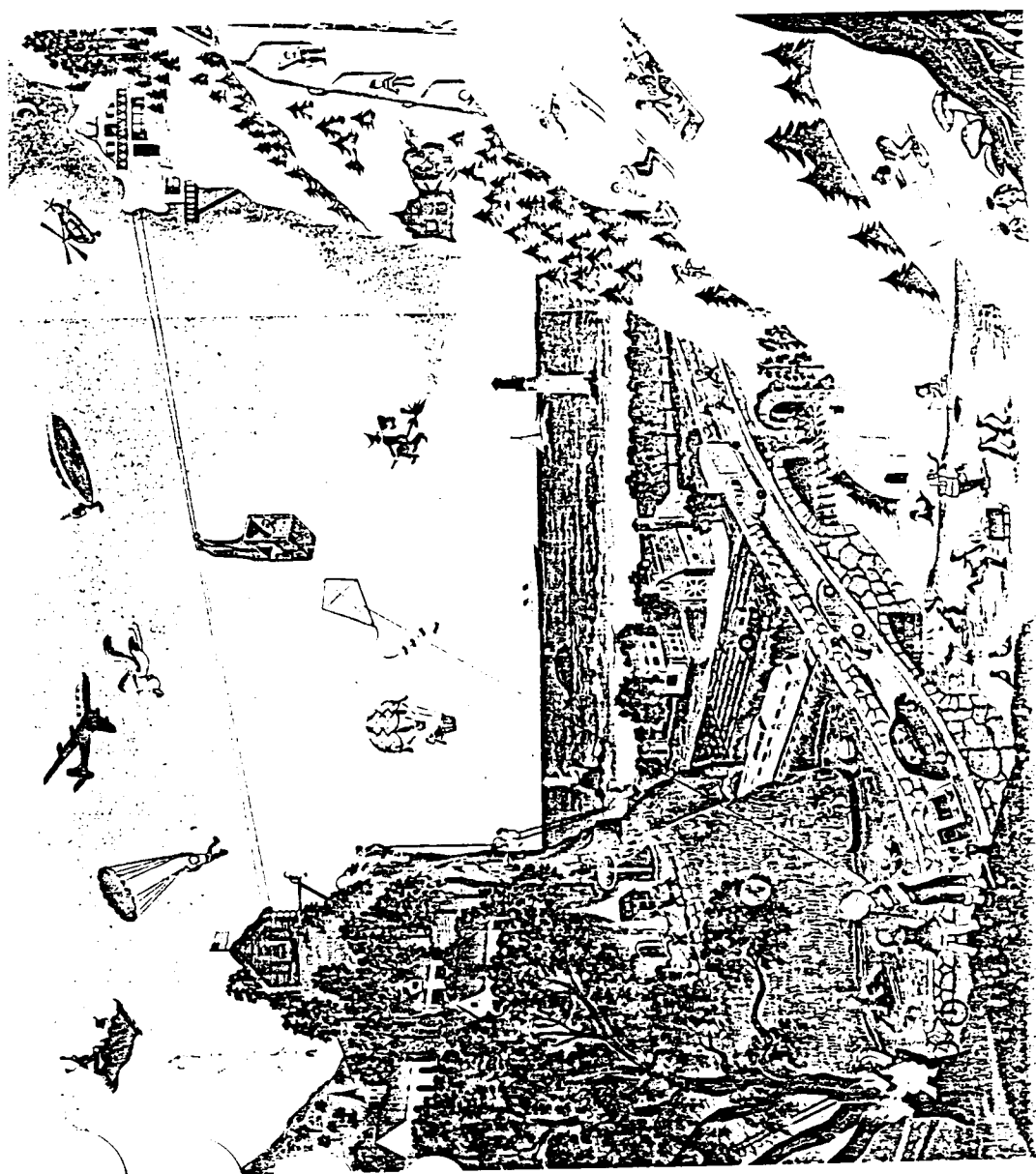
LIST OF CONTENTS:

FORM	PAGE
H-1	Very Light Copy..... 156
H-2	Light Copy 157
H-3	Normal Copy 158
H-4	Dark Copy 159
H-5	Very Dark Copy 160

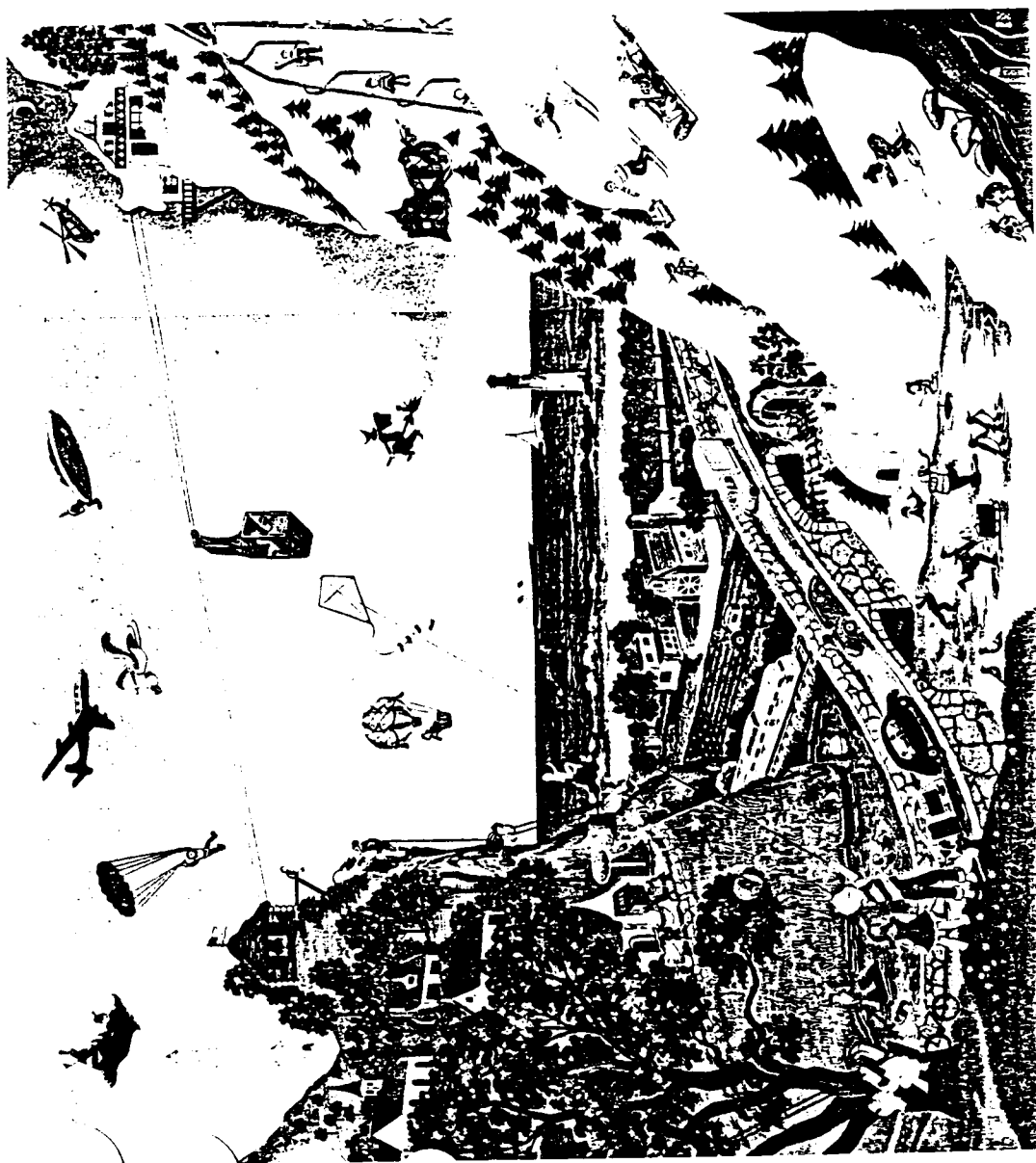
Note: The following pictures, because they are xerox copies of xerox copies do not preserve the original degree of clarity of those pictures used in the experiment.



Form H-1



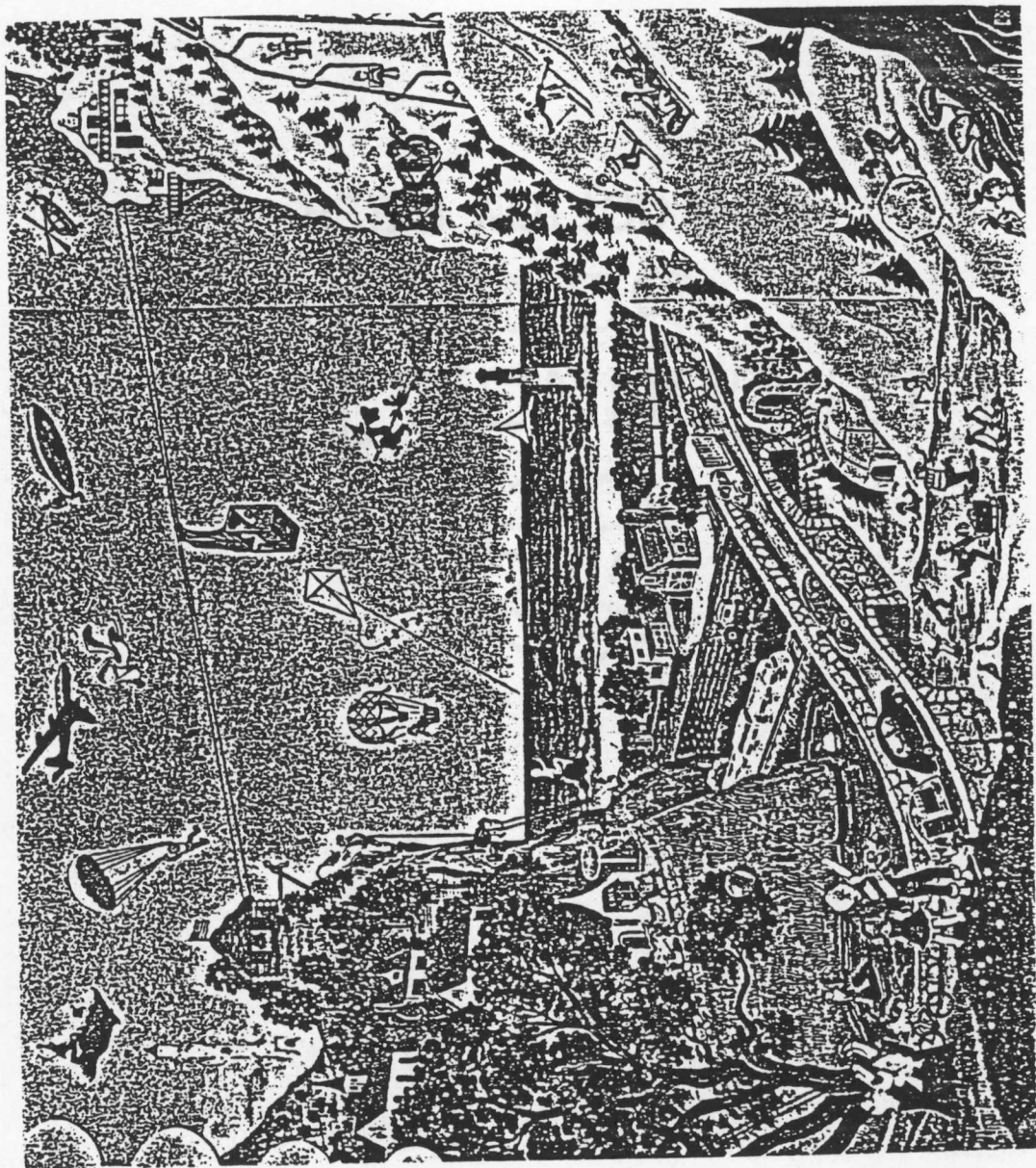
Form H-2



Form H-3



Form H-4



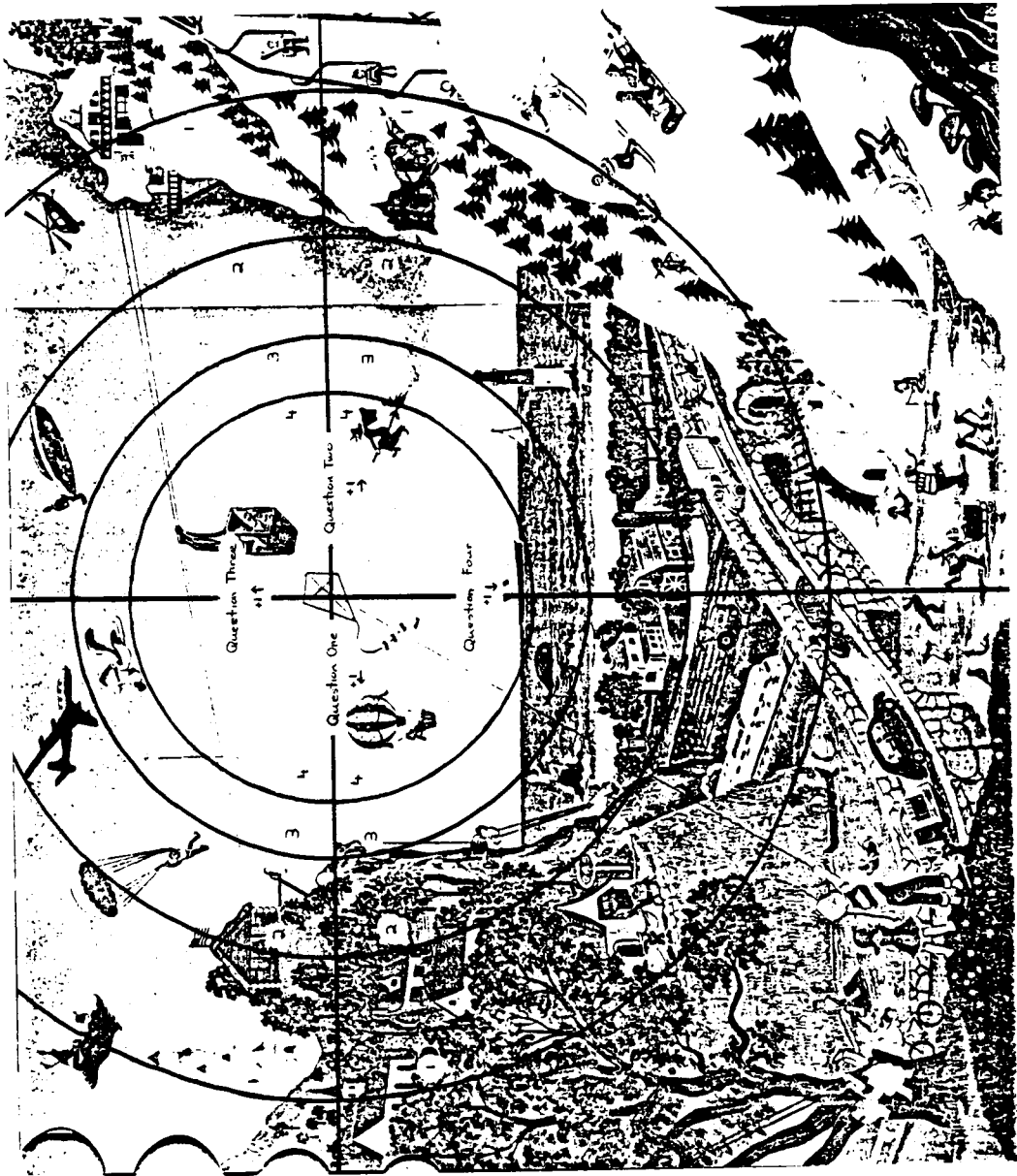
Form H-5

APPENDIX I

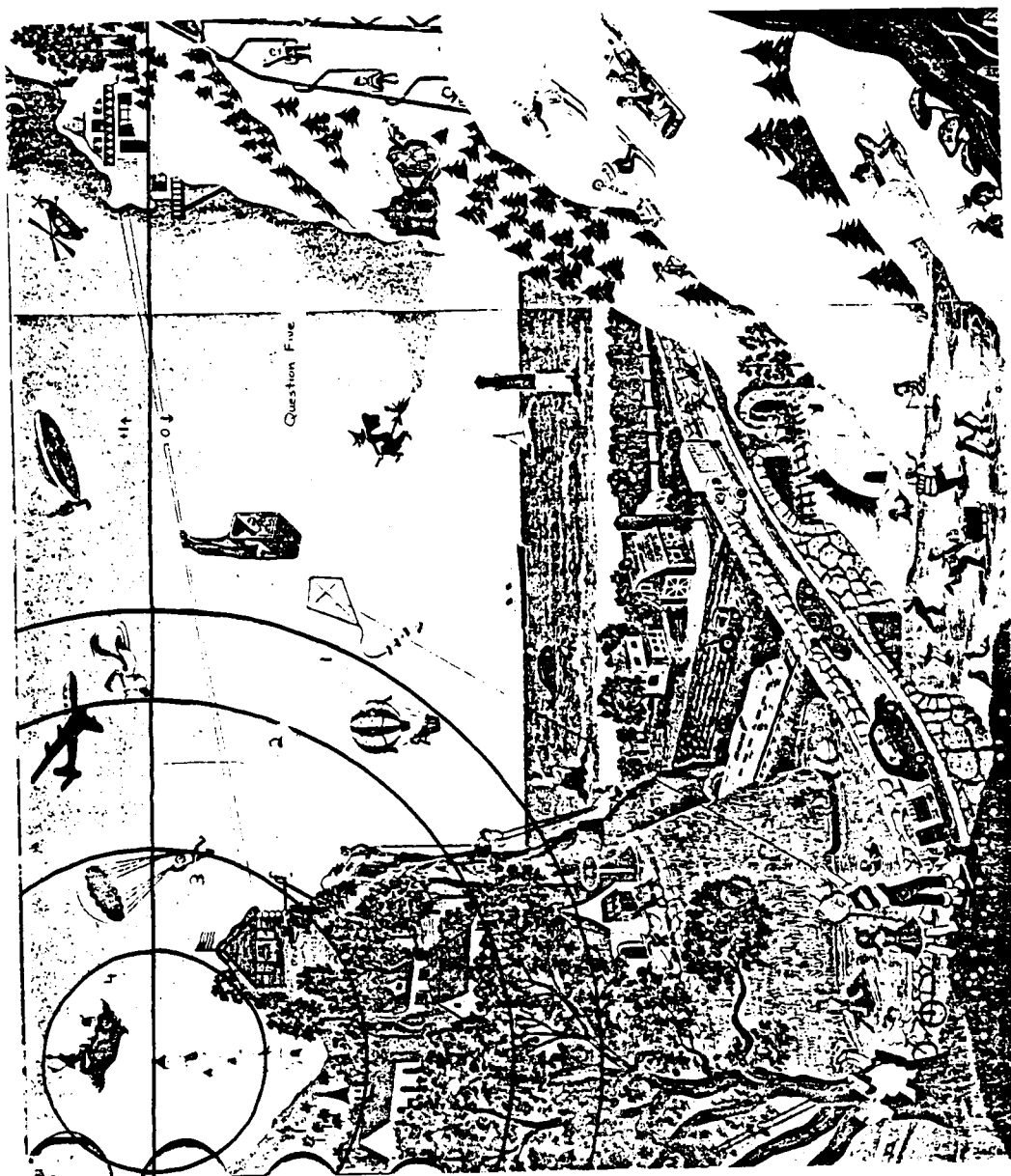
SCORING CODE FOR PICTURE QUESTIONNAIRE

LIST OF CONTENTS:

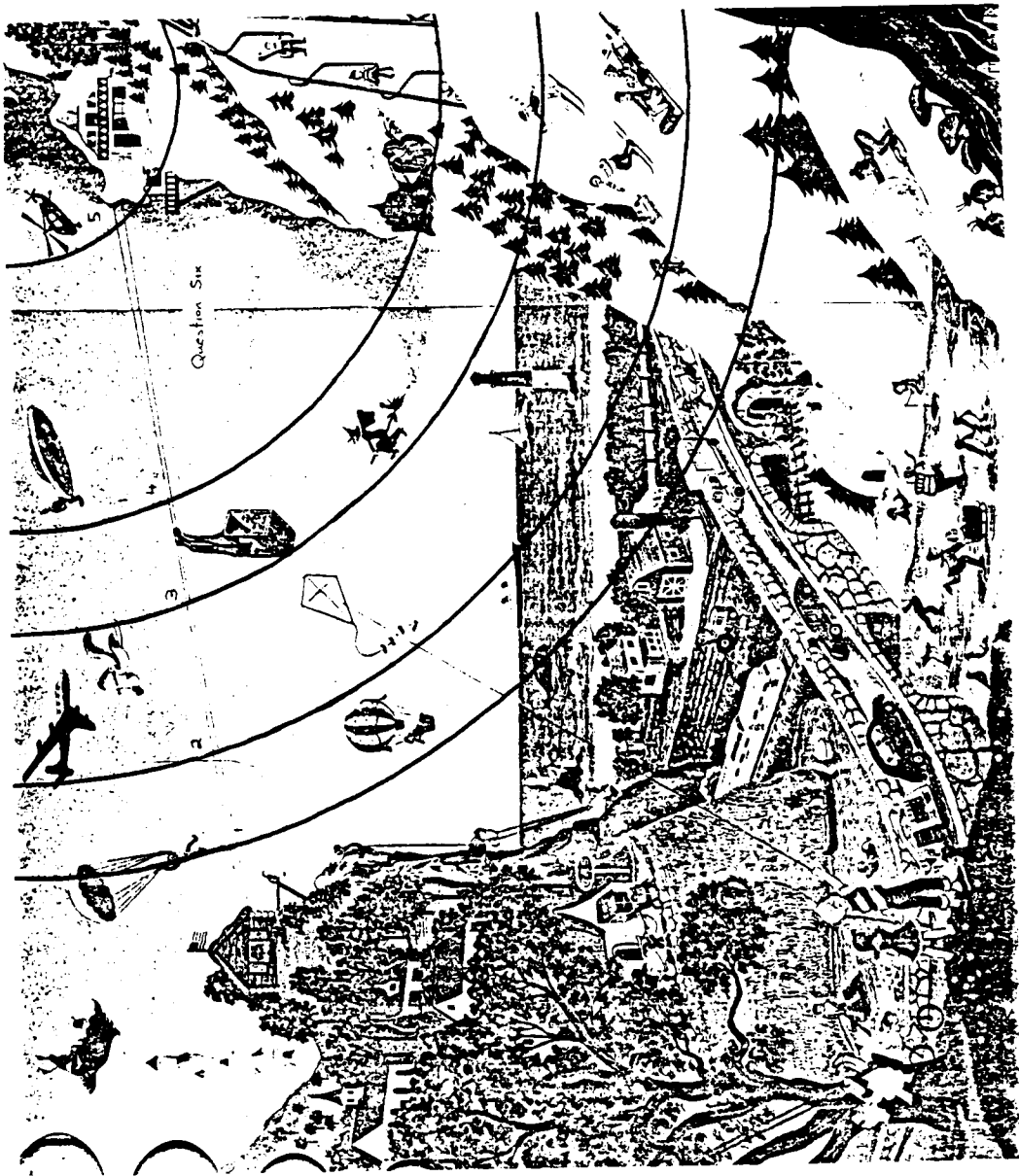
FORM	PAGE
I-1	Answer Key for Questions One through Four 162
I-2	Answer Key for Question Five 163
I-3	Answer Key for Question Six 164
I-4	Answer Key for Question Seven 165
I-5	Answer Key for Questions Eight and Nine 166
I-6	Answer Key for Questions Ten through Twelve 167



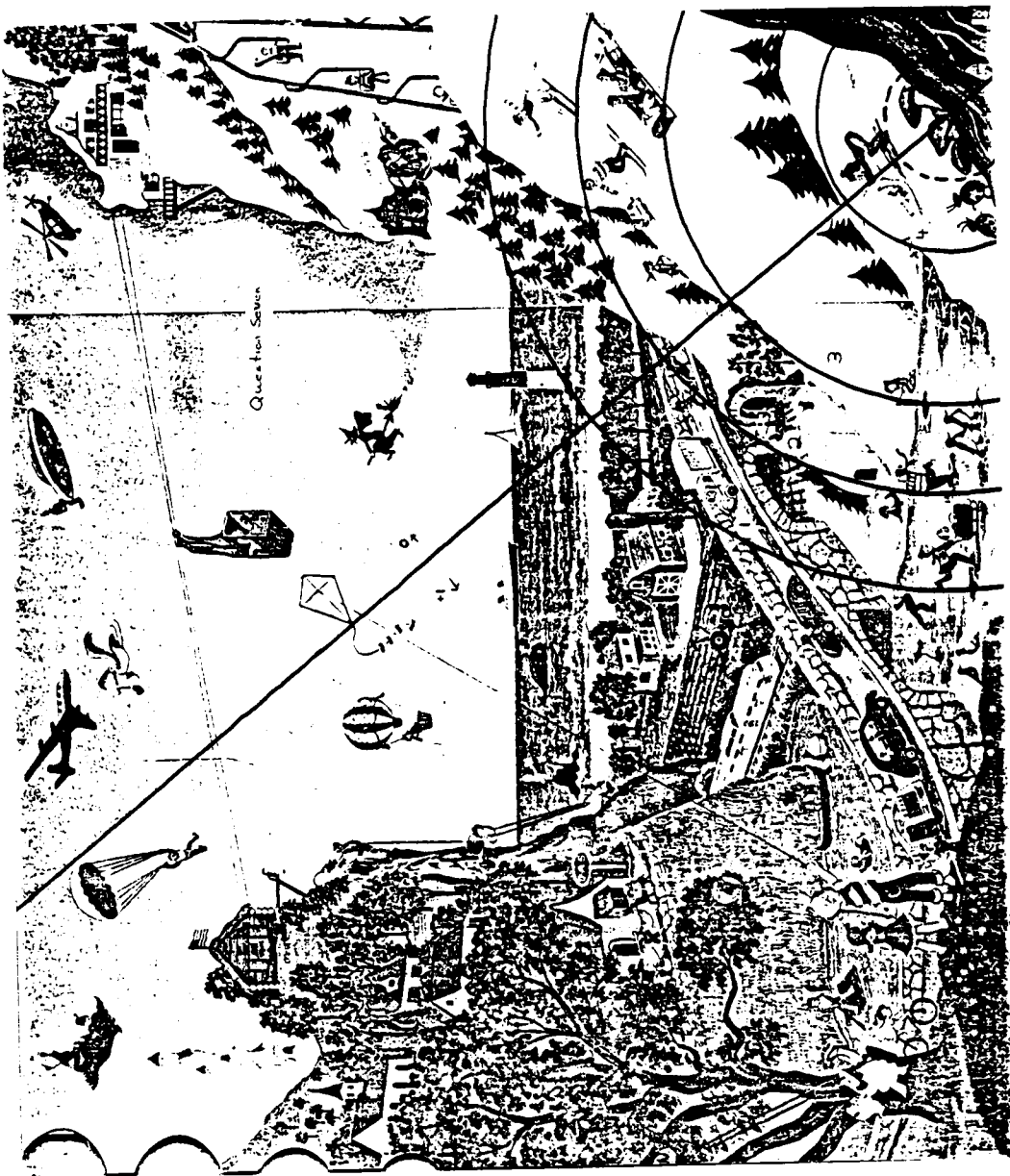
Form I-1



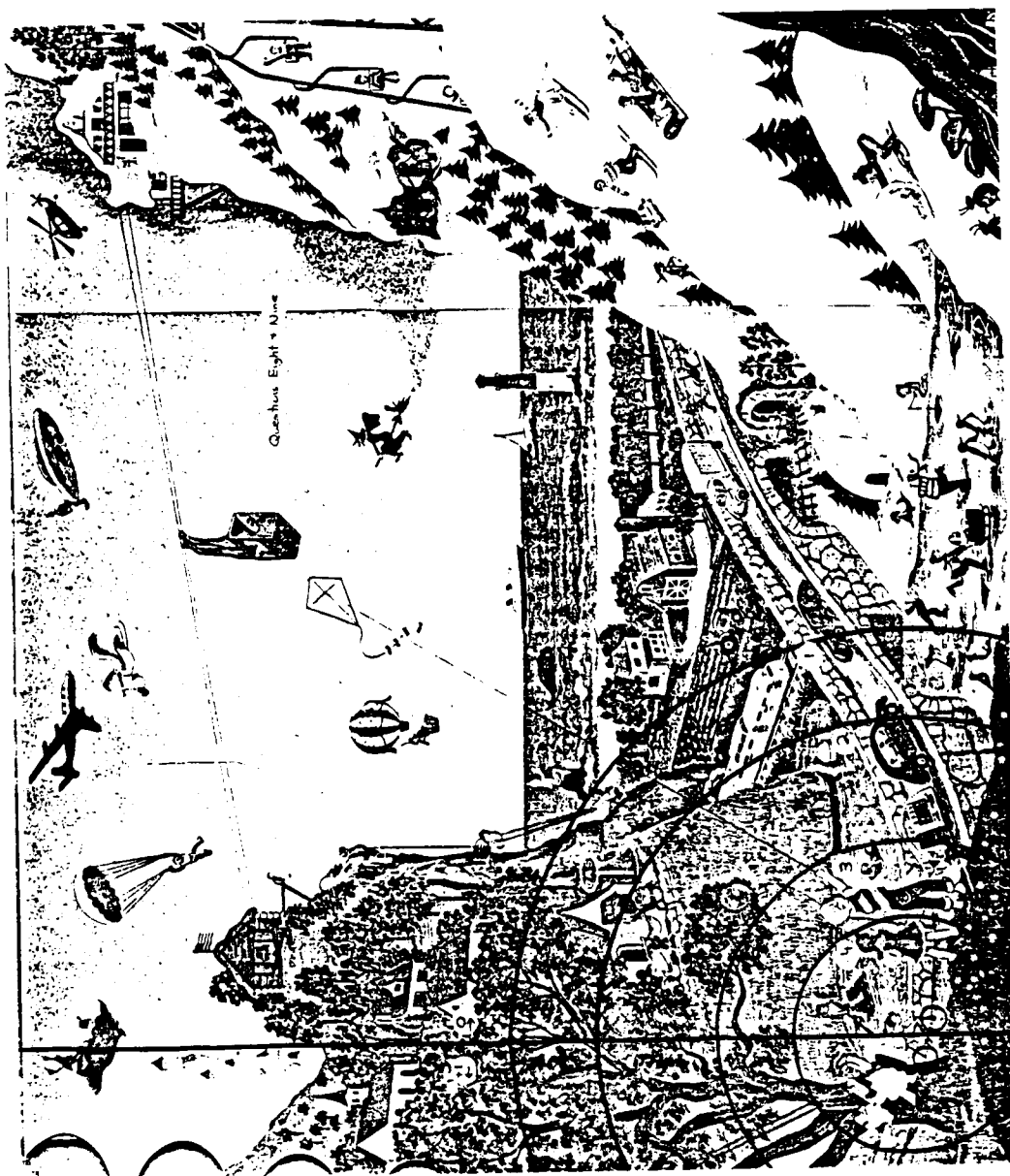
Form I-2



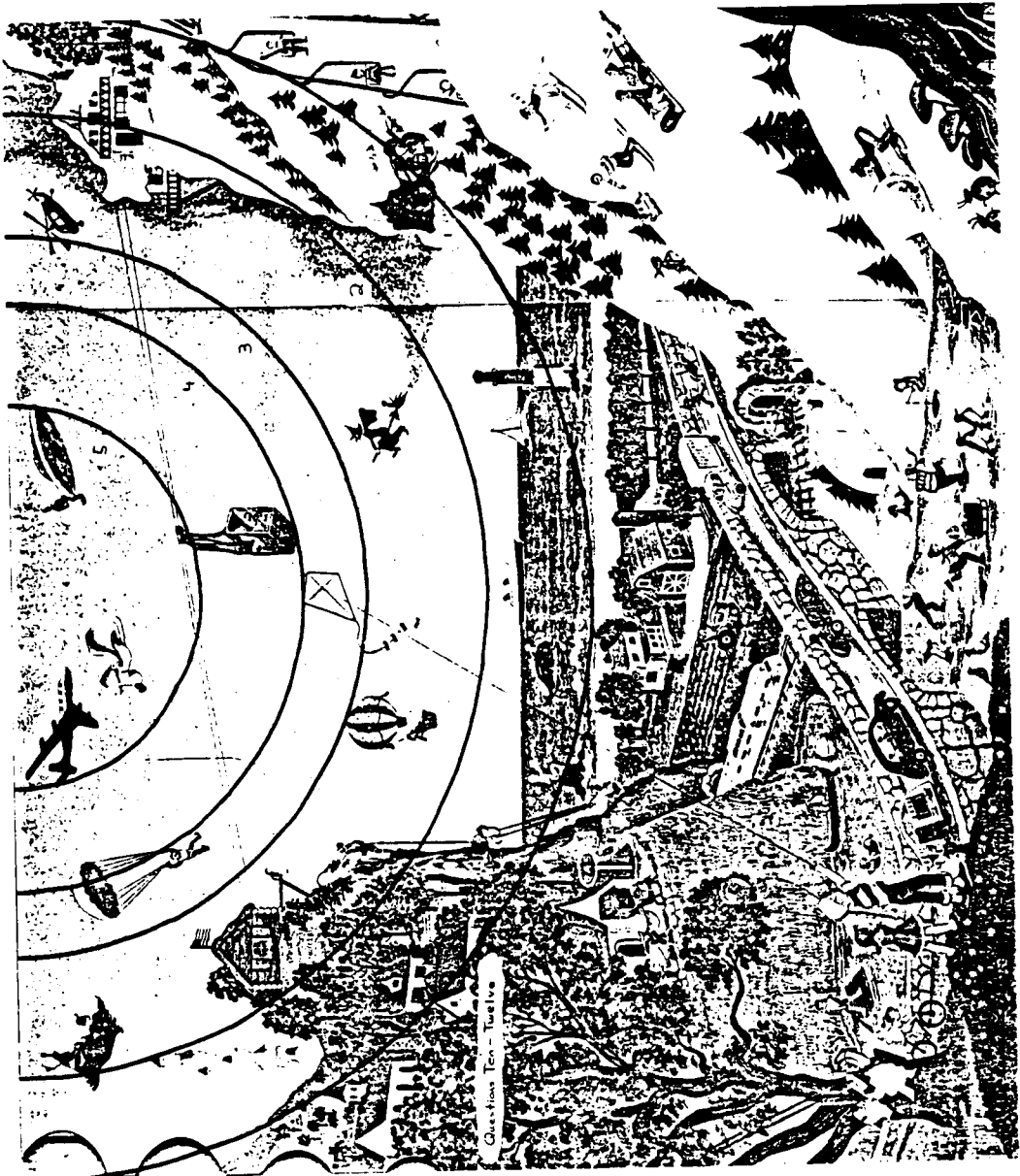
Form I-3



Form I-4



Form I-5



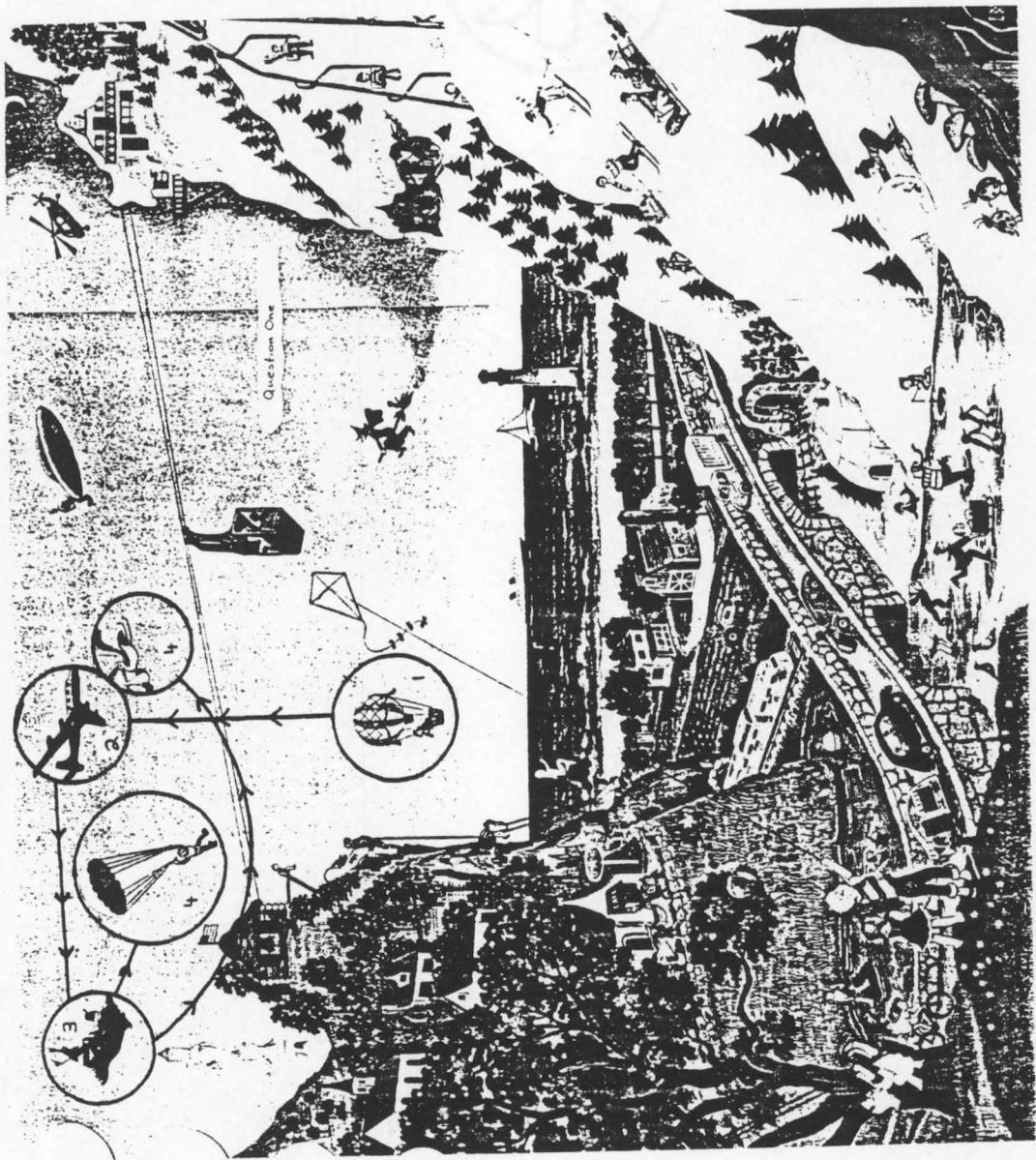
Form I-6

APPENDIX J

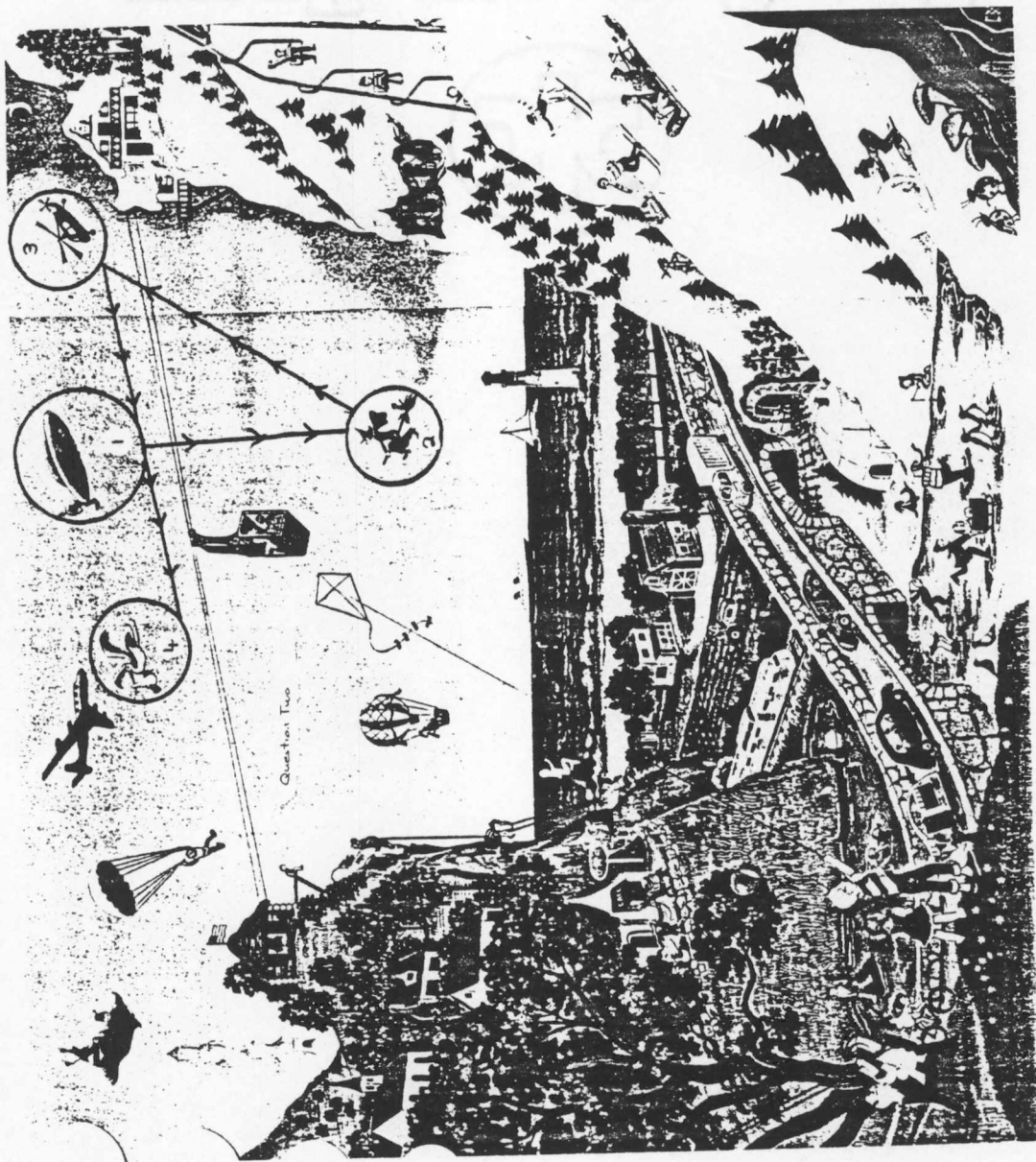
SCANNING DIAGRAMS FOR PICTURE QUESTIONNAIRE IN EXPERIMENT THREE

LIST OF CONTENTS:

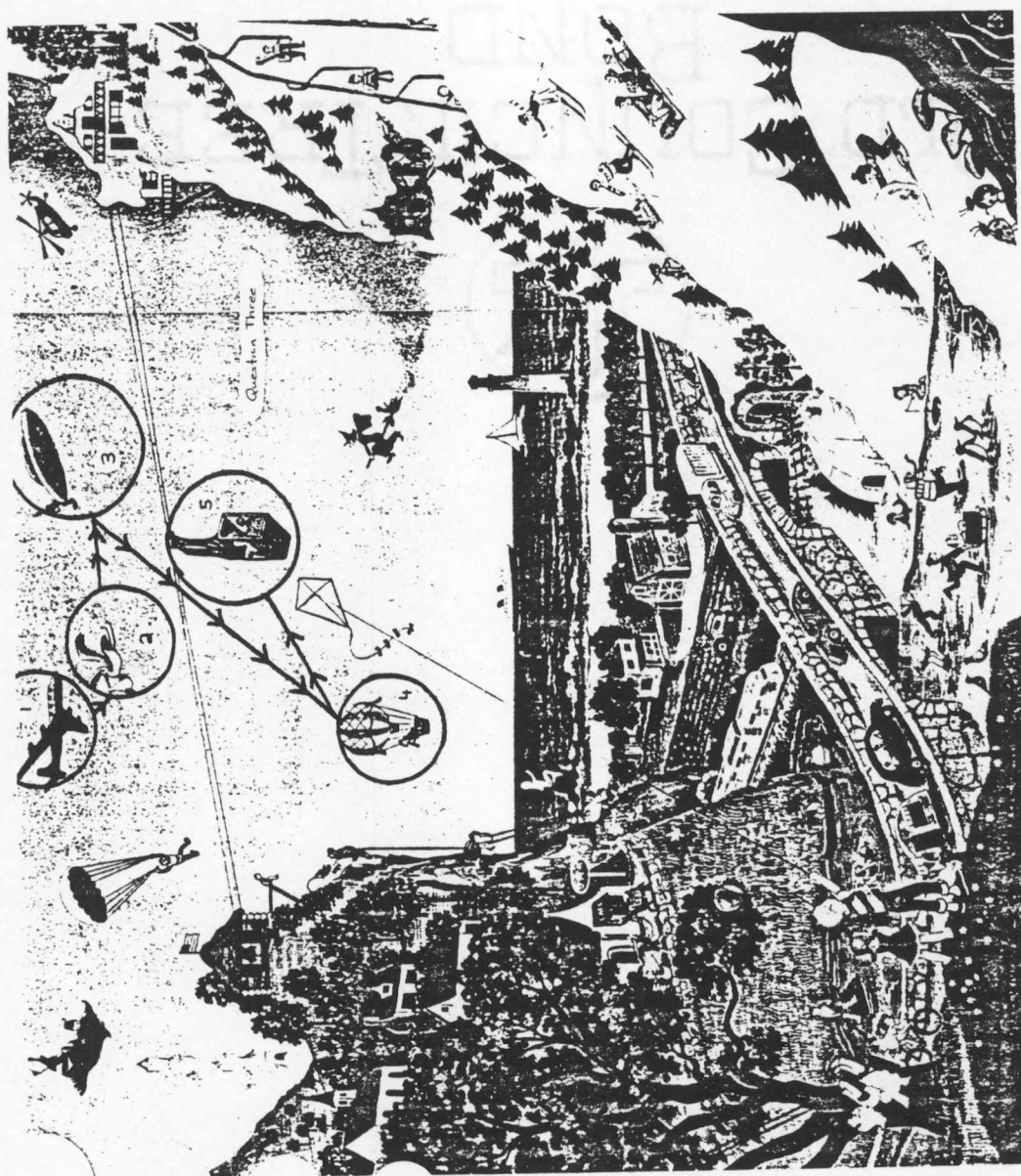
FORM	PAGE
J-1	Diagram for Question One 169
J-2	Diagram for Question Two 170
J-3	Diagram for Question Three 171
J-4	Diagram for Question Four 172
J-5	Diagram for Question Five 173
J-6	Diagram for Question Six 174
J-7	Diagram for Question Eleven 175
J-8	Diagram for Questions Fourteen through Sixteen 176
J-9	Diagram for Questions Seven through Ten 177
J-10	Diagram for Questions Seventeen through Twenty-One ... 178
J-11	Diagram for Questions Twenty-Two through Twenty-Seven. 179
J-12	Diagram for Questions Twenty-Eight through Thirty 180



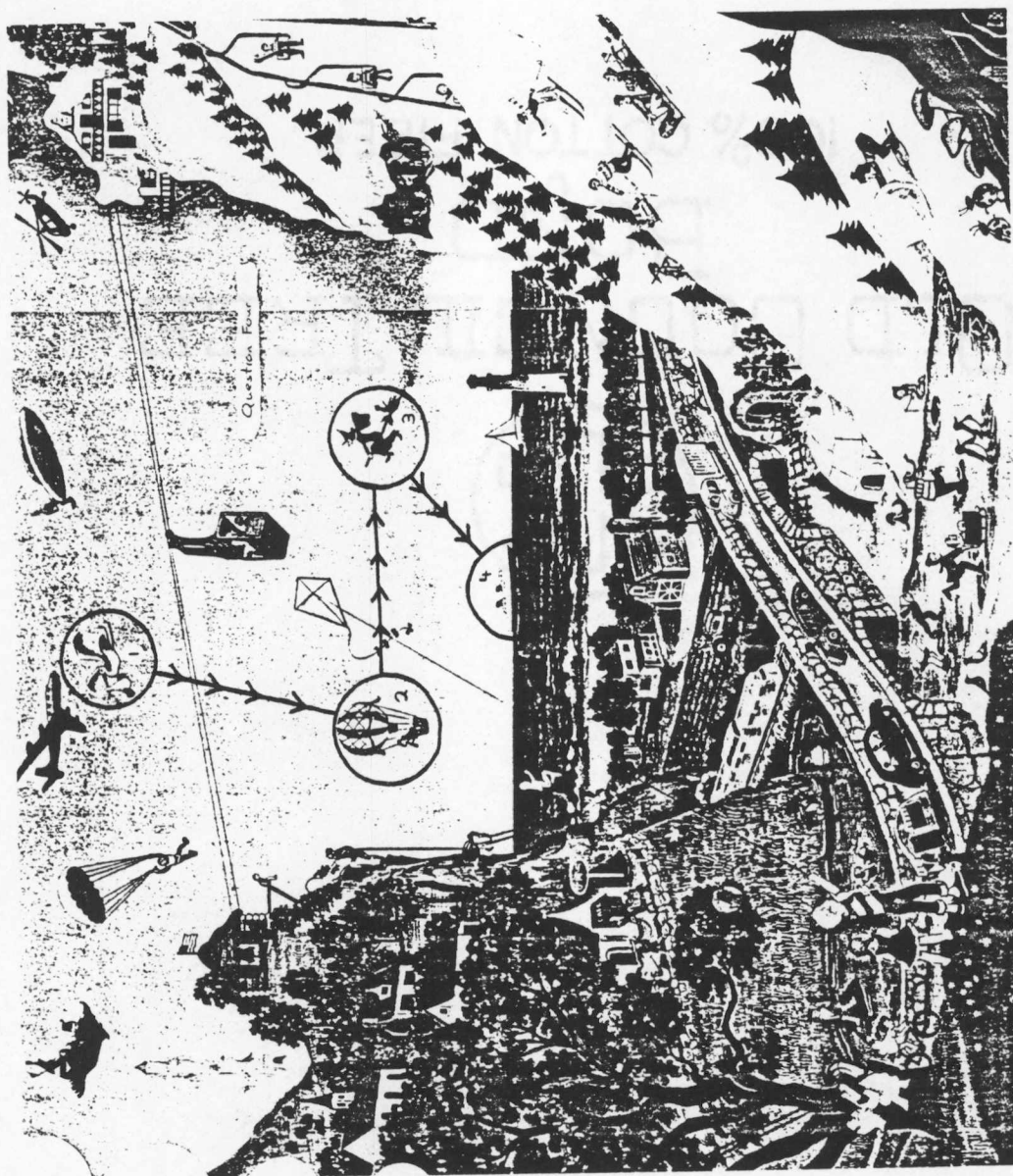
Form J-1



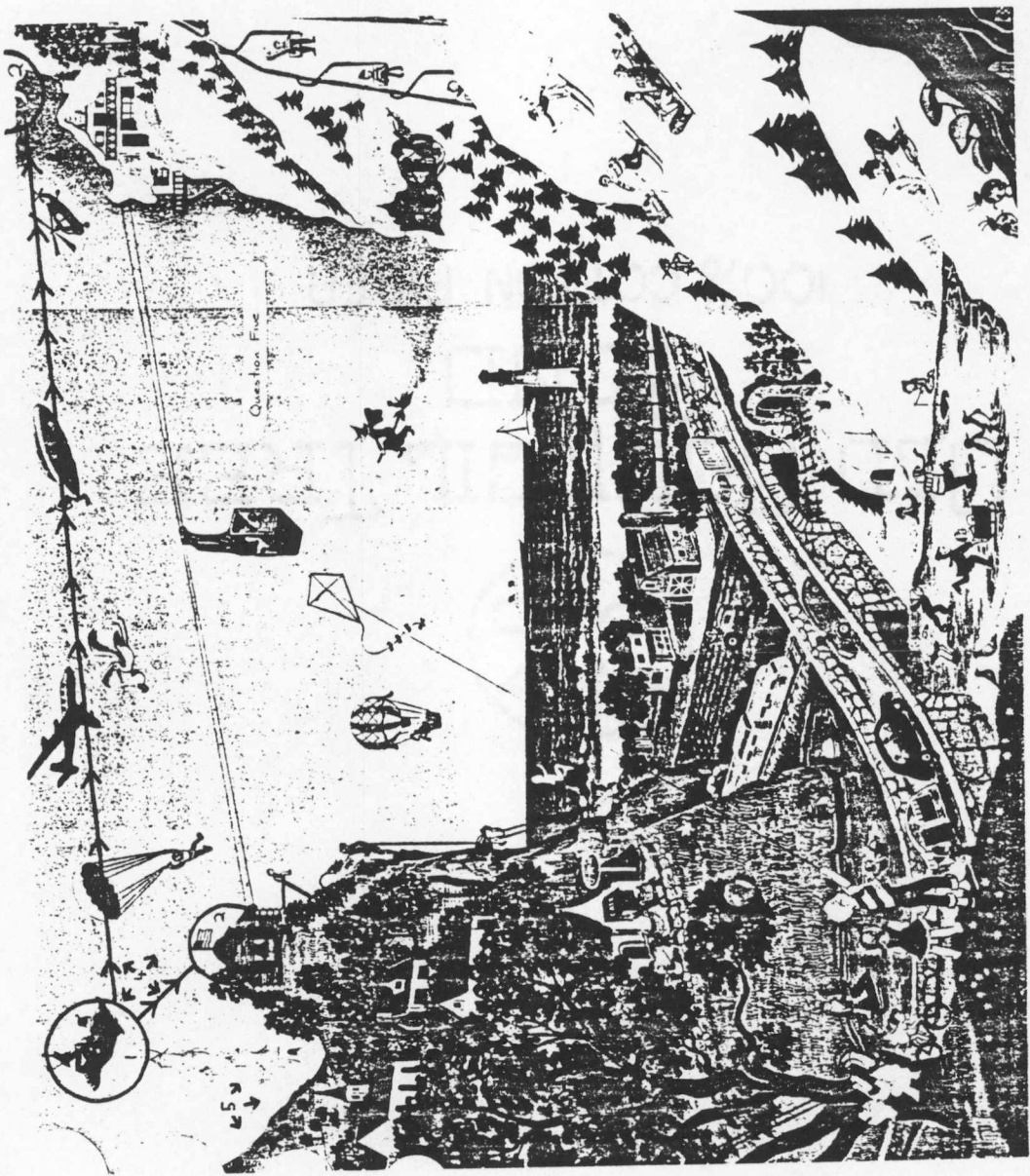
Form J-2



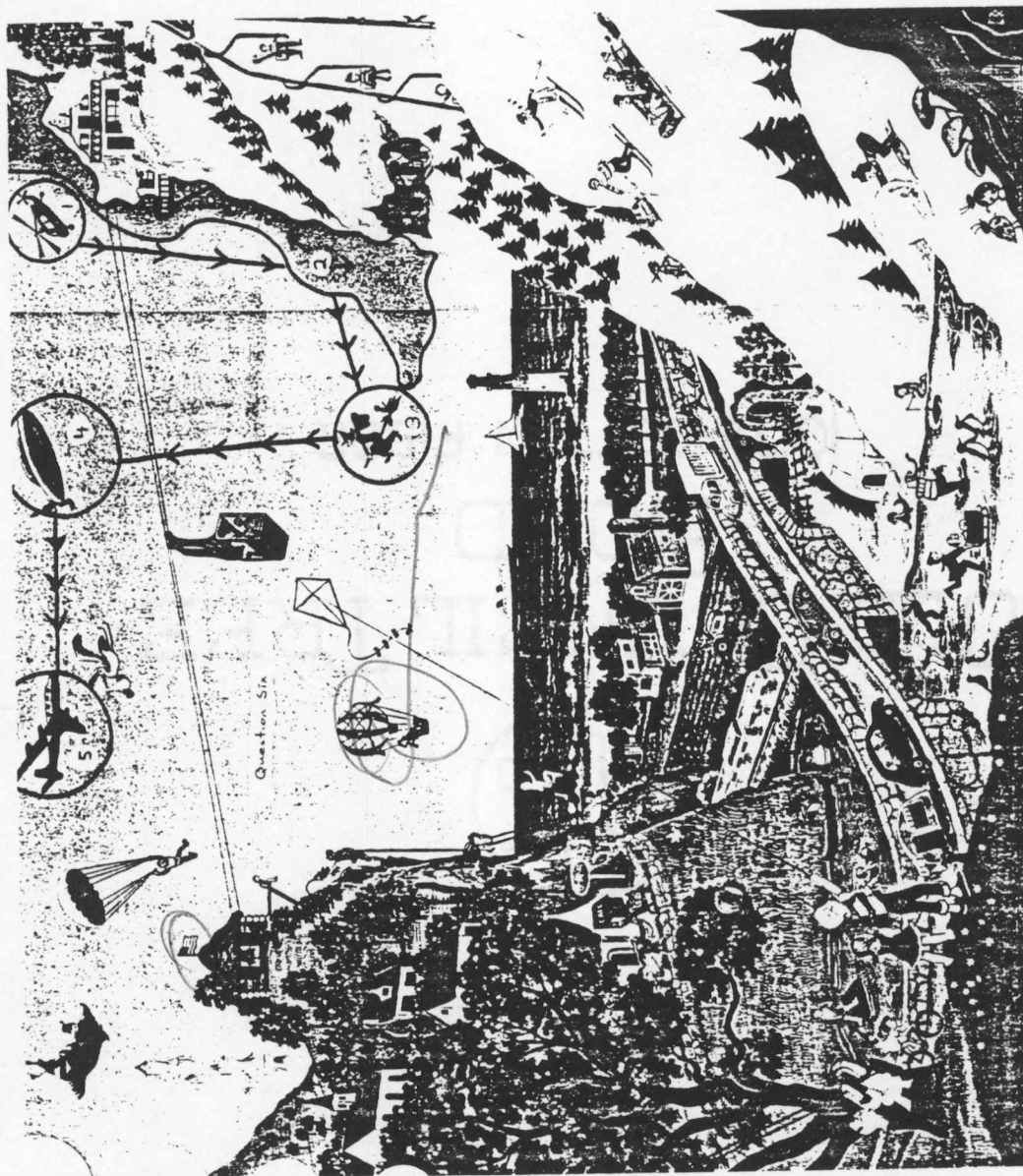
Form J-3



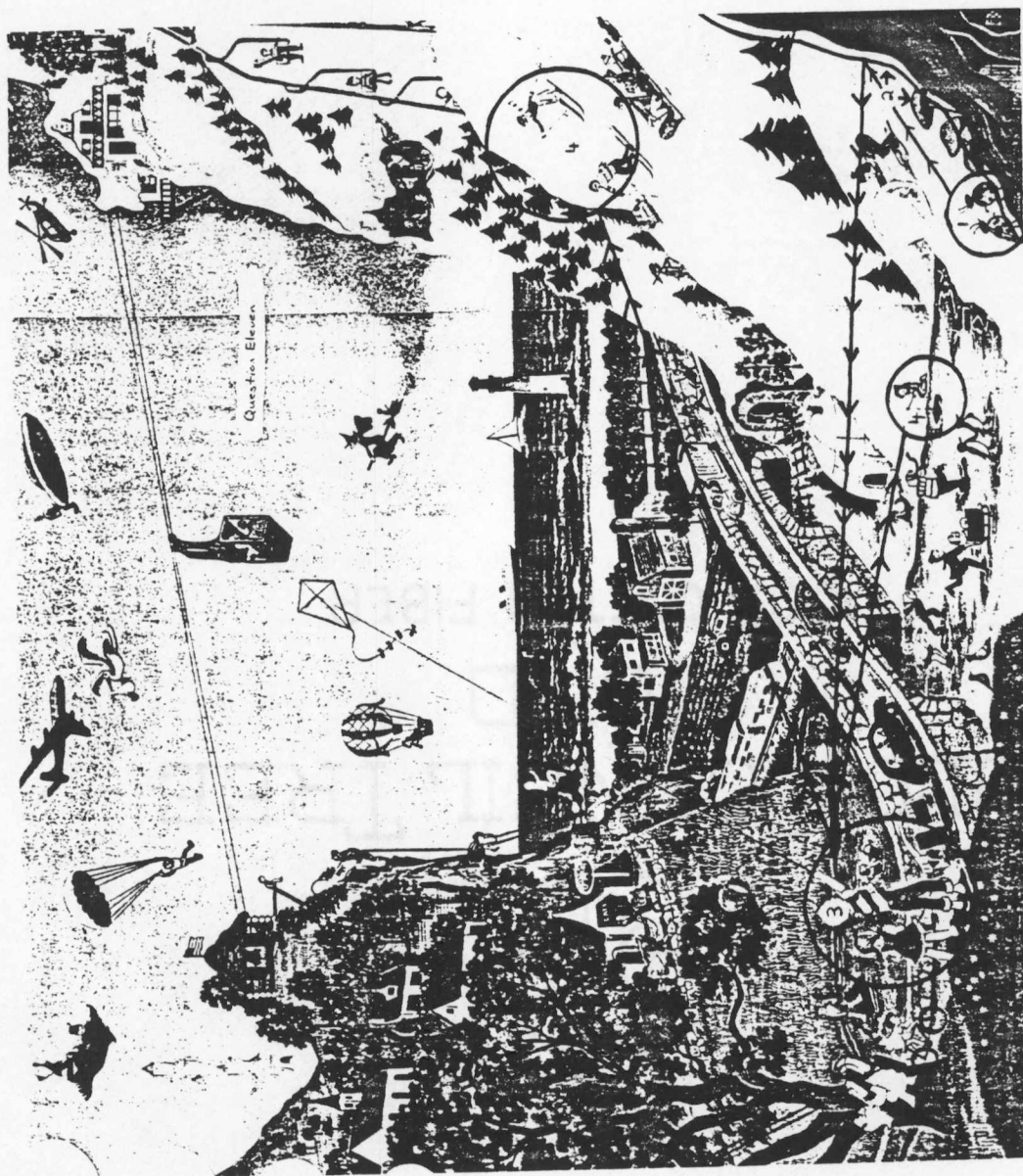
Form J-4



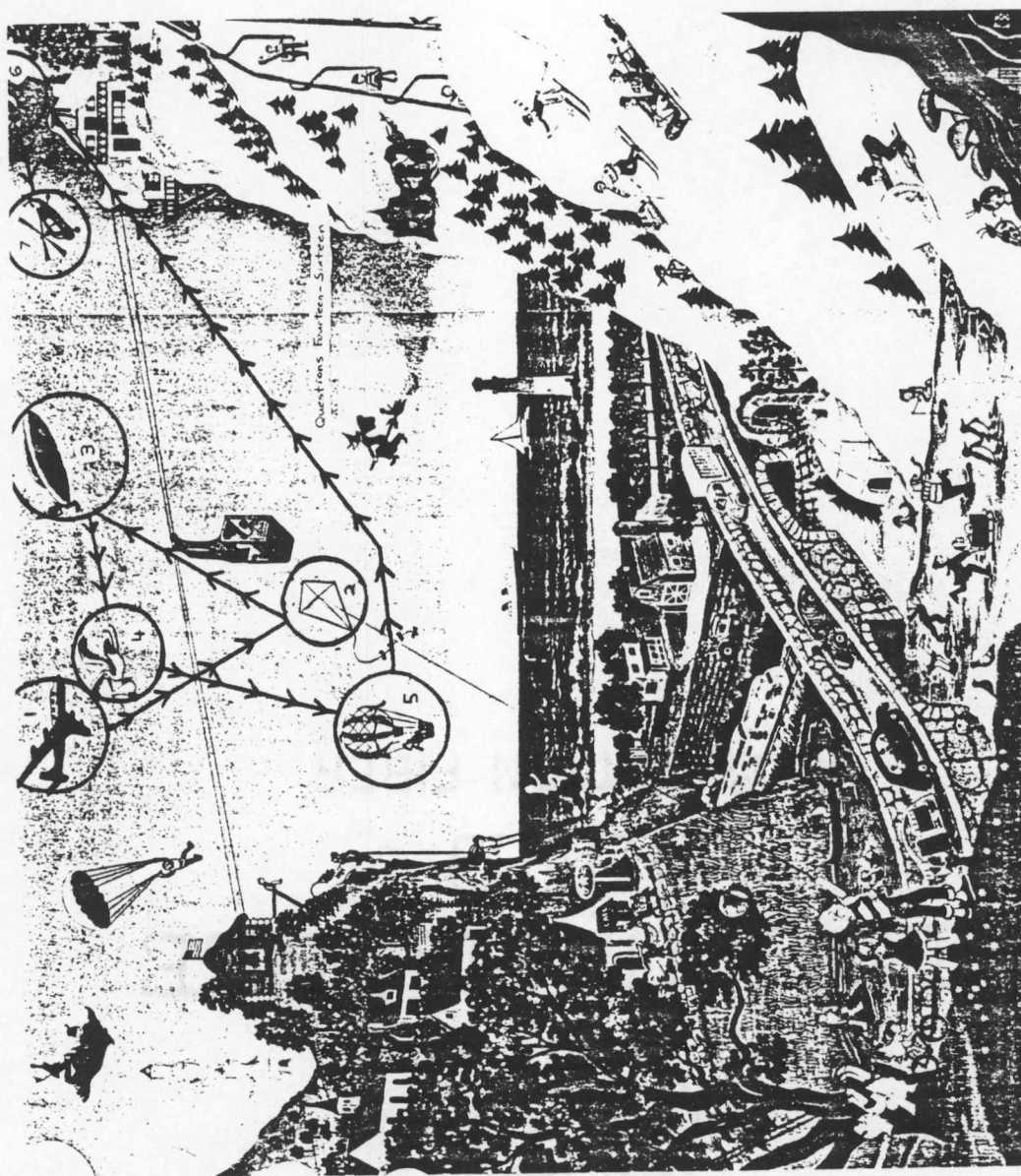
Form J-5



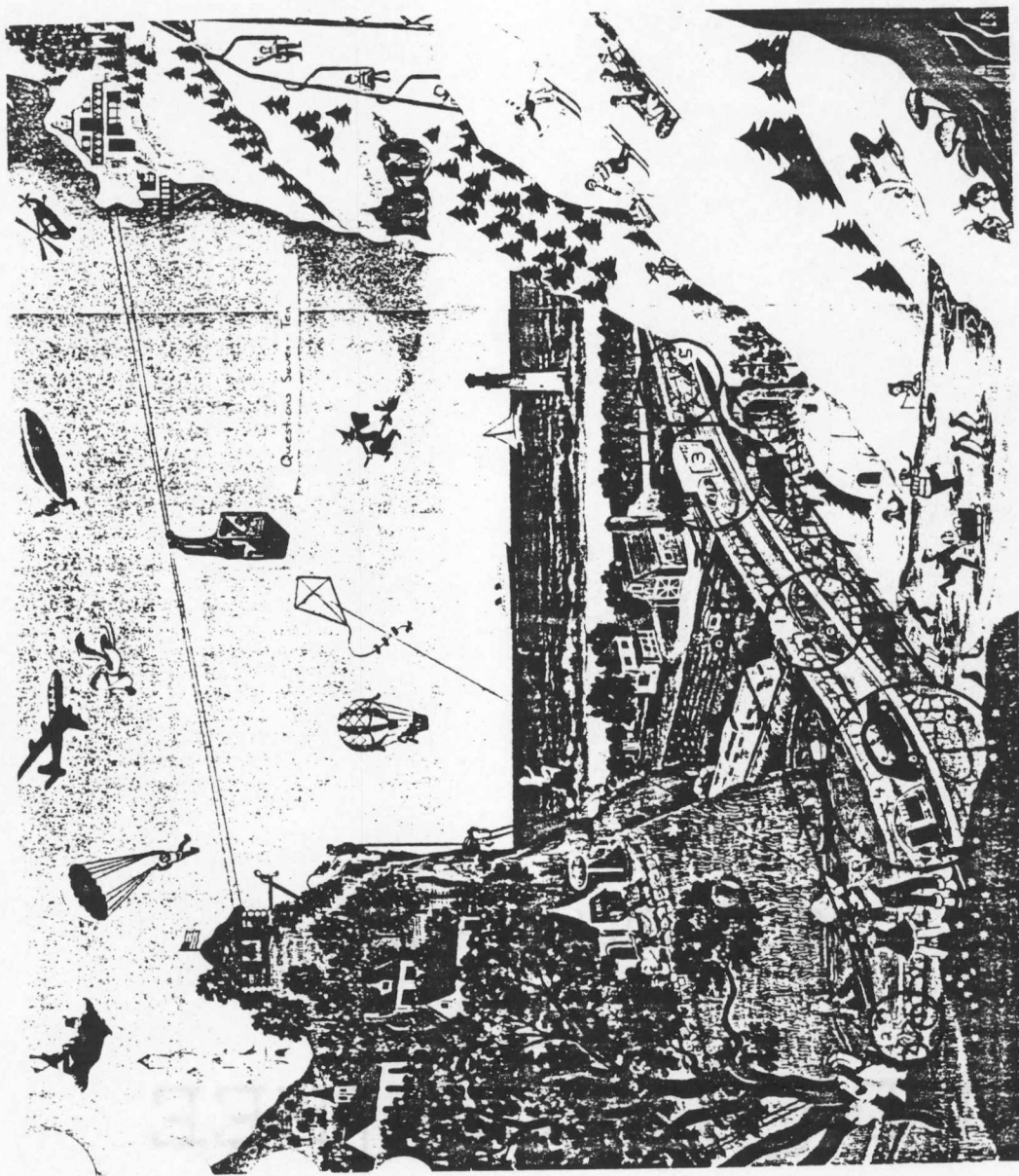
Form J-6



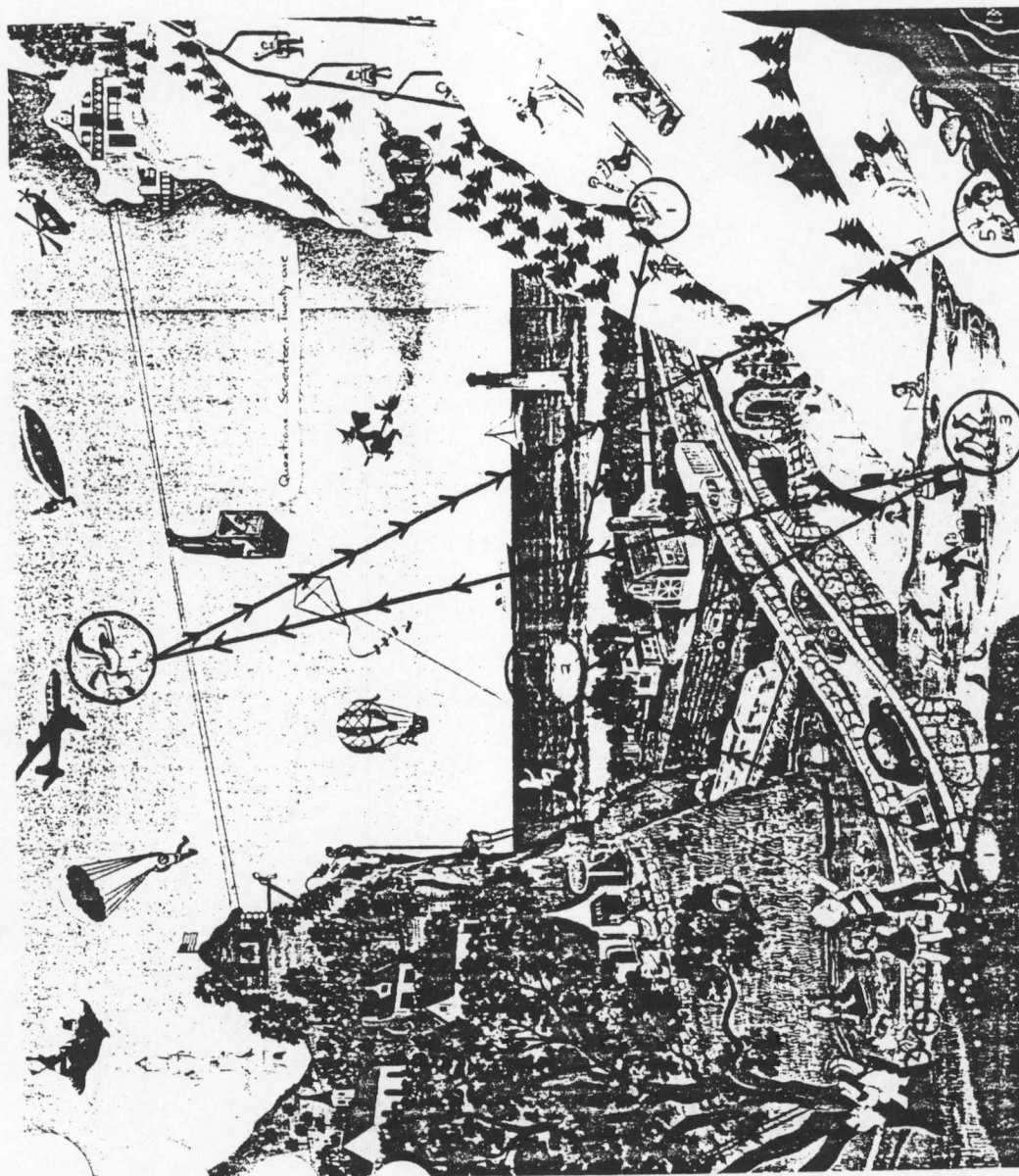
Form J-7



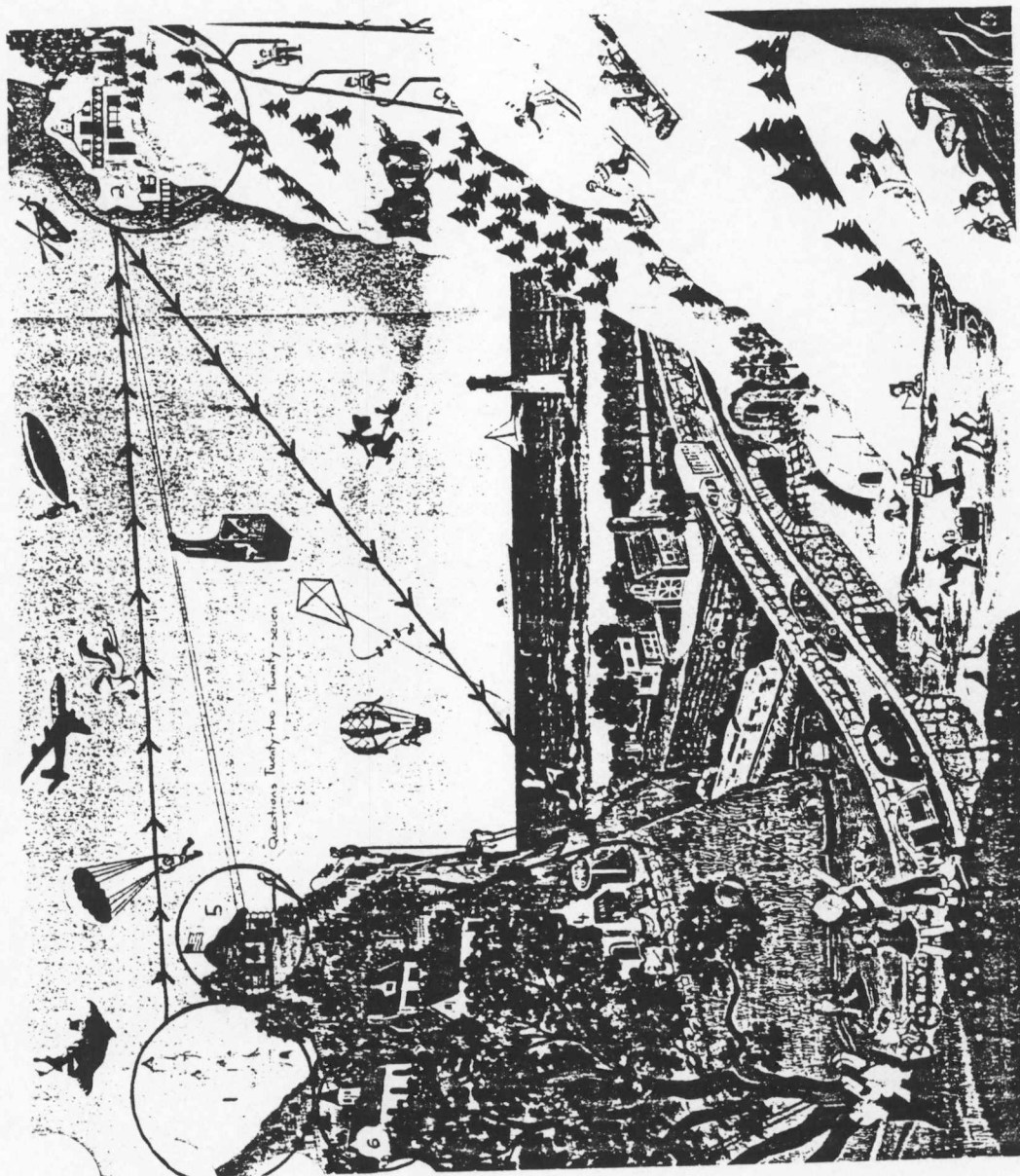
Form J-8



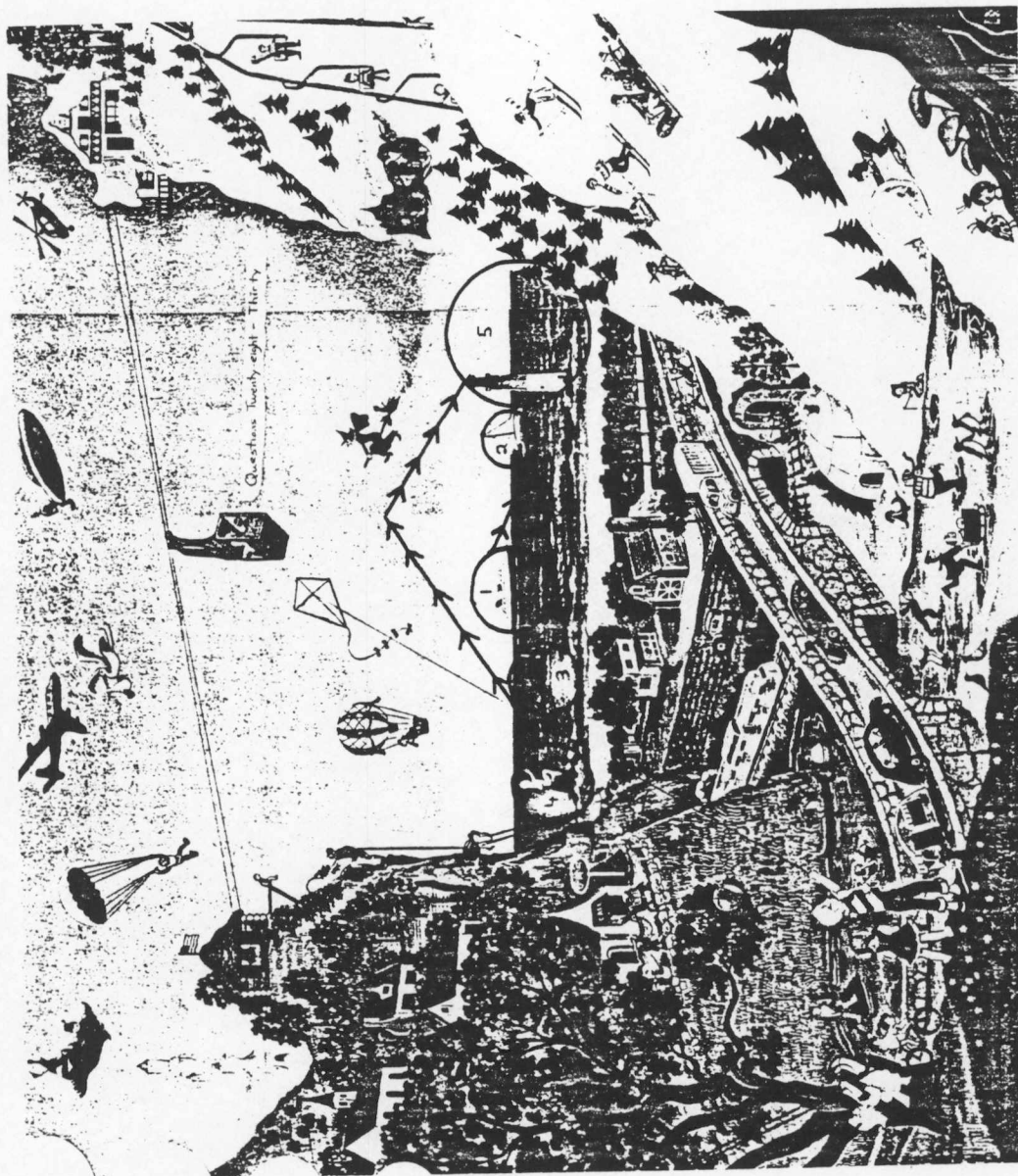
Form J-9



Form J-10



Form J-11



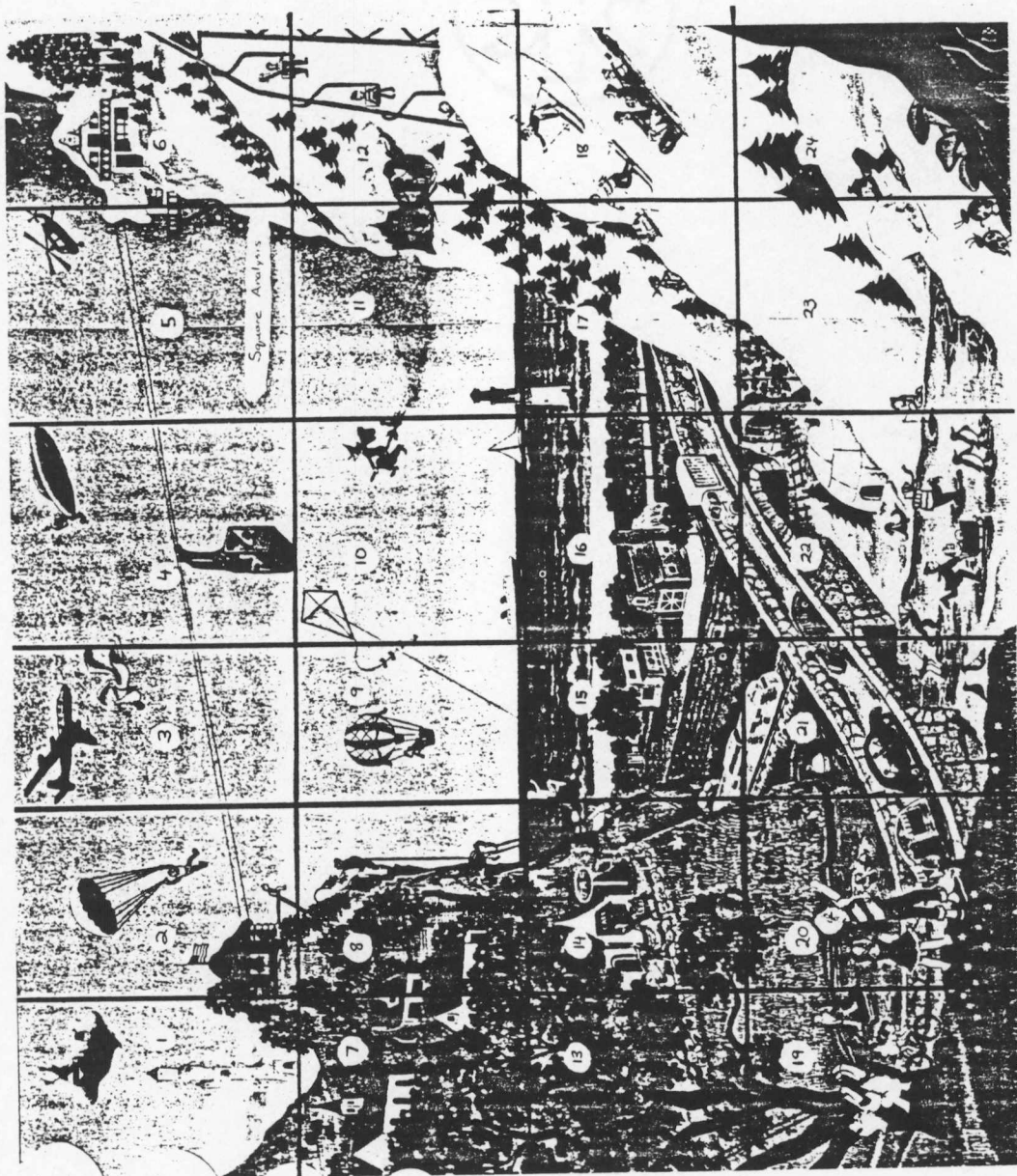
Form J-12

APPENDIX K

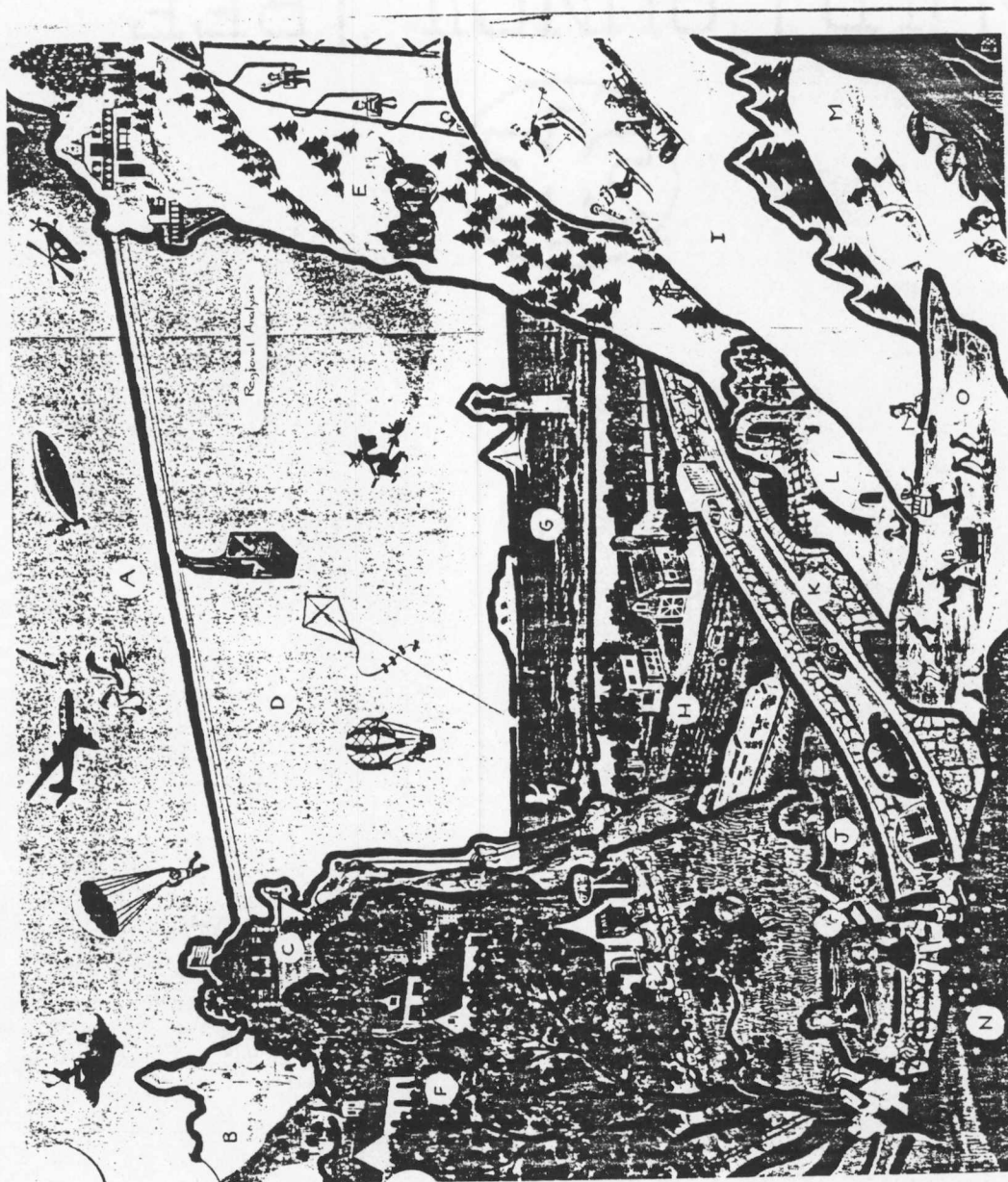
DIVISIONS OF THE PICTURE USED IN EXPERIMENT FOUR

LIST OF CONTENTS:

FORM		PAGE
K-1	Division into Squares	182
K-2	Division into Regions	183



Form K-1



Form K-2

APPENDIX L

OBJECTIVELY VERIFIABLE MEASURES AND TASKS USED IN EXPERIMENT FOUR

LIST OF CONTENTS:

FORM		PAGE
L-1	Free Recall Measure	185
L-2	Picture Questionnaire (Positional Questions only).....	186
L-3	Position Questionnaire	187
L-4	Depth Perception Questionnaire	188
L-5	List of Objects Measure	189
L-6	Drawing Task	190

FORM L-1

FREE RECALL DESCRIPTION

List all the things you recall as being in the picture:

FORM L-2

PICTURE QUESTIONNAIRE - #1

Please answer the following questions to the best of your ability.

For questions 1-4, focus your attention on the kite in the middle of the picture:

1. What flying object is to its immediate left? _____
2. What flying object is to its immediate right? _____
3. What object is closest above it? _____
4. What object is directly below it? _____

-
5. What is directly above the castle? _____
 6. What is directly to the left of the moon? _____
 7. Describe what is immediately to the left of the mushrooms. _____

For questions 8 - 9, describe two things immediately to the left of the girl on the bicycle:

8. _____
9. _____

For questions 10 - 12, describe the three objects in the top-most part of the picture that are most centered from the left and right hand sides of the picture:

10. _____
11. _____
12. _____

FORM L-3

POSITION QUESTIONNAIRE

For the following questions, you are to base your answers in terms of how things are placed in the picture; not on the basis of how things would relate to each other in physical terms if the scene depicted was reality. In other words, base your answers on the picture as being two-dimensional (absence of depth) rather than as three-dimensional (presence of depth). (Object can mean person, animal, vehicle, building, etc.)

-
1. _____ What object is closest to the lighthouse?
 2. _____ What object is closest to the upper left-hand corner of the picture?
 3. _____ In the picture, what object is directly vertically above the mushrooms?
 4. _____ What is the flying object closest to the upper right-hand corner of the picture?
 5. _____ What is the object in the furthest left-hand portion of the pond?
 6. _____ What object is closest above and to the right of the kite sail (excluding the kite string and tail)?
 7. _____ What object is closest in front of the entrance to the igloo?
 8. _____ What is the object on the road to the right of the truck?
 9. _____ What is the object directly in front of the "cafe" awning (window covering) on the road.
 10. _____ What is the object to the left and slightly below the kite (excluding the kite string and tail)?
 11. _____ What object is directly vertically above the farmhouse in the picture?
 12. _____ What object is directly to the right of the witch?

FORM L-4

DEPTH PERCEPTION QUESTIONS

Answer the following questions on the basis of how the objects would appear in real life; not on the basis of two-dimensional (absence of depth) physical distance in the picture. In other words, imagine you are looking out of a window and the three-dimensional (presence of depth) scene depicted appears before you.

1. _____ Which object in the scene would be furthest away from you, the viewer?
2. _____ Which object in the scene would be closest to you, the viewer?
3. _____ Which object on the road would be furthest away from you, the viewer?
4. _____ Which object on the road would be closest to you, the viewer?
5. _____ Which building would be furthest away from you, the viewer?
6. _____ Which building would be closest to you, the viewer?
7. _____ Which animal would be furthest away from you, the viewer?
8. _____ Which animal would be closest to you, the viewer?
9. _____ Which person (that is visible to you, not deduced to be there) would be furthest away from you, the viewer? Describe what he/she is doing.
10. _____ Which person (that is visible to you, not deduced to be there) would be closest to you, the viewer? Describe what he/she is doing.
11. _____ What would be directly below the kite as the scene is depicted to you, the viewer?
12. _____ What would be directly above the castle as the scene is depicted to you, the viewer?

FORM L-5

LIST OF OBJECTS

1. List all the different types of animals you recall as being in the picture:

2. List all the different types of modes of transportation you recall as being in the picture:

Form L-6

PLEASE SKETCH TO THE BEST OF YOUR ABILITY THE PICTURE YOU WERE JUST PRESENTED WITH:

APPENDIX M

SCANNING INSTRUCTIONS USED IN EXPERIMENT FOUR

LIST OF CONTENTS:

FORM		PAGE
M-1	Scan A: Vertical Instructions	192
M-2	Scan B: Horizontal Instructions	193
M-3	Scan C: No Specific Instructions	194
M-4	Scan D: Regional Instructions	195

FORM M-1

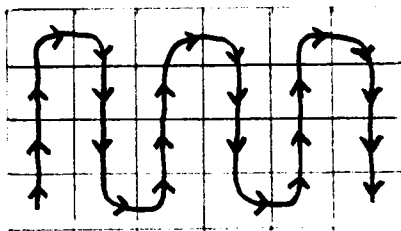
INSTRUCTIONS FOR EXPERIMENT

DO NOT UNCOVER THE UNDERLYING SHEET UNTIL YOU HAVE BEEN GIVEN PERMISSION!

In the following experiment you will be asked to look at a picture and then recall as much about the picture as you can. You will have less than a minute to look at the picture. You will do best if you follow the following directions for scanning the picture systematically:

- 1) Start at the bottom left-hand corner of the picture and scan the far left sixth of the picture from bottom to top.
- 2) Scan the second sixth of the picture from top to bottom.
- 3) Scan the third sixth of the picture from bottom to top.
- 4) Scan the fourth sixth of the picture from top to bottom.
- 5) Scan the fifth sixth of the picture from bottom to top.
- 6) Scan the final sixth of the picture from top to bottom.

In summary, your systematic scanning procedure for looking at the picture should look like this:



Be sure to follow the above scanning procedure as closely as possible. Please do not use another scanning procedure.

When I say GO you may uncover the underlying sheet and immediately scan it according to the above procedure.

FORM M-2

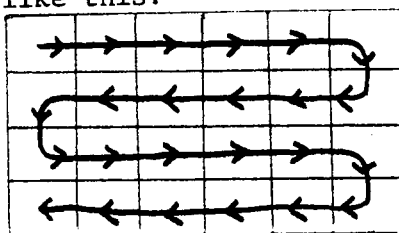
INSTRUCTIONS FOR EXPERIMENT

DO NOT UNCOVER THE UNDERLYING SHEET UNTIL YOU HAVE BEEN GIVEN PERMISSION!

In the following experiment you will be asked to look at a picture and then recall as much about the picture as you can. You will have less than a minute to look at the picture. You will do best if you follow the following directions for scanning the picture systematically:

- 1) Scan across the very top fourth of the picture - start at the left and scan to the right side.
- 2) Then scan back the next fourth of the picture - start at the right and scan back to the left side.
- 3) Then scan back the next fourth of the picture from left to the right.
- 4) Finally, scan back the bottom fourth of the picture from right to left.

In summary, your systematic scanning procedure for looking at the picture should look like this:



Be sure to follow the above scanning procedure as closely as possible. Please do not use another scanning procedure.

When I say GO you may uncover the underlying sheet and immediately scan it according to the above procedure.

FORM M-3

INSTRUCTIONS FOR EXPERIMENT

DO NOT UNCOVER THE UNDERLYING SHEET UNTIL YOU HAVE BEEN GIVEN PERMISSION!

In the following experiment you will be asked to look at a picture and then recall as much about the picture as you can. You will have less than a minute to look at the picture. Use whatever procedure you would like in scanning the picture.

When I say GO you may uncover the underlying sheet and immediately scan the picture.

FORM M-4

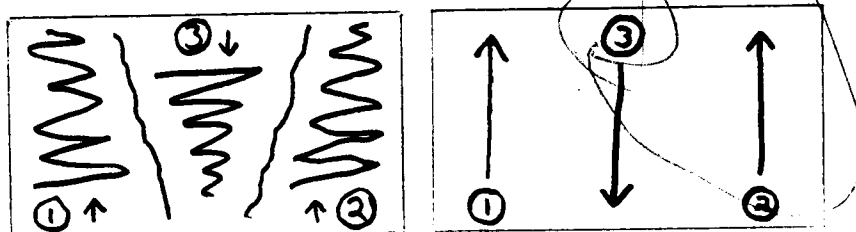
INSTRUCTIONS FOR EXPERIMENT

DO NOT UNCOVER THE UNDERLYING SHEET UNTIL YOU HAVE BEEN GIVEN PERMISSION!

In the following experiment you will be asked to look at a picture and then recall as much about the picture as you can. You will have less than a minute to look at the picture. You will do best if you follow the following directions for scanning the picture systematically:

- 1) Scan the picture by regions. In other words, scan one region of the picture before scanning another region of the picture. The procedure that you need to follow is given in the next three steps.
- 2) Start at the bottom left-hand side of the picture and scan to the top left-hand side of the picture, region-by-region.
- 3) Then, start at the bottom right-hand side of the picture and scan to the top right-hand side of the picture, region-by-region.
- 4) Finally, start at the top-middle portion of the picture and scan to the bottom-middle portion of the picture, region-by-region.

In summary, your systematic scanning procedure for looking at the picture should look like this:



Be sure to follow the above scanning procedure as closely as possible.

Please do not use another scanning procedure.

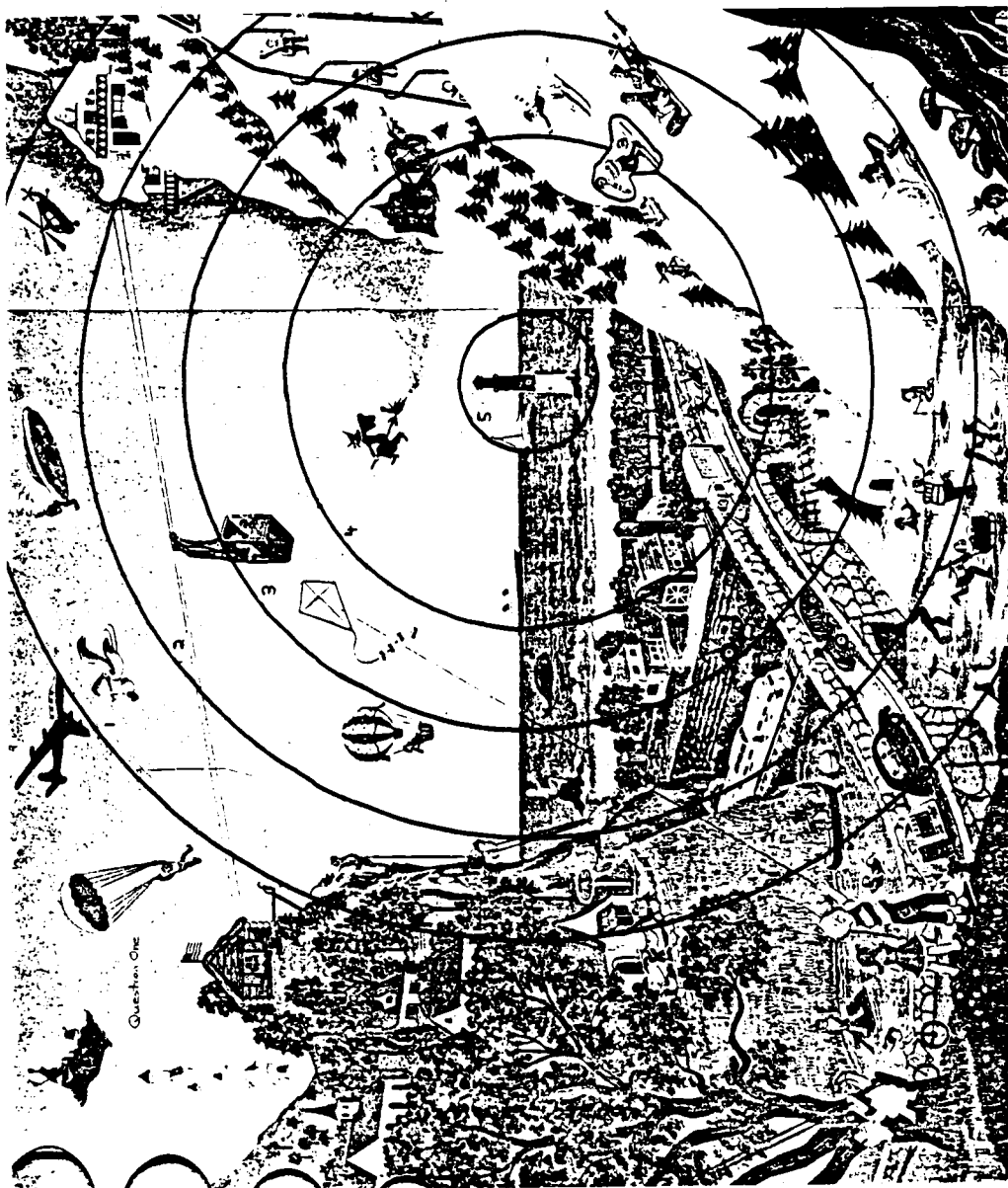
When I say GO you may uncover the underlying sheet and immediately scan it according to the above procedure.

APPENDIX N

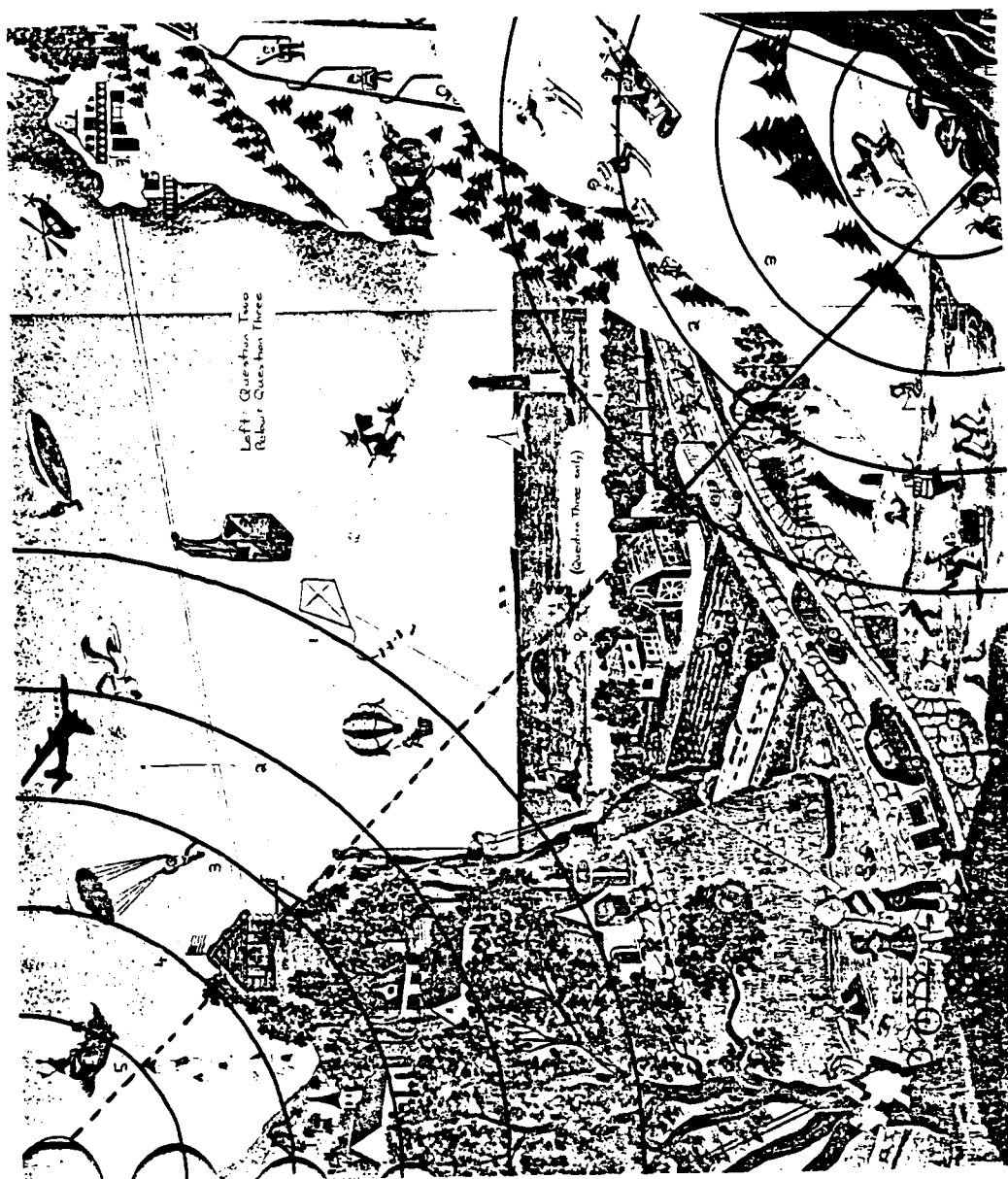
SCORING CODE FOR POSITION QUESTIONNAIRE

LIST OF CONTENTS:

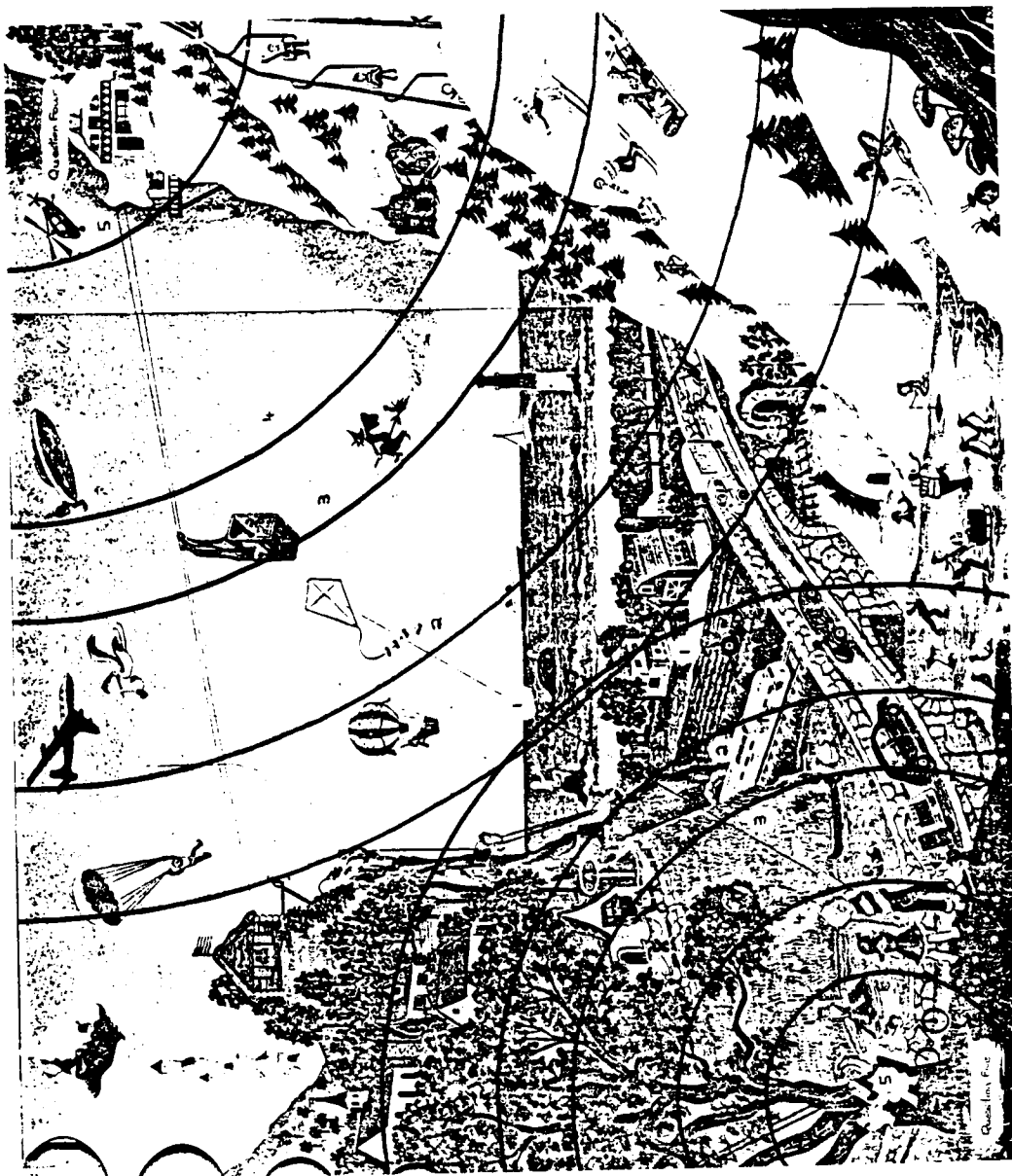
FORM		PAGE
N-1	Answer Key for Question One	197
N-2	Answer Key for Questions Two and Three	198
N-3	Answer Key for Questions Four and Five	199
N-4	Answer Key for Question Six	200
N-5	Answer Key for Question Seven	201
N-6	Answer Key for Questions Eight and Nine	202
N-7	Answer Key for Question Ten	203
N-8	Answer Key for Question Eleven	204
N-9	Answer Key for Question Twelve	205



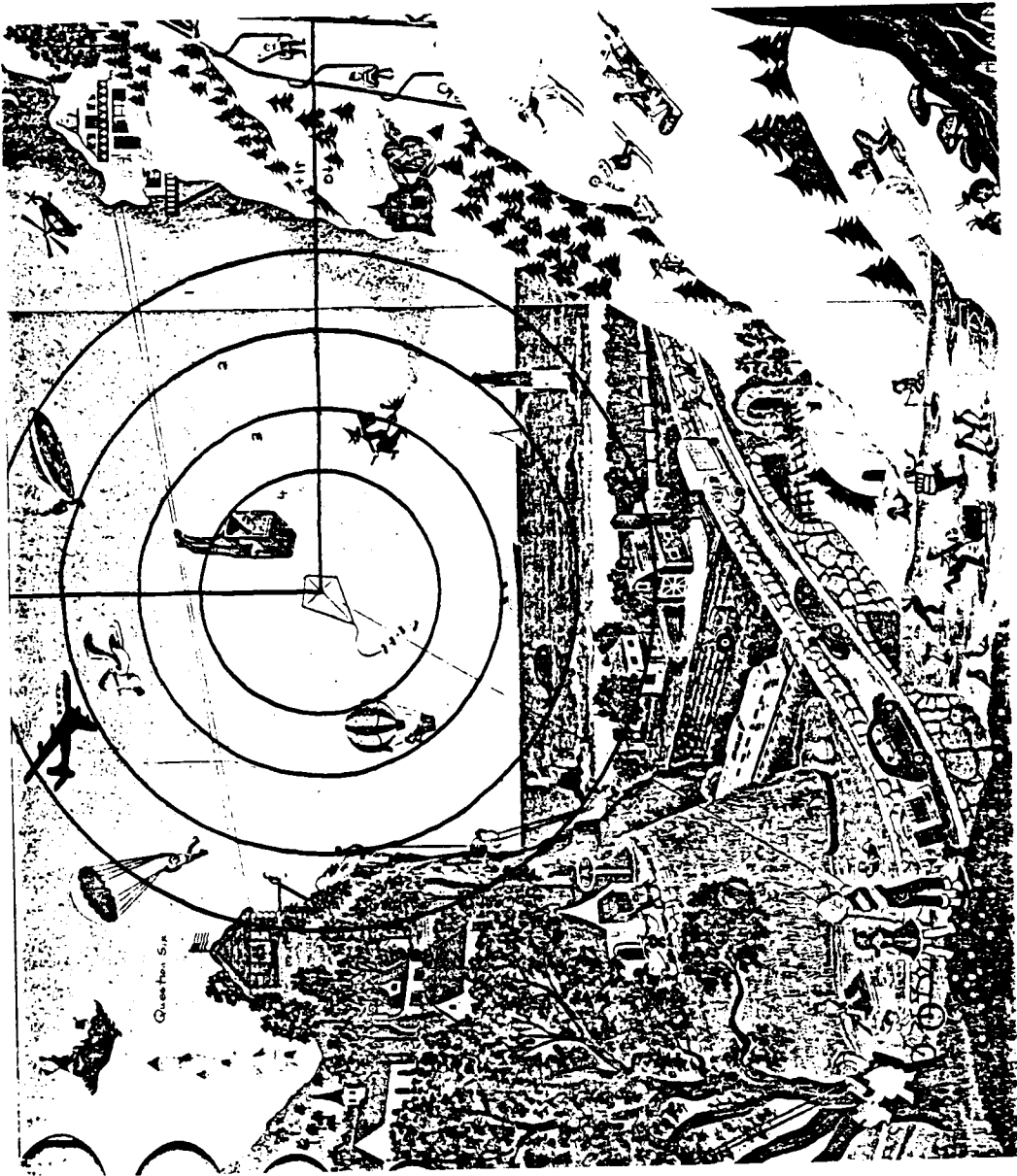
Form N-1



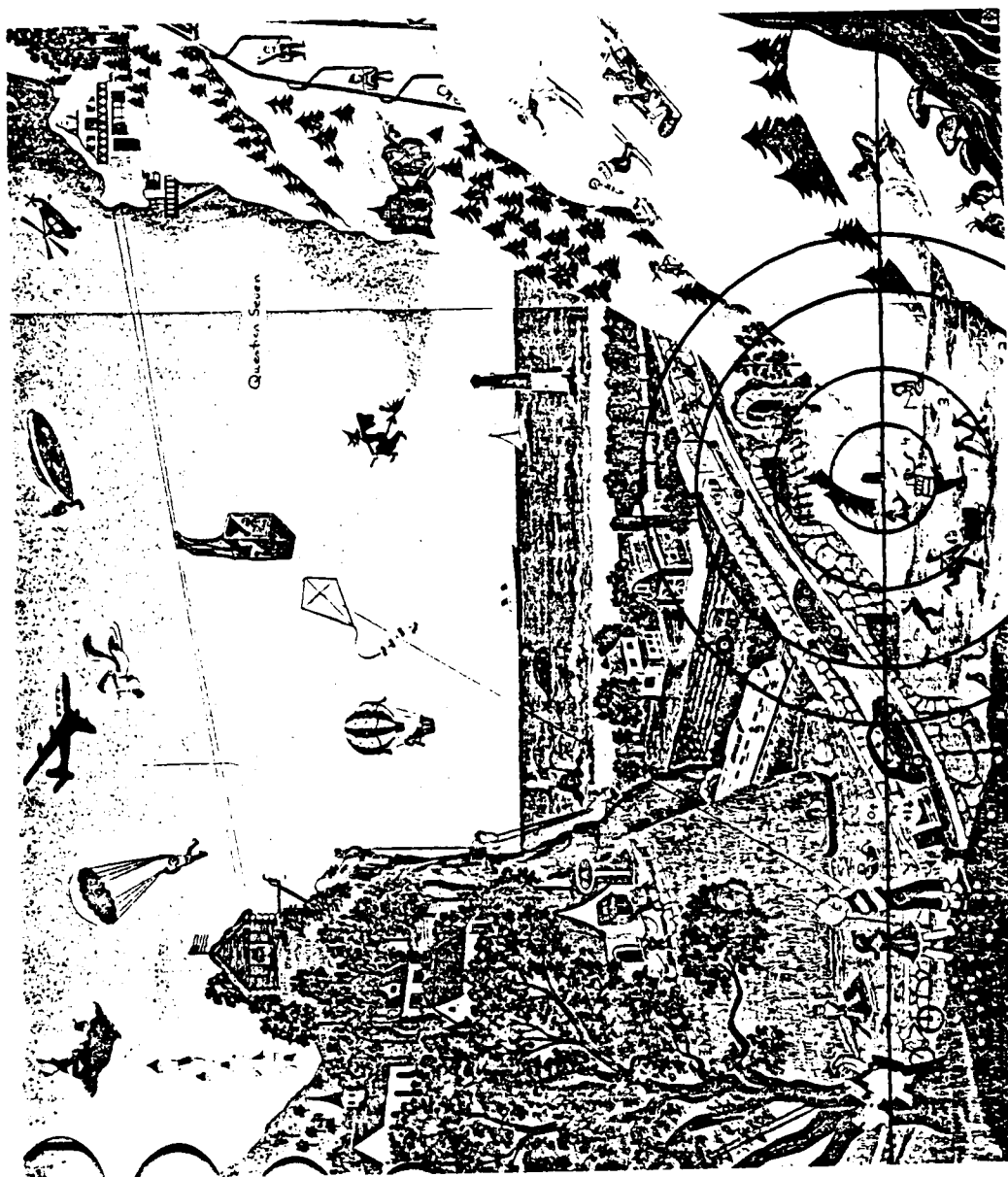
Form N-2



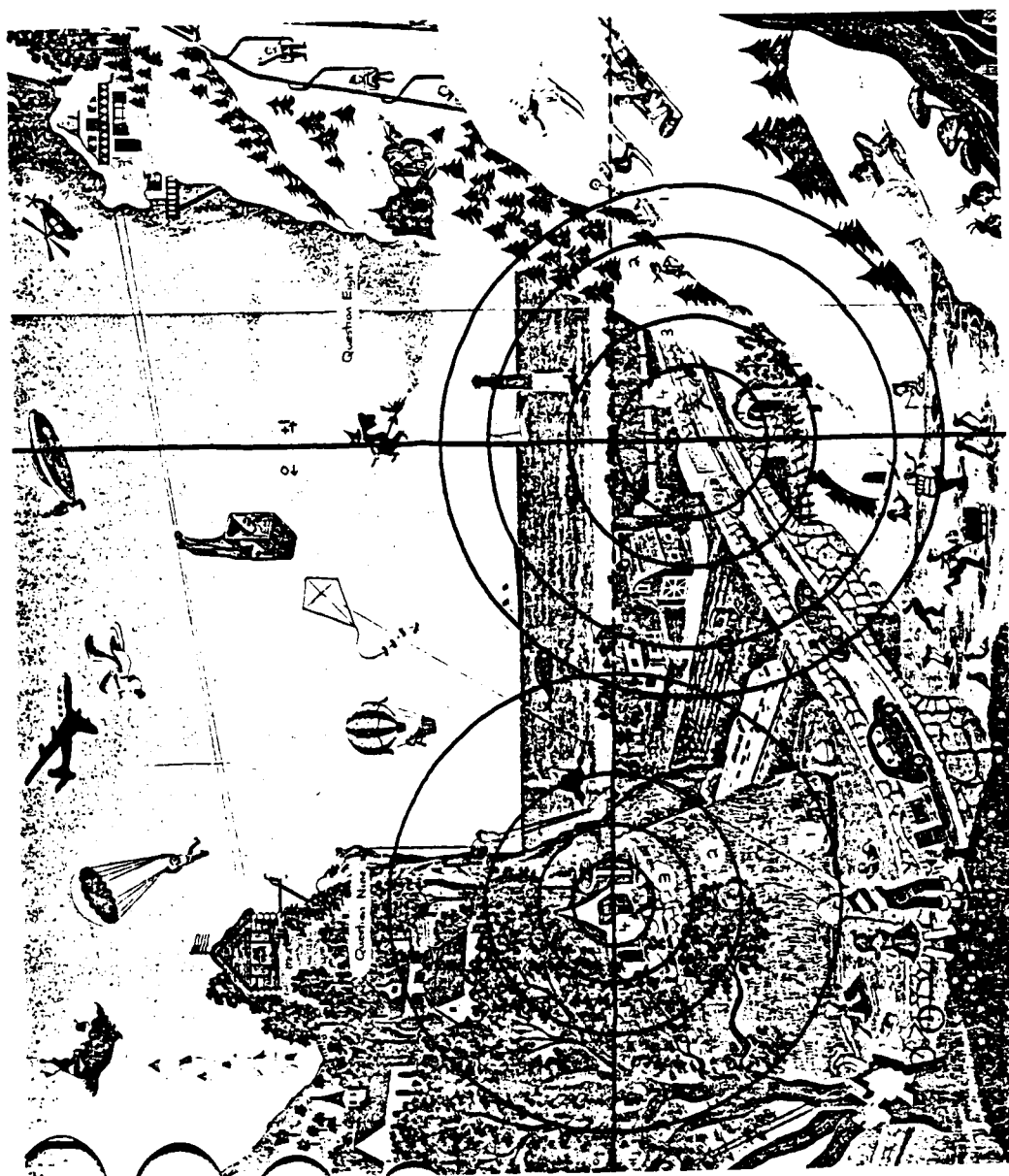
Form N-3



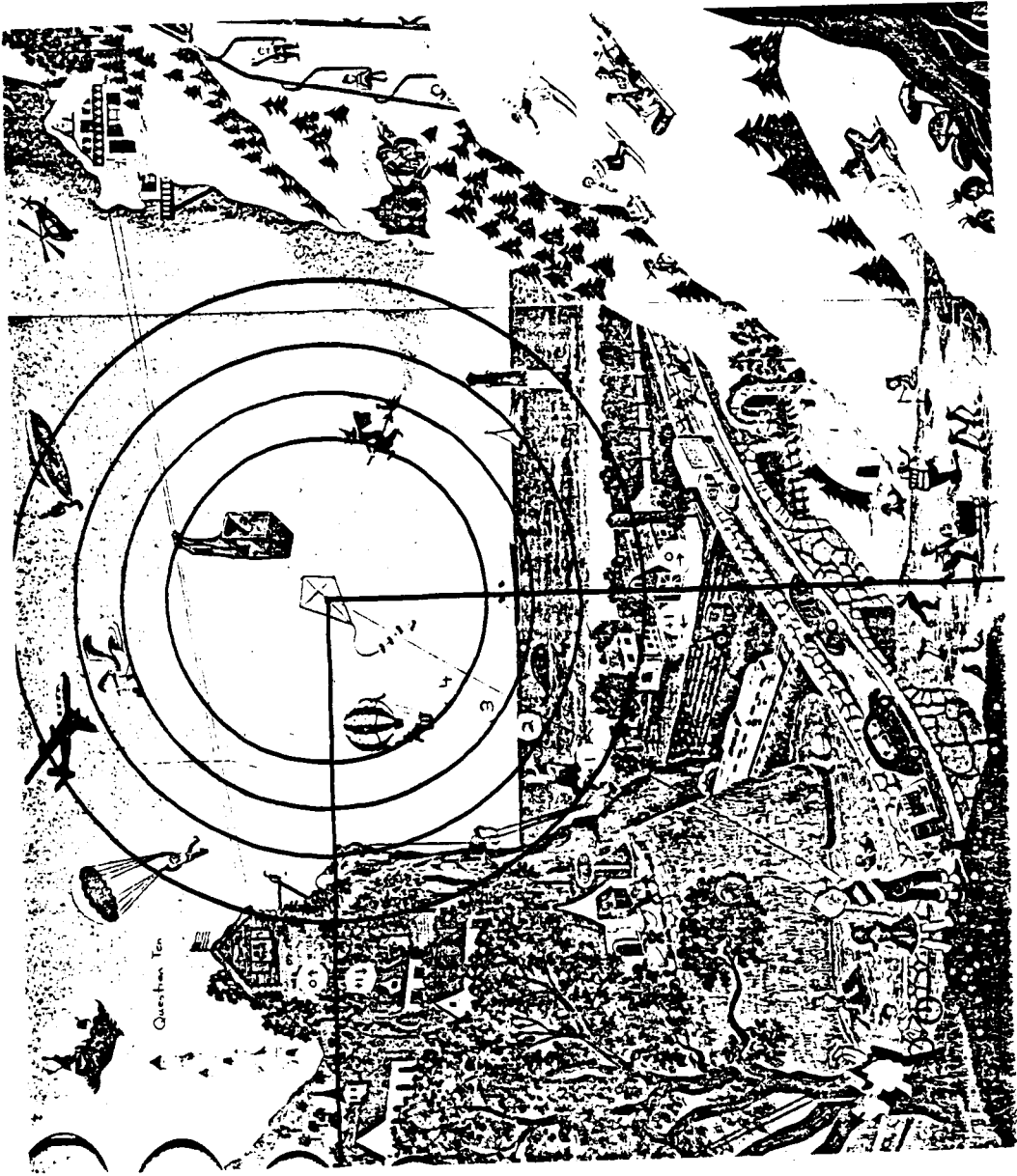
Form N-4



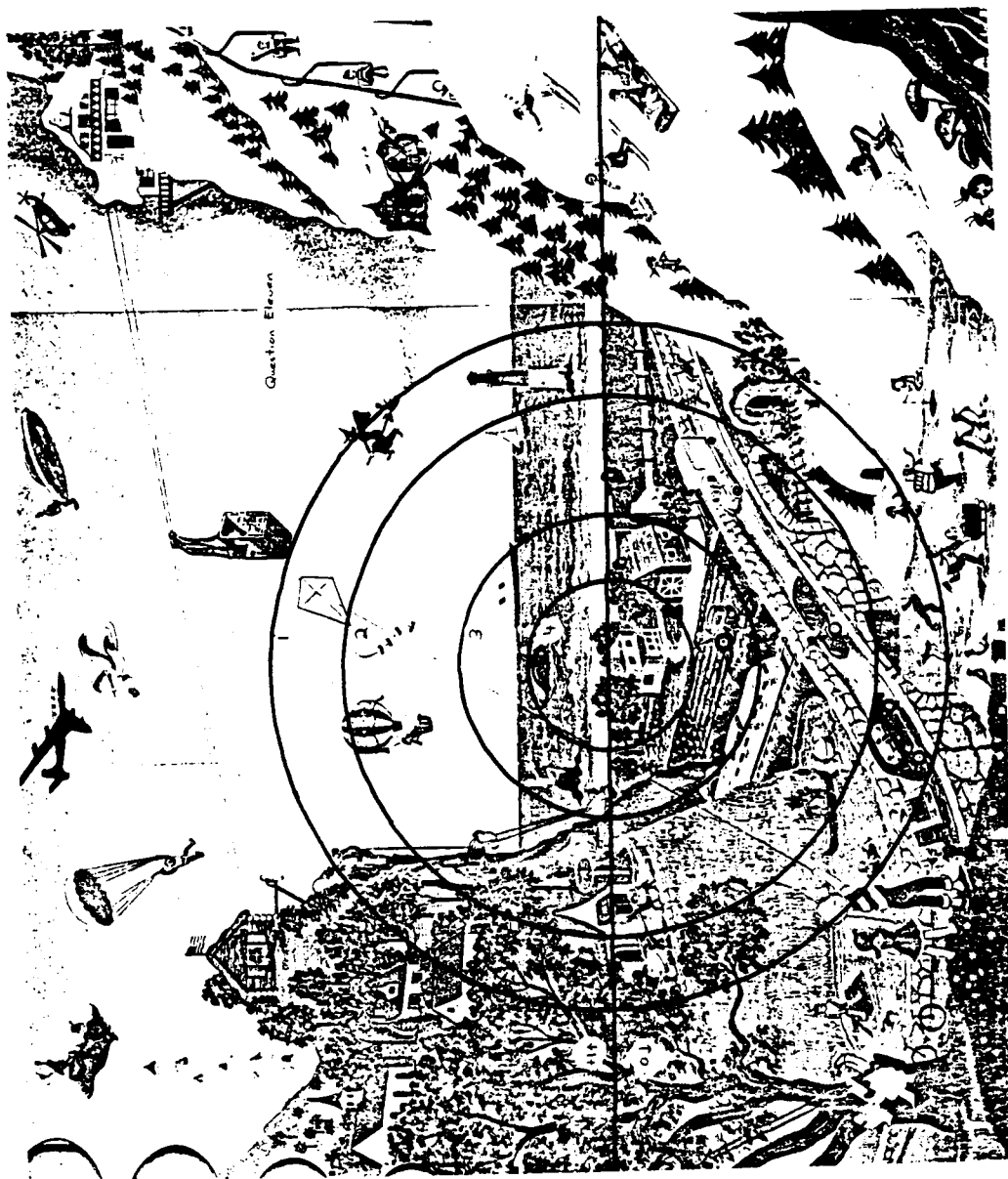
Form N-5



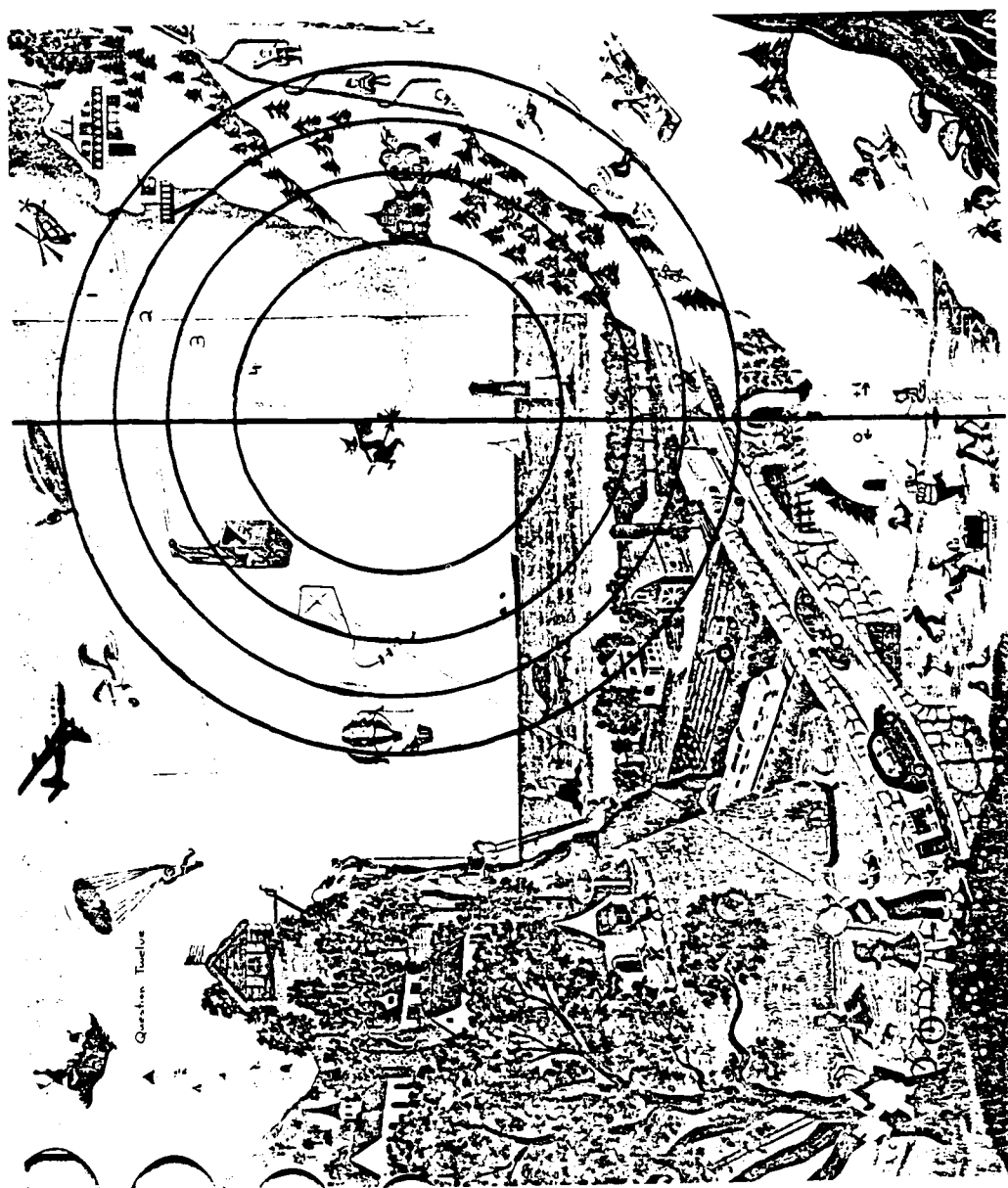
Form N-6



Form N-7



Form N-8

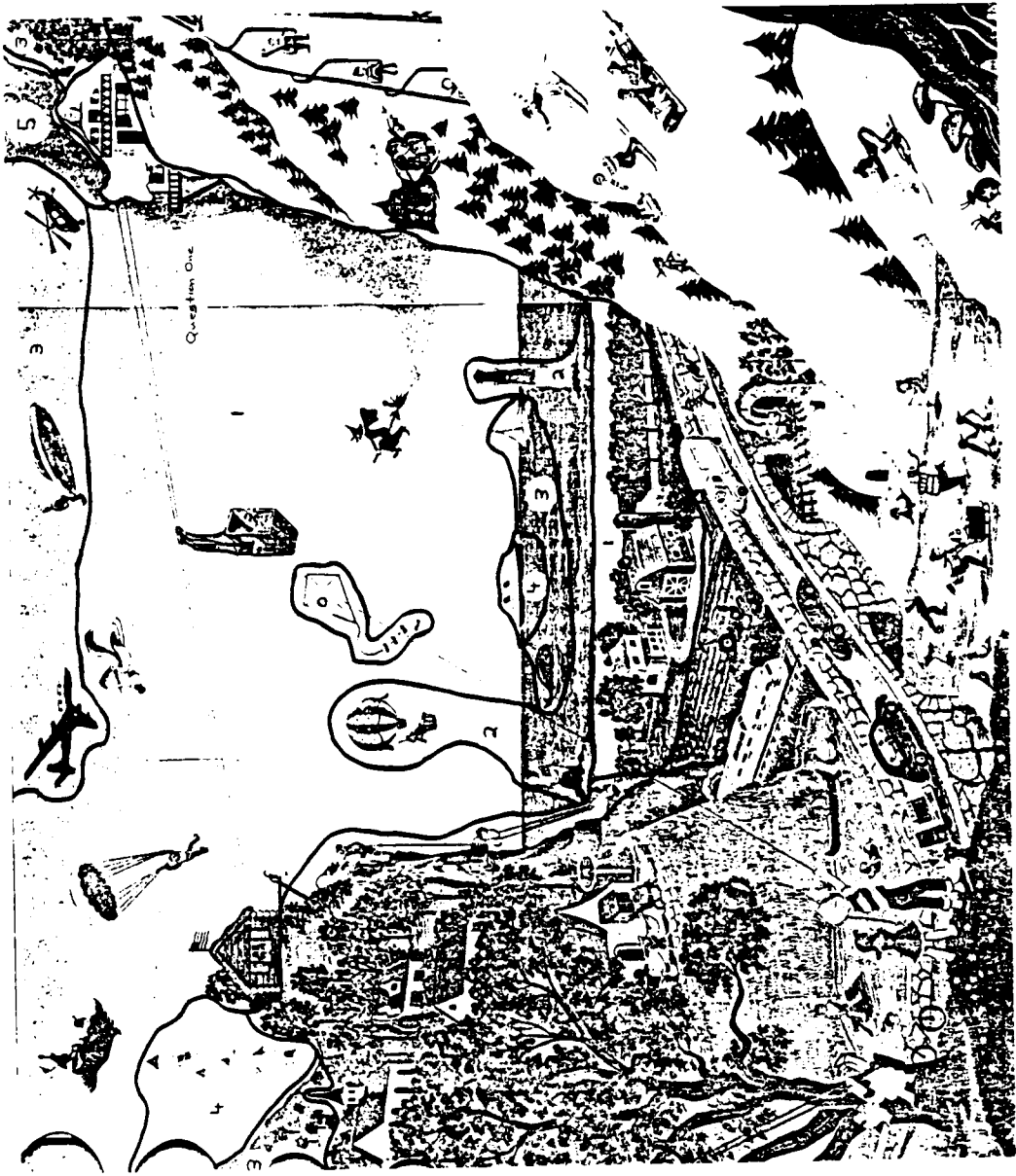


Form N-9

APPENDIX O

SCORING CODE FOR DEPTH PERCEPTION QUESTIONNAIRE

FORM		PAGE
0-1	Answer Key for Question One	207
0-2	Answer Key for Question Two	208
0-3	Answer Key for Question Three	209
0-4	Answer Key for Question Four	210
0-5	Answer Key for Question Five	211
0-6	Answer Key for Question Six	212
0-7	Answer Key for Question Seven	213
0-8	Answer Key for Question Eight	214
0-9	Answer Key for Question Nine	215
0-10	Answer Key for Question Ten	216
0-11	Answer Key for Question Eleven	217
0-12	Answer Key for Question Twelve	218



Form 0-1



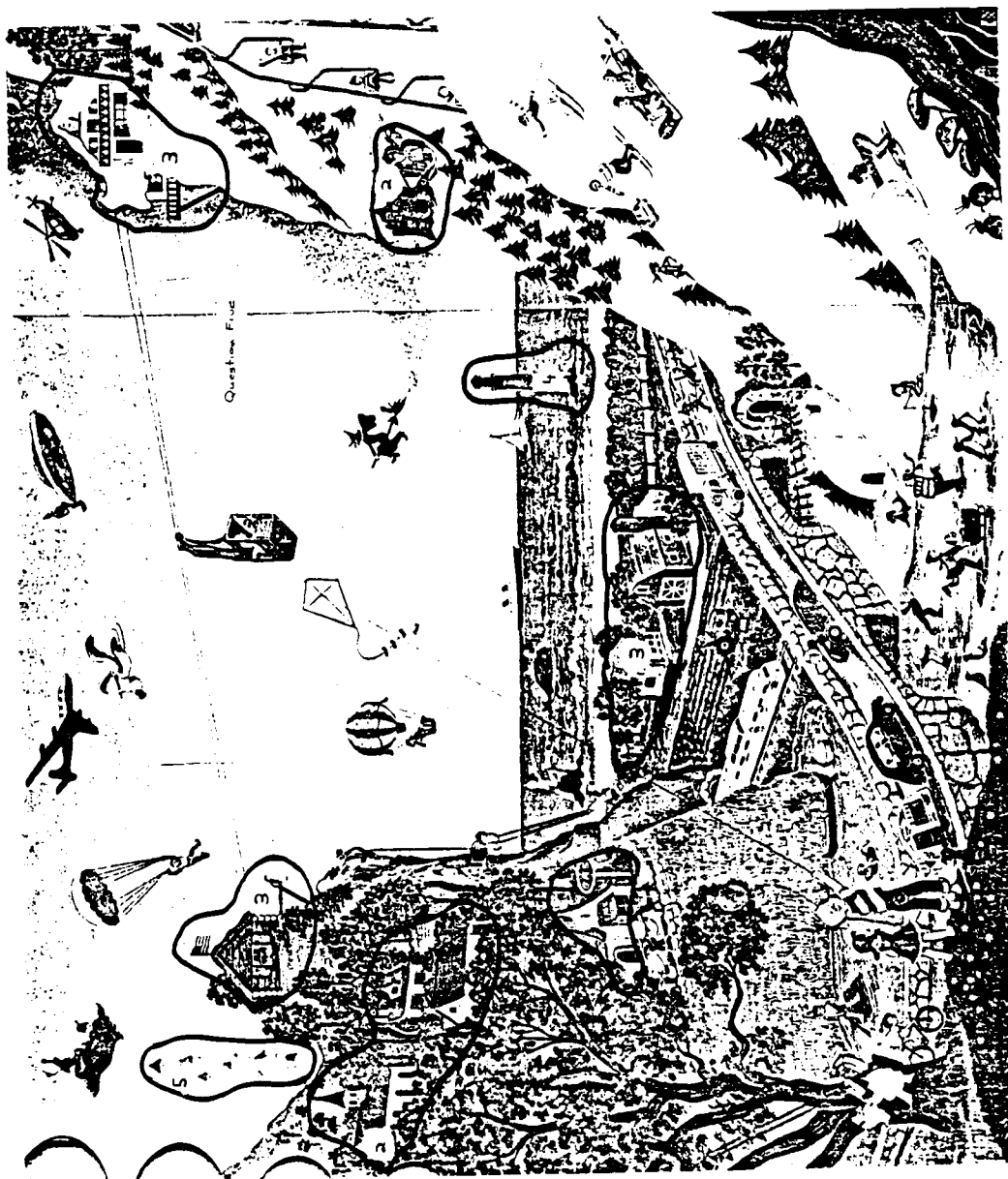
Form 0-2



Form 0-3



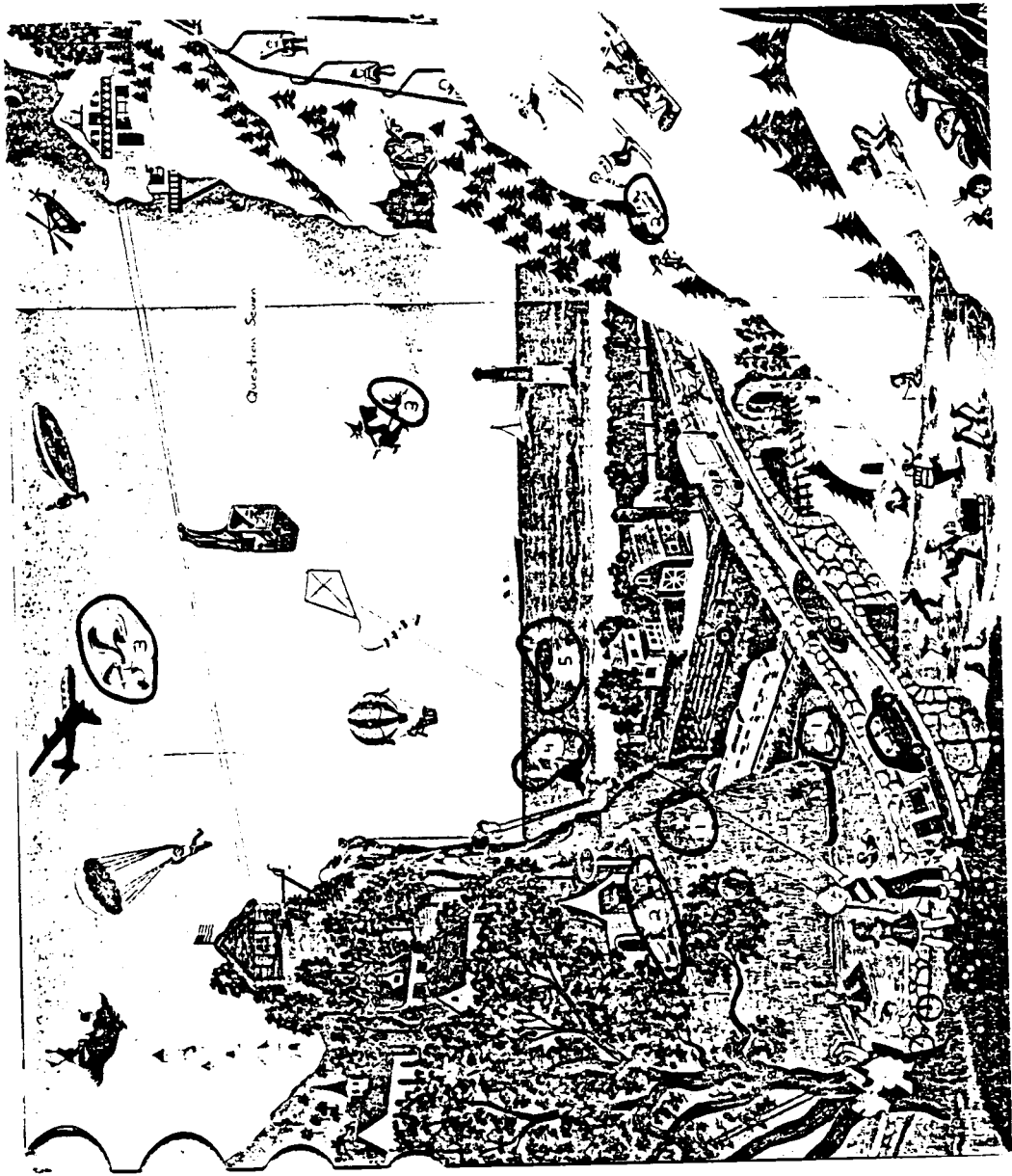
Form 0-4



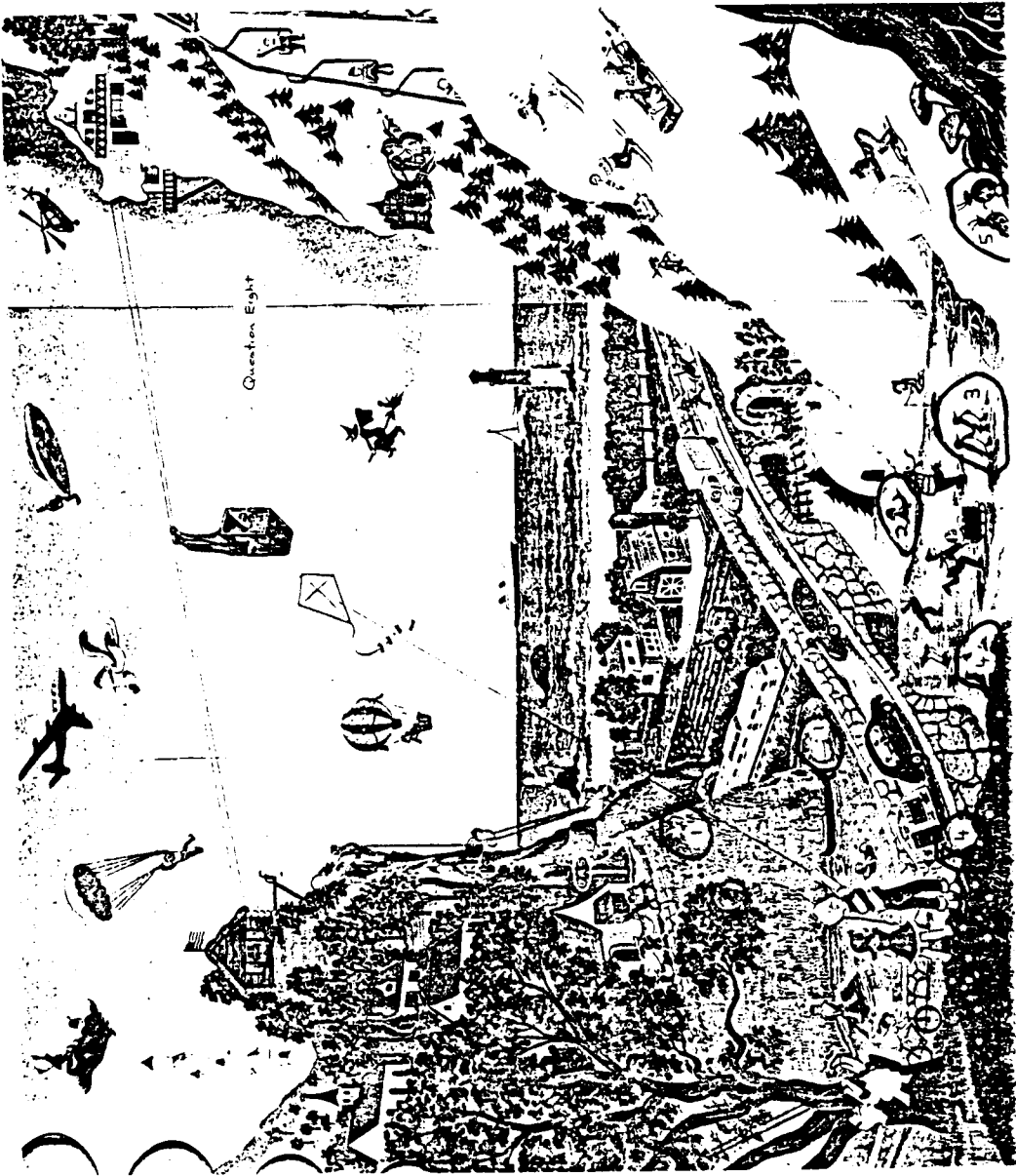
Form 0-5



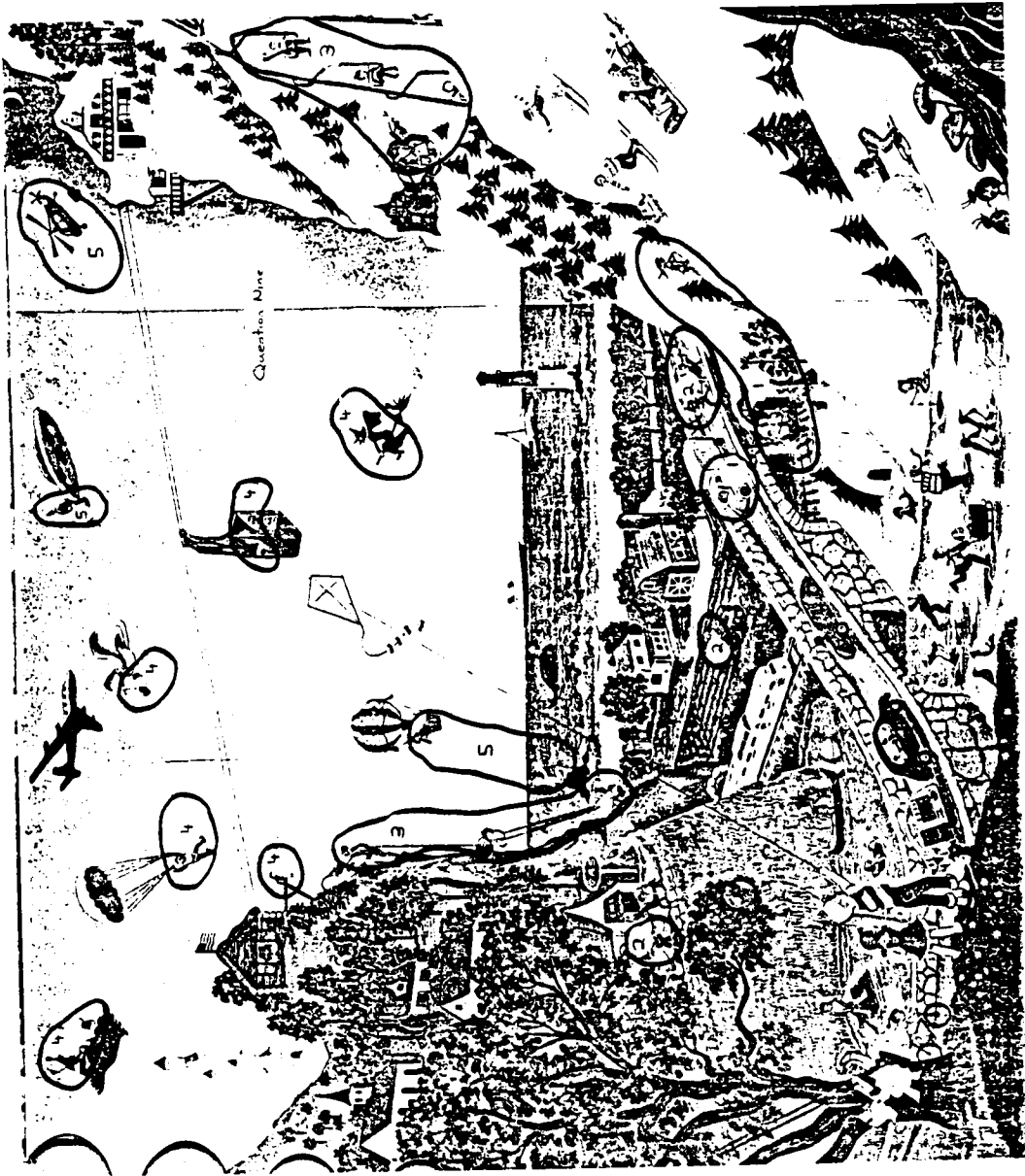
Form 0-6



Form 0-7



Form 0-8



Form 0-9



Form 0-10



Form 0-11



Form 0-12

APPENDIX P

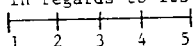
RATING INSTRUCTIONS FOR DRAWINGS IN
EXPERIMENT FOUR

EXPERIMENT FOUR: Rating Instructions for Drawings

For all the following categories use the numbers on the scales to indicate your rating. Please rate each category independent of how you rate the other categories for each drawing.

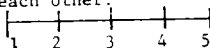
Category

- I) Overall Quality of Drawing - What is your overall impression of the drawing in regards to its artistic quality?



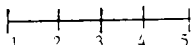
- (1 - excellent artistic quality, professional
- (2 - good artistic quality
- (3 - fair artistic quality
- (4 - poor artistic quality
- (5 - primitive artistic quality - child-like drawing

- II) Preservation of Features - How faithfully is the topography of of the picture reproduced? (e.g., the mountains, sky, sea, ponds, hill, etc.). Are they in the right relationship and proportion to each other?



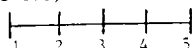
- (1 - excellent preservation - the important features are all maintained; in right relationship to each other.
- (2 - good preservation - there may be some things off, but for the most part the important features are maintained; in right relationship.
- (3 - fair preservation - some features are maintained; in right relationship to each other.
- (4 - poor preservation - most of the topographical features are not maintained, in right relationship with each.
- (5 - No preservation - none of the important features are maintained.

- III) Quantity of Objects Represented - Number of things reproduced. (Do not count objects drawn that are not in the actual picture).



- (1 - 41 and above - objects drawn
- (2 - 31 to 40 - objects drawn
- (3 - 21 to 30 - objects drawn
- (4 - 11 to 20 - objects drawn
- (5 - 0 to 10 - objects drawn

- IV) Position of Objects Represented - Left - Right Preservation - Number of objects drawn of which there are horizontal errors (e.g., Mushrooms on the left side of the picture; e.g., Stork to the right of the UFO).



- (1 - no errors
- (2 - one to four errors
- (3 - five to eight errors
- (4 - nine to twelve errors
- (5 - thirteen errors and above

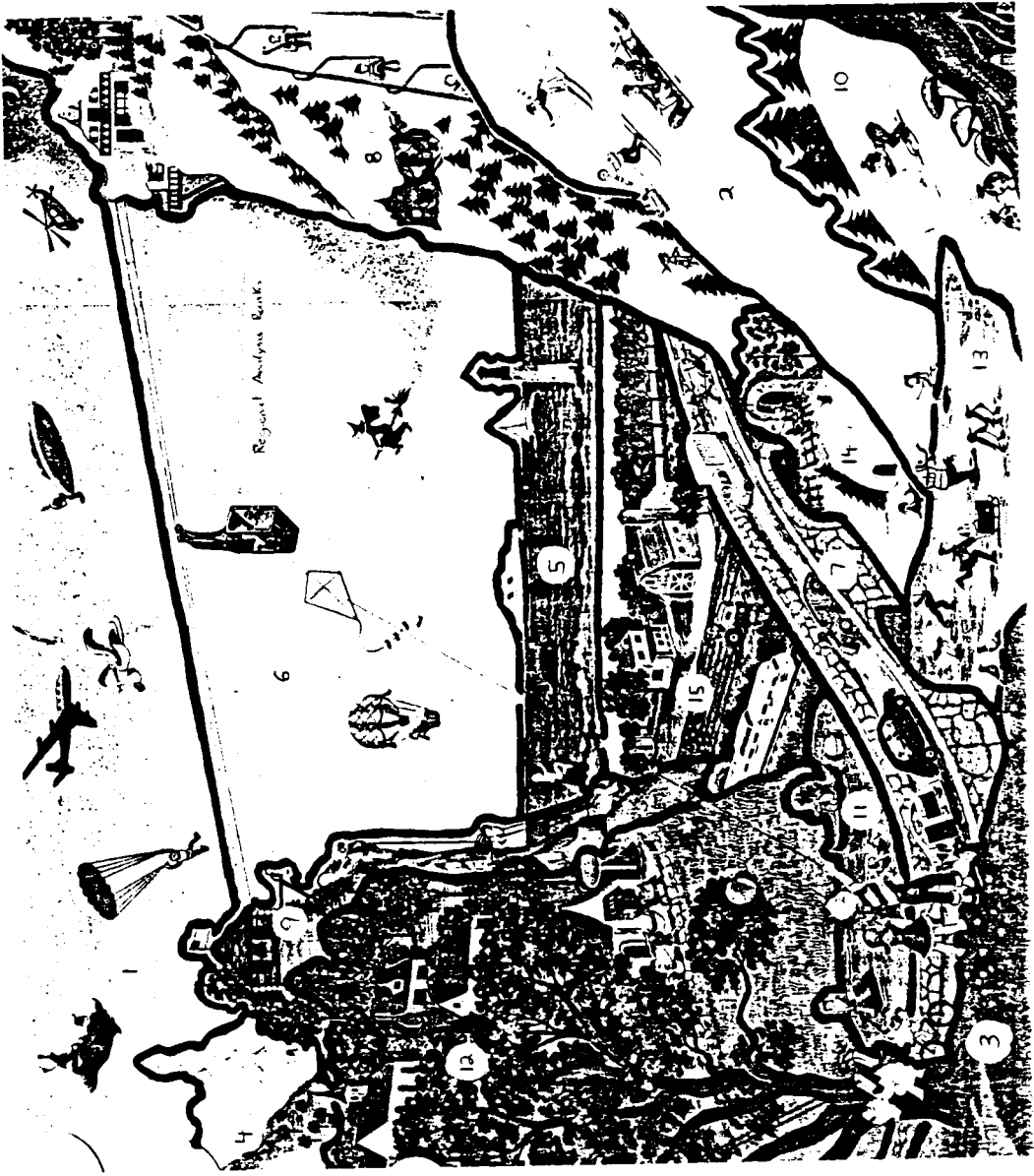
- V) Position of Objects Represented - above - Below Preservation - Number of objects drawn of which there are verticle errors. e.g., Cabin at bottom of picture; e.g., Balloon above plane) USE SAME RATING SCALE AS USED IN CATEGORY IV.

APPENDIX Q

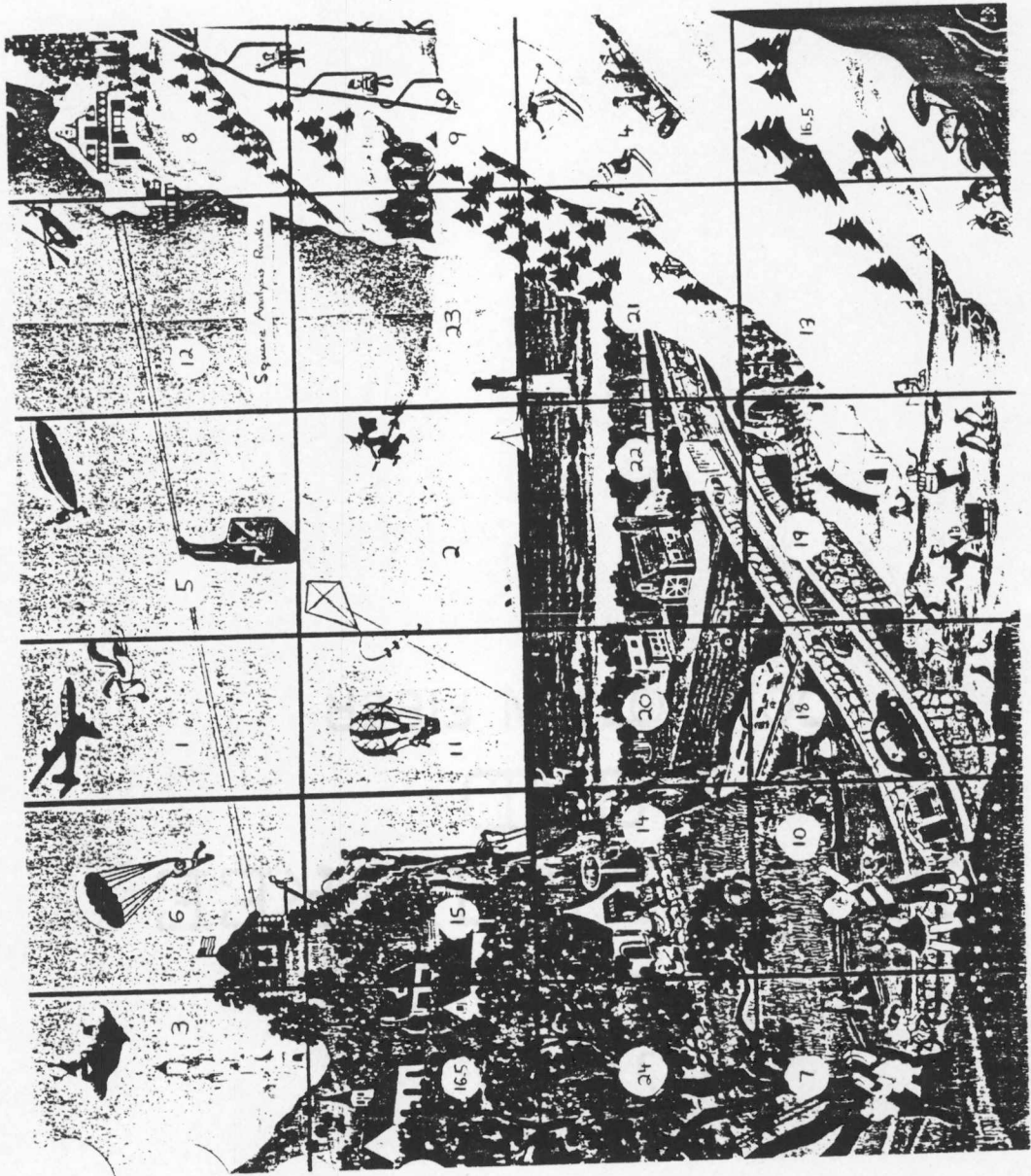
RANKS OF DIVISIONAL UNITS OF PICTURE USED IN EXPERIMENT FOUR VIA FREE RECALL ANALYSIS

LIST OF CONTENTS:

FORM		PAGE
Q-1	Ranks of Regional Divisional Units	222
Q-2	Ranks of Square Divisional Units	223



Form Q-1



Form Q-2

VITA

Paul John Chara, Jr. was born in Middletown, New York on June 13, 1953. He attended elementary schools in Goshen, New York and graduated from Goshen Central High School in June, 1971. The following September he entered The University of Rochester, New York. He received a Bachelor of Arts degree in Psychology in May, 1975.

Paul accepted an assistantship at Montana State University in September, 1975 and began study towards a Master's degree. He received a Master of Science degree with a major in psychology in March, 1977. The following September he entered the Graduate School of The University of Tennessee, Knoxville. He received the Doctor of Philosophy degree, with a major in Psychology in December, 1982.

The author accepted a position as an Assistant Professor of Psychology at Oral Roberts University, in Tulsa, Oklahoma in June, 1982. He began work there in August, 1982.

Mr. Chara is married to the former Sheila Taylor of St. Charles, Missouri. They have two children; Symon, the oldest, and Seth.