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COMPARISONS OF HOMOGENEOUS GANZFELDS WITH GANZFELDS CONTAINING SIMPLE FIGURES

by
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COMPARISONS OF HOMOGENEOUS GANZFELDS WITH GANZFELDS CONTAINING SIMPLE FIGURES

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The purpose of this study is to determine the phenomenal characteristics of the Ganzfeld under conditions of homogeneity and when a small differentiated area is present. The homogeneous Ganzfeld may be considered the simplest level of visual stimulation and information concerning its phenomenal characteristics may contribute to the evaluation of the effects of stimulus gradients. Those phenomenal aspects primarily dealt with are color, figure distinctness, mode of appearance, and phenomenal space.

The following three questions guided the design of the experiment. In what manner is the appearance of the homogeneous Ganzfeld dependent upon intensity and wavelength? How does the appearance of the inhomogeneous Ganzfeld differ from that of the homogeneous Ganzfeld? How are these differences in appearance related to the stimulus distributions?

Since none of the previous investigations provided a method that could be used in the present study, it was necessary to develop a new method. Two Ulbricht type spheres were joined and appropriate illumination produced either a uniform Ganzfeld or a Ganzfeld containing a small differentiated area. Sixteen observers, using monocular vision, gave phenomenological descriptions as well as paired comparisons of the Ganzfelds.

The most characteristic description of the homogeneous Ganzfeld was that of close, impenetrable fog. The experience was a unique one, and most observers had difficulty describing the field in terms usually associated with visual phenomena. In some instances, temporary cessation of visual experience was reported. Variations in intensity of illumination did not consistently alter the appearance of the field although there was some indication that fields of greater intensity appeared denser and closer. Dominant long wavelength illumination also produced closer and denser fogs than dominant short wavelength light. The uniform chromatic Ganzfeld was reported as either poorly saturated or neutral in appearance.

The presence of a differentiated area in the Ganzfeld resulted in changes in its phenomenal characteristics. When

the differentiation resulted from chromatic gradients alone, a distant, indefinite figure was reported, which was highly saturated. Modifications in the appearance of the fog were slight. Those situations involving dominant short wavelength light seemed more indefinite than those involving dominant long wavelength light. The addition of an intensity gradient to the chromatic gradient increased definiteness of the figure-ground segregation but reduced the saturation of the figure.

The effect of moderate intensity differences alone was to produce a relatively definite separation of figure and ground. Saturation was as poor as in the homogeneous Ganzfeld. The density of fog was considerably reduced. Increased intensity difference further separated figure and ground. The fog disappeared. The figure was seen as closer than the ground. Their modes of appearance differed and a distinct boundary separated them.

The phenomenal characteristics of the Ganzfeld do not appear to be independently determined. Any change in stimulation that modifies one aspect of experience produces concomitant changes in the other phenomenal characteristics of the Ganzfeld. The distribution of stimulation rather than the nature of the local stimulus seems to determine what is experienced. Thus, the results of the present investigation appear to be in harmony with a configurational approach rather than the traditional "constancy hypothesis."

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CHAPTER I

INTRODUCTION

The traditional analytic approach toward an understanding of vision has led to an abundance of research and theories. The very nature of the approach, however, has resulted in an artificial separation of the various problem areas. Even in the study of specific areas such as color vision, integration of the phenomena studied has not been achieved. A search through the literature for research directed toward a general theory of vision reveals a dearth of material. However, the Gestalt psychologists, and a few others who were phenomenologically oriented, have attempted to relate traditionally separate "dimensions" of experience.

A. General Statement of Problem

The present study is concerned with some of the interrelationships between color, figure-ground segregation, mode of appearance, and phenomenal space. It is assumed that stimulus gradients producing phenomenal articulation of the visual field are major determinants of these four aspects of experience.

Homogeneous Ganzfeld. Interest in the appearance of the homogeneous Ganzfeld may seem to border on the esoteric, since phenomena of this type rarely occur in everyday vision. However, as Koffka (21) has indicated, the relevance of homogeneous retinal stimulation lies in the fact that it

represents the simplest level of visual stimulation. Information about the nature of the phenomenal field when gradients are absent in the physical field is essential to the formulation of an adequate theory of vision. It is only after this information is available that the functions of various gradients in the field can be evaluated.

From the point of view of Gestalt psychology, the Ganzfeld is of utmost importance. A major characteristic of the Gestalt approach is an emphasis upon the differentiation of "wholes." The assumption is that the phenomenal properties of parts are determined by the differentiation and organization of the whole. Since the homogeneous Ganzfeld is an undifferentiated whole, it provides a fundamental method for studying the process of differentiation. Thus, Koffka (21) begins his treatment of perception with a discussion of Metzger's Ganzfeld experiment. His theories, concerning such diverse problems as color constancy, spatial perception, surface appearance, and ego factors, were partially based upon Metzger's findings. Because of certain imperfections in Metzger's method, verification of his results with more adequate apparatus is desirable.

The phenomenal changes that occur when a physically differential spot is introduced into the Ganzfeld permit an evaluation of the influence of various kinds of stimulus gradients. Under these conditions, the difference between spot and field stimulation is the only basis for articulation of the visual field. Thus, when the difference between

field and spot is modified, concomitant changes occur in many of the phenomenal characteristics of the field, i.e., in figure-ground segregation, color, mode of appearance, and spatial dimensions.

The present investigation required the construction of apparatus fulfilling two basic requirements: (1) uniform stimulation of the entire retina (homogeneous Ganzfeld), which could be varied as to wavelength and intensity, (2) some method by which stimulation could be modified in a limited portion of this homogeneous Ganzfeld in order to vary independently the intensity, wavelength, and purity of the resulting spot and field. In this way, various heterogeneous situations could be produced.

B. Previous Studies

Methods. Several techniques which have been supposed to produce homogeneous retinal stimulation were described by Gibson and Waddell (13): (1) aperture-screen, (2) cyclorama setup, (3) translucent globe setup, (4) translucent hemisphere for each eye.

The first method described, perhaps better known as the reduction screen, does not seem relevant. With the use of the reduction screen, only a small portion of the retina is uniformly stimulated rather than a homogeneous Ganzfeld. The other three methods yield an approximation of a uniform Ganzfeld.

Engel's (5) cyclorama setup, used by Metzger (24),

consisted of a large, white-washed plaster wall, with wings added on to the four sides in order to fill the complete field of vision. According to Engel, the wall was uniformly illuminated by the use of a special projection lantern. The subject was seated 1.25 m from the wall. The visual field appeared uniform to the subject under low illumination. However, with increased illumination, the microstructure of the plaster wall was experienced as texture. Parts of the subject's face must have prevented uniform stimulation of the retina. For example, the nose must have produced a shadow on the peripheral nasal area of the visual field.

Even when the field was experienced as homogeneous, the retinal stimulation only approximated uniformity since the physical microstructure was present. A differentiation should be made between heterogeneous stimulation, in which the gradients are not sufficient for establishment of phenomenal non-uniformity, and uniform stimulation. The latter is the ideal condition which, perhaps, can never be achieved except for the condition of zero stimulation, i.e., complete darkness. Katz (18) has described the visual field under conditions of zero stimulation, and his results, which are relevant to the study of the Ganzfeld, will be discussed in a later section.

Gibson and his associates (10,12,13) have recently utilized translucent media, rather than reflecting surfaces, in order to produce undifferentiated retinal stimulation of high intensity. The convex surface of a milk glass hemispherical lighting fixture, 26 inches in diameter,

was illuminated by a bank of six lamps. The concave surface was supposed to be uniformly luminous. An alternative method utilized a translucent hemisphere consisting of half of an ordinary table tennis ball fitted to each eye.

These techniques prevented the appearance of texture, but it is unlikely that the optical density of the translucent media was uniform. Again, caution should be exercised to avoid interpretation of the lack of a stable image as an indication of uniform stimulation. Further, the projections of nose and cheek would produce non-uniformity of the retinal stimulation in both of these methods. The table tennis ball technique was preferred by Gibson because of its simplicity and flexibility. Accommodation under this condition is impossible because of the short distance and, therefore, the residual effects of non-uniformity in the physical field would be minimized.

In addition to the methods already described, two other techniques deserve consideration. Helson and Judd (15) utilized a highly illuminated 36 inch diameter sphere, lined with Hering orange-red paper. The observer placed his head into the sphere and was presented with a visual field of uniform hue. There were, however, many inhomogeneities, such as the texture and the edges of the paper. Brown and Gebhard (2) were able to produce a nearly uniform field by placing mineral oil between the observer's cornea and an opal diffusing screen. This technique, however, did not produce a homogeneous Ganzfeld since the edges of the temporal and nasal regions of the field were visible.

Spatial and textural appearance resulting from uniform stimulation. Katz (18) investigated the appearance of subjective visual grey, which is the result of zero stimulation of the entire retina. The general appearance was that of voluminous film color. The condensed fog-like substance had a concave curvature which was often described as "funnel-shaped." The center of this curvature was localized at a distance of approximately 10-40 cm. Changes in convergence altered the apparent distance.

Under conditions of low illumination of the Ganzfeld, Metzger's subjects reported "swimming in a mist of light which becomes more condensed at an indefinite distance" (24). With increased intensity, the fog became condensed into a filmy curved surface with empty space between the surface and subject. The distance to this surface was judged to be about the same as the objective distance, 1.25 m. With a further increase in illumination, the distance was judged to be greater, and the filmy curved surface was transformed into a flat plane surface with microstructure.

Gibson and Waddell (13), using their translucent globe setup, found that, with high illumination, their subjects described a "sea of light" with something vaguely surface-like in front of the face. The major portion of their study involved the use of translucent hemispheres for each eye. Sophisticated observers reported having a "sea of light" type of experience with no surface quality. The experience consisted of an ambiguous, voluminous, or spacelike quality. The reports of thirteen naive subjects do not consistently

indicate the impression of space-filling fog. Descriptions such as wall, curtain, screen, "cone-like structure," and "spider web of shadow" were occasionally given. Gibson and Waddell concluded that "a homogeneous field of color is indeterminate with respect to depth. The impressions that do occur are indefinite, unspecific, and ambiguous. Some of the qualities that characterize the visual world (surfaces, edges, distance, and the like) did appear, but infrequently and inconsistently. Presumably they were determined not by peripheral stimulation but by central processes."

Gibson and Dibble (12) studied surface perception using three different techniques. These were a variation of Metzger's technique, Katz's aperture screen, and the translucent globe. The results were similar to Metzger's, except that the coarse textured material of the wall could be identified under high illumination. The other methods yielded results which indicated an association between visual hardness and the sharpness of contour in the retinal image.

Color and uniform stimulation. Helson and Judd (15), in an attempt to test the Hering color theory, used a technique that fell short of producing complete homogeneity. Using intense orange-red stimulation, they failed to obtain a complete stable disappearance of hue even after a 75 minute adaptation period.

Hochberg, Triebel, and Seaman (16), using the table tennis ball technique, stimulated the retina with red and

green light. The filters used transmitted a narrow band of wavelengths, thus reducing the illumination considerably. Under these conditions, disappearance of color occurred within a few minutes of continuous stimulation. Most subjects reported that the field became dark grey in appearance. This part of the data was consistent with Koffka's (21) prediction that a chromatic homogeneous Ganzfeld would lose its color. However, his concept of a general "chromatic neutral point" for the entire visual field was considered incompatible with some of the other data reported. For example, with monocular color adaptation, stimulation of the dark-adapted eye resulted in a return of color experience. Also, the introduction of a shadow into the field, after binocular color adaptation, resulted in the appearance of a halo of the stimulating color.

Inhomogeneous stimulation. Studies dealing with the effect of microstructure, or other textural factors, upon the Ganzfeld have been described above. Another type of inhomogeneity is figure-ground segregation, the simplest form of which consists of a Ganzfeld uniform except for a limited area differing from the rest of the field. Research dealing with the latter type of inhomogeneity is almost nonexistent.

Metzger (24) presented his subject with a small unilluminated square, surrounded by a highly illuminated field. At this level of illumination, the field assumed a bowl shape and a surface quality due to the presence of microstructure.

The introduction of the square did not affect the appearance of the field. The observer reported a black trapezoid on the surface of the bowl. This shape was consistent with the image that was projected on the retina since the plane of the square was not at right angles to the visual axis.

Gibson and Dibble (12) projected lantern slides on to the outside surface of their translucent globe. Photographs of various textured surfaces were focused for clear projection on the central region of the globe. This resulted in removal of the luminous fog. The degree of surface hardness and definiteness of distance was related to the extent to which the picture was focused. The unfocused regions appeared "vaguer and perhaps softer."

Hochberg, Triebel, and Seaman (16), using the table tennis ball technique, introduced a shadow into the field after color adaptation had been completed. The subjects reported a black shadow surrounded, in most cases, by a colored halo. In almost all cases, the hue of the halo was the same as the original stimulation.

There are a limited number of studies, in addition to the above, which are relevant, even though they do not deal with a uniform Ganzfeld. These are concerned with the relationships between: (1) color and figure-ground segregation, (2) color and apparent distance, (3) figure-ground segregation and apparent distance, (4) figure-ground segregation and texture.

Color and figure-ground segregation. Koffka and

Harrower (22) reported a number of experiments in which the color wheel technique was used to study the relationship between color and figure-ground segregation. They were primarily concerned with the verification and further investigation of the Liebmann effect. Liebmann had reported that mere color difference between figure and ground was not sufficient for the formation of a stable figure. Thus, if the figure and ground were of equal brightness but different in color, there was a loss of definition, i.e., the figure appeared blurred and diffuse. The Liebmann effect did not seem consistent with the findings of other investigators which indicated that color is most easily seen on a neutral field of equal brightness. Under this condition, it was found that the threshold for color was lowest, and contrast effects were at a maximum. Koffka and Harrower obtained results which were consistent with both of the previous findings. They resolved the apparent inconsistency by concluding that maximum purity of color was correlated with poor phenomenal articulation. Thus, a highly saturated figure may appear without concomitant clear articulation of the field, and, conversely, saturation of the figure appears to be enhanced by poor articulation.

In addition to this, Koffka and Harrower (22) made the distinction between hard and soft colors. Short wavelength colors were classified as soft because of their relatively low "articulatory power," whereas the hard colors, such as red and yellow, had relatively high "articulatory power." When figure and ground were of equal brightness, the hardness

or softness of their respective colors determined the degree of segregation.

The addition of a wavelength difference to figure-ground segregation, based solely upon an intensity gradient, tended to enhance the articulation. Thus, intensity difference alone was not as effective in producing as definite figure-ground segregation as a combined wavelength and intensity difference.

Two studies dealing with subjective colors have indicated that blurring of contour enhanced the saturation of these colors. Erb and Dallenbach (6) used the Luckiesh-Moss line pattern, which consists of parallel black lines on a white ground. When the point of fixation was not in the same plane as the figure, the color was enhanced. Gebhard (7) used intermittent stimulation of an equal figure and ground which were out of phase. When blurring was introduced, facilitation of the color phenomena resulted. Thus, when clear articulation of the field in terms of sharp intensity gradients is impossible, the experience of color is more prevalent.

Color and apparent distance. Some controversy has existed as to whether wavelength has an effect upon apparent distance. Katz (18) utilized a number of experimental situations in which he demonstrated that red appeared to be closer than blue. This was assumed to be partially due to the more insistent quality of red. Vernon (29) reported a decrease in insistency when the distance of an object was

increased. Equidistant objects of unequal brightness but equal albedos did not appear at different distances under conditions permitting whiteness constancy. Under the same conditions, albedo differences, rather than luminosity differences, determined the apparent distance of an object. Johns and Sumner (17) have recently reported differences in apparent distances of achromatic and chromatic papers. They conclude that the essential factor is luminance rather than hue. The brighter colors appear closer than the darker colors.

Figure-ground segregation and apparent distance. The relationship between apparent distance and appearance of contour is an aspect of aerial perspective. Although this phenomenon was described by Leonardo da Vince, there has been little research dealing with this problem. The blurring of contour which usually occurs with increased distance may be the result of a decrease in physical contrast.

Figure-ground segregation and texture. Gibson and Dibble (12) reported that the appearance of hardness of surface was dependent upon a sharp gradient in the retinal image. The steepness of luminosity gradients between regions of the image seemed to be most relevant for determining surface quality. The texture-hypothesis, which relates surface to microstructure, or to a textured surface, was considered inadequate. Hard surface may be experienced even when there is no texture. Katz had suggested that, when an

aperture-screen was used, the observer would experience film color. However, Gibson and Dibble found that this was not always the case. When the aperture was much darker or much lighter than the screen, a hard surface was reported.

C. The Present Study--An Attempt at Integration

An evaluation of the studies described above led to the formulation of four hypotheses which were tested in the present study. The first three hypotheses were derived from the assumption that the manner in which color, figure-ground segregation, texture, and distance are experienced is a function of the gradients present in the field. In the present experiment, these gradients are completely determined by the differences between field and spot. Thus, the phenomenal characteristics of the figure and ground should vary when the gradients are produced by: (1) chromatic differences between field and spot, (2) intensity differences between field and spot, (3) combined chromatic and intensity differences between field and spot, or (4) purity differences between field and spot. The fourth hypothesis was partially derived from Metzger's (24) experimental results.

Since figure-ground segregation appears to be a major function of the human visual mechanism, it may be assumed that a primary function of the color mechanism is to participate in the segregation of parts of the field. It follows, then, that saturation, or richness of color, will depend on the presence or absence of chromatic differences

between figure and ground. An absence of chromatic difference between spot and field will tend to produce a low degree of saturation even when illumination is chromatic. When articulation of the field is completely dependent upon chromatic differences between field and spot, saturation will be at a maximum level. Hypothesis 1 follows from this premis.

Hypothesis 1. The excitation gradients, partially resulting from stimulus differences between field and spot, operate in the determination of the saturation of figure and ground.

Sub-hypothesis 1.1. In the homogeneous Ganzfeld, minimal saturation occurs.

Sub-hypothesis 1.2. When the chromatic difference between field and spot is the only basis for figure-ground segregation, relatively high saturation results.

Sub-hypothesis 1.3. When field and spot are isochromatic, and the only basis for figure-ground segregation is an intensity difference, saturation is relatively low.

Sub-hypothesis 1.4. When both chromatic and intensity differences exist between field and spot, saturation is at a lower level than when the same chromatic difference alone is present.

Sub-hypothesis 1.5. Purity difference between field and spot can produce relatively high saturation.

Koffka and Harrower (22), in their study of the Liebmann effect, found that when articulation of the field

was dependent upon chromatic differences alone, the boundaries between figure and ground were relatively undefined. They concluded that intensity differences may be more effective in producing clear articulation than chromatic differences between figure and ground.

The assumption underlying Hypothesis 2 is that those stimulus gradients producing definiteness of boundary between figure and ground will concomitantly produce definiteness in other phenomenal characteristics of the field.

Hypothesis 2. The degree of definiteness of characteristics of the phenomenal field is partially determined by the excitation gradients producing figure-ground segregation.

Sub-hypothesis 2.1. Definiteness of figure-ground segregation is primarily determined by the differences between the stimuli of the field and spot. Intensity differences alone are relatively effective in producing definiteness of figure-ground segregation, whereas chromatic differences alone are relatively ineffective in producing definiteness of figure-ground segregation. Combined chromatic and intensity differences are more effective in producing definiteness of figure-ground segregation than either difference alone.

Sub-hypothesis 2.2. Definiteness of surface of both figure and ground is partially determined by the kind of inhomogeneity. Intensity differences between spot and field can produce more definite surfaces than chromatic differences. Combined chromatic and intensity differences produce a more

definite surface quality than either difference alone.

Sub-hypothesis 2.3. Definiteness of apparent distance of both figure and ground is partially determined by the kind of inhomogeneity. Intensity differences can result in more definite distance experience than chromatic differences. The combination of chromatic and intensity differences results in a more definite distance experience than either difference alone.

Sub-hypothesis 2.4. The textural and spatial characteristics of the homogeneous Ganzfeld are phenomenally less definite than those of inhomogeneous fields.

It has been suggested that blurring of contour is associated with increased phenomenal distance. It, therefore, follows that "hard" colors appear closer than "soft" colors since, according to Koffka and Harrower (22), the contours formed by "soft" colors appear less clear. Studies dealing with advancing and retreating colors tend to fulfill this prediction (17,26,29).

Metzger (24) reported that phenomenal distance of the visual field increased from a few cm to over a meter as microstructure became visible. This has been interpreted by Koffka (21) as an indication of expansion of the field resulting from increased articulation. However, it is possible that the field is simply more realistically judged. Koffka has also suggested that figure and ground tend to appear spatially separated, the figure in front of the ground. As a result of these suggestions and of prelimin-

ary observations of the present investigator, the following hypotheses were formulated.

Hypothesis 3. The phenomenal distances of both figure and ground depend upon the gradients of excitation producing figure-ground segregation. Phenomenal distances associated with clear figure-ground segregation differ from those associated with poor figure-ground segregation.

Sub-hypothesis 3.1. Figures produced by dominant long wavelength stimuli, i.e., hard colors, appear closer than those produced by dominant short wavelength stimuli, i.e., soft colors.

Sub-hypothesis 3.2. The degree of intensity differences between spot and field affects their apparent distances differently. Increase in intensity differences between field and spot reduces the apparent distance of the figure and increases the apparent distance of the ground.

Since Metzger's (24) techniques did not produce a uniform field at high levels of illumination, it is desirable to attempt verification of his results under more uniform conditions. Although Hypothesis 4 is primarily concerned with a test of Metzger's findings, it also deals with the comparisons of homogeneous fields of differing chroma.

Hypothesis 4. The mode of appearance and spatial properties of a Ganzfeld are determined by the intensity and dominant wavelength of the field.

Sub-hypothesis 4.1. As the intensity of the illumination of a Ganzfeld increases, phenomenal distance and surface quality increase.

Sub-hypothesis 4.2. A Ganzfeld produced by long wavelength illumination differs from one produced by short wavelength illumination as to surface quality and phenomenal distance.

In addition to the tests of the above hypotheses by means of comparisons of the initial phenomenal properties of various fields, a series of phenomenological descriptions was obtained. These detailed reports supplemented the comparison data, facilitated its interpretation, and also provided new information about temporal effects. The phenomena selected from these reports for analysis in this study included: (1) color adaptation, (2) cessation of visual experience, (3) mode of appearance of the figure and ground, (4) phenomenal movement, (5) shape of the figure and ground, (6) apparent distance of the figure and ground. They will be discussed in Chapter IV.

CHAPTER II

APPARATUS, SUBJECTS, AND PROCEDURE

A. Apparatus

A brief description of the apparatus used in this experiment and the underlying rationale for its design and construction will be presented in the following section. More detailed information concerning the apparatus, which is illustrated in Figures 1 and 2, will appear in later sections.

General description. For the purposes of this study, a method had to be devised which would produce a uniform Ganzfeld. The principle involved in the illumination of the photometer sphere, also referred to as an Ulbricht sphere, was utilized. As a result of direct illumination of a small part of the inner surface, there is indirect uniform illumination of the entire surface. The inside of this type of sphere is covered with white paint in order to obtain a surface which has a high uniform albedo and diffuse reflecting properties. This method has been used by Donaldson (4) in the construction of a trichromatic colorimeter. For this experiment, a modification was necessary in order to make possible the introduction of a spot into the field.

Two spheres, each having a diameter of one meter, were joined together. The observer looked into sphere A. The light entered by way of two openings in sphere B. Situated

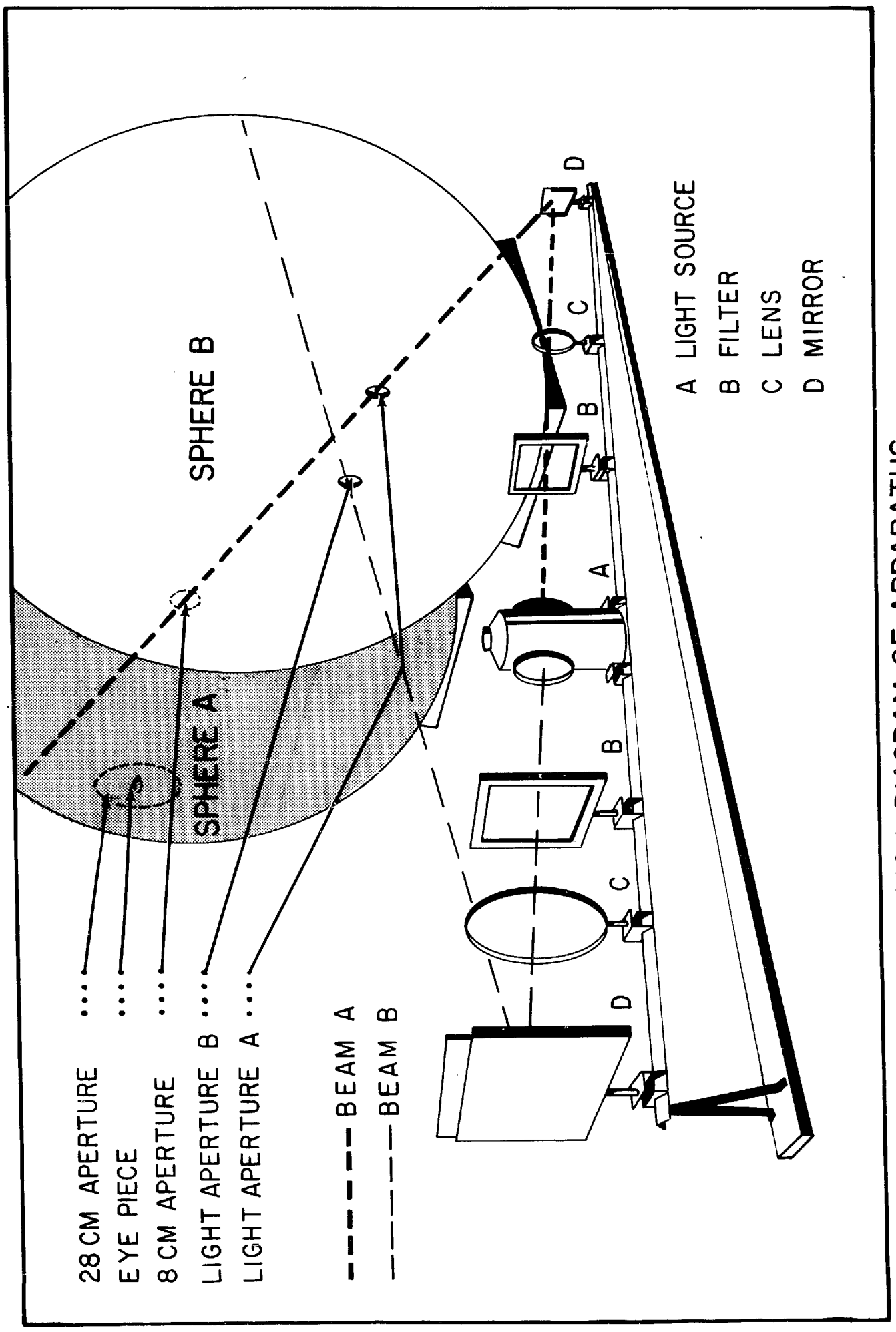
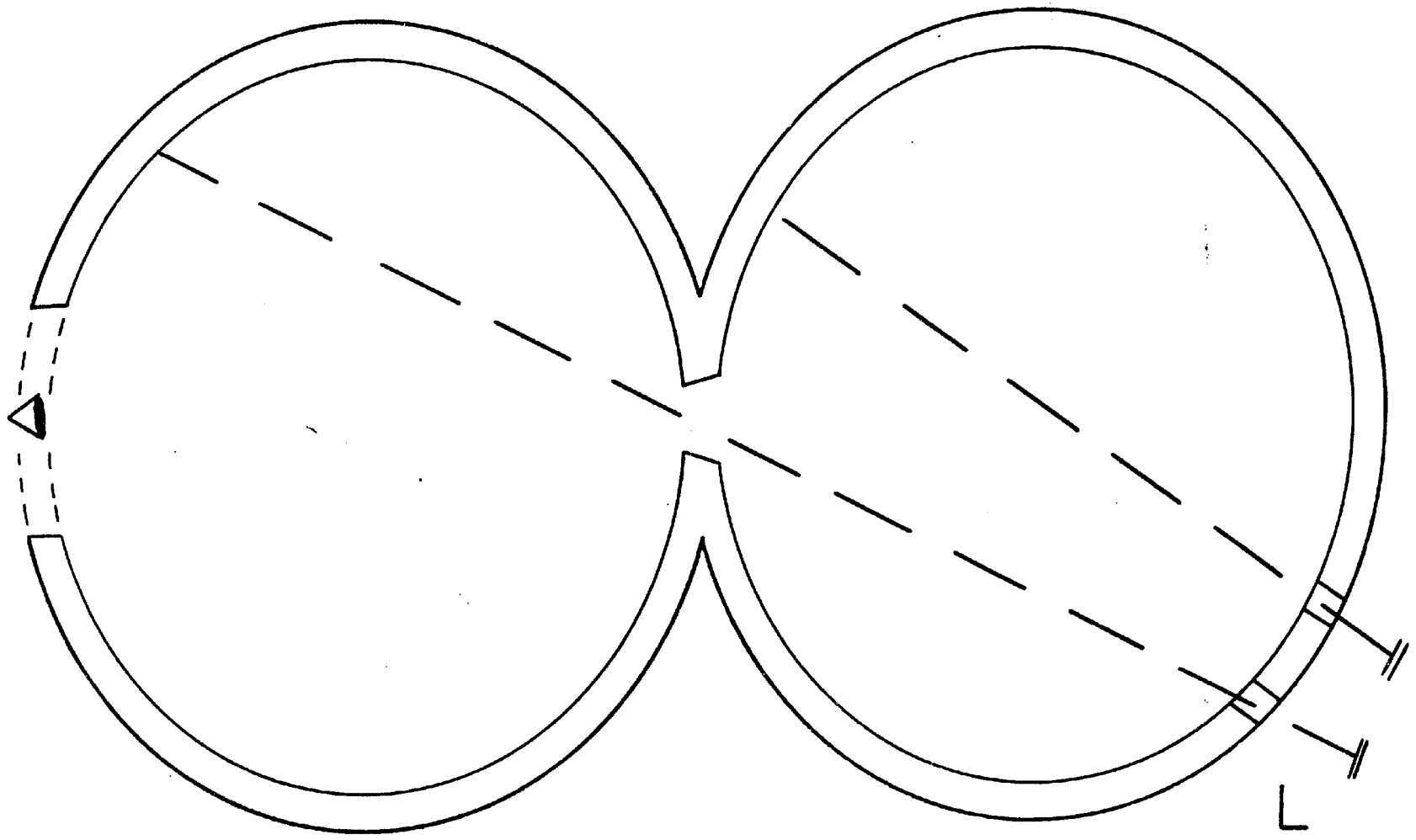


FIG.1 DIAGRAM OF APPARATUS



◀-OBSERVER L-LIGHT SOURCE

FIG. 2. SECTION OF APPARATUS

at the junction of the two spheres was a circular aperture with an 8 cm diameter.

Special masks were made which were fitted to the contours of each observer's face. The mask formed a removable section of the wall of sphere A and was used as a head rest. Each mask had an opening which permitted unobstructed monocular vision. When the observer looked to the right, no part of his mask or face was visible. The left eye was kept in complete darkness. The opening of the mask was placed in a position diametrically opposite the center of the 8 cm aperture. Thus, the subject's line of sight was perpendicular to the plane of the aperture.

A beam of light was projected on to the inner surface of sphere A, 20 cm above the observer's eye. In accordance with the principle of the Ulbricht sphere, uniform illumination of the sphere resulted, except for the area directly illuminated. Sphere B was uniformly illuminated by a beam of light that could be independently varied. By use of appropriate filters, the luminosity of both spheres was controlled in such a way as to produce either equality or a desired difference. When the luminous flux density in the two spheres was made equal, the aperture ceased to exist optically. A uniform Ganzfeld was produced. When the luminous flux density in the two spheres differed as to dominant wavelength, purity, or intensity, inhomogeneity was produced. Light coming from the aperture area was different from that coming from the rest of the field so that the observer was confronted with a simple inhomogeneity in an otherwise

uniform field.

The two beams of light originated from the same light source. By using appropriate lenses and mirrors, the beams were directed through two 5 cm openings in sphere B. These openings were not visible to the observers looking into sphere A. Neutral and color filters altered the intensity and composition of the light.

Eye-piece and head rest. A plaster mask was formed by making a cast of the observer's face. The mask was joined to a plaster ring which was essentially a removable circular section of sphere A, 28 cm in diameter. The center of the section had a 15 cm diameter hole. The mask was placed into the hole and adjusted so that the right eye would be centered, and, then, plaster was used to unite ring and mask. A small 2-3 cm hole was drilled through the eye region of the mask, permitting unobstructed vision of the right eye. The left eye was kept in complete darkness. The ring and mask were inserted into a large opening in sphere A. Since the observer was fitted to the mask, head movements were prevented. The curvature of the ring and mask approximated that of the sphere in order to minimize distortion of the spherical form. The head rest section was painted with the same white paint as the sphere in order to obtain the same albedo as the rest of the field.

The spheres. The two spheres were made of a special type of hard-setting plaster used by sculptors. Burlap was added to the outer layers of the plaster for reinforcement.

The walls were 5 cm thick. The inner walls were sanded so as to remove all surface irregularities. A special white paint (Benjamin Moore Sphere Paint) was sprayed on the inner surface. This paint produces a diffuse reflecting surface with a high albedo. Texture was completely invisible at a distance of one meter.

The two spheres were joined together by means of a plaster biconcave disk. This was made on the original mold used for the spheres so that, when it was inserted, it formed a continuation of the surface of the spheres. There was an 8 cm aperture with a beveled edge in the center of the disk. The edge at this opening was as thin as the media would permit. When an observer's face was properly placed in the mask and the luminous flux densities of the spheres were equal, the edge of the 8 cm opening was not visible.

Sphere A had a diameter of 1 m. There were two small areas that did not conform to the spherical shape, the mask, and the 8 cm aperture at the junction of the two spheres. These irregularities were not sufficient to interfere with the optical properties of the sphere. Thus, when a beam of light was projected upon the inner surface of the sphere 20 cm above the observer's eye, the visible portion of sphere A was uniformly illuminated.

Sphere B was formed on the same mold as sphere A. The two spheres differed slightly. No hole for insertion of the head rest was included in sphere B; instead, two 5 cm holes were drilled. These holes were invisible to the observer and permitted independent illumination of both

spheres.

Since the two spheres were independently illuminated, a spot and field could be produced which differed from each other in any desired manner. However, when the illumination of the two spheres was identical, the entire visual field was uniform.

Illumination. The source of illumination for both spheres was provided by a 12 volt, 240 watt, prefocussed airplane headlight bulb mounted in a water-cooled lamp house. Two 5 mm openings in the lamp house produced a separate light beam for each sphere. The course of the beam was controlled by the use of a convex lens and a mirror.

Chromatic illumination was obtained by the use of Wratten filters. It was not feasible to use filters that transmitted only a narrow band of wavelengths, since the resulting illumination would be too low for photopic vision.

Red light was produced by means of the Wratten CC-50R red filter, which had the following properties:

Luminous transmittance--41.3%
Dominant wavelength--608.5 mμ
Excitation purity--21.4%

Blue light was produced by means of the Wratten CC-30B blue filter, which had the following properties:

Luminous transmittance--52.0%
Dominant wavelength--461.0 mμ
Excitation purity--20.2%

Green light was produced by means of the Wratten CC-40G green filter, which had the following properties:

Luminous transmittance--67.7%

Dominant wavelength--554.3 mμ
Excitation purity--21.1%

A green light of less purity was also produced by means of the Wratten CC-30G green filter, which had the following properties:

Luminous transmittance--72.2%
Dominant wavelength--554.0 mμ
Excitation purity--15.8%

Different intensities of achromatic illumination were obtained by the use of neutral filters, except on those occasions when maximum intensity was required, at which time no filters were used. The neutral filters were prepared by differential exposure of fine grain, contrast sheet film. Combinations of these filters permitted photometric equality of chromatic and achromatic lights. Heterochromatic Flicker Photometry was used for the equalizations. Variations of brightness were obtained by the addition or subtraction of neutral filters.

There were eleven levels of brightness used for the major part of the experiment. The intensity at these levels was measured by means of a Luckiesh-Taylor Brightness Meter, and the values obtained were converted into millilamberts. The notation that follows will be used to designate the various levels of intensity and dominant wavelengths which were utilized.

The luminance of the sphere will be expressed in millilamberts. The dominant wavelength will be designated by letters representing the various filters used.

R signifies 605.5 mμ -- Filter CC-50R
G signifies 554.3 mμ -- Filter CC-40G
GX signifies 554.0 mμ -- Filter CC-30G

B signifies 461.0 mμ -- Filter CC-30B
A signifies --- Achromatic

The eleven levels of illumination used are:

0. millilamberts -- no light beam in the sphere
1.8 millilamberts
2.0 millilamberts
2.1 millilamberts -- equal to R
2.2 millilamberts
2.4 millilamberts -- equal to B
2.6 millilamberts
2.7 millilamberts -- G reduced to this level
2.8 millilamberts
3.1 millilamberts -- equal to G
4.9 millilamberts -- maximum brightness, no filter

This notation will be used in the following manner: (R 2.1 - A 4.9) signifies a field having a dominant wavelength of 605.5 mμ and a brightness of 2.1 millilamberts, with an achromatic spot having a brightness of 4.9 millilamberts.

B. Subjects

Thirteen men and three women served as observers. All had volunteered and were interested in the experiment but were naive as to the hypotheses and underlying theory of this study. The median age of the group was twenty-five, with a range of 22-50 years. The group contained three undergraduates, ten graduate students, and three faculty members, all specializing in psychology. All had normal color vision. Only six of the observers had normal visual acuity, i.e., 20-20 vision. Of the remaining ten, five had vision poorer than 20-200.

Six of the group participated in the experiment as major subjects, each observing for at least ten one-hour

sessions. The remaining ten subjects averaged three sessions each. Both subgroups were almost identical in age, sex, training, and visual acuity. Since there were no consistent differences between the judgements of the two subgroups, their data were combined.

C. Procedure

During an orientation session, each subject was fitted with a mask and given training with a color wheel in recognizing hue, degree of saturation, and brightness.

Each experimental session lasted approximately one hour. A complete record of the subjects' responses was obtained by means of a tape recorder. There were five basic kinds of visual fields with which the subjects were presented. These were:

(1) Homogeneity
(2) Inhomogeneity due to a difference in chromaticity between field and spot
(3) Inhomogeneity due to a difference in intensity between field and spot
(4) Inhomogeneity due to a difference in both intensity and chromaticity between field and spot
(5) Inhomogeneity due to a difference in purity between field and spot

The observers performed tasks of two kinds. In order to obtain quantitative data, the observer was required to compare the situation he was observing with the preceding situation as to initial appearance of hue, saturation, texture, distance, and figure segregation. These will be referred to as comparison situations. These situations were presented for approximately twenty seconds. The color and saturation level were judged. The field often appeared

foggy, and the observer compared the density of the fog with that of the preceding situation. Distances of both figure and ground were judged. Figure segregation was judged by evaluating the distinctness or vagueness of the boundary between figure and ground. There was an interval of approximately five seconds between successive comparison situations and approximately fifteen seconds between each set of comparisons.

For the second task, the observer remained in the situation for three minutes in order to report the effects of adaptation. Under these conditions, which will be referred to as the adaptation situations, the observer attempted to give a complete phenomenological description. Each of these situations was followed by a two minute rest period to permit recovery from adaptation. The experimental room was dark except for light from a flashlight used by the experimenter. During the periods when the subject was not observing, he was adapting to darkness to some degree.

The order of presentation of the various situations was arranged so as to control for possible time error, practice effects, and fatigue effects. This was accomplished by counterbalancing the order of presentation.

A total of fifty-one situations was used for comparison purposes. Each of the comparisons was made by eight subjects, four of whom were drawn from the group designated as major subjects. Each major subject participated in about two thirds of the entire series, whereas each minor subject was

presented with about one third of the entire series. The complete series consisted of sixty-six comparisons

All of the situations utilized in the comparison series were also used to study adaptation. In addition, the brightness of the spot was varied during an adaptation series. This permitted the observation of the effects of a gradual change in the brightness of the spot.

Treatment of data. The data obtained from the comparison series involved judgements of "more or less" rather than numerical values. The data were also based upon an N of 8 subjects for each of the pairs of situations compared. It was, therefore, necessary to select one of the nonparametric statistical procedures. The method chosen was the Sign Test (3). When the results were consistent with the hypotheses of this experiment, a one-tailed test of significance was applied. When the results could not be deduced from the hypotheses, a two-tailed test of significance was used.

There were no statistical tests used in conjunction with the phenomenological descriptions. These did not, in most cases, permit quantification. Instead, apparent trends and selected protocols are presented. The basis for protocol selection was representativeness.

CHAPTER III

RESULTS - STATISTICAL ANALYSIS

Two types of results are presented in this study. (1) The comparisons made between the initial appearances of the various experimental situations are subjected to statistical analysis. (2) The information obtained from the more complete phenomenological descriptions is presented in Chapter IV. The effects of adaptation and more detailed information concerning the initial appearances of the experimental situations will also be presented there. Verbatim protocols for illustrative purposes will be included.

A. Saturation

Apparent saturation as a function of inhomogeneity. Under the conditions of this experiment, the chromatic homogeneous Ganzfeld appeared to be poorly saturated. However, there was no evidence to indicate that heterogeneity necessarily enhances the saturation of the field. Only in half the situations tested did the lack of uniformity modify the saturation of the field. The major effects of heterogeneity were found in the figure area.

The first problem dealt with is whether the presence of a spot in the field influences the apparent saturation of the field. Data on the comparison of the ground areas of various inhomogeneous fields with the

homogeneous chromatic Ganzfeld appear in Table I.

When the differences between spot and field were of intensity only (Table I a,b,c), the ground area was not reported as more saturated than the uniform field. These results are consistent with Sub-hypothesis 1.3, which predicted poor saturation.

Inhomogeneity due to chromatic differences between spot and field (Table I d,e,f) tended to enhance the field saturation. However, the ground area of the green field-achromatic spot situation (Table I f) did not differ significantly from the uniform field. The failure to obtain higher saturation for the green ground may be related to the highly saturated contrast color induced in the spot. Mere purity difference between spot and field (Table I g) did not consistently modify field saturation. Since this situation involved the use of green only, the same factor of color induction may have been operating.

When the ground area of those situations involving both chromatic and intensity differences were compared with the homogeneous Ganzfeld, saturation differences were reported for those situations involving a chromatic field and an achromatic spot of zero intensity (Table I i,k). The chromatic field with a black figure appeared more saturated than the uniform chromatic Ganzfeld. When the achromatic spot, somewhat dimmer than the field, appeared with the induced complementary hue, the enhancement of field saturation was not consistent enough to be

Table I

Frequency of Relative Saturation Judgements Reported During Comparisons between Chromatic Homogeneous Fields and the Chromatic Ground Area of Inhomogeneous Fields

Situations Compared I	II	More sat. I	Equal sat.	More sat. II	Level of signif.
a. (R2.1-R2.1)	(R2.1-R1.8)	1	4	3	N.S.*
b. (G2.7-G2.7)	(G2.7-G2.4)	2	4	2	N.S.
c. (G2.7-G2.7)	(G2.7-G3.1)	2	5	1	N.S.
d. (R2.1-R2.1)	(R2.1-A2.1)	0	2	6	2.5%
e. (R2.1-R2.1)	(R2.1-G2.1)	0	3	5	5%
f. (G2.7-G2.7)	(G2.7-A2.7)	2	3	3	N.S.
g. (G2.7-G2.7)	(G2.7-GX2.7)	1	4	3	N.S.
h. (R2.1-R2.1)	(R2.1-A1.8)	1	2	5	N.S.
i. (R2.1-R2.1)	(R2.1-A0.0)	0	2	6	2.5%
j. (G2.7-G2.7)	(G2.7-A2.4)	1	4	3	N.S.
k. (G2.7-G2.7)	(G2.7-A0.0)	0	2	6	2.5%
l. Combined data		10	35	43	1%

Note: See page twenty-six for explanation of notation used to describe situations in Tables I - XII.

*N.S. indicates a level of significance greater than 5%.

statistically significant (Table I h,j).

All of the saturation comparisons described in Table I were combined (Table I 1). The combined data indicated that the chromatic ground areas of the inhomogeneous situations (II) appeared more saturated than the homogeneous Ganzfeld (I). This finding was consistent with Sub-hypothesis 1.1, which states that minimum saturation occurs in the homogeneous Ganzfeld.

Gestalt theory indicates that color is primarily experienced in the figure (21). It therefore follows that Hypothesis 1 of this experiment is more apt to be verified by data concerning the figural area. An examination of the data resulting from the comparisons of the figural areas of the inhomogeneous situations with the homogeneous Ganzfeld (Table II) indicates a very high degree of consistency with Hypothesis 1.

Mere intensity differences between spot and field did not enhance saturation of the figure (Table II a,b). On the other hand, solely chromatic difference between spot and field (Table II c,d,e,f,g) consistently enhanced the saturation of the figure. The figure appeared more saturated than the homogeneous Ganzfeld even when the color of the figure was due to simultaneous contrast only. Inhomogeneity due to difference in purity between spot and field also enhanced the saturation of the figure (Table II h).

When the situations involving both chromatic and

Table II

Frequency of Relative Saturation Judgements Reported during Comparisons between Chromatic Homogeneous Fields and the Figure Area of Inhomogeneous Fields

Situations Compared I	II	More sat. I	Equal sat.	More sat. II	Level of signif.
a. (R2.1-R2.1)	(R2.1-R1.8)	2	5	1	N.S.
b. (G2.7-G2.7)	(G3.1-G2.7)	1	4	3	N.S.
c.*(R2.1-R2.1)	(R2.1-A2.1)	0	0	8	1%
d. (R2.1-R2.1)	(A2.1-R2.1)	0	0	8	1%
e.*(G2.7-G2.7)	(G2.7-A2.7)	0	0	8	1%
f. (G2.7-G2.7)	(A2.7-G2.7)	0	0	8	1%
g. (B2.4-B2.4)	(A2.4-B2.4)	0	0	8	1%
h. (G2.7-G2.7)	(GX2.7-G2.7)	0	1	7	2.5%
i. (R2.1-R2.1)	(A1.8-R2.1)	0	4	4	N.S.
j. (G2.7-G2.7)	(A2.4-G2.7)	1	3	4	N.S.
k. (R2.1-R2.1)	(A0.0-R2.1)	0	2	6	2.5%
l. (G2.7-G2.7)	(A0.0-G2.7)	0	3	5	5%
m. Combined data		4	22	70	1%

*Complementary color resulting from simultaneous contrast

intensity inhomogeneity were compared with the homogeneous Ganzfeld (Table II i,j,k,l), consistent enhancement of figure saturation was observed for only the field of zero intensity with a chromatic spot (Table II k,l).

On the whole, whenever color was involved in figure-ground segregation, saturation of the figure was enhanced. The combined data (Table II m) indicates that the homogeneous field (I) was rarely reported as more saturated than the figure area (II).

When the ground areas of various inhomogeneous situations were compared, only two of the comparisons resulted in statistically significant differences in saturation (Table III). For the red situation, inhomogeneity due to chromatic difference resulted in greater saturation of the field than intensity difference (Table III a). Inhomogeneity due to a combination of chromatic and intensity difference did not differ in field saturation from inhomogeneity due to chromatic difference alone (Table III c,d). Comparison of chromatic inhomogeneity with purity inhomogeneity indicated no significant differences in field saturation (Table III e).

There was a tendency for inhomogeneity resulting from chromatic differences plus intensity to produce a more saturated field than mere intensity differences (Table III f,g,h,i). However, the only statistically significant difference was between the red field-dim achromatic spot situation and the red field-dim red spot situation (Table III h).

Table III

Frequency of Relative Saturation Judgements Reported during Comparisons between the Ground Area of Inhomogeneous Fields

Situations Compared		More sat.	Equal sat.	More sat.	Level of
I	II	I		II	signif.
a. (R2.1-A2.1)	(R2.1-R1.8)	6	2	0	2.5%
b. (G2.7-A2.7)	(G2.7-G2.4)	2	5	1	N.S.
c. (R2.1-A2.1)	(R2.1-A1.8)	2	5	1	N.S.
d. (G2.7-A2.7)	(G2.7-A2.4)	0	5	3	N.S.
e. (G2.7-A2.7)	(G2.7-GX2.7)	2	4	2	N.S.
f. (R2.1-A2.2)	(R2.1-R2.2)	4	3	1	N.S.
g. (R2.1-A2.0)	(R2.1-R2.0)	4	3	1	N.S.
h. (R2.1-A1.8)	(R2.1-R1.8)	6	2	0	2.5%
i. (G2.7-A2.4)	(G2.7-G2.4)	2	5	1	N.S.
j. Combined data		28	34	10	1%

Even though few of the individual comparisons were statistically significant, the combined data was significant at the 1% level (Table III j). This tends to verify Hypothesis 1, which predicts that the situations listed under I in Table III should appear more saturated than those listed under II.

When various inhomogeneous situations were compared with one another, the figural areas were often reported as differing in saturation (Table IV). The figure resulting from chromatic differences between field and spot appeared more saturated than the figure resulting from intensity difference (Table IV a,b,c,d). This appeared to be true even for the complementary colors that resulted from simultaneous contrast induction.

The figure resulting from chromatic differences between field and spot appeared more saturated than the figure resulting from a combination of intensity and chromatic inhomogeneity (Table IV e,f,g). Chromatic inhomogeneity was not consistently reported as different from purity inhomogeneity (Table IV h). The figures resulting from a combination of intensity and chromatic inhomogeneity appeared more saturated than the figures resulting from mere intensity differences (Table IV i,j,k,l). The only instance in which this difference was not significant was in the comparison of the achromatic field-dim red spot situation with the red field-dim red spot situation (Table IV k).

Table IV

Frequency of Relative Saturation Judgements Reported during Comparisons between the Figure Areas of Inhomogeneous Fields

Situations Compared I	II	More sat. I	Equal sat.	More sat. II	Level of signif.
a. (A1.8-R1.8)	(R2.1-R1.8)	8	0	0	1%
b. (A2.7-G2.7)	(G3.1-G2.7)	8	0	0	1%
c.*(R2.1-A2.1)	(R2.1-R1.8)	6	2	0	2.5%
d.*(G2.7-A2.7)	(G2.7-G2.4)	8	0	0	1%
e. (A2.1-R2.1)	(A1.8-R2.1)	8	0	0	1%
f. (A2.7-G2.7)	(A2.4-G2.7)	8	0	0	1%
g. (A1.8-R1.8)	(A2.1-R1.8)	8	0	0	1%
h. (A2.7-G2.7)	(GX2.7-G2.7)	4	4	0	N.S.
i. (A2.1-R2.0)	(R2.1-R2.0)	7	1	0	2.5%
j. (A2.7-G2.6)	(G2.7-G2.6)	8	0	0	1%
k. (A2.1-R1.8)	(R2.1-R1.8)	4	3	1	N.S.
l. (A2.7-G2.4)	(G2.7-G2.4)	5	3	0	5%
m. Combined data		82	13	1	1%

*Complementary color resulting from simultaneous contrast

All those situations listed first in each comparison (I) should appear more saturated than those listed second (II). For this reason, it was possible to combine the data (Table IV m). The results indicate complete confirmation of Hypothesis 1 and its sub-hypotheses in regard to the figure area.

B. Fog Density

Mode of appearance of the homogeneous Ganzfeld. During the preliminary phases of this investigation, it was observed that, in a homogeneous field, a dense fog was usually reported. Metzger (24) had reported a decrease in fog with increased intensity of the homogeneous Ganzfeld. In order to test these findings, the effects of intensity variation were studied.

Under the conditions of this experiment, there were no consistent differences between fog densities of the various homogeneous achromatic fields (Table V a,b,c,d). Variation of intensity did not affect this phenomenal characteristic of the field.

The fog density of the uniform Ganzfeld illuminated by dominant long wavelength light differed from that illuminated by dominant short wavelength light (Table V e,f,g). The only consistent difference was that the blue Ganzfeld was reported as having a less dense fog than the red Ganzfeld (Table V g). When the three chromatic homogeneous fields were compared with a homogeneous achromatic Ganzfeld (Table V h,i,j), only the blue homogeneous

Table V

Frequency of Relative Fog Density Judgements Reported during Comparisons between Homogeneous Fields

	Situations Compared		Denser	Equal	Denser	Level of signif.
	I	II	I		II	
a.	(A4.9-A4.9)	(A2.7-A2.7)	5	2	1	N.S.
b.	(A4.9-A4.9)	(A1.8-A1.8)	4	2	2	N.S.
c.	(A2.7-A2.7)	(A2.4-A2.4)	2	3	3	N.S.
d.	(A2.4-A2.4)	(A2.1-A2.1)	2	2	4	N.S.
e.	(R2.1-R2.1)	(G2.7-G2.7)	3	3	2	N.S.
f.	(R2.1-R2.1)	(B2.4-B2.4)	6	2	0	5%*
g.	(G2.7-G2.7)	(B2.4-B2.4)	4	3	1	N.S.
h.	(R2.1-R2.1)	(A2.1-A2.1)	2	2	4	N.S.
i.	(G2.7-G2.7)	(A2.7-A2.7)	1	3	4	N.S.
j.	(B2.4-B2.4)	(A2.4-A2.4)	0	2	6	5%*

*Two-tailed test of significance

Ganzfeld appeared with a less dense fog (Table V j). The results described in Table V are not consistent with Sub-hypothesis 4.1.

Mode of appearance of the inhomogeneous field.

Results of the comparisons of inhomogeneous fields with the homogeneous Ganzfeld appear in Table VI. Inhomogeneity due to intensity differences between field and spot altered the appearance of the fog in most cases (Table VI a,b,c,d,e,f,g). When the differences were of sufficient magnitude, the fog-like quality was reduced. This effect was not statistically significant when the intensity difference between field and spot was small (Table VI a). Inhomogeneity due to chromatic difference alone tended, in all cases, to reduce the fog density (Table VI h,i,j). The only comparison which did not yield a significant difference was that of the red homogeneous field with the red field-achromatic spot situation (Table VI h). Mere purity difference between field and spot did not consistently alter the appearance of the fog (Table VI k). Combined chromatic and intensity differences between field and spot consistently decreased fog density (Table VI l,m,n,o).

The combined data (Table VI p) indicates that the phenomenal density of fog is greater for the homogeneous situations (I) than for the inhomogeneous situations (II). The results, in general, indicate that the fog tended to dissipate when inhomogeneity was introduced into the field.

Table VI

Frequency of Relative Fog Density Judgements Reported during Comparisons between Homogeneous Fields and the Ground Area of Inhomogeneous Fields

	Situations Compared		Denser	Equal	Denser	Level of
	I	II	I		II	Signif.
a.	(R2.1-R2.1)	(R2.1-R2.2)	4	4	0	N.S.
b.	(R2.1-R2.1)	(R2.1-R2.0)	5	3	0	5%
c.	(R2.1-R2.1)	(R2.1-R1.8)	8	0	0	1%
d.	(G2.7-G2.7)	(G2.7-G2.4)	8	0	0	1%
e.	(G2.7-G2.7)	(G2.7-G3.1)	8	0	0	1%
f.	(A2.1-A2.1)	(A2.1-A4.9)	8	0	0	1%
g.	(A2.1-A2.1)	(A2.1-A0.0)	8	0	0	1%
h.	(R2.1-R2.1)	(R2.1-A2.1)	4	3	1	N.S.
i.	(G2.7-G2.7)	(G2.7-A2.7)	6	2	0	2.5%
j.	(R2.1-R2.1)	(R2.1-G2.1)	5	3	0	5%
k.	(G2.7-G2.7)	(G2.7-GX2.7)	3	3	2	N.S.
l.	(R2.1-R2.1)	(R2.1-A1.8)	8	0	0	1%
m.	(R2.1-R2.1)	(R2.1-A0.0)	8	0	0	1%
n.	(G2.7-G2.7)	(G2.7-A2.4)	8	0	0	1%
o.	(G2.7-G2.7)	(G2.7-A0.0)	8	0	0	1%
p.	Combined data		99	18	3	1%

The relative effects of various types of inhomogeneity upon the appearance of the fog are presented in Table VII. Inhomogeneity due to mere intensity differed from inhomogeneity due to chromatic difference between field and spot. Intensity differences resulted in a less dense fog (Table VII a,b). A combination of intensity and chromatic inhomogeneity differed from mere chromatic inhomogeneity. The latter situation appeared foggier (Table VII c,d).

Purity inhomogeneity did not differ from chromatic inhomogeneity as to density of fog (Table VII e). There were no consistent differences reported between those situations involving chromatic plus intensity inhomogeneity compared with mere intensity inhomogeneity (Table VII f,g,h,i).

The appearance of the fog depended on the intensity difference between field and spot. Increase of the intensity difference between field and spot decreased the apparent density of the fog (Table VII j,k,l,m). The density of the fog was determined by the degree of intensity difference between spot and field independently of the direction of this difference (Table VII n).

The appearance of the fog varied with variation in the dominant wavelength of the spot. The fog was less dense when the spot was illuminated by dominant long wavelength light than when illuminated by dominant short wavelength light (Table VII o,p). However, the fog

Table VII

Frequency of Relative Fog Density Judgements Reported during Comparisons between the Ground Areas of Inhomogeneous Fields

	Situations Compared		Denser	Equal	Denser	Level of signif.
	I	II	I		II	
a.	(R2.1-A2.1)	(R2.1-R1.8)	8	0	0	1%
b.	(G2.7-A2.7)	(G2.7-G2.4)	7	1	0	2.5%
c.	(R2.1-A2.1)	(R2.1-A1.8)	8	0	0	1%
d.	(G2.7-A2.7)	(G2.7-A2.4)	8	0	0	1%
e.	(G2.7-A2.7)	(G2.7-GX2.7)	1	4	3	N.S.
f.	(R2.1-A2.2)	(R2.1-R2.2)	2	5	1	N.S.
g.	(R2.1-A2.0)	(R2.1-R2.0)	1	6	1	N.S.
h.	(R2.1-A1.8)	(R2.1-R1.8)	3	4	1	N.S.
i.	(G2.7-A2.4)	(G2.7-G2.4)	3	3	2	N.S.
j.	(A2.1-A2.0)	(A2.1-A1.8)	6	2	0	2.5%
k.	(A2.1-A1.8)	(A2.1-A0.0)	8	0	0	1%
l.	(A2.1-A2.2)	(A2.1-A2.4)	7	1	0	2.5%
m.	(A2.1-A2.4)	(A2.1-A4.9)	8	0	0	1%
n.	(A2.1-A2.4)	(A2.1-A1.8)	2	5	1	N.S.
o.	(A2.1-R2.1)	(A2.1-G2.1)	0	3	5	5%
p.	(A2.1-R2.1)	(A2.1-B2.1)	0	2	6	2.5%
q.	(A2.1-G2.1)	(A2.1-B2.1)	1	4	3	N.S.

densities reported for the achromatic field-blue spot and the achromatic field-green spot situations were not different (Table VII q).

In general, the results described in this section are consistent with Hypothesis 3 of the present study.

C. Apparent Distance

Apparent distance of the homogeneous Ganzfeld. Metzger (24) reported that the apparent distance of the Ganzfeld increased when brightness was increased. No such relationship was found for the range of intensities used in the present study (Table VIII a,b,c,d).

The dominant wavelength of the homogeneous Ganzfeld did not consistently determine the apparent distance of the field (Table VIII e,f,g,h,i,j). There was, however, a slight tendency for the red field to appear closer than the other fields (Table VIII e,f,g). These results fail to verify Sub-hypothesis 4.2 of the present study.

Apparent distance of the inhomogeneous field. Comparisons of apparent distances in homogeneous and inhomogeneous fields are presented in Table IX. Hypothesis 3 predicts that the homogeneous field will appear closer than the inhomogeneous field. The results reported in Table IX consistently verify this prediction.

When there was an intensity difference between spot and field, the field appeared at a greater distance than the homogeneous Ganzfeld (Table IX a,b,c,d,e,f,g). Only

Table VIII

Frequency of Relative Distance Judgements Reported during Comparisons between Homogeneous Fields

	Situations Compared		Closer	Equal	Closer	Level of signif.
	I	II	I		II	
a.	(A4.9-A4.9)	(A2.7-A2.7)	5	2	1	N.S.
b.	(A4.9-A4.9)	(A1.8-A1.8)	3	3	2	N.S.
c.	(A2.7-A2.7)	(A2.4-A2.4)	2	4	2	N.S.
d.	(A2.4-A2.4)	(A2.1-A2.1)	1	5	2	N.S.
e.	(R2.1-R2.1)	(A2.1-A2.1)	5	2	1	N.S.
f.	(R2.1-R2.1)	(G2.7-G2.7)	3	3	2	N.S.
g.	(R2.1-R2.1)	(B2.4-B2.4)	4	4	0	N.S.
h.	(G2.7-G2.7)	(B2.4-B2.4)	5	2	1	N.S.
i.	(G2.7-G2.7)	(A2.7-A2.7)	2	4	2	N.S.
j.	(B2.4-B2.4)	(A2.4-A2.4)	1	4	3	N.S.

Table IX

Frequency of Relative Distance Judgements Reported during Comparisons between Homogeneous Fields and the Ground Area of Inhomogeneous Fields

	Situations Compared		Closer	Equal	Closer	Level of
	I	II	I		II	signif.
a.	(R2.1-R2.1)	(R2.1-R2.2)	4	4	0	N.S.
b.	(R2.1-R2.1)	(R2.1-R2.0)	3	5	0	N.S.
c.	(R2.1-R2.1)	(R2.1-R1.8)	8	0	0	1%
d.	(G2.7-G2.7)	(G2.7-G2.4)	8	0	0	1%
e.	(G2.7-G2.7)	(G2.7-G3.1)	7	1	0	2.5%
f.	(A2.1-A2.1)	(A2.1-A4.9)	8	0	0	1%
g.	(A2.1-A2.1)	(A2.1-A0.0)	7	1	0	2.5%
h.	(R2.1-R2.1)	(R2.1-A2.1)	5	3	0	5%
i.	(G2.7-G2.7)	(G2.7-A2.7)	5	3	0	5%
j.	(R2.1-R2.1)	(R2.1-G2.1)	6	2	0	2.5%
k.	(G2.7-G2.7)	(G2.7-GX2.7)	4	4	0	N.S.
l.	(R2.1-R2.1)	(R2.1-A1.8)	8	0	0	1%
m.	(R2.1-R2.1)	(R2.1-A0.0)	8	0	0	1%
n.	(G2.7-G2.7)	(G2.7-A2.4)	8	0	0	1%
o.	(G2.7-G2.7)	(G2.7-A0.0)	8	0	0	1%
p.	Combined data		97	23	0	1%

in the situations involving small intensity differences between spot and field (Table IX a,b) was this tendency statistically insignificant.

The fields inhomogeneous because of mere chromatic difference appeared at a greater distance than the homogeneous fields (Table IX h,i,j). Introduction of mere purity difference between field and spot did not consistently alter the apparent distance of the field (Table IX k). Introduction of combined chromatic and intensity inhomogeneity consistently increased the apparent distance of the field (Table IX l,m,n,o).

The consistency with which the homogeneous fields (I) were reported as closer than the inhomogeneous fields (II) is clearly indicated by the combined data (Table IX p).

The degree of inhomogeneity determined the phenomenal distance of the field. In general, those situations which appeared with a denser fog (Table VII) also appeared closer (Table X).

When inhomogeneity was merely chromatic, the resulting fields appeared closer than those in which the inhomogeneity was that of mere intensity (Table X a,b) or that of combined intensity and chromatic differences (Table X c,d). Chromatic inhomogeneity did not differ from purity inhomogeneity in so far as phenomenal distance is concerned (Table X e). Intensity inhomogeneity did not differ from combined intensity and chromatic inhomogeneity in relation to apparent distance (Table X f,g,h,i).

Table X

Frequency of Relative Distance Judgements Reported during Comparisons between the Ground Areas of Inhomogeneous Fields

	Situations Compared		Closer	Equal	Closer	Level of
	I	II	I		II	signif.
a.	(R2.1-A2.1)	(R2.1-R1.8)	8	0	0	1%
b.	(G2.7-A2.7)	(G2.7-G2.4)	8	0	0	1%
c.	(R2.1-A2.1)	(R2.1-A1.8)	8	0	0	1%
d.	(G2.7-A2.7)	(G2.7-A2.4)	8	0	0	1%
e.	(G2.7-A2.7)	(G2.7-GX2.7)	1	5	2	N.S.
f.	(R2.1-A2.2)	(R2.1-R2.2)	1	6	1	N.S.
g.	(R2.1-A2.0)	(R2.1-R2.0)	2	6	0	N.S.
h.	(R2.1-A1.8)	(R2.1-R1.8)	4	2	2	N.S.
i.	(G2.7-A2.4)	(G2.7-G2.4)	3	4	1	N.S.
j.	(A2.1-A2.0)	(A2.1-A1.8)	5	3	0	5%
k.	(A2.1-A1.8)	(A2.1-A0.0)	6	2	0	2.5%
l.	(A2.1-A2.2)	(A2.1-A2.4)	5	3	0	5%
m.	(A2.1-A2.4)	(A2.1-A4.9)	7	1	0	2.5%
n.	(A2.1-A2.4)	(A2.1-A1.8)	1	6	1	N.S.
o.	(A2.1-R2.1)	(A2.1-G2.1)	2	3	3	N.S.
p.	(A2.1-R2.1)	(A2.1-B2.1)	0	3	5	5%
q.	(A2.1-G2.1)	(A2.1-B2.1)	1	5	2	N.S.

The degree of intensity difference between field and spot was a determinant of the apparent field distance (Table X j,k,l,m). Situations having smaller differences in intensity between field and spot appeared closer than those situations involving greater intensity differences. The direction of the intensity difference was not relevant since a field with a light spot appeared equidistant to a field with a dark spot (Table X n).

Several reports of research dealing with "advancing" and "retreating" colors have been published (17,18,26,29). These studies dealt with the apparent distance of the figure only. Under the present experimental conditions, it was found that when the figure was formed by dominant short wavelength illumination, the achromatic field tended to appear closer than when the figure was formed by dominant long wavelength illumination (Table X p). The use of a "retreating" color for the figure resulted in an "advancing" field. No differences in apparent distance were found in the case of green figures (Table X o,q).

Apparent distance of the figure. The kind of inhomogeneity is not only correlated with the apparent distance of the field but also with that of the figure. The comparisons between the apparent figural distance of the various inhomogeneous situations are presented in Table XI.

Figures resulting from intensity inhomogeneity appeared closer than those resulting from chromatic

Table XI

Frequency of Relative Distance Judgements Reported during Comparisons between the Figure Areas of Inhomogeneous Fields

	Situations Compared		Closer	Equal	Closer	Level of
	I	II	I		II	signif.
a.	(A1.8-R1.8)	(R2.1-R1.8)	0	1	7	2.5%
b.	(A2.7-G2.7)	(G3.1-G2.7)	0	0	8	1%
c.	(A2.1-R2.1)	(A1.8-R2.1)	0	0	8	1%
d.	(A2.7-G2.7)	(A2.4-G2.7)	0	0	8	1%
e.	(A1.8-R1.8)	(A2.1-R1.8)	0	1	7	2.5%
f.	(A2.7-G2.7)	(GX2.7-G2.7)	3	3	2	N.S.
g.	(A2.1-R2.0)	(R2.1-R2.0)	3	3	2	N.S.
h.	(A2.7-G2.6)	(G2.7-G2.6)	4	2	2	N.S.
i.	(A2.1-R1.8)	(R2.1-R1.8)	5	2	1	N.S.
j.	(A2.7-G2.4)	(G2.7-G2.4)	4	4	0	N.S.
k.	(A2.0-A2.1)	(A1.8-A2.1)	0	1	7	2.5%
l.	(A1.8-A2.1)	(A0.0-A2.1)	0	2	6	2.5%
m.	(A2.2-A2.1)	(A2.4-A2.1)	0	0	8	1%
n.	(A2.4-A2.1)	(A4.9-A2.1)	0	3	5	5%
o.	(A2.4-A2.1)	(A1.8-A2.1)	3	3	2	N.S.
p.	(A2.1-R2.1)	(A2.1-G2.1)	5	2	1	N.S.
q.	(A2.1-R2.1)	(A2.1-B2.1)	5	3	0	5%
r.	(A2.1-G2.1)	(A2.1-B2.1)	3	3	2	N.S.

inhomogeneity (Table XI a,b). The figures resulting from combined chromatic and intensity difference between field and spot appeared closer than the figures produced by a mere chromatic difference (Table XI c,d,e). Figures resulting from purity inhomogeneity had the same apparent distance as those resulting from chromatic inhomogeneity (Table XI f). Apparent distances of the figures produced by intensity inhomogeneity did not differ significantly from those produced by combined chromatic and intensity inhomogeneity (Table XI g,h,i,j).

The intensity difference between figure and ground determined the apparent distance of the figure, the greater the difference, the shorter the apparent distance (Table XI k,l,m,n). The direction of the difference was irrelevant (Table XI o). These results support Sub-hypothesis 3.2.

According to Sub-hypothesis 3.1, figures produced by dominant long wavelength stimuli should appear closer than those produced by dominant short wavelength stimuli. The results of this experiment indicate that the red figure does appear closer than the blue figure (Table XI q). However, the differences between red and green figures and between green and blue figures are not statistically significant (Table XI p,r).

D. Distinctness of Figure-ground Segregation

Apparent definiteness of the figure. Judgements of the relative distinctness of figure segregation in various kinds of inhomogeneous fields are tabulated in

Table XII. Figures due to intensity inhomogeneity appeared more distinct than those due to chromatic inhomogeneity (Table XII a,b). Combined chromatic and intensity inhomogeneities produced better segregation than that due to either chromatic or intensity inhomogeneity alone (Table XII c,d,e,g,h,i,j). The difference was statistically significant in all but one of the seven comparisons (Table XII h). There was, however, no significant difference between purity inhomogeneity and chromatic inhomogeneity in regard to figure segregation (Table XII f).

The clearness of phenomenal articulation increased with increase of intensity difference between spot and field. This relationship was found in the comparison of small differences with medium differences but not in the comparison of medium with large differences (Table XII k, l,m,n). The direction of the intensity difference was irrelevant (Table XII o).

The dominant wavelength of the spot was one of the determinants of the distinctness of figure segregation. The differences between red and green figures were not statistically significant (Table XII p). However, the blue figure was reported as more diffuse than either the red or the green figure (Table XII q,r). These results are consistent with Koffka and Harrower's study of the Liebmann effect (22). It is possible, however, that chromatic aberration may account for these results (30).

In general, the data presented in this chapter are

Table XII

Frequency of Relative Distinctness of Figure-ground Segregation Judgements Reported during Comparisons between Inhomogeneous Fields

Situations Compared I	II	More distinct I	Equal	More distinct II	Level of signif.
a. (A1.8-R1.8)	(R2.1-R1.8)	0	2	6	2.5%
b. (A2.7-G2.7)	(G3.1-G2.7)	0	0	8	1%
c. (A2.1-R2.1)	(A1.8-R2.1)	0	0	8	1%
d. (A2.7-G2.7)	(A2.4-G2.7)	0	0	8	1%
e. (A1.8-R1.8)	(A2.1-R1.8)	0	0	8	1%
f. (A2.7-G2.7)	(GX2.7-G2.7)	5	2	1	N.S.
g. (A2.1-R2.0)	(R2.1-R2.0)	5	3	0	5%
h. (A2.7-G2.6)	(G2.7-G2.6)	4	4	0	N.S.
i. (A2.1-R1.8)	(R2.1-R1.8)	5	3	0	5%
j. (A2.7-G2.4)	(G2.7-G2.4)	5	3	0	5%
k. (A2.0-A2.1)	(A1.8-A2.1)	0	2	6	2.5%
l. (A1.8-A2.1)	(A0.0-A2.1)	0	5	3	N.S.
m. (A2.2-A2.1)	(A2.4-A2.1)	0	1	7	2.5%
n. (A2.4-A2.1)	(A4.9-A2.1)	0	4	4	N.S.
o. (A2.4-A2.1)	(A1.8-A2.1)	4	3	1	N.S.
p. (A2.1-R2.1)	(A2.1-G2.1)	3	5	0	N.S.
q. (A2.1-R2.1)	(A2.1-B2.1)	7	1	0	2.5%
r. (A2.1-G2.1)	(A2.1-B2.1)	5	3	0	5%

consistent with Hypotheses 1, 2, and 3 of this experiment but fail to verify Hypothesis 4, which was primarily based upon Metzger's study (24). Further discussion of these results will appear in Chapter V.

CHAPTER IV

RESULTS - QUALITATIVE OBSERVATIONS

Since so many different visual phenomena were described by the subjects, it was necessary to select those aspects which were regularly reported and appeared to have theoretical significance. These are: (1) color adaptation, (2) cessation of visual experience, (3) mode of appearance, (4) phenomenal movement, (5) shape of the figure and ground, (6) phenomenal distance of the figure and ground. Verbatim protocols which illustrate these aspects of experience are included in this section.

A. Color Adaptation

In the preceding chapter, data comparing the saturations of various fields were analysed. These comparisons were limited to the initial appearance of the field. However, descriptions of changes in color experience resulting from prolonged stimulation were also recorded. A minimum of eight observers described each of these adaptation situations.

The initial appearance of the blue homogeneous Ganzfeld was always achromatic or neutral. Although hue was almost always reported for the red or green uniform Ganzfeld, after three minutes adaptation, the saturation was considerably reduced. The subjects usually reported an achromatic experience after one minute, but, in a few cases,

a trace of color persisted throughout the entire three minute period for both the red and green homogeneous fields.

When an achromatic spot was introduced into the adapted uniform field, an increase in saturation of the field was usually reported. When homogeneity was eliminated by a change of brightness in the figure area, with the spot and field remaining isochromatic, no alteration of field saturation occurred.

In some instances, adaptation to the inhomogeneous situation resulted in color loss. Maximum desaturation occurred when the field and spot were isochromatic. When field and spot were of equal brightness but different wavelength, the saturation of the figure either remained the same or increased with adaptation. During adaptation, spontaneous fluctuation of the hue of the figure was frequently reported by half of the observers.

The most characteristic effect of adaptation to the heterogeneous field was the formation of a halo. This usually involved desaturation and darkening of the field, immediately followed by the formation of a small bright highly saturated area encircling the figure. The hue of the halo was usually a mixture of the hue corresponding to the dominant wavelength of the field and the hue complementary to the dominant wavelength of the spot, i.e., (R2.1-B2.4) might yield an orange halo.

Homogeneous chromatic Ganzfeld. A few excerpts from the protocols are presented below.

Homogeneous blue field (B2.4-B2.4)

"It's white-gray, no trace of color, completely homogeneous. There's no detail in the field. It's getting darker."

"It's pure white, I'm certain there is no color in it. Seems to be a little farther away."

"Homogeneous gray field. There's a dense fog."

Homogeneous red field (R2.1-R2.1)

"It's an orange homogeneous field....(After one minute) The field's darker, color's faded out, just a trace of red in it, pale, dark pink. More color has faded out of the field, the field's lost color, but the haze has a tinge of pink in it. The field has a wall in back of it which is dark gray (the wall) with a haze in front of it tinted red."

"Homogeneous. Sort of red for an instant, but almost immediately becomes white with just a pinkish trace. I've blacked out. Lights went on but I can't see anything. It's like a vague whiteness."

"Low saturation, red, homogeneous, not so much depth, it's misty....(After three minutes) It's getting darker, very low saturation, there's more than a trace of red."

"There's a light red field, it's right in front of me, it's more solid....(After one minute) It's getting more gray than red. The red's close to my eye, the gray's in the center, it's bowl-shaped, darker in the center.... (After three minutes) There's still some red."

Homogeneous green field (G2.7-G2.7)

"Looks like green homogeneous, medium saturation, milky, foggy, six inches away, there's a dense fog.... (After one minute) It's less saturated, becoming gray.... (After three minutes) There's practically no color, it's almost gray."

"I see a green mist, no figure, high saturation, there's yellow in it. It's dimensionless....(After two

minutes) It's getting darker, it's still saturated but not as much....(After three minutes) Less saturation, low saturation. The fog seems closer, I seem to be in it, I didn't have that impression at the beginning."

"Field's grayish white, there's texture off to the right, streaks, flecks. Faint streaks of light shot through it."

"Seems like a misty whiteness. I've blacked out. The blackness seems to have gray texture figures. Now it's white again. Rather than fogginess, there seem to be some threads through the field."

"I would say it's homogeneous green. At least, it has a tinge of green....(After one minute) The green's disappeared and the field's become gray. The field's not on top of my eye this time."

Several points in the preceding protocols concerning the chromatic homogeneous Ganzfeld should be noted. If the field becomes achromatic in appearance, it will do so within sixty seconds. Longer duration of adaptation resulted in complete desaturation in only a few cases. Along with a loss in saturation, the field appears darker with the passage of time. In a few cases, the hue appeared to be spatially separated from the achromatic component of the experience. Thus, the hue may appear as part of the fog, or mist, while the gray exists in a different plane.

Inhomogeneity and color adaptation. The following excerpts are from the protocols obtained during the observation of various inhomogeneous fields.

Red field-red spot (R2.1-R2.2)

"Field is pinkish, spot yellow, there's a halo, a dense fog, the spot is five feet away, has a black outline,

the spot swells....(After one minute) The field and spot are becoming gray, field is foggy, the gray spot is receding into the distance....(After two minutes) Only a partial outline now, very foggy, the spot's receding. It's a gray field, maybe slightly pinkish."

Red field-achromatic spot (R2.1-A2.1)

"I'd call it a pink field with a blue-green spot surrounded by more saturated red, and there's a tunnel-like effect. Red surrounds the spot....(After two minutes) Mostly solid green in spot but moving purple, that is, the blue in the middle of the spot is transitory, sometimes two-thirds of the spot is purplish....(After three minutes) Highly saturated green spot, just a red trace in the darker field."

Achromatic field-red spot (A2.4-R2.1)

"Spot's red, fog is not as dense as the last, about the same as the red field, a greenish halo is forming as the field gets darker. The halo builds up very rapidly, seems to remove color or makes the field darker. Whatever is in the field runs into the center, happens quite quickly but not like turning on a switch."

Green field-green spot (G2.7-G2.4)

"The field has a tinge of yellow-green, spot is about one foot away with fog in front of it. The spot is greener than the field, the center of the spot greener, the outside a dark gray. There's a greenish halo, the halo's behind the spot, the field's behind the halo and the fog is right up in front."

Red field-green spot (R2.1-G2.4)

"A green spot in a dark gray field with a tinge of red. The red is fading out and now there's a red halo around the green spot, the red in the halo is more saturated than the green. It didn't have a halo right away, first it picked up red in field, then the red disappeared and became the halo around the spot. The green spot seems less clear than the previous red spot and seems farther away."

Red field-green spot (R2.1-G1.8)

"Spot is real dark green, almost a blue, still has a red halo around it. The field is up close and dark, there's

a switching of green and blue in the spot, like flickering. Before, the center of the spot seemed to have some movement to it. It's a real deep blue spot, then it's dark green. The field is dark gray and very close to me. The halo is half an inch all around."

Blue field-red spot (B2.4-R2.1)

"Misty white field, looks like there's an orange pasted on the back wall, about three feet away. The spot's not as bright as the field, it's medium saturated, the boundaries are fuzzy, not sharp, there's no halo. If I stare at the rim of the spot, I get an aqua halo, as if blue and green were both in halo but not mixed up. There's mist in front of the spot, the spot is a couple of feet away, the field is darkening."

Green field-green spot (G2.7-GX2.7)

"Spot is difficult to see, has a tinge of red, spot fluctuates and disappears. The spot is brighter, the field darker and still greenish, there's a halo around the spot, reddish tinge. You might say it's a dark grayish field with a greenish tinge and a light yellowish spot around which is a halo, halo's dark gray, no color. I get the feeling of red around the spot, the halo isn't red and the spot's not but I can't see the transition point."

"Red medium to high saturated spot, white field, deeper saturated red on left of spot. Spot gets more red and then spot is gone, comes back light, less saturated, frequent fluctuations, this effect is consistent. The spot continues to get more saturated as time goes on."

Achromatic field-achromatic spot (A2.6-A2.7)

"Even when it's equal, the spot is white with a brownish tinge. Now the spot's alternately blue, green, blue, neutral. It's quite unsaturated."

Green field-red spot (G2.4-R2.2)

"There is a bright red spot in a cream or whitish field with a suggestion of green in the field. It's a bright, deep red spot, almost a purplish color. The center of the spot fades out like there is something over the center of it, fog. The outline of the spot disappeared and then came back, a green halo is forming around it, the spot is becoming more red."

There are a few aspects of the inhomogeneous situation that should be emphasized. When chromatic differences between field and spot are the sole basis for figure differentiation, saturation tends to increase with time. Even when segregation is so unstable that the spot disappears, there are often highly saturated colors observed. The maximum saturation immediately precedes the disappearance of the spot.

The halo requires time for formation and seems to occur immediately after the field becomes dark and desaturated. It is as if "color seeps out of the field into the halo." The spatial characteristics of the halo vary, but most often it is seen as being in a plane behind the figure but in front of the field. It may also consist of a mixture of colors which are not fused but appear to exist independently in different planes.

When the segregation of the figure is unstable, fluctuation of color may occur. Very often blue and green alternate with each other in a rhythmic manner. The figure appears dark and blue, then light and green. Many dark figures are reported as blue, regardless of their dominant wavelength.

B. Cessation of Visual Experience

Of the group of sixteen subjects, five reported a complete cessation of visual experience during the course of observation. This occurred when the figure-ground segregation was absent or unstable. When there was a sharp

intensity gradient, the visual field remained. Two of the subjects reported "black-outs" almost every time they were confronted with homogeneous stimulation.

In addition to complete disappearance of the visual field, a more frequent occurrence was the phenomenal constriction of the ground area. Often only the figure and halo remained. This was usually described as a "tunnel effect" or a figure in a "vacuum."

Homogeneous Ganzfeld. The following excerpts from the protocols will serve to illustrate the "black-out" phenomena.

Achromatic homogeneous situation (A4.9-A4.9)

"Foggy whiteness, everything blacks out, returns, goes. I feel blind, I'm not even seeing blackness. Now an indescribable mistiness, no concept of distance. Blinded again, getting white again, blacked out, still blacked out, I'm blind. I can see neither black nor white, this differs from the black when lights are out."

"There's a feeling that there's light coming into your eye, cues of depth are missing, it's like having a cataract on your lens and you get diffuse light coming into your lens. As if your eyes were open and closed at the same time, odd feeling, I keep wanting to put my hand to my eye to see if it is really open. There's no visual field."

"It's difficult to describe, white by inference, blacking out, get the feeling that I'm looking at my black-out condition, like the black-out condition was outside. There's fog present, now getting my bonafide black-outs, don't like it."

"Yellowish-white fog, left side seems a little darker, gets black and fluctuates to light again for a short time, but is always darker than the right side, as though some film were over it. When the left side becomes darker, it loses fogginess, it's just black. The milky material fuses in gradually to the black area."

Blue homogeneous field (B2.4-B2.4)

"On the nasal side of the field, the light goes out, ground glass screen light, spreads out and extends to all of the field in a fraction of a second. It's becoming like an absence of visual sensation, the field's getting darker coming from the left, like a cloud drifting over. Now I have no idea of what I do see, perhaps the whole field is dark gray, not sure, same absence of sensation."

Inhomogeneous fields. The following excerpts will serve to illustrate the disappearance or constriction of the ground area.

Green spot-green field (G2.7-GX2.7)

"White fog, radiating lines, the fog tends to disappear, there's a little spot that disappears and returns. I'm losing visual experience often, spot is extremely unstable, the field is narrowing, leaving a medium saturated red spot with a narrow band of gray-white, the rest of the field is black. It's difficult to describe because of consistent fluctuations. It's strange, but I feel very anxious, feel the need to check and see if my eye is still open."

Achromatic spot-achromatic field (A2.7-A2.4)

"Dark spot in light surroundings, like looking in a tube, no mist, sort of a vacuum, as if nothing is really in front, I just see the spot in the rear."

Blue field-achromatic spot (B2.4-A1.8)

"Black spot with a white halo, the field is changing to a dark gray. The spot is less than six inches away, right out in front, there isn't any haze but the boundary's not clear, it has a ragged edge. The white halo is a little behind the spot, I'm not aware of anything behind the halo, the background appears to be absent."

C. Mode of Appearance

Both figure and ground appeared in a variety of modes. Among those described by the observers were illuminant, illumination, surface, volume, and film modes.

all of which have been discussed by Katz (18). Although there was a high degree of intra-subject consistency in the descriptions of similar situations, there was some inter-subject variation. Thus, the same situation might be described by one subject as a surface color and by another subject as film color. However, there were several general trends indicated by the descriptions.

Description of fog. One of the most characteristic descriptions of the field was that it appeared to be "fog-like." All sixteen subjects, when confronted with the homogeneous situations almost always reported a fog-like appearance of the field. These reports varied as to density and degree of immersion and in the manner of description. Some of these variations are illustrated in the excerpts below.

Homogeneous achromatic field (A4.9-A4.9)

"A homogeneous field, a little lighter toward the back, there's a light fog about four or five inches away. There's a feeling of depth and there might be an indistinct light wall at the end, about a foot away. Between me and the fog is air-filled space, looks like a space with a wall in back, the fog starts about six inches in front of the wall, the wall is a solid surface but not clear. The wall itself is a thick haze, there's a light fog in front of it that doesn't build up."

"It's kind of a big yellowness, like a hazy, insipid yellow, a yellowish gray mass. It's a thick foggy sensation, everyplace I can see is like a diffuse fog, there's no distance, it's everyplace. It's located at a indefinite distance, like a fog would seem if you were out in it, it's right next to you."

"The fog doesn't seem as dense as last situation (A2.1-A2.1) but deeper. No question of any surface. I

detect a trace of yellow in the white. The brighter it is the further into it I can see. Seems to be less depth in the darker ones, as if there's the same amount of fog, but it's been condensed. It seems that the darker the field is, the more the impression that it's condensing into a plane. The darker it gets, the less I feel immersed and the more it seems to begin at some indefinite point ahead of me."

"This appears more gaseous, less condensed. It feels farther away, it's still brighter at the periphery. I feel more of a gaseous effect, as though it was a few inches beyond my eye. Here, there's no sensation of solidity, but more homogeneous compared to the feeling I had of a membrane filled with liquid before (G2.7-G2.7)."

Homogeneous achromatic field (A2.1-A2.1)

"Homogeneous, more hazy rather than foggy, the fog gets denser but is less insistent than the situation before. It's all up against me, but the previous situation (A4.9-4.9) seemed more enveloping, it was pressing in on me, this doesn't crowd in as much."

"A homogeneous very foggy gray field. This fog seems further away than the first time (A2.7-A2.7), it's not as misty, there isn't any surface quality, but I don't know how far you'd go before you'd run into it. I'm not as enveloped in fog, not as much a feeling of opaqueness here, it might condense into a surface."

"The only thing I can say is that I experience "nothing," there's nothing there. It's very dark gray, almost black, like a plane surface. It's right up against me, isn't any feeling of depth, it's not like looking into something."

Homogeneous red field (R2.1-R2.1)

"It has the appearance of depth, starts right up close to me and appears to be going way back. The starting point is nearer here. I can see deep into it, the haze is thicker and I'm not aware of the wisp effect. It's a heavy fog, there's a feeling that fog is all around you, a feeling that you're in it and it maybe is behind you, though you can't see it."

"It's a cloudy pink homogeneous field, has a subdued milky quality, it fills up all space. It's like looking into a chamber filled with a milky substance, about a few inches from the eye. Patches of gray are forming now."

Homogeneous green field (G2.7-G2.7)

"The field is directly in front of me, right off the edge of my eye. It gives me the sensation of being pressed up against a transparent membrane. I can't penetrate very far, it resembles an opaque fluid filling the sphere past the membrane."

"Misty, like being in a lemon pie, except more green than the yellow we talked of before. I'm not as immersed as before. It's foggy, distance is ambiguous."

Homogeneous blue field (B2.4-B2.4)

"Smoky, like a smoke-filled room, indefinite distance, wisps of smoke."

Achromatic field-achromatic spot (A2.7-A2.6)

"Hazy, the spot isn't within reaching distance, I lose the spot occasionally, sometimes it appears as a half circle. Everything looks darker, like looking through a media, there are no boundaries, no surface."

Achromatic field-achromatic spot (A2.4-A2.7)

"There's an indefinite white spot, a thick fog, about six inches away, it looks like a light fog that starts getting much thicker. The spot is one to one and a half feet away, it's indefinite and lighter than the field. (Situation changed to A2.4-A0.0) Now the spot is black, the field looks darker, there's a little fog, not too much, looks more like a wall, the spot is about four inches away."

Red field-achromatic spot (R2.1-A2.1)

"Greenish spot, about two feet away. (Spot is made black) It appears closer, but I didn't see it move closer, it just appears that way. When the spot is lighter, the fog is closer and more foggy. When the spot is black, the fog solidifies and moves away a bit, it appears more like a wall than a fog, or like a fog with a definite end to it. When the spot is light, it's in the fog, when dark, it's in front of the fog."

Modes of appearance other than fog. In general, the fog tended to disappear when intensity differences between

field and spot were increased. However, even with large intensity differences, only half of the reports described complete absence of fog. Surface-like appearance of the figure or ground was rarely reported in situations involving mere chromatic inhomogeneity or small intensity differences between field and spot. When chromatic differences were combined with large intensity differences between field and spot, almost seventy-five per cent of the subjects reported the absence of fog.

The following excerpts illustrate descriptions of the field and spot that involve phenomena other than fog.

Achromatic field-achromatic spot (A4.9-A0.0)

"I see a dark black spot in a white field, the spot is about three or four inches away, the field is right up and all around, although there's no fog. I have the impression of being in the field, it's all around but not directly in front, not between me and the spot, like looking into a cone, like the spot is a hole. (Spot is made brighter) It seems to move back, it's still darker than the field, the haze is increasing, spot's gone, fog is crowding into my eye."

Achromatic field-achromatic spot (A2.7-A3.1)

"Diffused light field with a circular mirror three feet back, the field is smoke-like."

"The spot is white, brighter than the field, the surface of the field is behind the spot which is like an electric bulb stuck in the center. The surface of the field is three inches behind the spot."

Achromatic field-achromatic spot (A2.7-A2.4)

"It doesn't look like reflected light, rather like seeing direct light. It's like looking into a completely open space with only one object in it, a disc. I hardly see any fog, it reminds me of looking up at the moon on a cloudy night."

"I can't discriminate the field, can't tell where the field is, seems to start at the eye, then there's a separation. Blackness intervenes between the field next to my eye and the field where the spot is, like looking into a black void, except for the light around my eye. There's no fog in the field but the area around my eye which is light has fog. Seems to be a white periphery on the right for a short distance and then a void or blackness which stretches out to the spot."

Green field-green spot (G2.7-G2.1)

"It's not hazy, there's still no wall, it's round with a dark spot. The spot seems more solid than the field, when the spot was lighter or equal, it still seemed hazy like the field."

Blue field-blue spot (B2.4-B2.3)

"Whiter mist than generally, not as gray as in the past, the spot is a little darker. Cracked ice appears in the field, looks like a frozen lake that has cracked ice, rippled effect, it gets grayer. There's a thick fog, at first it was about globe-size distance, but now it's very close to my eye."

Red field-achromatic spot (R2.1-A0.0)

"Space extends behind the spot. Even when there is no fog, the spot seems suspended in space. The spot is always a flat surface."

Red field-blue spot (R2.1-B2.4)

"When the spot is lighter than the field, it looks like a hole through which bluish-green illumination is coming. The field is reddish orange. (Spot made darker than field) The spot is now like a disc, there's a point where it's half way between a hole and a disc. When it's definitely a cardboard spot, it looks a little closer."

The preceding excerpts indicate that both figure and ground may appear in any of the five modes mentioned above. When there is a large intensity difference between the field and spot, the subjects tend to report surface,

illuminant, and illumination as the modes of appearance. When there is a small intensity difference between field and spot, volume or film color is apt to be reported. Absence of intensity difference between field and spot usually results in a voluminous appearance (fog-like).

D. Phenomenal Movement

Although there was no real movement in any of the situations, a wide variety of movement was described. Movement was perceived both spontaneously and as a result of experimental modification of the brightness of the spot.

Autokinetic movement of the spot was reported by nine of the sixteen observers. In most cases, the movement was described as a drifting toward the right. There were also frequent upward movements of the spot reported. Reports of movement toward the left or downward were infrequent. Examination of the data did not indicate any obvious relationship between movement perception and the type of inhomogeneity presented. The existence of a phenomenal spot seemed to be the only requirement for the perception of movement. About twenty per cent of the protocols involving a phenomenal spot made reference to movement.

Another type of spontaneous movement involved the apparent approach and recession of both field and spot. The homogeneous field was often described as being closer after several minutes adaptation. This was not usually reported as movement. However, forward movement of the

spot seemed to occur during adaptation and was occasionally reported by four of the observers.

In addition, several other types of spontaneous movement were reported. Movement involving rotation of the figure, the halo, or the ground was described in a few instances. When articulation of the field was poor, movement of the boundary of an amorphous figure was described.

When the brightness of the spot was gradually modified, all sixteen subjects described movement of the spot and field. There was some variation in the consistency of this response. Half the subjects almost always reported a forward movement of the spot and a recession of the field as the intensity gradient between field and spot was made steeper. Six subjects described this effect most of the time. However, they reported a reversal of the movement of the spot or no movement at all about twenty per cent of the time. The remaining two subjects were consistent in approximately sixty per cent of their responses.

Spontaneous movement. The following excerpts will illustrate the variety of spontaneous movement reported.

Achromatic field-achromatic spot (A4.9-A2.7)

"The fog is disappearing, the spot is moving from left to right. The spot is real dark and still moves sideways."

"Black spot seems to be rotating, it looks octagonal, oh, it's gone. The spot began to spin and took off. The spot is still octagonal, it jerks along like on a bumpy road."

"Now the spot is moving back and forth, it appears about three feet away or closer. The distance fluctuates, sometimes I feel like it's right in my eye."

Achromatic field-blue spot (A2.4-B2.4)

"Gray field with a very faint blue low saturated spot, I think my accommodation is shot, the blue spot dissolves and everything becomes gray. It's back, the location of the spot is indefinite, saturation of the spot has increased, it's amorphous, has hardly any form. The saturation decreases when it becomes disembodied, it's floating around. I get two spots with the saturation fluctuating widely, highly saturated, the spot's gone, I've no idea what's going on, where is she."

Red field-achromatic spot (R2.1-A0.0)

"The spot is drifting, it's black, the fog has subsided, there's a forward pulsation of the spot. At times it's a couple of feet away and then it comes real close. Under these conditions, the fog seems to extend back for about six feet."

Green field-green spot (G2.7-G2.8)

"A green field with a spot of the same color, it has a thin black boundary which vibrates. The spot is lighter and seems more green than the field, the line has an amoeba-like quality and moves about."

Green field-green spot (GX2.7-G2.7)

"A medium saturated deep green dot, whitish gray mist, shape of the dot is ambiguous. I can only infer roundness, the dot gets darker and leaves me every few seconds. There is a rotation movement of the dot, also the dot keeps moving to the right."

Green field-achromatic spot (G2.7-A2.7)

"Green halo, when the spot is way back, it becomes amorphous. When the spot disappears, it's gray, then it comes back reddish. The field is gray with a tinge of green, it shifts from light to dark gray. The halo seems to be moving around the spot."

Green field-achromatic spot (G2.7-A1.8)

"The spot is almost black, it's close and moving. Difficult to focus, it's difficult to keep the spot in the center of the field, it moves to the right slowly and jiggles up and down."

Movement resulting from varying brightness. The following excerpts will serve to illustrate movement resulting from changes in the intensity of the spot.

Achromatic field-achromatic spot (A2.4-A3.1)

"When the spot was made darker, it receded, when it's made even darker, it seems to come toward me and also it rises. It's difficult to decide on the transition point, you suddenly get the feeling that the thing is moving toward you, but you don't exactly know when it stopped moving away."

Achromatic field-blue spot (A2.4-B2.4)

"I have a faint impression of the spot, it's a very indistinct glob in the back of the field, sometimes there's a blue tinge to it. (Spot made darker) The spot's clearer, but it's color isn't any clearer, dark gray, maybe, through a fog. Now blacker, more distinct, less fog, and it comes closer as it gets darker. (Spot made brighter) The spot is receding, it's less distinct, fog is forming in front of the spot as it gets to be as bright as the field."

Red field-achromatic spot (R2.1-A2.4)

"Gray spot, pinkish field, the field is like looking into a cone from the bottom. The spot is about five feet away and brighter than the field. (Spot made darker) The spot is darker than it was, it looked like it came forward for a moment, then back where it was. (Spot made darker) The spot comes forward and very black, it recedes to where it was, like a reversible image. When it came forward, it was almost on top of me, when back, it was five feet away."

Green field-green spot (G2.7-G2.6)

"I'm aware of fog right up in front of me, spot's way out, eighteen inches away. Although fog is in front, it has an end which is located at the same distance as the spot. (Spot made darker) As the spot moves forward when made darker, the fog seems to recede to meet it."

Green field-achromatic spot (G2.7-A0.0)

"(Spot made brighter) The spot starts about six inches away and moves back to about twenty inches and

then comes forward again (past the point of equal brightness). The spot is reddish at twenty inches away and tends to disappear. Quite foggy."

"The fog disappears when the spot is black, when the spot is real dark, the field appears as a plane surface from which the spot moves away. The field is behind the spot and the field is hazy but not the spot when it's real black. When the spot is somewhat lighter but still dark, there's haze all around and the field is right up to my eye. A wall seems to form after the fog has moved back, you don't see this happening."

E. Shape of the Figure and Ground

There have been many references to the shape of the figure and ground in the preceding sections. The shape of the field varied with the type of situation the observer was describing.

The homogeneous field was usually described as indefinite or formless. The absence of intensity differences between spot and field elicited similar descriptions. It was only after large intensity differences were introduced that the field began to assume a different form. Under these conditions, three types of descriptions tended to prevail, a plane wall, a cone shape, and a bowl shape. Other responses referred to variations of these basic forms.

Shape of the ground. The following descriptions will supplement those in the preceding sections that have already referred to the shape of the ground area.

Achromatic field-achromatic spot (A4.9-A1.8)

"Like looking into a cone. I see a wall, a flat wall, looks like the spot is a hole."

Achromatic field-achromatic spot (A2.1-A2.4)

"It's the same as looking into a cavern, I can see a surface with curvature. There's no texture, just a smooth gray surface, the field is kind of bowl-shaped."

Red field-achromatic spot (R2.1-A0.0)

"No wall experience, when foggy, I can't see the end of the field, when not foggy looks like looking into the broad end of a cone, the disc represents the top of the cone."

Green field-achromatic spot (G2.7-A2.4)

"The field looks pretty much like a wall, solid. Spot is two feet away. The field looks like a wall, straight up and down, no curvature. The spot is in front of the wall like pasted on it, about the same brightness. Stable spot, definite boundary but not black. Spot is uniform throughout."

Green field-green spot (G2.7-GX2.7)

"Spot in back, texture in field. Field is a tunnel leading up to the spot, darker in the periphery and lighter toward the spot. The spot remains constant, it's very indistinct."

Shape of the figure. The circular form of the figure was not perceived when intensity gradients were not steep, and the figure was usually described as amorphous. As intensity gradients were made steeper, the spot appeared circular. There were variations in the descriptions. The figure was described as a hole, a solid disc, and, when the spot was brighter than the field, as a three-dimensional ball.

Almost eighty per cent of the protocols described the figure as a spot, a circle, a hole, or a disc. These have been excluded in the following excerpts since they have

often been presented in the previous sections. Of the descriptions presented below, the only ones that were reported with any great frequency were those involving an amorphous spot.

Achromatic field-achromatic spot (A2.4-A3.1)

"Field's getting foggy, the spot isn't very distinct, it bulges out like a white snowball. The spot is brighter than the field."

Red field-red spot (R2.1-R2.2)

"The field is foggy and still gray, almost a uniform fog. The spot is way back with only a partial outline. It's very foggy."

Red field-achromatic spot (R2.1-A2.2)

"I've lost the surface feeling. The spot looks flatter rather than three-dimensional. When it was black, it appeared as a hole with something beyond it. When it became green, there was no feeling of a hole but a round piece of paper pasted on a non-surface or fog."

Green field-green spot (G2.7-G2.8)

"About the same as the field, perhaps a little brighter, the whole field is darker, a gradation with the center brighter. A polygon effect to the outline, the circle seems to flatten out."

F. Phenomenal Distance of the Figure and Ground

The apparent distances of the figure and ground have been described in many of the previous protocols. In the preceding analysis of phenomenal movement, it was indicated that the relative distance of figure and ground was dependent upon the gradients producing figure-ground segregation. With increased intensity differences between field and spot,

the figure appeared closer and the ground area more distant.

The homogeneous Ganzfeld was reported as close by all of the observers. Only one consistently judged the field to be more than six inches away. The remaining fifteen described the field as being much closer; the most frequent judgement was that the field appeared to be about two inches away from the observer. These were judgements of the area of fog that appeared closest to the observer. In many cases, the fog seemed to extend for an indefinite distance. It should be noted that the actual distance to the wall of sphere A was almost forty inches.

When figure-ground segregation was poor because of the absence of steep intensity gradients, the field continued to be seen as close, but the figure was seen as far. Distance judgements of the figure under these conditions ranged from five inches to six feet away from the observer. The average judgement was about two feet away.

Increasing the intensity difference between field and spot resulted in a closer figure and a more distant ground. When these intensity differences were at a maximum, the figure was judged, on the average, as being a foot away. The range of responses was from "next to the eye" to three feet away. The ground was usually judged as being a few inches behind the spot. However, a few observers reported the field as being several feet behind the spot.

Each observer was consistent in his distance judgements. There were, however, many differences among the observers in the range of values that they used to describe the distance of the figure. The terms "close" and "far" varied considerably in meaning. Thus, for one observer, an apparent distance of five inches was considered far, three inches, close. Another observer described five feet as far and three feet as close. For the average observer, a figure perceived as two feet away was considered far, whereas an apparent distance of one foot was reported as close.

The following excerpts illustrate the range of distance judgements.

Red homogeneous field (R2.1-R2.1)

"It doesn't have extension, it's as if I didn't have an eye, it might be a pinkness. It's as if it comes so close to your eye that it passes into your head, as though you're aware of it but can't see it. It's right inside your head, not aware of either flatness or dimension. Space becomes internalized."

"Pink orange homogeneous, shadows on the periphery, it looks pinker this time. The shadows clear up. Peripheral part looks close, center looks far away. The periphery is about a foot away, the center four feet away."

Achromatic homogeneous field (A4.9-A4.9)

"Homogeneous field, it's light gray, no color, foggy, even denser than the last situation (G2.7-G2.7). It's extremely close up to my eye, fog all over the place, almost feel as if it's behind me. I can only see a couple of inches into it, I'm really in it this time."

Green field-achromatic spot (G2.7-A2.7)

"Pink figure and a whitish-gray field, the field

is darker than other situations. The spot moves to the right, still foggy, the pink spot has surface, the rest is foggy. Spot seems three to six feet away, has a slight fuzzy outline around the pink. Foggy field is closer than the spot."

"Hazy red tinge to spot, outline indefinite. The fog's in front of my eye, the spot's two feet back, much fog, a green halo appears."

"Low saturated green field, the spot is a medium saturated red. A lot of haze. The spot is four or five inches away."

Achromatic field-achromatic spot (A2.4-A0.0)

"Black spot moving to the right, it's closer, no haze. Now there's a little haze in front of the spot. The spot is four inches away, field's way back two feet or so."

"There's a black spot with a halo forming around it. The spot is six inches away. There's very little mist, a wall, the background has an end now out behind the spot. The field's about a foot away."

G. Qualitative Observations and the Experimental Hypotheses

The descriptions of color phenomena were consistent with Hypothesis 1 and its sub-hypotheses. When figure-ground segregation was completely dependent upon chromatic differences, the observers tended to report highly saturated hues which persisted even after three minutes adaptation. In the absence of chromatic differences between field and spot, poor saturation, as well as rapid adaptation to a neutral color, was reported.

Hypothesis 2 and its sub-hypotheses were verified by the phenomenological descriptions. Sub-hypothesis 2.1 was consistent with the data analysed in Chapter III. The

protocols also indicated that the figure was perceived as amorphous in the absence of steep intensity gradients and that chromatic difference between field and spot did not produce a stable, well-defined figure. It was only when intensity gradients were steep that a definite wall or surface was reported with any consistency. This applied to both figure and ground and did not depend upon the direction of the intensity gradients. These phenomena were consistent with Sub-hypotheses 2.2 and 2.4.

There was a high degree of uncertainty as to distance in the absence of intensity gradients. The termination of the fog appeared indefinite, and many observers were extremely hesitant in making any absolute distance judgements when the field appeared foggy. These results were predicted by Sub-hypotheses 2.3 and 2.4. Hypothesis 3 and its sub-hypotheses were consistent with the observer's descriptions. In almost all cases, well-defined figures were described as closer than those appearing vague or amorphous.

Of all the hypotheses proposed, only Hypothesis 4 and its sub-hypotheses were not confirmed by the phenomenological descriptions. There were, in fact, indications of a reversal of some of the predictions. The homogeneous field of maximum brightness (4.9 millilamberts) brought forth more reports of immersion in a heavy fog than any of the other situations. The blue homogeneous field was described as more distant and less foggy than the other chromatic fields.

CHAPTER V

DISCUSSION

One of the major purposes of the present investigation was to acquire information useful to the development of a general theory of vision. Before discussing these broader implications, however, it is necessary to evaluate the methodology and results of this experiment and relate them to those of previous studies.

A. Methodology

Apparatus. Various kinds of inhomogeneity interfered with the attempts of previous investigators to study the uniform visual Ganzfeld. These have been described in Chapter I. The apparatus developed for the present investigation produced an adequate uniform Ganzfeld by eliminating the sources of these inhomogeneities. The use of an Ulbricht type sphere assured a more uniform illumination than the methods of previous investigators. Apparent surface texture was eliminated by the use of "sphere" paint. The fine grain of the painted surface was not visible to the subject. A fitted plaster mask having the same albedo as the rest of the field assured a Ganzfeld in which the various parts of the face did not enter into the visual field.

When the field and spot were qualitatively and quantitatively equal, all of the observers reported a uniform Ganzfeld. Surface texture was never reported. The few

inhomogeneities described were transient and seemed to be determined by factors other than the stimulus pattern.

In addition to producing uniform stimulation, the apparatus permitted the introduction of a spot which differed from the rest of the field. The result was a differential uniform spot in an otherwise homogeneous Ganzfeld. The difference between field and spot was one of chromaticity, intensity, or a combination of both. Thus it was possible to study the effects of various stimulus gradients. It should be noted that when a differential spot was present, the observers did not report surface texture. Even with adequate accommodation, the fine grain of the inner surface of the sphere was not visible.

Procedure. Although the present study was primarily exploratory, a number of hypotheses stemming from previous investigations were tested. The very nature of the Ganzfeld prohibits its investigation by means of simultaneous comparisons. Nor was the method of adjustment to equality feasible. A variant of the Method of Paired Comparisons, involving comparisons of successive situations, was therefore utilized. This probably resulted in some error because of the introduction of a memory factor. This kind of error, however, is unavoidable in an investigation of the Ganzfeld.

Information limited to a few characteristics of visual experience was obtained through the use of these comparisons. Verification of this information, as well as additional material, was acquired by means of the more complete

phenomenological descriptions.

The observers were confronted with the difficult task of attempting to describe unique experiences. Their descriptions can only be thought of as an attempt to translate these unusual experiences into familiar but inadequate terminology.

B. Homogeneous Ganzfeld

In order to properly evaluate the effects of differentiation in the visual field, the phenomenal characteristics of the homogeneous Ganzfeld must be determined. It would seem most appropriate, therefore, to discuss these phenomena first.

Color phenomena. The saturation of the chromatic Ganzfeld was initially low and, in many instances, hue was absent from the beginning. Desaturation was rapid, so that in a few minutes the field appeared neutral. When differentiation in the field is absent because of level gradients of stimulation, color experience is minimal. The fact that any hue is reported under conditions of uniformity may be attributed to temporal inhomogeneity, i.e., the change from darkness to stimulation. This, however, is not meant to imply that the mere introduction of inhomogeneity increases saturation.

Although the effects of adaptation in the present investigation were similar to those described by Hochberg, Triebel, and Seaman (16), there are some differences. Complete

desaturation was reported by most of the observers in both studies. However, most of the reports in the present study described the field after desaturation as appearing medium gray, as opposed to the dark gray reported by Hochberg's subjects. Lower intensity and longer duration of stimulation may account for the reports of darker gray obtained by Hochberg, Triebel, and Seaman (16).

Even though the short wavelength light was approximately equal in purity to the long wavelength light, it was perceived as neutral in the homogeneous Ganzfeld. The fact that the long wavelength light appears more saturated than the short wavelength light may be related to differences in their photochromatic intervals. Since there was partial dark adaptation, desaturation may involve the functioning of the scotopic mechanism (25).

The results of the present experiment show that whiteness constancy is absent in the homogeneous Ganzfeld. Under achromatic illumination, the walls, which had a relatively high albedo, were reported not only as white but, also, as light, medium, or dark gray. A relationship existed between the shade of gray reported and the intensity of illumination, the dim fields usually being described as grayish black. Continued stimulation always resulted in a darkening of the field. It should be noted that a field appearing almost black when homogeneous was described as medium or light gray when a darker spot was introduced.

Neutral appearing chromatic fields and achromatic fields of equal brightness did not appear equally white.

For example, the neutral appearing "blue" field was usually described as white or light gray, whereas the achromatic field of equal brightness was described as medium gray. This would seem to indicate that equal brightness differs from equal whiteness. The difference in appearance between the "blue" and the achromatic field may be related to the differences in their relative fog densities and distances. Koffka (21) has suggested that "energy" may be used up in the process of condensation and distance reduction. Thus, since the achromatic surface appears denser, and possibly closer, it also appears darker.

When confronted with a chromatic Ganzfeld, several observers described a colored fog with a neutral terminus. The hue was in front of the achromatic ground. Under both homogeneous and inhomogeneous conditions, the ground tends to appear neutral.

Mode of appearance. When the observers were presented with a homogeneous field, they reported a "fog-like" experience in almost every case. This corresponded to the description Metzger (24) obtained under conditions of low illumination. In the present study, the fog was described as indefinite as to terminus. The terminus was described as a condensed, impenetrable fog rather than a hard wall.

Gibson and Waddell (13) found that an impression of space-filling fog was not the only experience resulting from an undifferentiated retinal image. Although the frequency of the responses not referring to fog was small in the Gibson

and Waddell study, they occurred more often than in the present study. This disparity may be due to differences in procedure as well as to the fact that the apparatus used in the present study produced a more adequate Ganzfeld.

Gibson and Waddell used a questionnaire and a training procedure which may have influenced their subjects to search for something other than fog. Failure to control for facial shadows may account for the reports of a boundary. Other limitations of the table tennis ball method have been discussed on page five.

During the present investigation, there were a few descriptions of a "cracked ice effect" or a "web-like structure." These were eliminated by slight changes in the intensity of the illumination of sphere B. It may be that intensity gradients which are insufficient for the formation of figure and ground result in other forms of phenomenal inhomogeneity.

The statistical analysis of the comparison data did not indicate significant differences in the density of fog between homogeneous situations varying in intensity. These results did not correspond to Metzger's results (24) and failed to confirm Sub-hypothesis 4.1 of the present study. The discrepancy between Metzger's study and the present investigation may be accounted for by the absence of surface texture in the present experiment.

In the formulation of Hypothesis 4 and its sub-hypotheses, it had been deduced that long wavelength stimulation,

like high intensity stimulation, would condense into a surface. However, a surface was not experienced. Instead, the red field appeared as a denser fog than the blue field.

Although the "blue" field was experienced as gray, it differed in fog density from the achromatic field of equal brightness. Of all the homogeneous fields observed, those involving short wavelength light were described as least foggy. These results suggest that the receptors sensitive to long wavelength light are more densely concentrated than those sensitive to short wavelength light.

Apparent distance. Under conditions of uniform stimulation, the apparent depth of the field is reduced. The apparent distance to the terminus of the fog was, in most cases, only a fraction of the "real" distance to the wall. Often the fog began at the observer's eye, and, in a few cases, the field was internalized. Werner (31) has described a similar internalization of sound. When differentiation in the field is absent, there appears to be a contraction of space. A two-dimensional surface does not exist under these conditions. Instead, the "surface" appears three-dimensional, with depth.

The relative density of the fog appeared to be related to its apparent distance and depth. Those fields appearing denser also appeared closer and less extensive.

In a somewhat different context, the relationship between intensity and thickness of surface has been studied by Gelb (8). He found that two of his brain-injured patients

perceived all surfaces as having thickness. However, the white surfaces were not as thick as the black surfaces. A similar relationship was described in the present study. The brighter homogeneous field tended to appear with less depth than the darker fields. Short wavelength stimulation was perceived as having more depth than long wavelength stimulation.

In general, those stimuli which under "normal" conditions have been described by Katz (18) as having greater insistence were reported as denser, closer, and less extensive under uniform Ganzfeld conditions. The depth and density of the fog may be a function of the concentration of the receptors stimulated.

Other phenomena. Cessation of visual experience resulted from the absence of differentiation in the visual field. This was a unique experience which involved a complete disappearance of the sense of vision for short periods of time and not simply the presence of a dark undifferentiated visual field. This experience often produced anxiety and fear of blindness. Hochberg, Triebel, and Seaman (16) obtained similar responses. In addition, they reported the frequent appearance of "hallucinatory" shapes or objects. Hallucinations were infrequent in the present study. Perhaps, the greater approximation of uniformity was responsible for their relative absence in the present experiment. Their appearance may be dependent upon a poorly articulated field rather than an unarticulated field.

Riggs and his associates (27) report the disappearance of steadily fixated visual patterns. Their study suggests that a loss of vision results from prolonged, unchanging retinal stimulation. It is not clear, however, whether Riggs is referring to a temporary cessation of vision or merely to the disappearance of the test object.

C. Inhomogeneity I (Absence of Intensity Gradients)

There were two kinds of inhomogeneous fields studied in which the gradients of intensity were absent. These were inhomogeneity due to a chromatic difference between field and spot and inhomogeneity due to a difference in purity between field and spot. Under both of these conditions, the brightness of figure and ground was equal. Because of the absence of those physiological gradients related to brightness differences, the gradients corresponding to hue or saturation differences were responsible for figure-ground segregation.

Color. When differentiation of the field resulted from chromatic gradients alone, experience of hue was richest. Saturation is not only dependent upon the purity of the stimulus but also upon the articulatory function of the stimulus. When color is the only means of figure-ground segregation, experience of hue is most pronounced (Sub-hypothesis 1.2). This is true for the figure and, possibly, for the ground. These results are consistent with the Koffka and Harrower study of the Liebmann Effect (22).

The present study also investigated field articulation produced by differences in purity. As in the case of chromatic inhomogeneity, there appeared to be an enhancement of saturation in the figure area (Sub-hypothesis 1.5.)

When stimulation of the spot was achromatic and the surrounding field chromatic, the resulting figure was well saturated. The complementary hue resulting from induction was more saturated than that of the surrounding chromatic field. The figure appeared more saturated than the ground area and was more influenced by the kind of gradients producing articulation. Koffka (20), in his discussion of color constancy, developed the principle of "the shift of level" and "neutral level." In the present study, it was found that chromatically illuminated fields were perceived as either neutral or poorly saturated.

The color of the field appeared concentrated in a small area surrounding the figure. This "halo" was probably the result of eye movements and differential adaptation of the figure and ground areas. Color appeared to "seep out of the field into the halo." The halo seemed to accentuate the spatial separation of figure and ground in that it appeared in a plane different from either.

Figure-segregation. Although figures were perceived in the absence of intensity gradients, they were poorly defined and unstable. This phenomenon has been referred to as the Liebmann Effect. The present investigator found, as did Koffka and Harrower (22), that the short wavelength figures

were more amorphous than the long wavelength figures. In addition, it was found that, when figure segregation was dependent upon differences in purity of color, articulation was even more indefinite (Sub-hypothesis 2.1).

Although the differences in hue between figure and ground were pronounced, the boundary separating figure from ground was weak and unstable. The form and extent of the ground also tended to be ambiguous under these conditions. A possible explanation of these results may be that chromatic gradients are relatively ineffective in producing adequate accommodation.

The indefiniteness of the blue figure is at least partially a function of chromatic aberration which prevents the formation of a sharp image. However, accommodation may permit sharper focusing of the red spot (28,30).

Mode of appearance. The mere existence of a figure in the absence of brightness differences did not greatly alter the apparent fogginess of the field. There was some reduction in the fog density, but fog was reported in almost all instances. Thus, the mere presence of chromatic gradients does not result in surface formation. An amorphous surface, as well as an amorphous shape, appears to characterize those situations in which gradients of intensity are absent.

The fog density of the achromatic field was influenced by the dominant wavelength of the figure. The "soft" colored figure was not only poorly defined, but its surrounding field appeared foggier. The same factors that determine the

definiteness of the figure also appear to determine the definiteness of the field's surface.

Apparent distance. The apparent distance of the inhomogeneous field was not radically different from that of the homogeneous Ganzfeld when the inhomogeneity was due to chromatic differences alone. Although the apparent distance was still ambiguous, there appeared to be an expansion of space. Under these conditions, the figure was reported at its maximum apparent distance which was, however, considerably less than its "real" distance.

The ground, as fog, appeared in front of the figure. "Normally," the reverse relationship is experienced. It was only when the ground lost much of its "foglike" quality through the introduction of intensity gradients that the field was described as being behind the figure.

The "hard" colored figures appeared closer than the "soft" colored figures. This phenomenon has been described by several investigators (17,18,26,29). The definiteness of boundary seems to be related to the apparent distance of both figure and ground. Throughout this experiment, it was observed that increased definiteness of boundary was correlated with decreased distance of the figure and increased distance of the ground.

D. Inhomogeneity II (Intensity Gradients)

Inhomogeneity due to mere intensity differences between field and spot and inhomogeneity resulting from combined chromatic and intensity differences will be

discussed in this section.

Color. When intensity differences alone produced inhomogeneity in the chromatic field, saturation was poor for both figure and ground. The absence of gradients of wavelength eliminated color as a determining factor in figure-ground segregation. The resulting saturation was as low as in the chromatic homogeneous field. Adaptation also led to complete desaturation in many instances. These results indicate that it was not homogeneity per se that was responsible for the poor saturation but, rather, the isochromatic factor (Sub-hypothesis 1.3).

In a study of the effects of chromatic illumination, Helson (14) found that achromatic objects appeared to have the same hue as the illumination when their reflectance was greater than the achromatic surroundings. The brighter objects appeared more saturated. When the achromatic objects were darker than the field, their hue was the complement of the illuminant. In contrast to the present study, Helson used a fifteen minute adaptation period, light of greater purity, and a well articulated field. Only on a few occasions did the observers in the present investigation describe the brighter spot as more saturated or the darker spot as the complement of the hue of the illuminant. Instead, yellow was frequently reported for the brighter spot and blue for the darker spot, regardless of the wavelength used.

Inhomogeneity due to combined intensity and chromatic differences resulted in a less saturated field than inhomo-

geneity due to chromatic differences alone. The presence of a steep intensity gradient reduces the importance of hue for the segregation of figure and ground. However, those fields in which chromatic inhomogeneity exists appear more saturated than those which are isochromatic (Sub-hypothesis 1.4).

When Hochberg, Triebel, and Seaman (16) introduced a shadow into the homogeneous field after adaptation, their subjects reported the immediate formation of a chromatic halo in almost all cases. In the present study, this phenomenon was occasionally reported when a black spot was introduced after adaptation. In most cases, however, the entire field, with the exception of the spot, appeared more saturated, and, in about ten per cent of the descriptions, no change in saturation was reported. This discrepancy may be related to differences in sharpness of boundary. The boundary of the shadow was not as well defined as that of the black spot. There appears to be a relationship between halo formation and sharpness of boundary.

Definiteness of figure. With increased intensity differences, the figure becomes more defined. Small intensity differences, however, are not any more effective than chromatic differences in producing a sharply defined figure.

Although chromatic differences are not very effective in producing stable figure segregation, they tend to enhance figure-ground segregation when functioning in conjunction with intensity gradients (Sub-hypothesis 2.1).

Mode of appearance. When steep intensity gradients were present, the foglike appearance changed. Both figure and ground were more apt to be perceived as having solid surfaces. This tendency was not increased when chromatic differences were combined with intensity differences. The mode of appearance of the field seems to be partially related to the definiteness of figure-ground segregation. With increased sharpness of boundary, there is greater definiteness of surface (Sub-hypothesis 2.2).

Gibson and Dibble (12), in their study of visual surface, found that the steepness of gradients of luminous intensity was a determinant of visual surface hardness. This was found to be true in the present study to a limited extent. Steep intensity gradients completely eliminated reports of fog in less than fifty per cent of the protocols, and, in many cases, absence of fog did not result in a definite surface. In only a few cases did the subjects actually report the ground area as appearing hard. The figure area was more frequently described as hard.

Apparent distance. Although the presence of steep intensity gradients resulted in an expansion of space, the apparent distance to the ground area was about half that of the "real" distance. The figure appeared closer as intensity differences were increased. The definiteness of contour was related to the apparent distance. Figures having a distinct boundary appeared at a closer and more definite distance than less distinct figures (Sub-hypotheses 2.3 and

3.2).

These differences in the apparent distance of the figure are consistent with the supposition that indistinctness of boundary is a "cue" of increased distance. However, this supposition does not account for the increased distance of the ground which accompanies the decreased distance of the figure. Koffka (21) suggests that contraction and expansion of space may be a function of forces related to articulation of the field. According to his formulation, well articulated fields would be perceived as being at a greater distance than those which are poorly articulated.

The fact that apparent distance is modified by changes in intensity gradients may be of use in the development of a new method for Heterochromatic Photometry. There is evidence that, when field and spot differ in dominant wavelength but are of equal brightness, the figure is seen at a maximum distance. Thus, with a change in brightness toward equality, the figure appears to recede until a point of equality is reached. Further change in brightness results in an apparent approach of the figure. Additional research will be required to determine the validity and feasibility of this method for Heterochromatic Photometry.

Apparent size has not been systematically investigated in this study. There were, however, many references to the size of the figure which seem relevant to the size invariance hypothesis. In most cases, the figure was judged to be about one and one half times as large as its "real" size. It has been suggested that there is an invariant relationship

between phenomenal size and phenomenal distance (1,11). If there were such a relationship, the underestimation of the apparent distance of the figure should have been accompanied by an underestimation, rather than an overestimation, of its apparent size. When steepness of the intensity gradients was increased, the figure appeared closer, but there was no systematic change in apparent size. The apparent distance changed without a change in either retinal size or apparent size. These results are consistent with Kilpatrick and Ittleson's (19) conclusion that the invariant relationship between size and distance is restricted to special conditions and does not apply to those situations in which the field is poorly articulated.

E. General Discussion

The results of the present experiment indicate the validity of the basic tenet of Gestalt psychology, i.e., the dependence of experience upon the pattern of stimulation rather than upon the nature of the local stimuli. Almost all the dimensions of visual experience have been shown to be dependent upon the manner of differentiation between field and spot, which, in the present experiment, was the sole determinant of the pattern of excitation. The phenomenal characteristics of the entire situation constitute in themselves an organized totality. There are several modes of figure-ground segregation, each of which corresponds to a particular kind of stimulus gradient. Thus, a simple change in the stimulus gradient may alter all the phenomenal

characteristics of the entire field and produce a radically different mode of figure-ground segregation. None of the phenomenal characteristics appear to be independently determined. A number of conjectures derived from these results may provide insight into the nature of perception.

It is obvious that the major function of the visual perception mechanism is to provide adequate information for the organism. The information obtained by the organism during the observation of the homogeneous field is unique. It does not correspond to any situation previously experienced by the observer. As a result, difficulty is encountered in attempting a description. It should be stressed that ambiguity lies in the naming of the phenomena rather than in the phenomena themselves in most instances. With persistent uniform stimulation, the perceptual mechanism may fail to produce a phenomenal field. Cessation of vision as a sense modality may result. The findings of Riggs and his associates (27) suggest that it is the lack of change in stimulation rather than homogeneity per se that is responsible for this phenomenon. In any case, the absence of differentiation produces a phenomenal field often lacking characteristics present under "normal" conditions.

Although the uniform proximal stimulation does not provide a basis for articulation, the separation of the field into a fog in front of a ground occurs. This may be related to the process of figure-ground segregation. It should be noted that when hue is experienced in the chromatic Ganzfeld, it is seen as a phenomenal characteristic of the

fog, whereas the ground behind the fog may appear as neutral.

The definiteness of figure-ground segregation, as well as the other phenomenal characteristics of the field, are dependent upon the gradient between spot and field. The presence of a chromatic gradient did not radically modify most of the phenomenal characteristics of the Ganzfeld. Its principal effect was on the experience of hue. Although the segregation of figure and ground was relatively indefinite, the observer reported a well saturated figure in a poorly saturated ground even when stimulation from the spot was achromatic.

High saturation persists even after long periods of stimulation. If, however, an intensity gradient is combined with the chromatic gradient, there is a loss of saturation. Saturation of the figure appears to be related to the relative importance of hue in the articulation of the field. If there is no chromatic difference between field and spot, saturation is at a minimum.

The dependence of saturation (S) upon the chromatic differences (Dc) and brightness differences (Db) between spot and field can be expressed by the equation

$$S = f\left(\frac{Dc + A}{Db + B}\right)$$

where A and B are constants.

In the absence of distinct figure-ground segregation, apparent space and distance are indefinite. The phenomenal space of the Ganzfeld is reported in three ways. It may be internalized and thus experienced as being "inside the head" of the observer. The individual may feel himself completely

immersed in the fog-filled space. The observer and the fog may be phenomenally separated, but even then localization is indefinite. It is only when the field is clearly articulated by means of a steep intensity gradient that the observer reports definite localization.

The importance of the spatial aspect in figure-ground segregation should be stressed. Not only are the figure and ground separated by a boundary but their relative distances differ. In the absence of a clear cut boundary, the figure appears immersed in the fog. At such times, phenomenal distances are indefinite. With increased intensity difference between field and spot, the spatial aspects become more definite. The figure appears in front of the ground. The fog recedes and condenses in a definite plane behind the figure. Thus, not only is the figure separated from the ground by a distinct boundary, but it is also in a different spatial plane.

Surface color and film color are absent in the uniform field. The Ganzfeld is generally characterized by volume color. It would, however, be difficult to classify the internalization of color in terms of Katz's categories. Although chromatic gradients alone do not produce an experience of surface, with increased intensity gradients, the appearance of the field shifts from volume color toward surface color.

The effects of the manner of differentiation upon the phenomenal characteristics of the Ganzfeld are summarized in Table XIII. These interrelationships may be partially

Table XIII

The Effects of the Manner of Differentiation upon the Phenomenal Characteristics of the Ganzfeld

Manner of Field Differentiation	Hue Saturation Field--Spot		Fog Density Field	Distance Field--Spot		Distinctness Spot
1. Homogeneity (Absence of differentiation)	A		C	A		
2. Chromatic Gradient	C	C	B	B	C	A
3. Moderate Intensity Gradient	A	A	B	B	B	B
4. Combined Chromatic and Moderate Intensity Gradient	C	B	B	B	B	C
5. Greater Intensity Gradient	B	B	A	C	A	C

Note: the symbols A, B, and C are used to represent the relative values listed below.

A - approaches minimum
B - medium
C - approaches maximum

represented by the following quasi-mathematical equation

$$\frac{(\text{Figure Distinctness, Ground Distance})}{(\text{Fog Density, Figure Distance})} = f\,(Db, Dc)$$

where Db, Dc represent brightness and chromatic differences between field and spot.

Although there may be considerable ambiguity in the Gestaltists' concept that figure-ground segregation will "be as 'good' as the prevailing conditions allow" (21), it appears to lend unity to the diversity of results in the present experiment. Even in the homogeneous field, a phenomenon analogous to figure-ground segregation occurs in the apparent separation of chromatic fog and achromatic ground.

When chromatic gradients alone produce field articulation, differences in hue are accentuated. The figure appears most saturated and is, thus, phenomenologically differentiated from the ground. However, the differentiation is primarily in one dimension of experience. With the introduction of intensity gradients, segregation becomes possible in other dimensions as well, and it is with increased intensity differences that these aspects of segregation become more pronounced. Thus, figure and ground not only differ in color and brightness but also in apparent distance, mode of appearance, and definiteness of boundary.

CHAPTER VI

SUMMARY

The purpose of this study is to determine the phenomenal characteristics of the Ganzfeld under conditions of homogeneity and when a small differentiated area is present. The homogeneous Ganzfeld may be considered the simplest level of visual stimulation and information concerning its phenomenal characteristics may contribute to the evaluation of the effects of stimulus gradients. Those phenomenal aspects primarily dealt with are color, figure distinctness, mode of appearance, and phenomenal space.

The following three questions guided the design of the experiment. In what manner is the appearance of the homogeneous Ganzfeld dependent upon intensity and wavelength? How does the appearance of the inhomogeneous Ganzfeld differ from that of the homogeneous Ganzfeld? How are these differences in appearance related to the stimulus distributions?

Since none of the previous investigations provided a method that could be used in the present study, it was necessary to develop a new method. Two Ulbricht type spheres were joined and appropriate illumination produced either a uniform Ganzfeld or a Ganzfeld containing a small differentiated area. Sixteen observers, using monocular vision, gave phenomenological descriptions as well as paired comparisons of the Ganzfelds.

The most characteristic description of the homogeneous

Ganzfeld was that of close, impenetrable fog. The experience was a unique one, and most observers had difficulty describing the field in terms usually associated with visual phenomena. In some instances, temporary cessation of visual experience was reported. Variations in intensity of illumination did not consistently alter the appearance of the field although there was some indication that fields of greater intensity appeared denser and closer. Dominant long wavelength illumination also produced closer and denser fogs than dominant short wavelength light. The uniform chromatic Ganzfeld was reported as either poorly saturated or neutral in appearance.

The presence of a differentiated area in the Ganzfeld resulted in changes in its phenomenal characteristics. When the differentiation resulted from chromatic gradients alone, a distant, indefinite figure was reported, which was highly saturated. Modifications in the appearance of the fog were slight. Those situations involving dominant short wavelength light seemed more indefinite than those involving dominant long wavelength light. The addition of an intensity gradient to the chromatic gradient increased definiteness of the figure-ground segregation but reduced the saturation of the figure.

The effect of moderate intensity differences alone was to produce a relatively definite separation of figure and ground. Saturation was as poor as in the homogeneous Ganzfeld The density of fog was considerably reduced. Increased

intensity difference further separated figure and ground. The fog disappeared. The figure was seen as closer than the ground. Their modes of appearance differed and a distinct boundary separated them.

The phenomenal characteristics of the Ganzfeld do not appear to be independently determined. Any change in stimulation that modifies one aspect of experience produces concomitant changes in the other phenomenal characteristics of the Ganzfeld. The distribution of stimulation rather than the nature of the local stimulus seems to determine what is experienced. Thus, the results of the present investigation appear to be in harmony with a configurational approach rather than the traditional "constancy hypothesis." (Koffka)

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