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THE LANGUAGE OF EXPERIENCE

A Study in Methodology

by

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Since the time this MS has been hectographed a few suggestions have been made, particularly by Ithiel de S. Pool, which will rather improve the paper and which will, therefore, be incorporated in the final copy. Further criticisms and suggestions will be appreciated.

PREFACE

With the exception of the field work in Zuni in 1953, the research on which this study is based has been supported by the Center for International Studies, Communications Program, Massachusetts Institute of Technology. The Zuni investigation was supported by the Values Study, Laboratory of Social Relations, Harvard University. Publication of this report was made possible by the Center for International Studies. The authors gratefully acknowledge this aid.

The authors also wish to thank Clyde Kluckhohn, Stanley Newman, Ithiel de Sola Pool, and Harry G. Schrickel for their helpful suggestions and criticisms. A particular debt is owed to Stanley Newman who checked Zuni transcriptions and contributed some of his own data. The cooperation of the subjects used in this study was appreciated, particularly in Zuni where rapport can be a problem to an investigator. It may be of interest to spell out the nature of the collaboration in this project. The material presented here falls clearly into two categories: a) theoretical considerations, and b) application. The responsibility for these categories lies almost entirely with E. H. L. for the former

and J. M. B. for the latter. The projected field work has not yet been entirely completed but it has been decided to publish the results obtained so far because they fully illustrate the approach introduced here. When the field work is completed, the junior author is planning to publish the entire data in the form of a detailed technical report.

E. H. L.
J. M. B.

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I. THE PROBLEM AND ITS EARLIER APPROACHES.

The goal of understanding the relationship between man's language and his experience of the world has been a challenge to linguists, psychologists, anthropologists, and philosophers alike. The literature on this topic may be divided roughly into two schools of thought. First, there are scholars who treat language as if it were a direct manifestation of the speakers' Weltanschauung. Writers of this persuasion tend to deny translatability between languages. Second, there are the nominalists who regard language as an arbitrary, outer form for thought, who believe in perfect translatability, and who deny that translation presents a psychological problem at all. Crude as this dichotomy is, it clearly points to the significance of the questions at stake. If the exponents of the Weltanschauung thesis were completely right, communication across language boundaries could actually be reduced to a psychological investigation. We would study the relation between language and that phantasmagoric concept, Weltanschauung, and as we gain knowledge on this score, our understanding of the translation process would automatically and by implication be elucidated also.

If, however, the nominalists were right, psychology has nothing to contribute to interlingual communication. The efficiency of communication between two language systems would be a matter of "translating correctly" and this would be assumed to be possible to the degree that the translator knows his languages.

Most authors are more subtle than these antithetical expositions would indicate. We have outlined these positions in their most drastic form to provide a frame for discussion. A close analysis of the Weltanschauung and the nominalistic claims reveals that a host of subsidiary problems are conjured up by each thesis and that it is not possible to do a piece of research which would simply decide for one or the other side and thus pave the way for an early and simple solution of the general question: What conclusions may be drawn from the fact that languages are different from one another? If we may be intuitive about this entire matter, both theses seem to have some merit and yet neither seems to be capable of drawing a conclusion that is consistent with itself and the facts of language. Anyone who has had to learn more than one language in his childhood knows that

there is some translatability between the languages he speaks, but that this is far from being a one-to-one correspondence; and that there are some realms of thought which seem to be peculiarly affected by one of his languages but not by the other.

Among the many contemporary authors who have written on the subject, probably no one has influenced current research as much as Ernst Cassirer and Benjamin L. Whorf. They were exponents of the Weltanschauung thesis and believed that an analysis of language was immediately relevant to the study and description of the cognitive make-up of its speakers. Their works have not been accepted uncritically but they have stimulated thought about language in many disciplines. Hardly any one working in this area today can deny his indebtedness to either of these men no matter whether he accepts their ideas or not.

While Cassirer and Whorf have made great theoretical advance over earlier work, their approach had a weakness which is common to virtually all of the early investigations into language and cognition. Neither Cassirer nor Whorf was explicit enough on the nature of the relationship which they purported to describe. They failed to state in general, yet concrete, terms which types of behavior

were supposed to be related to which. It is true enough that both of them have cited a mass of empirical facts but since they have not at the same time provided a criterion of relevance, we do not know why they have selected the data that they have selected, nor whether it would be possible to marshall facts that would disprove their hypotheses. The empirical material in their writings has an anecdotal character which serves to adumbrate considerations of a basically epistemological nature; it must not be mistaken for corroborative evidence of a hypothesis. In fact, it would be in vain if we were to search their works for practical working hypotheses--hypotheses whose verification require compilation of clearly circumscribed data--hypothesis that can be accepted or rejected in the light of objective observations.[1]

The purpose of this paper is to review the conditions under which language data may contribute towards verification of a "language-and-cognition" hypothesis. We shall develop criteria for the selection of data and then delineate a general method for a formal description of such data. Our approach is illustrated by a report of a comparative study into the nature of American English and Zuni color nomenclatures. The consequences of such research

for other fields are also briefly discussed.

II. TYPES OF HYPOTHESES AND RESEARCH STRATEGIES

Typically, a hypothesis about the relation between language and cognition has the form "linguistic condition C is functionally related to non-linguistic behavior K;" we accept the hypothesis if K is observed to change with C. Verification proceeds by studying varying instances of C, expecting the corresponding K-instances to vary predictably. For example, Miller and Selfridge[2] have hypothesized that the linguistic condition, Order of approximation to English word sequences, is a determinant of the non-linguistic behavior, recall of meaningless strings of words. (We feel justified in calling this "non-linguistic behavior" because the task is essentially that of parroting.) In Miller's own words:

> "...various approximations to English can be constructed by permitting contextual dependencies to work over longer and longer sequences of symbols. If we deal with word units, a zero-order approximation picks words at random from the dictionary. A first-order approximation reflects the relative frequencies of occurrence of the individual words. A second-order approximation reflects the relative frequencies of occurrence of pairs of words. And so we proceed to higher orders of approximation. As the amount of contextual

> determination is increased, the approximations to English change from sheer gibberish to something very like human writing. The constraints of context are gradually introduced, and the sequences become more familiar. ... When subjects try to learn materials constructed in this fashion? An exploratory experiment has been done with zero-, first-, second-, third-, fourth-, fifth, and seventh-order approximations to English and with passages from connected text. Lists of 10, 20, 30, and 50 words were used. Subjects heard the words read aloud once and attempted to recall them immediately afterward. .../[It was found that] the greater the contextual constraint, the easier it is to remember the material. By the time the fourth- or fifth-order approximation is reached, there is little further improvement. It is the short-term dependencies that are most important for recall. A fourth-order approximation is still nonsense. It is apparently not important that the sequence of words has a meaning. It is sufficient that it does not violate familiar intraverbal connections extending over sequences of only four or five words."[3]

In this experiment subjects, due to their language training, had developed certain habits towards the stimulus material of a conventional memory experiment so that their "recall-behavior" could be predicted on the grounds of previously ascertained language behavior.

The language condition C can easily be manipulated in this design, holding all other linguistic and cultural factors constant. Instances of condition C, i.e. orders of approximation to the statistical structure of English, can be selected so as to form a series of stimuli, as it were, where each

stimulus differs from its neighbor in only one respect, namely the very quality under investigation. This research design has been called the intracultural method because here the verification of hypotheses does not depend on cross-cultural comparison.[4] It can easily be seen why this is an advantage: Suppose an anthropologist wanted to repeat the Miller and Selfridge experiment in a culture where a language is spoken that cannot be analysed unambiguously in terms of <u>words</u>. An analogous and highly pertinent experiment could still be performed by using any other structural unit, say phonemes. The anthropologist could construct a sequence of speech sounds such that none is a "meaningful utterance" yet each represents a different order of approximation to the sequence of phonemes typical for that language. Of course, one would expect that order of approximation again predicts memory capacity but we would not be surprised if the strength of the relationship between the two phenomena is somewhat different from the relationship found in the English situation. After all, a different unit of analysis has been used, not to mention the many other factors that had to be changed by going from one culture to another. We may characterize this type of research strategy thus:

Language A:

C_1 corresponds to K_1
C_2 " " K_{ii}
C_3 " " K_{iii}
⋮ ⋮
C_n " " K_N

degree of correspondence = F

Language B:

C_I corresponds to K_I
$C_{\overline{2}}$ cor " " $K_{\overline{ii}}$
$C_{\overline{3}}$ " " $K_{\overline{iii}}$
⋮ ⋮
$C_{\overline{n}}$ " " $K_{\overline{N}}$

degree of correspondence = V

We do not compare the C's of language A with the C's of language B because they are not quite commensurable; the comparison is between the correspondences F and V. The reason for doing cross-cultural work in this instance is to prevent us from over-generalizing our theory rather than to validate our hypothesis.

Not all hypotheses can be verified intraculturally. Consider the hypothesis: "Acuity of auditory discrimination between given isolated speech sounds is not the same for subjects speaking different languages." It is a rather common assumption that some languages train their speakers to make certain accoustical distinctions which in other languages

do not need to be made. Thus it is reasonable to postulate that speakers of some languages have learned to make discriminations that other language groups have not learned. This hypothesis is not verified simply by pointing to differences in phonemic structures because phonemic analyses are made on patterned sounds--on complex sequences--but never on isolated phones. On the other hand, it is the observed difference in phonemic structure which gives rise to the hypothesis.

We might verify this proposition in the following way. By means of Stevens' Electrical Analogue of the Vocal Tract[3] we generate various series of speech sounds (e.g. a series ranging from a given phone [e] to a given phone [a]) thus constructing a number of linear stimulus continua. The stimuli are presented to the informant in pairs. In the course of the experiment, every sound is paired with each other and the informant's task is to indicate whether he judges the stimuli to be the same or different. We draw subjects from various languages and compare their performances. The prediction is that the finest discriminations made by every speech group fall on different locations in the continua if the languages are different. The research design here is:

Lang. A (C_1) corresponds to K_1
Lang. B (C_2) " " K_{ii}
Lang. C (C_3) " " K_{iii}

If the C's are unequal(i.e. if each of these languages requires its speakers to make acoustical distinctions which are said to be unimportant in the other two languages) the K's are predicted to be unequal as well. In this case the cross-cultural approach was indispensable because the hypothesis predicated the entire language.

The question arises whether this last hypothesis might have been thrown into a form that could be amenable to intra-cultural verification. Why, for instance, could we not have hypothesized that acuity of discrimination is sharper between phoneme boundaries than within phonemes. If we have several stimulus continua, linguists may be able to map the extent of every phoneme so that we could characterize some locations in the continuum as "boundaries" and some as "phonemic centers." In this form the linguistic condition that is being predicated in the hypothesis presents many instances within every individual language so that the prerequisite for the use of the intra-cultural approach seems to be fulfilled. The logic of this verification would be perfectly sound if the phonematization had been made exclusively on the grounds

of distributional criteria, that is, if the linguist had not been influenced in his segmentation by acoustical or perceptual phenomena. Of course, it can hardly be maintained that this was the case. Linguists usually take note of their informants' discrimination behavior in order to establish phoneme boundaries. Therefore intra-cultural verification of the hypothesis under consideration would constitute a circular argument.

There are certain kinds of hypotheses whose verification seem to be amenable to the cross-cultural approach, but which, upon a methodological analysis, appear to be unverifiable. For the sake of illustration, may we be allowed to present a hypothesis whose absurdity is purposely pushed to the extreme. Let our mock-hypothesis be, "There is a relationship between language and national character." The design of the pseudo-verification is this:

Language Conditions (C's)		National Character Traits (K's)	
Japanese:	harsh sounds	purported to correspond to	harsh discipline
German:	complicated sentence structure	"	complicated philosophical thoughts
English:	preponderance of monosyllabic words	"	conciseness; thriftyness

Quite apart from the lack of objectivity of the data, it is obvious that "harsh sounds," "complicated

sentence structure," and "preponderance of monosyllabic words" have virtually nothing in common except for the obscure notion that they all belong to language. Verification requires that we know what we are varying, which, of course, is not the case here. We have no terms in which to make a comparison of the C's or, in other words, there are no parameters that describe pertinent qualities of the C's involved. The problem of comparability is of paramount importance in this kind of research and we shall, therefore, devote to it a major portion of this paper.

In view of the incomparability of the C's in the last example we have not, in reality, verified anything. Instead we have merely stated three subhypotheses each of which is still in need of corroboration. In contrast to this situation, the previous hypothesis, that phonemic structure affects certain aspects of acoustical perception, has completely commensurable C's: We can easily describe and thus compare phoneme boundaries in terms of locations on physical speech sound continua. This research design has therefore avoided the pitfall of a pseudo-verification.

The discussion of an intra-cultural research strategy on the one hand and a cross-cultural one on the other, should not be interpreted as two entirely

different possibilities. Many investigations are amenable to either approach although one is usually more profitable than the other. The following two criteria may guide us in our choice of approach: A) ubiquity of the linguistic condition (this criterion answers the question "is the phenomenon we are investigating a peculierity of one single language, of a few languages, or of most languages?"); and B) the number of instances of the linguistic condition within individual languages. Chart I summarizes the relevance of these criteria to the appropriate choice of approach.

III. THREE CRITERIA FOR THE SELECTION OF DATA

Since language is the coordination of several extremely complex activities, it would be foolish to try to state canonically which language data may and which may not be used for our purposes. And yet, the very intricacy of language makes it desirable to have a few guide-lines to govern our selection of possible data particularly for research that is to be conducted cross-culturally. It is in this sense that we offer the following three criteria for the choice of language data: A) universality, B) variation, C) simplicity.

a) Universality: This criterion, when spelled out, is simple to the point of banality. We dwell on it merely because a survey of the literature shows that it is frequently disregarded. In detail: We cannot expect to make a meaningful comparison if the referents of our lexical items are not completely universal, i.e. exist in every culture. The words meat-pie, respect, and learning cannot be translated into many languages because the referents are typical of our but not of other cultures. The question whether the Germans have developed their philosophy because of peculiarities in their language, or whether the complete absence of any epistemology among the Bororo Indians is caused by theirs, is unanswerable and in that sense absurd, not so much because the implied relationship is necessarily false but because it is theoretically impossible to verify it. Compare now a hypothesis that concerns a universal referent, say time. Suppose we had two languages, one of which has no specialized words for time-denotation whereas the other language has an elaborate terminology for time periods of various durations as well as means for the description of sequences and temporal relations. Since the speakers of both languages live in time it would not be altogether unreasonable

to investigate whether the time experience for the two peoples is affected by the linguistic condition. We could verify this hypothesis in a number of ways. It would be possible, for instance, to construct a memory test where a certain sequence of time intervals of varying duration would have to be recalled, the act of recall consisting of a sequential pressing of various kinds of buttons. In this case the two instances of Condition C are two types of linguistic treatment of the time continuum and the instances of condition K would be the recalling of temporal stimulation. This hypothesis is verifiable because the two instances of condition C are commensurable inasmuch as a universal referent is involved.

b) Variation: It has been pointed out that we can "manipulate," so to speak, the language-end of the language-and -cognition apparatus by means of the cross-cultural approach. This means that our research will be interesting if the instances of the language condition C, while commensurable, are not identical. For otherwise we have no variation and we can not expect any changes in cognitive behavior either. Take the example of the previous paragraph but suppose that we had used some other languages. Now, these other languages have temporal words with exactly the same denotata. Remarks about time in

one language can be translated into the other without the slightest distortion. In this situation it would not be very interesting to subject the speakers of the two languages to the memory test because if the two groups attain the same score (as we would have to predict) we would still have no evidence that there was any relation between the performance on the test and the structure of the languages. The causal factor in the memorization may have been, for all we know, a biological one that did not change in the comparison. If, to the contrary, the performance on the test had been different for the two kinds of speakers despite the fact that the language conditions had been held constant then we would know that such difference was not likely to have been caused by the language situation. Such a negative result could also have been obtained had we chosen languages which, instead of being identical with respect to temporal distinctions, were describably different; for in this case our research can also confirm our hypothesis which, in the absence of controlled variation is impossible. The better we can describe the difference between two instances of a particular language condition, the more interesting our work will be.

c) Simplicity: Commensurability depends on our

construction of descriptive parameters. A wrist-watch and a hog are commensurable if we compare their weights, i.e. describe the two in terms of the parameter weight. But this parameter leaves a lot of aspects undescribed that are of importance to us when dealing with wrist-watches or hogs. If we want to know just enough about these two items so as to decide how to ship them from one suburb to another, a few other descriptive parameters in addition to weight would be necessary, e.g. volume, air consumption, need for careful handling, etc. Evaluating the difference between any two things becomes more difficult the more parameters are needed for any particular description. If all objects were sold by weight and the price per pound were universal, the description of the difference between a wrist-watch and a hog would be easy from the point of view of price; from the shipper's point of view the description of the difference between them is more difficult; and from an ontological point of view it is practically impossible and, of course, absurd. Coming back to language symbols and their referents, there are many words that have universal referents, satisfying criterion a), and there may also be reasonably varied linguistic treatments of such referents,

satisfying criterion b). But the simplicity criterion is only rarely satisfied. Take the word justice and its referents. If we wanted to describe objectively those social actions to which the word is applicable, we would need a very large number of dimensions or parameters. The coordinate system that would result (and by means of which we could describe all such actions objectively) would be so complicated that it would become very difficult to describe parametrically the difference between one group of actions called justice in one culture and another group of actions called justice or its translated equivalent in another culture. There is one realm of words that satisfies the simplicity as well as the other two criteria. These words constitute the language of experience.

IV. THE LANGUAGE OF EXPERIENCE AND THE STRUCTURE OF ITS REFERENCE.

By language of experience we mean the words and morphemes that refer to the most elementary form of experience such as the sensation of temperature, of humidity, or of light. Nothing can be more apropos to the Cassirer-Whorf thesis than to study the language of experience and its relationship to cog-

nitive processes. The study of language behavior elicited directly or indirectly by specific and easily described stimuli will enable us to discover whether there is any transfer of learning from acquired language behavior to non-linguistic behavior.

It should not be difficult to see how the language of experience satisfies the three criteria for the selection of data. The world over man is equipped with the same sensorium. He may not always make the same use of it but the sensory mechanisms are there and the basic sensory stimuli are available to him everywhere. It is a fairly safe guess that it is possible to refer to elementary sensations in virtually every language, and it is quite immaterial to this claim whether languages differ in their linguistic treatment of the referents. Nor does it matter here whether some languages have so-called "abstract" or universal terms such as our word green or whether they have, instead, one word that refers to the green color of plants and another that is used only for green paints or green objects. In either case there is a language of experience with common referents and thus the requirement of universality is met. As to the criterion of variability, the language of experience promises to be rather interesting, if we may judge by the ample

literature on the subject.

The criterion of simplicity of the referent is much more easy to satisfy in the case of the language of experience than for most other words with determinable referents. This is due to the fact that the stimuli of sense perception can in most cases be ordered in systematic ways and the ordering systems provide frames for description. For instance, we can order thermal stimuli on a single dimension of intensity such that any thermal stimulus has one and only one place within the continuum. The same thing is true of gustatory, auditory, and many other types of stimulation except that more than one dimension is frequently necessary for exhaustive ordering. It is possible to obtain stimuli that differ from one another in only one perceptual quality, e.g. identical iron bars heated to different temperatures, samples of water of different degrees of sweetness, a pure tone in various intensities, etc. Thus description of the referents or range of referents of the words hot, sweet, loud can sometimes be accomplished with a single parameter and very often with as few as two or three.

Turning now to the structure of the reference of the language of experience, we must be allowed to dwell for a minute on what may seem to be very

obvious points. Suppose we have an apparatus by means of which we can produce stimuli that differ from each other in only one respect, say a series of white light patches of varying intensity. We show these patches to the speakers of a given language, say English, and then ask them to give a name to every shade of light. In the course of the experiment, we may have flashed in random order a hundred different shades on a screen. Yet the verbal response will consist of not more than four terms; white, light gray, gray, dark gray. (There may be an occasional attempt to characterize the grays still further, e.g., smoke gray or Oxford gray, but such qualifiers are certain to occur irregularly and with very little inter-personal consistency so that we cannot accept them as standard English usage.)[6] From this it is apparent that a verbal response is not given to just one stimulus but to a group of similar but not identical stimuli. In learning a language, the child is taught not only how to respond to a given stimulus but also how to generalize the response. He learns that a number of different stimuli constitute one group, and it is not always easy for him to discover the precise location of the boundaries of the group.

After having asked a sufficient number of Eng-

lish speakers what name they would give to the various shades, we can determine where the boundaries of the English response classes are in the intensity continuum. Thus we learn how English classifies various kinds of light stimuli. If this procedure is repeated with speakers of some other language, the two kinds of grouping arrangements can be compared and we may thus ascertain whether there is a difference between them. Should we find that a difference exists--and the odds are in favor of it--we have observed what has been called a code phenomenon.[7] A code phenomenon is a characteristic feature of a specific language--a piece of linguistic behavior which is essential for efficient communication via language. It is distinct from a message phenomenon by which is meant the subject matter a communicator chooses to speak about.

This type of investigation only shows that in a given language a certain range of stimuli is dealt with in such-and-such a way. It must still be determined whether there is any transfer from the observed speech behavior to some non-linguistic type of behavior such as recognition or retention. This latter question cannot be answered a priori (as has frequently been done in the past) but is a matter to be ascertained empirically. Nor should we expect that there will be one general answer. Speech be-

havior may affect memory but not perception; or it may affect problem-solving ability but not other kinds of learning. Only empirical and systematic research, experimental or observational, can give us a clue as to the relationship between language and cognitive processes.

We have mentioned the comparison of "grouping arrangement," i.e., comparison of the ways in which an identical response is given to a group of different stimuli. How can one make such a comparison? Suppose a set of stimuli were arranged in terms of a uni-dimensional continuum. In one language the continuum is cut at a given point into two groups. In Portuguese, for example, the temperature continuum is cut into quente and frio (intermediary words such as tepido or caldo are rarely used in colloquial speech). Any stimulus above the cut elicits word A

Fig.1

(say quente), and any one below it word B (frio). Another language, for instance English, makes two cuts through the same continuum so that three groups result (hot, warm, and cold), each containing stimuli eliciting words a, b, and c, respectively. If speech behavior were so simple as to provide one or more clear cuts through a continuum, constituting easily detectable response thresholds, the comparison of

stimulus groups would be very easy. The groups could differ from one another in only two ways: They could differ in range (one comprising more just-noticeably-different stimuli than the other) and they could differ in absolute location within the continuum. These two parameters would be in functional dependence (a variation on one parameter is concomitant with a variation on the other) so that the comparison could be accomplished by simply stating, in physical terms, the position on the continuum of all the cuts involved. Unfortunately, language does not work this way. Instead of making precise cuts and providing sharply defined groups, the boundaries between groups tend to be rather fuzzy. In very many areas of discourse (even within the language of sensory experience) the entire grouping structure is in a state of flux. According to the wider contexts within which sense-terms occur, there may be greater or less flexibility of where to draw the line between two groups. Take for instance the words loud and soft. A certain noise may be called soft if we speak about airplanes, but loud in the context of automobiles. Contrast this with the use of the word yellow which is much more stable. Verbal or situational contexts have relatively little influence on the usage of ~~these~~ this words. The degree of fuzziness

or flexibility appears to be a significant code phenomenon that deserves to be taken into consideration when comparing grouping arrangement.

(Fig. 2).

Figure 2 is a more realistic representation of how a language might deal with a linear stimulus continuum. It can be seen that the complete description of the stimulus group to which a given word is applied, requires more parameters than the two mentioned before. Besides width and absolute position, the probability gradient (the particular shape of the curves) and the symmetry of the groups, as well as that of the transition areas, are further and distinct parameters. The probability gradient can, at least theoretically, vary in so many ways that a number of "sub-parameters" may be required or desirable. Further complications in the description of the groups are introduced by the fact that the stimuli impinging upon our senses can only rarely be arranged in terms of a uni-dimensional continuum; two-, three-, or more-dimensional continua are much more common.

The choice of any parameter is, of course, always arbitrary, the criterion for the choice being convenience. At this point we cannot lay down hard and fast rules on which parameters are to be used. This

is something that will have to be worked out by trial and error and in conformity with the aims of the research. As a general directive, it may be said that before the actual descriptive work begins, the investigator must study first the nature of the stimulus continuum, and second, the most likely properties that a stimulus group within that continuum might have. From a realization of these properties descriptive parameters may be derived, bearing in mind, of course, that some of these parameters may prove irrelevant to the research aim, as well as the possibility that unexpected properties may emerge from the research itself requiring again the development of other appropriate parameters.

Whatever appears as abstruse in these theoretical considerations will be clarified, we hope, by a complete demonstration of our approach, using color terminology for an illustration. The pedantic presentation in terms of "steps," was adopted simply for the sake of clarity.

V DEMONSTRATION: COLOR TERMINOLOGY

The study of minute details such as advocated here is anathema in some schools of anthropological thought. As Redfield has pointed out:

"In places the invention and teaching of special procedures have gone ahead of the possibility of finding out anything very significant with their aid. It is certainly desirable to be precise, but it is quite as needful to be precise about something worth knowing."[8]

Among the greatest achievements of modern Anthropology is the trend towards the study of functional relationships, connections, structures rather than isolated facts, and the arguments that have been leveled against "atomistic" methods in ethnology are certainly sound. On the other hand, we must not forget that it is quite possible to see connections where there are none; to deal with "structured wholes" that are the product of a flourishing imagination. A sound theory can be erected only on the grounds of reliable data. In the social sciences it is not always easy to gather data that can lay claim to objectivity, a problem which appears to be particularly acute in the kind of research we are concerned with here. The exclusive purpose of this section is to make explicit the procedures by which we gather data. Obviously, the data themselves "prove" nothing. They are generated so as to have some hard facts which can give rise to a verifiable hypothesis. We agree that on the theory-forming level we must detach ourselves from the immediately given, and rise to a level of abstraction that permits us to survey synoptically the individual facts. But we

insist that this phase must be preceded by one in which these facts are established objectively and in complete disregard of the particular theses that we should like to see proven.

Step I. Study of the Discriminanda

Our knowledge of a given language will usually determine which kind of sense-perception terminology we wish to study. We may be struck by a peculiar vocabulary in the area of smells, of touch, or depth-perception. Whatever our choice is, it is essential that we familiarize ourselves with the most important psycho-physical variables of the stimulus material.[9]

A word of warning is in place here. One of the layman's most common misconceptions is that he assumes a linear relationship between physical variation of the stimulus material and psychological variation in perception. There is, however, no such linear relationship. A temperature differential of 10° Centigrade is not always perceived as the same differential. The difference between two objects, one -30° C. and the other -20° C., may, under certain conditions, seem smaller than the difference between two objects, one of which is 37° and the other 47°. It is important to distinguish between physical and psychological descriptions of stimuli. In physical description we measure the stimulus, and describe its variation

in terms of some physically constant measuring unit, and disregard our body's ability to perceive directly the variation measured. In psychological description the measuring unit is also constant, in a sense, but its constancy is of a perceptual nature. A scale made up of such units tells us how differently we perceive two stimuli but it tells us nothing of the physical nature of the variation. The problem of psycho-physics is to find the rules by which a psychological variable may be translated into a physical variable. Such transformation rules have been worked out in the fields of vision and hearing, but much still needs to be done relative to other sensory processes. For our research it is essential to have at our disposal psychological scales by means of which we may measure and describe a stimulus in terms of its perceptual qualities. Furthermore, we must be able to obtain series of perceptually equidistant stimuli along such scales and the stimuli must at the same time be describable in physical terms. The procedure is illustrated by the followwing considerations about color.

If we were given a great number of color samples and asked to arrange them in a systematic fashion, we would soon discover that it is not possible to order all of them in terms of a single criterion.

For instance, the spectral order would leave us with a great number of colors such as black, white, gray, and all sorts of pastel colors which would appear to have no place in a series composed of the colors of the rainbow. With a little further concentration on this ordering game, we will discover that the necessary number of criteria for assigning every single color (chromatic and achrometic) a logical place in a system or catalog is three (provided the surface or conditions of reflectance are held constant for all colors). These criteria correspond to the three perceptual attributes of color; hue, saturation, and brightness in the terminology of the Optical Society of America (OSA). An objective definition of these attributes is difficult inasmuch as they are phenomenal variables that have no perfect correspondence with one single physical property of the stimulus.[10]

Nonetheless, these attributes are a psychological reality which can be studied without getting caught in the traps of interpersonal relativity. The only requirement is that scales be developed which are, ceteris paribus, invariable for one group of observers, say, the English speaking adult population of the United States not exceeding the age of 50. That is to say, we must be able, as in fact we are, to

calibrate these three dimensions in what appear to be perceptually uniform steps for any observer within the defined population.

The traditional and most convenient way of combining the three pereeptual dimensions of color into a coordinate system is a cylindrical continuum. (Fig. 3) In this continuum, hue varies with angular distance or position around the vertical axis; brightness varies with height or position along the vertical axis; and saturation varies with centrality or distance from the vertical axis. The locus of achromatic colors is the axis itself whereas all other positions specify chromatic colors. Thus every conceivable color has a distinct place in this continuum, which is technically known as the psychological color solid or color space. Nickerson and Newhall[11] point out that an ideally constructed color solid would have the following properties:

> The dimensional scales would be calibrated in perceptually uniform steps; the units of the several scales would be equated; the surface of the solid would represent all colors of maximum saturation; the volume would be representative of all colors which are perceptibly different...

The same authors have actually constructed a three-dimensional model of the psychological color solid.

(Fig. 4)

The irregular shape is due to the fact that the sensitivity of our eye varies with brightness and hue. The model shows that at a higher level of brightness we can discriminate fewer steps of saturation than at a medium level.

Thanks to the meticulous research of various specialized committees of the Optical Society of America, the construction of scales has now been accomplished by means of which it is possible to specify for any color its perceptual properties in terms of the three dimensions. At the same time, there are convenient and simple ways of converting the perceptual specifications into colorimetric data, thus equating perceptual to at least one type of physically determinable properties of color.[12]

Since we are proposing to use the three perceptual dimensions as a metalanguage in terms of which we could describe the referent of any color term, we might pause to ask in how far the coordinate system arising from the use of these dimensions might itself be culture bound. There are clearly two questions involved; the first is whether the dimensions hue, brightness, and saturation are universally applicable; and the second is whether the calibration of these dimensions is reliable. For the time being,

we may leave the first question unanswered, realizing, of course, that there is nothing "natural, logical, or necessary" in these dimensions. For our purposes these are convenient measuring sticks that enable us to describe cross-cultural similarities or differences.

The question of reliable calibrations is of greater interest. Ethnographic data on the perceptual abilities of peoples in various cultures refer, without exception, as far as we know, to learned skills. Reports on highly sharpened discrimination of sounds, colors, or sizes abound, yet no trustworthy source seems to have asserted in recent times that there are actual differences in biological potentialities within the human species. It is now usually assumed that the healthy offspring of any parents could be placed in <u>any</u> cultural environment and thereby acquire all the cultural traits that are typical of the members of that culture. In order to measure the perceptual skills fostered by a particular culture, we need some kind of a standard. One way of obtaining such a standard would be to take a representative sample of adult Anglo-American subjects and determine their perceptual differential thresholds. In appropriate field work we can then ascertain how much other peoples' performance differs from that of our reference group. Slightly more

interesting results can be obtained if we do not only have one reference group consisting of "naive" subjects, but investigate at the same time how much we can improve the discriminatory ability by intensive discrimination training. We might, for instance, work with one reference group consisting of "naive" Americans and one consisting of "trained Americans," and compare these with equivalent groups from different cultures. It is interesting to note that the perceptual spacing of the Munsell colors was obtained by using a highly trained group of subjects.

Step II. Theoretically possible properties of stimulus groups, given the nature of the continuum.

We must now ask ourselves what would a group of stimuli that are capable of eliciting identical verbal responses look like? How could such groups (henceforth simply referred to as **categories**) differ from one another? In what terms shall the comparison of categories take place? A number of descriptive parameters will have to be singled out, and the choice of such parameters will largely be guided by the nature of the stimulus continuum.

In our illustration with color, we have seen that the continuum is three-dimensional. It is estimated that the color solid, i.e., the continuum, contains several million elemental, discriminable units[13] whereas no color terminology is known to

exceed the order of magnitude of a couple of thousand words. Clearly, grouping of discriminable stimuli takes place and the resulting groups are three-dimensional, i.e., the stimuli vary and can be described in terms of three attributes. In practice this is even true of the categories defined by our terms black, gray, white, although in this case the attribute hue is reduced to minimum variation. (Visualize this by letting red, blue, or green fade out. There comes a point where the colors are so extremely pale that one would ordinarily call them gray, although when these three grays are put next to each other, one might distinctly see that one is slightly reddish, one bluish, and one greenish.) If three-dimensionality is a property of color categories, what are the ways in which these categories can differ, what are the parameters we should use? Here is a tentative list. Parameters 1 through 4 describe the categories by themselves.

1. Size of Category: A color word may be reserved for a very limited number of stimuli (such as the word orange) or it may cover a great variety of stimuli (such as the word green). Thus, a category may occupy large or small volumes of space within the continuum.

2. Focus: If we study a little closer the

stimuli in a category, it appears that some of them are more likely to elicit a given verbal response than others. We can think, for instance, of a color that is more typically yellow than another one, yet both will be called in ordinary parlance "yellow." We shall use the term focus for that cluster of stimuli which has an extremely high probability of eliciting one distinct verbal response. Three sub-parameters are now needed to describe the focus and the relation to the entire category of stimuli which is referred to by the same term.

2a. Size of Focus: Obviously, the size of the cluster of stimuli that meet the prescribed requirement might turn out to be an interesting variable.

2b. Centrality of Focus: The focus may or may not be located in the center of the category. For instance, the focus of the category corresponding to the English term blue is located near the periphery of its category, a fact which has been determined empirically.

2c. Stability of Focus: If there is no agreement between informants where in the color space the most typical representative of a given category is located, then there would be no stimulus with a high probability of eliciting one and only one verbal response from the speech community at large, and con-

sequently there would be no cluster of stimuli which would meet our definition of focus. Nor would we speak in this case of "stability," for stability is a function of inter-individual agreement. Note, however, that there are two distinct types of such agreement: First, informants may agree on the absolute location of the focus in the color space but they may disagree in the position of the enveloping category. The category for the English blue is again an example of this. Subjects were found to agree which of a number of color samples is the most typical blue, yet there was little agreement on which colors constitute borderline cases, i.e., neither blue nor green. Second, subjects may with great regularity consider the topological center of the category as the focus without, however, being perfectly agreed on the location of the whole category within the color-space. There is no example for this possibility in English.

3. Homogeneity within Category: This is the ratio of the size of the focus to the size of the category. A number of sub-variables might be developed from the notion of homogeneity of which we give only one example:

3a. Symmetry of Probability Gradients within

Category: The probability referred to here is that of a given stimulus to elicit a given response. One kind of asymmetry results from a decentralized focus. The reader may easily visualize other types of asymmetry.

4. Width of the Transition Area between Two Categories: The point at which a category ends and a transition area begins is, of course, arbitrary. In fact, the usefulness of the very notion of a transition area depends upon the conditions encountered in further research of this kind. If we find occasionally a very fuzzy sort of categorization (so that there are extraordinarily large numbers of borderline cases) this notion may prove quite useful.

The following two parameters describe the color space as a whole, rather than the individual categories.

5. Category Density in the Color Space: Obviously, the color space may be divided up into a few gross regions or into a great number of small ones. The more categories are crowded into the continuum, the denser we shall say it is.

6. Category Distribution throughout the Color Space: A number of small and sharply defined categories may be crowded into one area of the continuum,

whereas in another part of the space there are only a few large and fuzzy categories. This is precisely the case with the English way of sub-dividing the color space. Pink, red, orange, brown, and yellow are tightly packed into about one-third of the color space; green, blue, and purple occupy the remainder.

These parameters describe the most obvious ways in which the referents of color terms may vary. The investigator who intends going into the field will, of course, consider also other variables, e.g., variables of codification. Examples would be the comparison of the relative frequency of occurrence of color terms or the phonological or morphological structure of that word class. Elaboration of this point behooves the linguist rather than the anthropologist or psychologist.

Step III. Preparation of appropriate test materials.

In Step I we examined how stimuli can be graded on a perceptual scale. In Step II we examined the theoretically possible ways in which stimuli might be grouped together. If we wish to describe the ways in which they are actually grouped by the speakers of any language, then our next step is to prepare a representative sample of all possible stimuli so that we may investigate how various languages deal

with them. We must be certain that our sample of stimuli is adequate in size and that the selection of material is not biased by our own cultural frame of reference. Reverting to the field of colors we need a rather large sample to represent the color space satisfactorily. If we did our research with a small collection of two or three dozen colors, our research may be seriously distorted unless some special precautions are taken. Man can discriminate well over a million colors under ideal conditions if our counting criterion is that the subject must be 50% certain that two shades are different from one another (this is the standard measure). With greater exigency on his discriminatory ability (say, the subject must be 100% certain that two shades are different from one another) and under less favorable testing conditions, one can still distinguish over a thousand different colors. For simplicity's sake, let us conservatively assume that the size of the universe which we want to sample is one thousand. Most color terminologies as found in natural languages (i.e., excluding specialized discourse, ad hoc names such as the color of a peacock feather, or descriptive phrases achieved by the use of modifiers or combinations of basic terms) do not exceed ten terms

or so. If we further assume now that each term refers to a category with a focus consisting of a cluster of four stimuli (distinguishable colors), then altogether we have only forty stimuli in our universe which are typical representatives of the existing color-categories. Now, if we sample 25 instances of this universe we cannot expect by the laws of probability to draw more than one single focus color. If we draw a sample of one hundred, we cannot expect to have more than four focus colors in our sample if blind chance were operating. In actual fact, blind chance is not operating in this procedure, but the cards are stacked against us, because the forty focus colors are not distributed randomly over the universe. First of all, they are clustered in the foci; second, the foci themselves are far from being distributed evenly throughout the color space. Under these circumstances, none of the assumptions underlying random sampling methods can be made. The situation is still worsened if we go into the field with a collection of some 30 odd colors which, instead of having been drawn randomly, have been selected for appearing to the investigator as "clear and definite" colors. In this case we may be pretty sure that the collection includes at least all of the foci of the investigator's own color

categories and that he has thus biased the sample to begin with.

An accurate picture of how the color space is categorized by a given language cannot be obtained without the initial use of a color collection of at least 500 perceptually equidistant colors. In other words, it will be necessary to cover the entire color space in such a way that approximately every other absolutely identifiable color is represented. There are several such collections available commercially. The oldest one is Ridgway's Color Dictionary,[14] containing 1,113 painted color samples. Unfortunately, no spectrophotometric analysis has been made so far of these colors so that their specification in psychophysical terms is inaccurate. The German scientist, W. Ostwald, has published a Farbenatlas of which there are several editions,[15] the earliest of which contains over 2,000 color samples. For this collection various colorimetric measurements are available, but the publications are not easily accessible to the American scholar.[16] Also the coordinate system used by Ostwald is slightly different from the cylindrical one discussed earlier which is the one best known in this country. A very popular and not very expensive work is the

Dictionary of Color by Maerz and Paul.[17] It contains over 7,000 different colors arranged in convenient charts. The greatest drawback of this book is that the color samples are printed and not hand painted and that no colorimetric data are available for them.

By far the most desirable color collection is that produced by the Munsell Color Company,[18] a research foundation devoted to the standardization and specification of color.[19] These colors have been subjected to psychological, psychophysical, and colorimetric analyses so that we can easily inform ourselves about any of the most important properties of our test material. The foundation sells any number of color samples either individually or in the form of charts or atlases. All samples are hand painted and the charts are arranged so as to represent horizontal or vertical sections through the cylindrical coordinate system mentioned.

(Fig. 5)

There are also charts available that show the "outside" of the color solid, i.e., all hues through all levels of brightness at their highest degree of saturation. The perceptual attributes hue, brightness, and saturation are called in the Munsell System hue,

value, and chroma. The system provides for a hundred-step hue scale, ten levels of brightness, and 20 degrees of saturation. Over a thousand color samples are carried in stock but the foundation willingly produces any color "between" the stocked notations upon request. Thus the collection provides us with an ideal instrument for the exploration of color terminologies.

Step IV. Field Work

In this phase of the work we can no longer generalize the method to apply to any research on the language of experience. Field techniques have to be worked out in accordance with the particular problems posed by the individual project. We begin our work by making up a list of color words in the language. Without confronting our informants with any color material whatever, we compile as complete a list as possible of all color terms and qualifiers they use. If we work in a literate society, we can substitute written documents or dictionaries for informants. In an illiterate society we ask a number of individuals to recite all the color words they can remember. Occasionally we may find that in this compilation the terminology seems to take on staggering proportions. If all of our informants

appear to be equally familiar with every item on the list we must assume that the actually spoken language comprises a very complex color terminology indeed. In most cases, however, it will become evident at once that only a tiny fraction of these long and impressive lists constitute common coin in the language. The vast majority of words will have no sharply defined meaning to the population at large. Work with the informants continues until we are sure that we have a list of color terms that includes all those words which are familiar to the majority of the speakers.

Next we show our color charts to informants (preferably a fresh group of people), but instead of pointing to one or the other color and asking what do you call this or that and thereby predetermining the sub-division of the color solid, we take item by item from our terminological compilation and ask the informants to point out which of the color chips might be called "_____." Each informant records his own answers in the following way. Clear acetate sheets are placed over the color charts and with a soft china-marker the informant draws a map on that sheet so as to include all of the color chips which are subsumed under one name ~~category~~. The informant

is also asked to mark with an X the one color chip which to him seems to be the most typical case of the color in question. Before removing the acetate sheets, the field worker writes on them the number of the color chart, the names of the color categories outlined, and the informant's name.[20]

In this phase of the work at least five informants should be used so that we may study the fluctuations in the location and size of the maps and their respective foci (marked by the X's) resulting from interpersonal differences. From this type of data we will be able to make measurements on the six parameters outlined above. In what terms the measurements are made and how such notions as focus, category border, or transition area are defined are again matters of convenience. In a study conducted by Brown and Lenneberg,[21] it appeared that one of the most interesting aspects of color terminologies, and probably of the language of experience at large, is a variable termed <u>codability</u>. This is a measure of the efficiency with which a color or other sensory experiences may be transmitted in a given language code. If a given color stimulus has a word reserved for it alone and if that word and its referent are well known to everyone who speaks that language, then the linguistically encoded color

experience can be decoded with great efficiency by anyone who knows the code; we may be fairly certain in this case that the decoder can refer back to exactly the same color to which the encoder had referred originally. On the other hand, if a color has no universally accepted name or if there is no good agreement on what color is meant by a given term, then the "nameless" color cannot be transmitted over the code nor can the sending of the meaningless term result in proper decodification.

Some inference as to codability may, of course, be made from the mapping data. However, it may be desirable to gather more accurate data for the computation of codability than is possible from the maps alone. The following procedure is recommended for this.

From the maps we choose those colors which appear to be the center of the foci. To the number of focal colors we add again approximately the same number of colors, choosing them so as to give us an even distribution of colors throughout the color space. All colors are then mounted on cards and the method indicated by Ray[22] is followed except that we suggest that before each informant names individual colors, he be shown the extent of the

entire sample of colors to be named. This is essential because in many languages various degrees of precision in naming are possible. In a context where only three colors have to be distinguished, we might call something red which in another context would be called dusty rose or pale purplish red. The entire color set must be presented to at least 10 informants because what primarily interests us in this phase is the degree of unanimity with which a color is named.

VI. A SAMPLE REPORT: ENGLISH AND ZUNI COLOR TERMS.

The data are derived from the testing of 24 English-speaking and 12 Zuni subjects. For the first group Harvard and Radcliffe students were used, excluding anyone who was found to be color-blind (determined through testing with Pseudo-Isochromatic Plates), who had had unusual training in discriminating colors, who was not a native speaker of English, who had lived abroad for any length of time, or who had received more than a few years of instruction in a foreign language.

The Zuni speakers were also tested for color blindness and their language backgrounds were ascer-

tained and recorded individually. Although Zuni was the primary language of each subject and the language regularly used at home and in daily life, the sample included only four monolingual Indians, the remaining eight possessing varying degrees of proficiency and education in English. Each subject, however, regularly lived in the pueblo of Zuni and fully participated in modern Zuni culture. This culture is sufficiently different from that of the college group to warrant a brief ethnographic discussion.

The Zuni tribe occupies a reservation in western New Mexico. In 1953, when the research was conducted, the tribe had a population of approximately 3,100. In winter nearly the entire tribe, with the exception of a small number living in outlying farming villages and of an ever-increasing number living off the reservation, is concentrated in the single pueblo of Zuni. In summer the farming villages and outlying houses are occupied, but even then, ties with the central pueblo are very close. Zuni, then, is essentially a single, small, and closely knit community.

Zuni culture has been well described in the literature, and summaries appear in a number of

of sources?[23] A good summary of modern Zuni culture will soon appear in a study entitled People of the Middle Place, by Dorothea Leighton and John Adair. Suffice it to state here that theZunis are a western Pueblo group. They formerly derived their subsistence from agriculture, hunting, and collecting, but today various other activities are economically important: Stock raising, craft work, wage labor, etc. Their social structure is dominated by a complex system of religious groups, and religion has traditionally been the chief concern of the Zunis. This intricate religious organization is still extraordinarily important today. Other features of their culture need not be mentioned here.

Although the Zunis share many cultural traits with other pueblo tribes, they are linguistically distinct. The data on the Zuni language have been reviewed by Newman:

> Zuni. The grammar of Bunzel[24] and the phonemic presentation by Newman[25] comprise the descriptive treatments of Zuni. Although Bunzel refers to age and sex "dialects," no geographically defined dialects have been reported among the villages around Zuni pueblo.
>
> Zuni remains without any proved linguistic affiliations...The inclusion of Zuni in the Aztec-Tanoan stock is based on a suggestion unsupported by evidence. If one may judge from the negative results of the search for Zuni linguistic relationships,

> beginning with Turner's attempt in 1856 to compare Zuni and Keresan vocabularies,[26] this is a language without any close affiliates. In so far as Zuni is to be linked to remote linguistic relatives, better descriptive materials, both in quality and quantity, will be needed to provide the basic data for successful comparative results

It is worthy of note that Newman is currently conducting research in Zuni linguistics and that there is hope for more information in the near future.

Conditions of field work in Zuni also deserve comment. Although the large ethnographic literature would seem to belie the statement, field research in Zuni has never been easy. Zuni resistance to investigation is well documented in the literature.[28] Hostility and non-cooperativeness can take many forms, but a common rationalization for hostility in Zuni is that the investigator is attempting to buy or steal religious secrets to the detriment of the entire tribe. Field work was very difficult immediately after World War II, but by 1953 the situation seemed to have eased, at least temporarily.

In any event rapport was no particular problem in this study since most of the subjects had long been known to the investigator, who had been conducting field work intermittently in Zuni since 1949. The subjects were selected from individuals found in a small group net which in turn had been chosen

as a universe of study in connection with other research. Despite the fact that most of the subjects were friends, many were apprehensive and somewhat reluctant to participate in an unfamiliar test situation with puzzling materials. Patient hours of preliminary work and preparation were needed to allay these fears. An attempt was made to give the test in conditions of privacy, but in view of other members of the households so that all could see that there was no attempt made to deal with religious matters. Complete privacy would have been more suspicious save under conditions of absolute secrecy. An interpreter, of course, was always present, although he was not always needed. It can be reported, however, that all went well and that no unusual difficulties were encountered in the administration of the test.

Our first task was to compile a list of color names elicited without the help of stimulus material. The fifty-two names elicited from a small number of informants are given below. The Zuni terms are written in the practical orthography proposed by Newman[29] and with few exceptions, the terms have been checked by him. In many instances a literal translation of the expression is given together with the closest English equivalent. The translations are those of

informants. Some of the expressions, of course, are only slightly variant from one another. The list is arranged alphabetically, placing the symbol for the glottal stop "/" at the head of the alphabet.

/a/polyananne	sky blue (like the blue sky)
/ahhonna	reddish brown (bay)
/ajok/onanne	light brown (a light brown ochre color)
/alasa:ninanne	light reddish brown (sorrel)
/amitolanne	rainbow colored (like the rainbow)
/aqalhinanne	pale blue (like blue paint stones)
/ashena	green
/ashena k/ojanna	light green (whitish green)
/ashena q/inna	dark green
/ateyananne	bright yellow (like a squash blossom)
/awishonanne	forest green (moss green)
/itopenahnanne	mixed colors ("all pretty colors put together")
/olenshinanne	orange (like the orange)
/o:lonanne	gold (like gold)
/oneya: muponne	dark yellow (like a bumble bee)
/oneyanne	light yellow (like corn pollen)
/owelu ja/lenanne	greenish yellow (like a cattail plant)
/ushshahmenanne	dark grey (like mold)
jek/oja:wananne	silver (like silver)
jekk/achonanne	pink (like pink clay)

je:lhupziqananne	yellow (like yellow ochre)
k/e:q/ina	purple (corn stalk purple)
k/ojanna	white
k/uchunanne	mixed color ("like corn with mixed colors--black, white and gray")
lhaya: luk/onanne	light green blue (like a blue bird)
lhi//anna	blue
lhi//anna q/inna	dark blue (blackish blue)
lhi//aqananne	turquoise blue (like turquoise)
lhi/k/onanne	smoky (brown grey)
lhupz/inna	yellow
lokk/ana	grey
ma:lhayaluk/onanne	purple blue (like a blue bird)--different bird from above.
mo:shiq/uteyananne	light pink (like a peach blossom)
na/samunne	dark grey (like a mean deer)
noje/lenanne	lavender (like boiled beans)
pintupa	spotted (pinto)
q/i/niqa	grey-black (black corn color)
q/inna	black
shakk/ana	wine (red cedar wood color)
shikqamunne	maroon (like a cactus blossom)
shilowa	red
shilowa /oneyanne	light red (a light yellow red)
shilowa q/inna	dark red (blackish red)
shukkutuliyanne	roan (like a bull snake)

sossona	brown
sumapponanne	(grey mixed with black and white like a cottontail rabbit's fur)
tonazo/ikna lhi//anna	greenish blue (like a peacock feather)
yuk/ohatinan lhupz/inna	light yellow (almost white yellow)
yulhi//atina	light blue (almost blue)
yulokk/atina	light blue (ashes color)
yuq/itinanne	blackish grey (like almost black)
yushilowatinanne	pink (like almost red)

This list, together with subsidiary information, enabled us to administer the mapping test described in Step IV above. In order to simplify our procedure we selected our stimulus colors in such a way as to hold one of the three perceptual color attributes, saturation (or in Munsell terminology: chroma), constant. Thus the variation between Zuni and English color terminology reported here concerns only two dimensions in the color space. There may be further variations in the third dimensions which were not investigated.

The general nature of our findings is presented in the graphs on Figure 6.

(Fig. 6)

The description of the two color terminologies (English and Zuni) in terms of the parameters 1 through 6 des-

cribed in Step IV above can easily be deduced from the graphs. Although the graphs furnish only brightness (i.e., value in Munsell terms) and hue specifications for any square, the full Munsell notation may be obtained by adding always the highest saturation (Munsell's chroma) available in the standard Munsell Collection[30].

The shading in the graphs represents the probability that informants will call a given color by the specific name most generally used for it; the darker the shading, the higher the probability.

The same data may be presented in another way. The relationship between brightness, hue and naming-probability could be graphed as in Figure 7. This three-dimensional graph would give us the contours like those of mountains where the height of the mountain indicates the probability of naming,

(Fig. 7)

the mountain as a whole being the name category. Vertical sections (profiles) through such mountains would give us curves approximating those shown in Figure 2 above which represents the probability gradients for given categories.

Returning to Figure 6, let us see how these graphs were arrived at. The location of the foci

were determined first by the mapping technique, and second they were checked by the procedure which we used to determine codability. In this latter method the subject is shown colors which he has to name. We count here how often a color is given an identical name by the various subjects. Due to this procedure the English categories green and blue each have two peaks or foci. Specific colors were consistently called by a great majority of subjects green, light green, blue, light blue. It is immaterial to our scoring procedure that some of these names appear to be composed of two words. There were only these two foci that corresponded to names consisting of two words used consistently together.

Following is a list of one hundred and five color expressions consisting of the terms given by ten informants to twenty-four selected stimulus colors. In some instances an informant used the same expression for more than one color, and in other instances, he was unable to give any expression at all. Since the duplication of expressions is relatively unimportant for the present purpose, the number following each expression is the number of informants citing it in this part of the test. The referents of the most common words are indicated on Figure 6.

a/poyan /ikna/ lhi//anna	(1) sky blue (sky like blue)
/ajok /ikna/ shilowa	(1) dark red (red ochre like red)
/akattol /uteyan lhi//anna	(1) purplish blue (tulip flower blue)
/aqalhinanne	(2) pale blue (like blue paint stones)
/ashena	(7) green
/ashenanne	(3) green (like green)
/ashena k/ojanna	(2) light green (whitish green)
/ashena yuk/ojatinanne	(3) pale green (almost white green)
ashena yuq/itinanne	(1) dark green (almost dark green)
/ashena q/inna	(7) dark green (blackish green)
/ashena zo/ya	(2) bright green (pretty green)
/ateyan /ikna/ lhupz/inna	(1) bright yellow (squash blossom like yellow)
/ist /a:na k/e:q/ina	(1) dull purple (somewhat like purple)
/olenshi	(1) orange
/olenshinanne	(6) orange (like the orange)
/oneya: muponne	(1) yellow (like a bumble bee)
/oneya: zo/ya	(1) light yellow (pretty corn pollen)
/owel ja/l/ikna	(1)greenish yellow (like the cattail leaf)

/owelu ja/lenanne	(1) greenish yellow (like the cattail plant)
/unaj tennanne lhi//enna	(1) faded blue (it's faded and it's blue)
jekk/achona	(4) pink
jekk/achona shilowa	(1) reddish pink
jekk/achona zo/ya	(2) bright pink (pretty pink)
jekk/achona yuk/ojatinanne	(1) light pink (almost white pink)
jekk/achona yuq/itinanne	(1) dark pink (almost black pink)
jekk/achonanne	(1) pink (like pink clay)
je:lhupziqananne	(1) yellow (like yellow paint stones)
je:lhupziqananne zo/ya	(1) bright yellow (pretty like yellow paint stones)
kok/a:wan jekk/asho	(2) pale pink (the dancer's clay pink)
kok /a:wan lhi//anna	(1) light blue green (the dancer's blue)
kumashakananne	(1) reddish brown (like ochre)
k/e:q/ina	(8) purple (corn stalk purple)
k/e:q/ina k/ojanna	(1) light purple (whitish purple)
k/e:q/ina zo/ya	(2) bright purple (pretty purple)
k/e:q/ina yuk/ojatinanne	(2) light purple (almost white purple)
k/e:q/inanne	(1) purple (like corn stalks)

lokk/ana	(1) grey
lokk/ana lhi//anna	(1) bluish grey
luwikna/ lokk/ana	(1) ash grey* expression cited and then changed.
luwikna/ lhi//anna	(1) ash blue
lhi//aqa poch /ikna	(1) dull turquoise (like poor turquoise)
lhi//aqananne	(2) turquoise blue
lhi//anna	(5) blue
lhi//an/ashena	(1) greenish blue
lhi//an /oshonanne	(1) faded or light blue (worn out blue)
lhi//anna ko:wi k/ojanna	(1) whitish blue (blue a little white)
lhi//anna q/inna	(3) dark blue (blackish blue)
lhi//anna ma:lhaya luk/onanne	(1) purplish blue (like a blue bird)
lhi//anna zo/ya	(4) bright blue (pretty blue)
lhi//anna yuk/ojatinanne	(3) whitish blue (almost white blue)
lhupz/inna	(8) yellow
lhupz/in /ashena	(1) greenish yellow
lhupz/in /oneyanne	(2) light yellow (corn pollen yellow)
lhupz/in /owelu ja/l/ikna	(1) greenish yellow (cat-tail leaf yellow).
lhupz/inna pajayanne	(1) pale yellow

lhupz/inna sossona	(1) brownish yellow
lhupz/inna zo/ya	(1) bright yellow (pretty yellow)
lhupz/inna yuq/itinanne	(3) dark yellow (almost black yellow)
may/ikna/lhi//anna	(1) blue (like a blue jay)
ma:lhayaluk/o	(1) purple (like a blue bird)
ma:lhayaluk/onanne	(3) purple blue (like a blue bird)
milo:/ikna/ lhupz/inna	(1) dark yellow (like baked sweet corn)
molhana: /uteyanne	(1) bright yellow (herb blossom)
mo:shik /uteyanne	(1) pink (peach blossom)
no:je/l/ikna	(1) pink (like bean paper bread)
no:je/lenanne	(1) dull pink (like bean paper bread)
sossona	(7) brown
sossona q/inna	(2) dark brown
sossona zo/ya	(1) rich brown (pretty brown
sossonanne	(1) brown (roasted color)
shakk/ana /oneyanne	(1) dark yellow
shikqamunne	(4) maroon (like a cactus flower)
shilowa	(8) red
shilowa k/e:q/ina	(1) purplish red
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yuq/itina lhupz/inna	(1) dark yellow (almost black yellow)
yulokk/atina shilowa	(1) purplish red (almost grey red)
yulokk/atinanne	(1) light grey (almost grey)
yulhi//atina	(1) light blue (almost blue)
yulhi//atina k/ojanna	(1) whitish blue (almost blue white)

yulhi//ɛtina q/inna	(1) dark blue (almost blue black)
yulhi//ɛtinanne	(1) light blue (almost blue)
yulhupz/itina zo/ya	(1) bright, light yellow (pretty almost yellow)
yulhupz/itina lokk/ena	(1) tan (greyish almost yellow)
yusossonanne	(1) light brown (almost brown)
yusossotina	(1) light brown (almost brown)
yusossotina lhupz/inna	(1) yellowish brown (yellowish almost brown)
yusossotinanne	(1) light brown (almost brown)
yushilowa	(1) rose (almost red)
yushilowa zo/ya	(1) bright pink (pretty almost red)
yushilowanne	(1) pink (almost red)
yushilowatinanne	(4) pink (almost red)

The comparison of monolingual Zuni with English reveals that most of the color categories of one language have an equivalent category in the other with only one drastic exception: In English <u>yellow</u> and <u>orange</u> are very sharply defined, separate categories whereas in monolingual Zuni, there is only one category comprising both our <u>orange</u> and <u>yellow</u>. More interesting is the comparison of the over-all structure of the entire color space in the two languages:

ENGLISH	MONOLINGUAL ZUNI
Considerable crowding of categories in the left of our graph.	Fairly even distribution of categories throughout the color space.
Categories are differentiated in homogeneity, e.g., red consists entirely of focus; blue has two foci, a considerable area of fair unanimity, a wide 50% transition area.	Degree of homogeneity seems to be fairly constant for all categories
Categories are differentiated by size.	Categories are more evenly sized.
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The bilingual Zuni group appears to be in a state of transition between monolinguals and English.

VII. CONCLUSION

This type of research might prove of interest to a variety of investigations. We shall give three examples progressing from the esoteric to the concrete. Philosophers of language, semanticists and logical empiricists have postulated the existence of certain terms in every language which constitute the anchors, so to speak, to reality. Most words may be defined contextually, that is, in terms of other words, except these elemental terms. Joergensen[31] describing

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The positivistic and other analytic philosophers build their logico-linguistic systems out of the elemental terms whose existence and relationship to reality are axiomatic for them. Anthropological research as outlined here does not verify the philosophical system but adds to it in that it describes further the nature of these axiomatic elements and differentiates them in terms of their specific relationships to physical stimuli. At the same time the work may enable us to discover whether such relationship is culturally determined or not.

The next example concerns research in communication. Since the language of experience serves to moor a potentially self-sufficient, "floating" symbolic system to the terra firma of reality, i.e., to a rigid frame of reference, we should ask whether all languages are equally efficient in codifying

the elemental experiences. If we give two native speakers of English the task of communicating to one another their choice of a particular color (e.g., by having each look at one of two identical color charts and restricting their intercommunication to the use of English color-terminology) we can predict from the data gathered in our research the probability of perfect communication for each color chosen, as well as the efficiency of communication of any term used during the communication process. We could compute "coefficients of efficiency" for every term or a "coefficient of codability" for every color and these numbers could be compared to similar ones based on other cultures or languages.

An application of direct psychological interest was described in detail by Brown and Lenneberg.[33] The mapping and naming data were used to make predictions (fairly successfully) on recognition behavior. The hypothesis was that the more accurately a color can be named in English, the better its chance for accurate recognition. Colors whose namability had been previously ascertained, were briefly presented to subjects. After a given waiting period the colors seen had to be identified from a large collection of other colors. The results fully sup-

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In summary, a close examination of various types of hypotheses in the area of language and cognition studies has revealed that one of the major problems in this field is the comparability of data. It has been shown that formalization is one way of overcoming this problem. We have demonstrated how data on reference can be formalized and how formal characteristics are amenable to cross-cultural comparison. The principal phases of the investigation of the reference function of language are; 1) the psychophysical description of certain referents; 2) the development of parameters which can describe the relationship between the linguistic symbol and the referent; 3) an empirical investigation on which of these parameters (which are conceived a priori) actually produces data that are signigicant either in revealing cultural variations or in the characterization of various kinds of symbol-referent relationships within individual languages.

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23. Goldman, Irving, 1937, "The Zuni Indians of New Mexico" in M. Mead, ed., Cooperation and Competition among Primitive Peoples. Eggan, Frederick R., 1950, Social Organization of the Western Pueblos. Chicago.

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25. Newman, Stanley, 1954, "A Practical Zuni Orthography," in Smith, Watson, and Roberts, J. M., Zuni Law; A Field of Values, Peabody Museum of Harvard University, Papers vol. 43, #1.

26. Powell, J. W., 1891, "Indian Linguistic Families of America North of Mexico." Seventh Annual Report of the Bureau of Ethnology, 1885-86, pp. 7-142.

27. Newman, Stanley, 1954, "American Indian Linguistics

in the Southwest." AA 56:626-644.

28. cf. Smith and Roberts op cit. p. 7.

29. #Newman, 1954. The practical orthography is identical with a technical orthography with the following exceptions: ch = č, j = h, lh = ɬ, q = kʷ, sh = š, z = c, / = ʔ, and : indicates vowel length.

30. This information may be gathered from Munsell Price lists or references cited in footnotes 12 and 19.

31. Joergensen, Joergen, 1951, "The Development of Logical Empiricism." International Encyclopedia of Unified Science, vol. 2, no. 9, Chicago. p. 8.

32. Mach, E., 1900, "Die Analyse der Empfindungen und das Verhaeltniss des Physischen zum Psychischen." Jena.

33. Brown and Lenneberg, op. cit.

/owelu ja/lenanne	(1) greenish yellow (like the cattail plant)
/unaj tennanne lhi//anna	(1) faded blue (it's faded and it's blue)
jekk/achona	**(4) pink**
jekk/achona shilowa	(1) reddish pink
jekk/achona zo/ya	(2) bright pink (pretty pink)
jekk/achona yuk/ojatinanne	(1) light pink (almost white pink)
jekk/achona yuq/itinanne	**(1) dark pink (almost black pink)**
jekk/achonanne	(1) pink (like pink clay)
je:lhupziqananne	(1) yellow (like yellow paint stones)
je:lhupziqananne zo/ya	(1) bright yellow (pretty like yellow paint stones)
kok/a:wan jekk/asho	(2) pale pink (the dancer's clay pink)
kok /a:wan lhi//anna	(1) light blue green (the dancer's blue)
kumashakananne	(1) reddish brown (like ochre)
k/e:q/ina	**(8) purple (corn stalk purple)**
k/e:q/ina k/ojanna	(1) light purple (whitish purple)
k/e:q/ina zo/ya	(2) bright purple (pretty purple)
k/e:q/ina yuk/ojatinanne	(2) light purple (almost white purple)
k/e:q/inanne	(1) purple (like corn stalks)

lokk/ana	(1) grey
lokk/ana lhi//anna	(1) bluish grey
luwikna/ lokk/ana	(1) ash grey* expression cited and then changed.
luwikna/ lhi//anna	(1) ash blue
lhi//aqa poch /ikna	(1) dull turquoise (like poor turquoise)
lhi//aqananne	(2) turquoise blue
lhi//anna	(5) blue
lhi//an/ashena	(1) greenish blue
lhi//an /oshonanne	(1) faded or light blue (worn out blue)
lhi//anna ko:wi k/ojanna	(1) whitish blue (blue a little white)
lhi//anna q/inna	(3) dark blue (blackish blue)
lhi//anna ma:lhaya luk/onanne	(1) purplish blue (like a blue bird)
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no:je/lenanne	(1) dull pink (like bean paper bread)
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yulhi//atina	(1) light blue (almost blue)
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Considerable crowding of categories in the left of our graph.	Fairly even distribution of categories throughout the color space.
Categories are differentiated in homogeneity, e.g., red consists entirely of focus; blue has two foci, a considerable area of fair unanimity, a wide 50% transition area.	Degree of homogeneity seems to be fairly constant for all categories
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21. Brown and Lenneberg, op. cit.

22. Ray, Verne F., 1952, "Techniques and Problems in the Study of Human Color Perception." SJA 8:251-259.

23. Goldman, Irving, 1937, "The Zuni Indians of New Mexico" in M. Mead, ed., Cooperation and Competition among Primitive Peoples. Eggan, Frederick R., 1950, Social Organization of the Western Pueblos. Chicago.

24. Bunzel, R. L., 1933-38, Zuni. Handbook of American Indian Languages, part 3 ed. by F. Boas

25. Newman, Stanley, 1954, "A Practical Zuni Orthography," in Smith, Watson, and Roberts, J. M., Zuni Law; A Field of Values, Peabody Museum of Harvard University, Papers vol. 43, #1.

26. Powell, J. W., 1891, "Indian Linguistic Families of America North of Mexico." Seventh Annual Report of the Bureau of Ethnology, 1885-86, pp. 7-142.

27. Newman, Stanley, 1954, "American Indian Linguistics

in the Southwest." AA 56:626-644.

28. cf. Smith and Roberts op cit. p. 7.

29. #Newman, 1954. The practical orthography is identical with a technical orthography with the following exceptions: ch = č, j = h, lh = ł, q = k^w, sh = š, z = c, / = ʔ, and : indicates vowel length.

30. This information may be gathered from Munsell Price lists or references cited in footnotes 12 and 19.

31. Joergensen, Joergen, 1951, "The Development of Logical Empiricism." International Encyclopedia of Unified Science, vol. 2, no. 9, Chicago. p. 8.

32. Mach, E., 1900, "Die Analyse der Empfindungen und das Verhaeltniss des Physischen zum Psychischen." Jena.

33. Brown and Lenneberg, op. cit.

VARIETY OF INSTANCES IN INDIVIDUAL LANGUAGE

UBIQUITY OF LINGUISTIC CONDITION

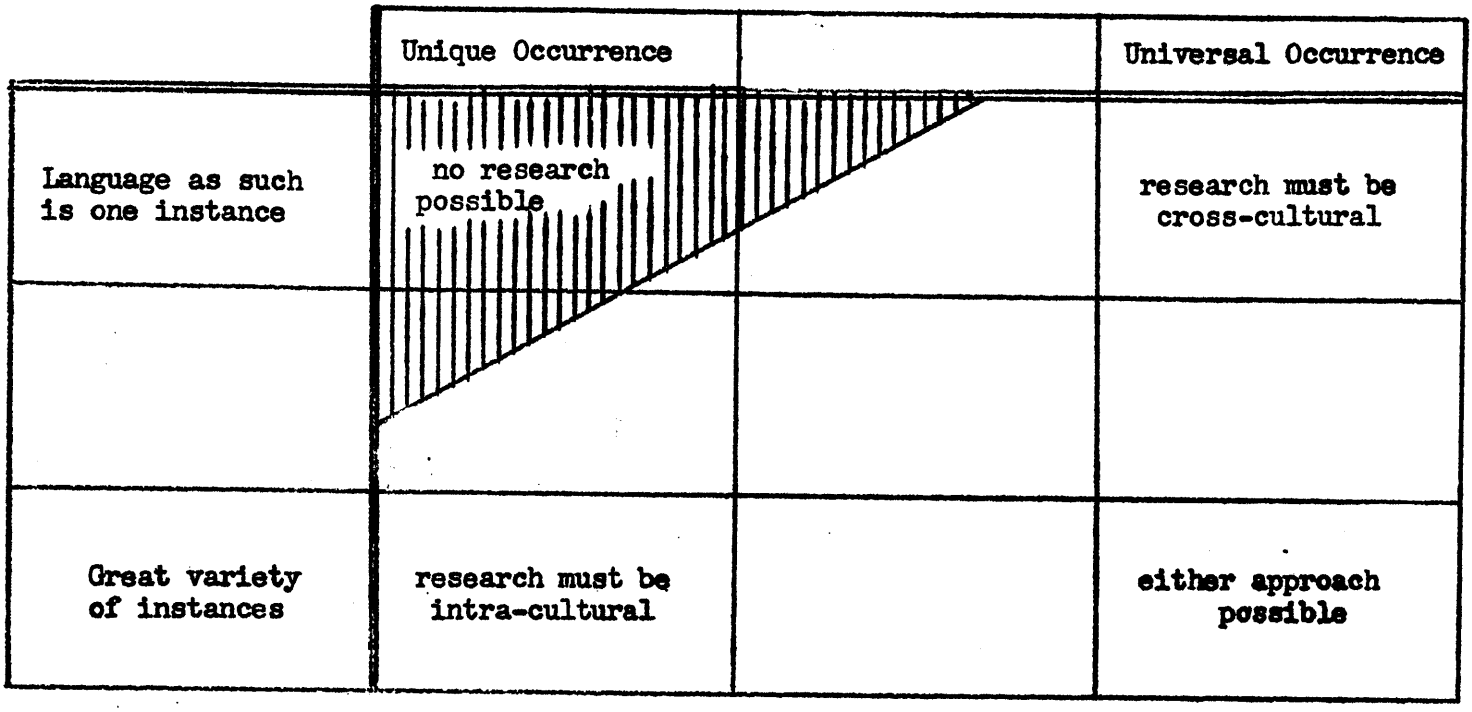
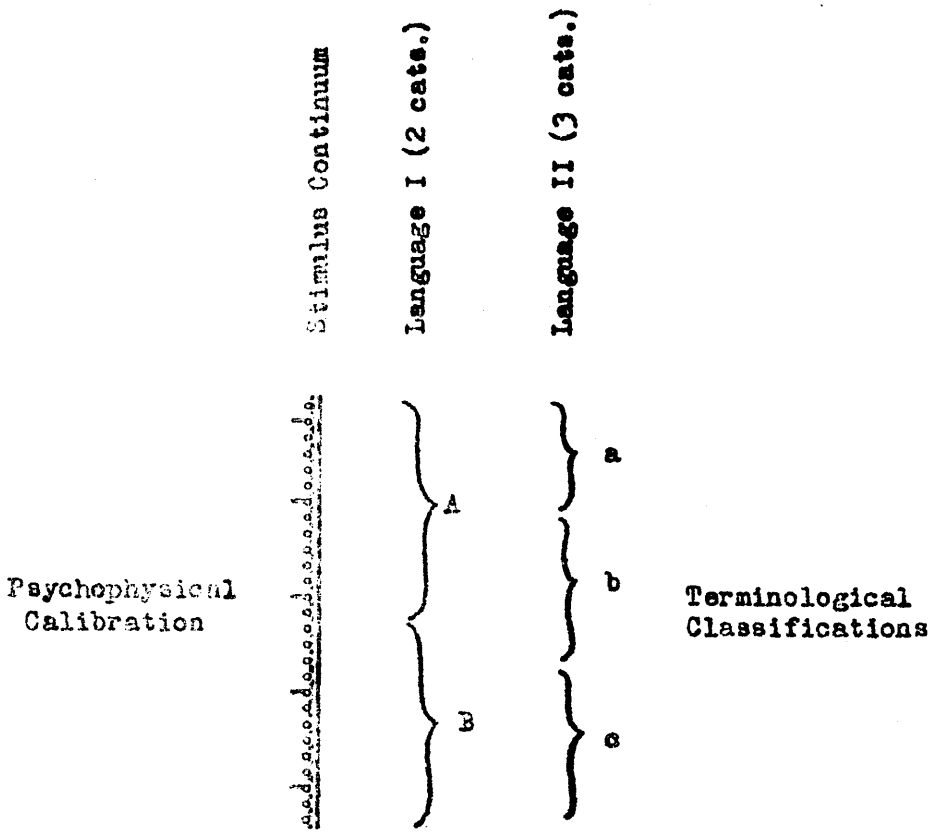


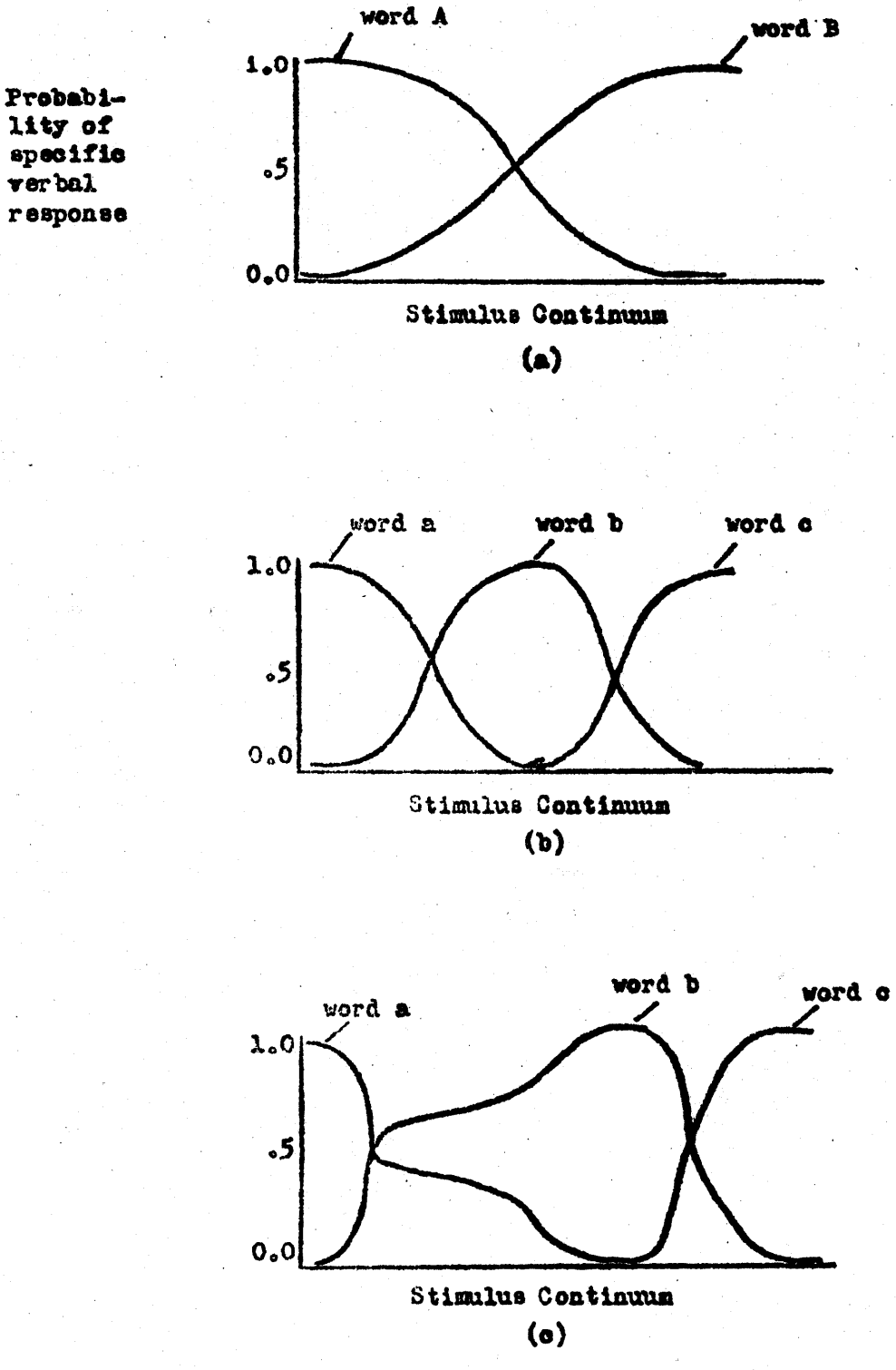
CHART I

Fig. 1



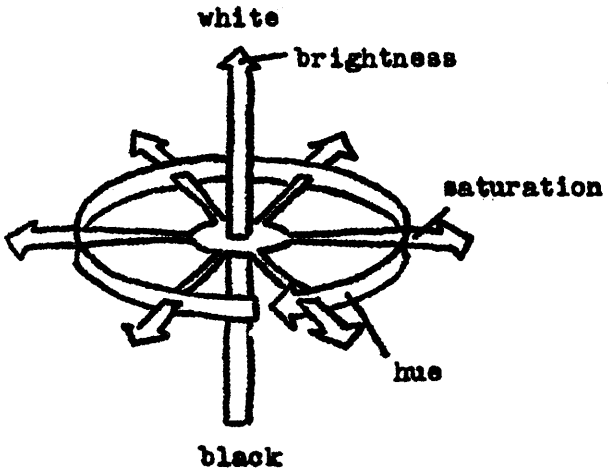
A stimulus continuum may be divided up in different ways by two languages.

Fig. 2



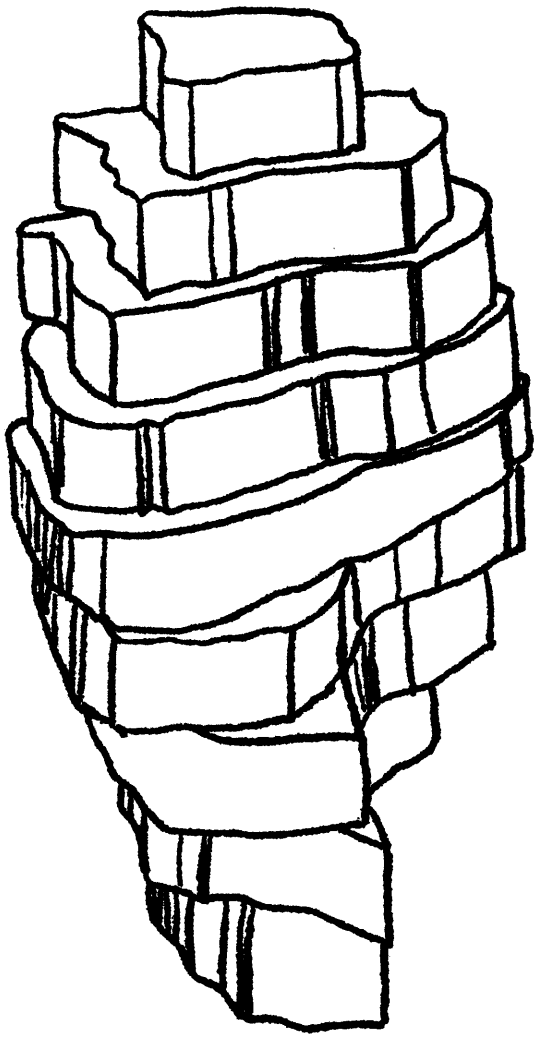
Probability gradients of codification; (a) twofold symmetric classification; (b) threefold symmetric classification; (c) threefold asymmetric classification.

Fig. 3



Simplified schematic diagram showing relation among hue, brightness, and saturation. (After Tufts, Hdbk. of Hum. Eng., 23)

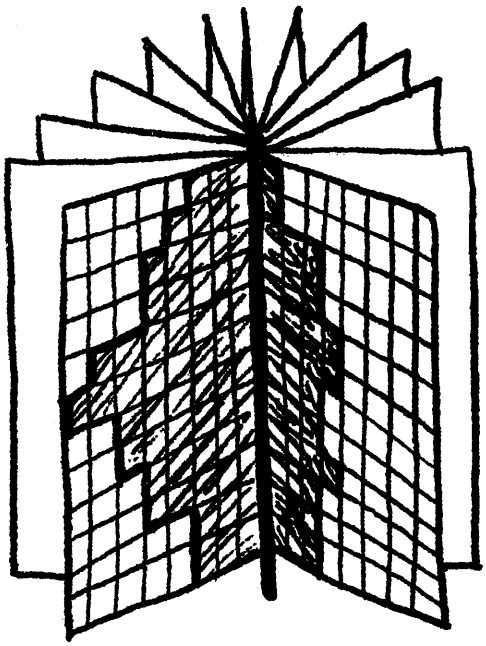
Fig. 4



Psychological color solid for colors perceived under good visual color matching conditions

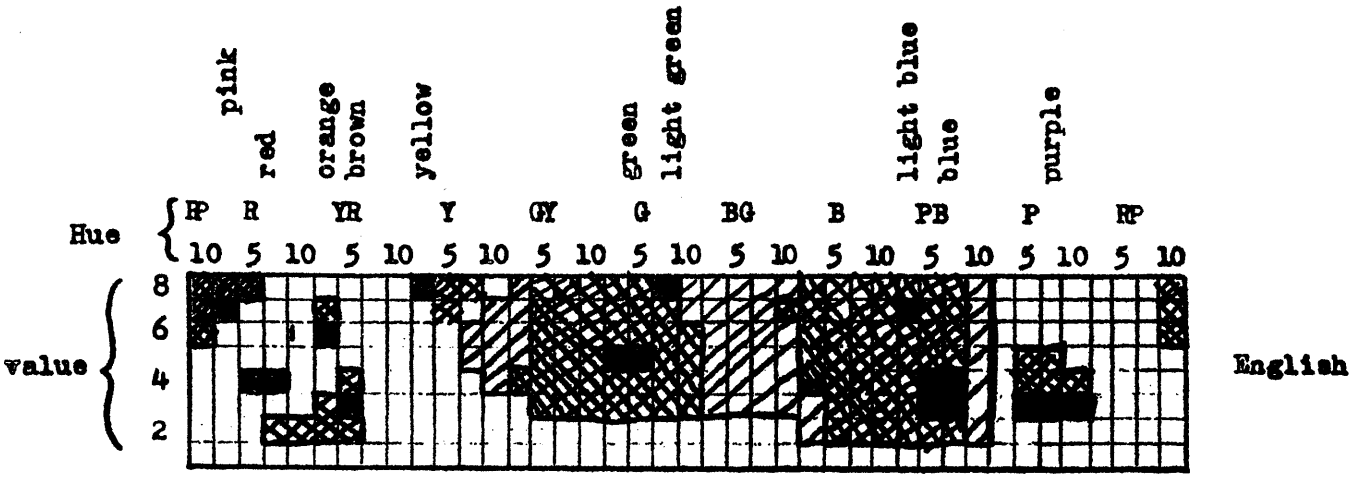
(This is a sketch for half-tone; high-gloss prints to be supplied.)

Fig. 5

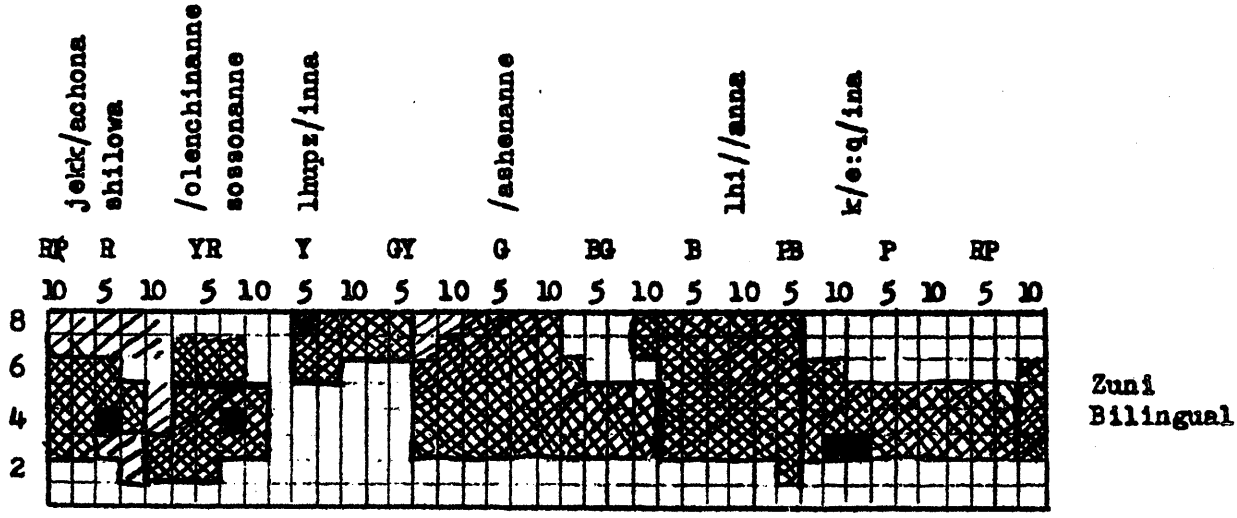


Schematization of the Munsell method
of sampling the color solid.

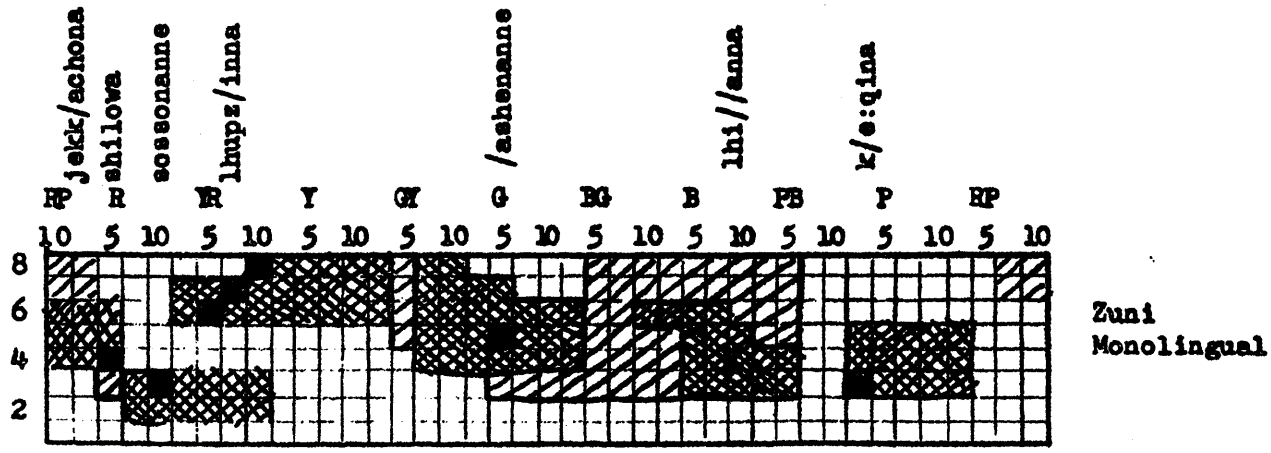
Figs. 6, 7, 8



graph 6



Graph 7



Graph 8

■ Focus (i.e. perfect unanimity in naming)
▩ Category (i.e. fair unanimity in naming)
▨ Transition area (i.e. one name occurs 50% of the time)
□ Nameless region (i.e. ad hoc names; no unanimity)

Fig. 9