AN INVESTIGATION OF "EIDETIC IMAGERY"

by

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Chapter I

Introduction

We became interested in the subject of visual imagery while taking a university course in Experimental Psychology. During the term, as part of our work with vision, we investigated after-images and discussed the topic of eidetic imagery. We searched for more information about the latter but found that many writers of general psychology texts had avoided any mention of eidetic imagery. Apparently few psychologists were personally interested in the topic and those who were interested seemed inclined to accept the interpretation of the eidetic phenomena as outlined by the German school of Jaensch *et. al.* Only Rauth and Klüver had done any extensive experimental work here on this continent.

During our research we encountered remarkable reports concerning eidetikers of which the following are typical. A boy looked for a few seconds at a postcard showing a street scene with many details. Months afterwards he could recall at will, and with great clearness, an image of the picture he had seen. In the image he could read off words foreign to him. Another boy could count the teeth in the mouth of an alligator seen as an after-image a year after seeing the original picture (21). A woman was asked to call up a memory image of red. She did so and was then asked to project this image onto a white wall. To her surprise she saw a green after-image. (24, p.69)

We had gained enough acquaintance with after-images through class experiments to make these claims seem incredible. Therefore, in an attempt to find people with unusual after-

images and seeking also to discover the relationship among memory images, eidetic images and after-images we began the present study. During a period of four years we worked in six schools in different parts of British Columbia. We carried on individual after-image experiments with over three hundred school children during that time.

Some of our earlier experiments in the field of after-images made use of the "blink" method adapted for the study of children by J. E. Morsh. This work was reported on by Morsh at a meeting of the Western Psychological Association in 1938.

The experiments providing the data for this thesis were performed at the White Rock Elementary School and the Semiahmoo Junior and Senior High Schools from October, 1941 to March, 1942. In this later work the subjects looked at a picture for 40 seconds and then projected their after-image onto a grey background. Those with strong powers of after-imagery were given a second test with a picture having greater detail. In this case there was an exposure of only 10 seconds. It will be noted that while the experiments deal with after-images, the phenomena are those which concern investigators in the field of eidetic imagery. The term "eidetic images" has been taken in this study to mean unusually vivid and persistent after-images which are frequently influenced by memory and imagination.

Chapter II

History of the Problem

The first experiments in the field of eidetic imagery in America were reported in 1924 at a meeting of Western American Psychological Association by Klüver of Minnesota. The topic of after-images and memory images, however, has long been of interest to psychologists. Galton in 1883 wrote, "There exists a power which is rare naturally, but can, I believe, be acquired without much difficulty, of projecting a mental picture upon a piece of paper, and holding it fast there, so that it can be outlined with a pencil." (3, p.99)

Although literature on eidetic imagery has appeared in English, French, Italian and even Japanese it has been the Germans who have shown the greatest interest. The first important investigator was Urbantschitsch whose book in 1907 aroused concern among German psychologists. Urbantschitsch spoke of two kinds of visual memory images which he called anschauungsbild (AB). He believed that AB were of a pathological nature, and that only young and very excitable children experienced these phenomena.

Urbantschitsch was especially interested in what effect disturbing stimuli might have upon AB. He reported that he could produce distortion of the AB by producing various tones with tuning forks, by applying cold or heat to the forehead, or by focusing light on the closed eyes of the subject.

At Marburg, two years later, E. R. Jaensch took issue with the view that AB are abnormal. Undoubtedly the phenomenon designated as perceptual memory image or

anschauungsbild (AB) is equivalent to what later writers have termed eidetic imagery. He stated his opinion of the importance to general psychology of what he called eidetische anlage, the ability of eidetikers to produce these special images. At the Marburg Institute Jaensch, his assistants and pupils set out to discover and study persons gifted with eidetic ability. Thus O. Kroh, a Marburg high school teacher, in 1917 reported that this phenomenon was common and normal at a certain age.

The Marburg school based their theories upon several years of elaborate researches. However, as Koffka pointed out in 1923, they have gone far beyond their data in theorizing. The four main theories which may be attributed to Jaensch, the leader of eidetic imagery school, are his genetic theory, identity of optical and eidetic phenomena, hierarchy of memory grades, and somatic basis. He assumed that the eidetic stage is merely a normal phase of child development. Subjects who do not manifest this ability are said to be "latent" eidetikers. In support of this theory various German investigators report frequencies of occurrence among children ranging from 17 per cent to 99.3 per cent. Among adults they find a much smaller percentage, Kroh, reporting only 7 per cent of eidetikers among adults.

According to Jaensch's second hypothesis the same optical laws apply to eidetic phenomena as to normal perception. Any differences noted are quantitative rather than qualitative. We must note, however, that these images do not

follow optical laws in many respects such as their susceptibility to alterations by "distortion" stimuli, to be discussed.

Thirdly, Jaensch proposed a genetic theory of memory levels. He suggested a hierarchy of grades of memory going from after-image to eidetic image to memory image. He held that the eye was originally a cerebral organ and still possesses some of the retentive capacity of the brain. Thus we go from perception to conception in the series after-image, eidetic image, memory image in the development of intellect.

Jaensch insisted that eidetic investigations could furnish the explanation of many problems of general psychology. In fact he went beyond psychology and even invaded the fields of Biology, Sociology, History, Mythology, Philology, Education, Art and Philosophy. In this respect he may be compared with the psychoanalysts who have entered approximately the same fields.

A fourth major theory of Jaensch was that eidetikers differ somatically. He found a B type, a T type and, most frequently, a mixed type (BT). Persons of the B type manifest some of the signs of Basedow's Disease (Graves' Disease or exophthalmic goitre). They sweat easily, have large, bulging, bright eyes, and lively reactions. Their thyroid glands are often slightly enlarged. Calcium treatment will not effect the nature of their eidetic images.

The T type is held to be a normal youthful type whose pathological form is the tetanoid condition. The

characteristics of the personality and also the attendant eidetic phenomena are susceptible to feeding with calcium (a treatment used in dealing with tetany). The eidetic images of T type persons instead of being positive become negative. The skin of these individuals is hyper-sensitive to electrical or mechanical stimulation. Their eyes are in marked contrast to those of the B type, as they are small, deep-set, dull, and lacking in childlike appearance. In extreme cases they have the "tetany" face with its pinched expression which may indicate their hypersensitivity.

The eidetic images of the T type resemble after-images, those of the B type, memory images. The T type of images may be further characterized as voluntary, fluctuating, spontaneous and rich in detail. The T type of images are non-voluntary, complementary, non-fluctuating, non-spontaneous and fixed in form. Since calcium treatment will extinguish the characteristics of the T type it is possible to change the images of individuals from the BT type to the B type by this means.

In addition to these somatic types Jaensch differentiates eidetikers as integrates or disintegrates according to the degree of correlation between sensations and images. The B and T types themselves are examples of integrates and disintegrates. The integrates are sometimes spoken of as the unity type. The disintegrate builds up his perception of an object piecemeal. He stands outside of the object. On the other hand the integrate uses the "intuitive" method of

perception and places himself within the object. Jaensch here feels he has applications important to education (activity and appreciation schools) and to art (empathy).

During the last twenty years experimenters have interested themselves in many problems arising in the eidetic field. There is such a tremendous amount of disagreement in their reports that one wonders whether the same methods are being used and if all are working on the same problem. The frequency of eidetic occurrence varies according to investigator and geographical area from zero to one hundred per cent. A careful study of the Psychological Abstracts reveals that the best age for eidetic imagery is variously reported from six years to fifteen or later. Roessler selects the sixth year, Liefmann the twelfth, Bonte the pre-pubertal stage, and Kratina the fifteenth year. Jaensch (7) asserts that while pre-school children are at the best age for eidetic image their reports are not sufficiently reliable. A slight majority of investigators find girls more frequently are eidetikers. Jaensch believes there are differences in the abilities of the various "races", but Klüver's results are in disagreement. Brother Rogatus of Catholic University (working under Rauth, one of the leading American eidetic investigators) has shown as a result of his studies certain racial differences.

Jaensch and other German experimenters have prepared scales for measuring eidetic ability but these are arbitrary measures subject to a wide range of interpretations, the

results obtained depending upon the user.

There have been studies of the relationship of art and eidetic imagery as it seems reasonable to suppose that children who have this ability could make use of it in art work. Here again we find conflicting reports. O'Neill (10, p.23) states that some eidetikers are able to trace their images on the background while Metz and Pollitt (32) found their subjects unable to do so. Apparently the effort to copy the image in some cases causes it to disappear. Many reports show that eidetikers do not spontaneously make any use of their ability.

Biographies of great men in music, literature, art, science and other fields have been studied in an attempt to discover whether eidetic ability of an optical, auditory or other type has been a contributory factor in the success of these distinguished men. While these studies are interesting the results obtained are of little more than mere speculative value. In a recent magazine article (23, p.77) an account was given of a favorite "parlor" entertainment of Thomas A. Edison. He would delight his guests by looking at a page of a dictionary for a minute and then answering any question put to him regarding what he had read. The writer of the article did not mention the word "eidetic" but simply concluded that Edison had a "photographic memory."

Efforts have been made to discover any relation which may exist between eidetic imagery and intelligence. While most studies reveal that persons of all grades of intelligence

may exhibit eidetic characteristics, Kluver (24, p.219) finds that young eidetikers are of higher intelligence than young non-eidetikers, while adult eidetikers are seldom of high intelligence. Some writers suggest that children might be taught to use their gift in school subjects such as geography and physiology. The spelling text book used in British Columbia suggests, "Let pupils study the word a moment and then close their eyes and try to visualize it. Pupils will look at the word again to see if they visualized it correctly." (16, p.9)

Eidetic imagery has been studied also in connection with some sociological problems. Healy, speaks of "criminalistic mental imagery" (6, p.830) as playing a part in the making of delinquents. Sex delinquents are often eidetikers accoring to some writers. In this connection it has been pointed out by O'Neill (10, p.72) that children must be protected from visual stimuli which might have an unwholesome effect, especially for the young eidetiker who may experience again at will the original sight. Similarly children's "lies" have been explained by some writers who say that children do not sharply distinguish between their images and reality and hence may often be unjustly punished. Courtroom testimony too, it is claimed, may be colored by strong eidetic imagery. Careful experiments have been conducted to determine the validity of eye-witness accounts of events and the results have shown that suggestion, habit, and interest do influence testimony. Possibly eidetic phenomena also play their part.

In conclusion it might be remarked that the eidetic

imagery school has divisions within its own ranks just as have the gestaltists, behaviourists and psychoanalysts. The English translation of Jaensch's book, "Eidetic Imagery", in 1930 may result in a wider American following. The German psychologists apparently labored assiduously with their eidetikers but this very zeal has caused them to branch out into many fields and to theorize unduly about phenomena concerning which investigators are in wide disagreement.

Chapter III

After-Images, Eidetic Images and Memory Images

Before entering upon a discussion of these three types of images it is well to emphasize the disagreement in the theories held by various investigators who assume that they are studying the same phenomena. Jaensch himself has a theory that these three types of images are not quantitatively different but that developmentally they appear on a scale of memory ranging from after-image through eidetic image to memory image.

This genetic theory has been sharply criticised by Scola and Koffka who say that where the eidetic image is like the after-image it is actually an after-image. The genetic theory is disclaimed also by Allport who claims that the true eidetic image is really a special kind of memory image. He points out that the only similarity between the after-image and the eidetic image is the tendency to project the image on the screen. For him an eidetic image is a memory image of sufficient detail, concreteness and strength to permit of projection in such a manner as to simulate perception. In support of his theory that the eidetic image is merely a lively and accurately projected memory image Allport suggests the following points of similarity:

> "(a) both are influenced in content according to interest and other associative determinants;
> (b) a brief exposure of the Vorlage serves to arouse both types of image, the slightly longer time usually required for the EI (circa.10 sec.) is simply because more detail and greater clearness are expected in it;
> (c) The frequency of production conditions the clearness and intensity of both;

(d) the richness and detail of both greatly exceed that of optimum AI;
(e) the content of both is influenced by preceding images;
(f) both alter their contents within the limits of experience at will;
(g) if colored at all, both tend to retain their original color;
(h) their behavior under conditions of distraction stimuli is the same;
(i) they persist as long as desired, and recur after intervals of time, sometimes bidden, sometimes unbidden;
(j) they grow indistinct and less accurate with disuse;
(k) they may arise spontaneously (i.e., with Vorlage), which of course is never the case with AI." (173, p.119)

Allport feels, however, that it is profitable to distinguish between memory image and eidetic image. O'Neill agrees with Allport and, further, suggests that images are either physical (after-images) or mental (memory images). It is interesting to compare this view with the following statement by a physiologist (5, p.850),

> "By retina here and elsewhere we mean cerebro-retinal apparatus. We have no knowledge of the precise share of retina and brain in the development of visual sensations and after-sensations."

O'Neill gives the further suggestion that the eidetic image technique is really just a method of arousing vivid memory images, and supports this by pointing out that the eidetic image is not ordinarily evoked by the child. In making this distinction between mental and physical images this experimenter is reverting to a totally discredited psychological theory. Further, both O'Neill, and Jaensch contradict themselves when they mention subjects who can get a projected after-image of a memory image. It is difficult to reconcile the view that

mental and physical images are distinct with the view that a mental image can call up a physical image.

Allport and O'Neill have by no means solved the problem of the nature of the eidetic image by stating that the eidetic image is closer to the memory image than to the after-image. They are merely recognizing that many of the phenomena reported are of creative as well as reproductive imagination. Klüver and Jaensch have reported many cases where subjects can voluntarily produce movements, distortions and rearrangements of the details of their images. Sometimes these changes appear involuntarily according to Jaensch. "In Spain hundreds of sworn statements have been made to the effect that certain pictures of saints perform miracles, step out of their panels and carry out actions. These assertions are based in particular on testimony of scientifically educated persons like engineers and doctors who are accustomed to sober thinking." (7, p.23). But if scientifically educated adults are unable to distinguish between perception and creative imagination how much more difficult it is for young children, who provide most of the data for eidetic reports.

To illustrate the kind of data with which the investigators are working the following examples are given of feats produced by Klüver's subjects.

(1) The subject projects an eidetic image on a screen. The experimenter turns the screen 90 degrees but the subject reports no movement of the image. The experimenter tells the subject to imagine that the objects (watch and stick) are

lying on the screen. Again the screen is rotated. This time the subject reports with surprise that the image moved with the screen. The subject is told to bring the stick back to its original position but leave the watch behind. He is able to do so. (24, p.182).

(2) The subject is shown a picture of a boy in a tree. In the same tree is a snake, while at the foot of the tree is an alligator. In his eidetic image the subject sees the boy struggling and moving constantly. (24, p.143)

It is possible that these child subjects are indulging their imaginations for the benefit of the experimenters who have suggested first, that something will be seen, and second, that it is possible to produce movement or alteration in the image. Since the image can be altered by the subject it seems difficult for the experimenter to check on what is actually being seen as the image can no longer be compared with the original stimulus object. All the inherent difficulties found in other introspective experiments are present in eidetic studies. Phenomena of this subjective, unverifiable nature might well be treated with extreme caution if they are to supply the data upon which far-reaching theories are to be built. Movement of the projected image is not a mere side-issue with the proponents of eidetic imagery. On the contrary, ability to see moving images is held to be one of the most conclusive tests of the true eidetiker.

An allied phenomenon is that of distortion produced in the eidetic image by the experimenter. Various operations

such as: shining a light on the eyes of the subject, producing a sudden loud noise, stretching the subject's arms, or squeezing the subject himself are said to bring about distortions such as change of color, position or size of certain elements in the image. Morsh, in an unpublished paper, (31), read before the Western Psychological Association in 1939, suggested that many of the distortions produced in the image might possibly be caused by the subject's shift of position in relation to the screen as a reaction to the distortion stimuli. If the subject moved we should expect a change in the size of the image in accordance with Emmert's law which states that the size of the after-image is to the distance of the after-image as the size of the stimulus is to the distance of the stimulus.

In any case there is some doubt as to the possibility of securing anything approximating exact measurement in the case of such exceedingly fleeting and intangible phenomena. Klüver, (24, p.101), reports that in attempting to measure an image of a line he got different results depending upon whether he approached the ends of the line from the inside or from the outside. Similarly the writer has encountered difficulty in trying to get an exact timing of, latent period, duration, beginning of fading, final fading, and the fading in and fading out of elements of the image while other elements remain. There are so many factors involved and the changes are often so gradual that it is little wonder that children give reports which result in conflicting theories. Often too, it has

appeared that children are not reporting what they are actually seeing. This may be due to the novelty of the experience and the consequent fear of appearing queer. On the other hand children may report seeing images because they want to be like a friend who has reported to them his interesting images seen during a previous experiment. The writer has heard children compare experiences afterward and has even had subjects come back to ask if their results indicated color blindness or poor intelligence.

A factor noted by Morsh in the paper mentioned above is that subjects are instructed merely to "look at the picture." Some subjects will fixate a point, while others will let their gaze wander about at will over the picture. It is understandable that two different types of images may result. Those who fixate a point will likely have after-images with a minimum of memory images. Those whose gaze wanders over the picture will likely have a large content of memory image supported weakly if at all by after-image. Since Jaensch did not control the eye movements, it is suggested by Morsh that this factor alone could conceivably account for Jaensch's two types: the B type who see whatever they are thinking about, whose images are positive, rich in detail, fluctuating and generally like memory images; and the T type whose images are complementary, non-fluctuating and fixed in form, and in general close to the after-image. Our own conclusion is that these subjects are seeing, broadly, either after-images or memory images, although there may be varying degrees of both

components present supplemented frequently by creative imagination.

If the concept of eidetic imagery were discarded the eidetic phenomena would still be explicable in terms of after-images and memory images. Where high frequency of eidetic imagery is reported the investigator is likely dealing with memory images, where the frequency is low the reports may concern after-imagery. Thus it is not necessary to call upon diet, angle of inclination of the sun, pedagogical methods, latency, or any of a host of other explanations to account for the great range of incidence of eidetikers in various geographical areas.

If the term eidetic were to be applied merely to strong powers of after-imagery it might be acceptable. But when proponents become so enthusiastic over their discoveries as to build up a new interpretation of a large part of psychology their school may well be called into question. Jaensch and his followers are like their fellow-German psychologists Freud, Jung, Adler and the gestaltists who have been carried away by their own zeal and have built up a super-structure of theory far too heavy for the frail foundations of experimental fact.

In conclusion it might be noted that, as Shaffer (13) points out, psychology is no longer greatly interested in typologies. Thus Galen's "humors", Kretschmer's somatic types, and various other personality typologies are no longer widely accepted. Medical men may truly speak of types of

disease and blood types, but psychologists today look upon most human responses as more truly represented in a continuum. When groupings are made for the sake of convenience there is a tendency to forget the artificiality, to erect high barriers between the groups, and to magnify the differences among the entities so created. This leads inevitably to false conclusions.

Our general finding as a result of experiments to be described was that subjects could be placed upon a rough scale ranging from those having no after-images to subjects reporting vivid, detailed and lasting after-images. Creative and reproductive memory entered the picture as a complicating factor.

Chapter IV

PRELIMINARY EXPERIMENTS

Before attempting the "picture" experiments, which are described in the next chapter, we tested children for after-images in preliminary investigations using what might be considered simpler stimuli. These stimuli were windows, patterns (holes of various shapes cut out of black paper which was placed over a window) and the Union Jack. Two methods were employed in arousing after-images by these stimuli. In one case the "blink" method was used with the dark-adapted eye. By this means we performed 300 individual tests at the Balfour, Quelchena, and Towers Schools using 52 subjects who averaged 11 years of age. The ages ranged from 6 to 19 years. In the second case we had several group tests with entire classrooms of children at Surrey High School and Semiahmoo Junior and Senior High Schools. In these group experiments the classes fixated a window (or the flag) for 40 seconds and then projected the image onto the bare, white plaster wall.

The blink after-image was obtained with the dark-adapted eye. Light was excluded from the eye in order to increase visual sensitivity for short intervals of stimulation. The eye was made to perform in a manner somewhat similar to the action of a camera. The subject seated himself facing a window in the daylight. He closed his eyes and placed a hand over each eye so as to exclude as much light as possible, but at the same time avoiding the application of pressure on the eyeballs. Two minutes dark adaption time was found to be optimum for securing good after-images. The subject was

given a forewarning and then at two minutes told to blink his eyes in the direction of the window (the eye remained open approximately one-third of a second), immediately thereafter replacing his hands over the closed eyes and projecting the after-image of the window on his eyelids.

With an ordinary watch the experimenter noted the latent time, that is the time between exposure and appearance of an image, or the time between succeeding images and the duration of the images themselves. Spontaneous remarks and replies of the subjects were also recorded.

All subjects required some latent time before the image appeared. The average latent time was six seconds. There was a range of latent period from one to thirty-three seconds although there is a possibility that those reporting a long latent period were failing to report a faint after-image which may have appeared during that time.

Following this latent period all subjects reported seeing an after-image of the window or some parts of it. The image was generally positive, that is, dark bars were seen between the light panes. No attempt was made to record the initial fading time as the precise moment is not clearly observed even by adults. Furthermore there is a complicating factor in the fact that the complete image may not, in its entirety, appear and disappear. Different elements of the image gradually appear and disappear, as we are well aware, not only from reports but also from observing our own after-images. Elements of the image may build up from peripheral areas or from some

central area of the image. The positive after-images were generally more distinct in outline and richer in detail than the negative after-images.

Most subjects experienced other latent periods, or periods of no imagery, which intervened between successive images. These intervening periods were of widely varying lengths, even for the same subject, but averaged approximately five seconds in length. The range was from one to fifty seconds.

Most subjects reported negative after-images as well as the positive kind. The negative after-images showed a reversal of shades of grey, and complementary colors. These images did not differ in length from the positive images. It must be noted that the duration of images showed the same wide variability as did all the other measurable phenomena; there being, for instance, a wide range in the number of after-images seen by different subjects. Various subjects reported durations of from one to 120 seconds. We considered it possible that, in the case of exceptionally long durations the subject might have failed to report a momentary fading. In many cases images can be so indistinct that even the most observant and highly trained adult subject can not be certain about the image he is seeing.

Although some subjects experienced a succession of images in which positive and negative after-images alternated fairly regularly, this was by no means the general rule. One boy aged 8½ years saw 33 successive images almost all of which

alternated between positive and negative and were separated by latent periods. There was no constant variation of durations or latent periods in this series. This experiment had finally to be terminated as it had taken 20 minutes and the young subject was becoming tired. This child, like most others, reported the sky as purple in the positive and black in the negative after-image.

Some subjects gave surprising reports. One boy, aged 7, immediately after blinking his eyes saw an image of his own face inside a circle. Several subjects reported that they saw two or more images superimposed one upon another. Very likely these children were still seeing the image of a previous exposure along with the latest image. The experimenter was interested in this and had several subjects try three blinks in rapid succession, first with the head leaning to the left, then held erect and finally leaning to the right. The result was similar to a triple exposure of a camera film where three images appear, one superimposed upon another. The children were most amused at this phenomenon. Some subjects reported that they could make the image more distinct by pressing the eyes slightly with the hands. Very often the image would show not only the outline of a window but also details of the landscape such as a telephone pole, wires, trees, mountains, and clouds. One boy astonished the experimenter when he reported that he saw not only the outline of a sailing vessel (which had been placed on the window sill previous to the experiment) but also the blue waves of the ocean. The last

detail was evidently supplied by the boy's imagination as there was no ocean visible from that window.

As a general conclusion regarding the results of these "blink" after-images we must stress the wide variation in the reports. This is in some disagreement with the assertions of certain writers of general psychology texts who suggest that subjects exhibit very similar after-image phenomena.

The next group of preliminary experiments also made use of the "blink" method. A piece of heavy, black paper with holes of various shapes: circles, squares and triangles, was placed in the window. Different numbers and sizes of holes and various patterns were tried but for the most part the findings of this experiment proved to be negative. The best results were obtained with a pattern of 12 round holes, each two inches in diameter. The subject was seated at a distance of eight feet from the covered window. Of twenty-five children (aged 6 to 14 years) tested in this way six saw the correct number of holes. Generally the image became indistinct before the subject could complete the count. Two six year old children who could count gave reports of 20 and 46 holes. Apparently they were competing for number.

In some later experiments two different visual stimuli were used, the row of windows at the side of the classroom, and the replica in color of the Union Jack on the front wall. The purpose of these experiments was to determine the value of this method of discovering subjects of unusual after-image ability.

The method used was to have the class face the window (or flag) and stare at it for 40 seconds, fixating some point. When the experimenter called, "Time", the subjects looked quickly at the blank, white wall. The experimenter called the elapsed time every 10 seconds thereafter and the subjects wrote down the last time announced after they could no longer an image on the wall. The experimenter later called the names of the class and they responded with the time which they had recorded.

The method has weaknesses inasmuch as there are a great many distracting factors in the classroom. Some children who might prolong their images do not do so when they realize that others about them have finished and are staring at the few still looking at the wall. On the other hand the competitive spirit may become aroused and some children may keep on staring at the blank wall long after their image has gone. Of course a great deal depends upon what degree of rapport exists between subject and experimenter. The children were especially amazed at seeing their flag in complementary colors, as they almost invariably did. They described what they had seen with great eagerness and the amazement and delight which they expressed was very evidently sincere. Our conclusion was that this method would serve as a quick way of finding a few of those with strong powers of after-imagery, but that it would not serve to detect all of these subjects.

After considering the results obtained from these experiments we decided that pictures might offer a greater

scope for investigating after-images. Further, we hoped that by conducting experiments similar to those reported by Jaensch and Klüver some interesting comparisons could be made.

Chapter V

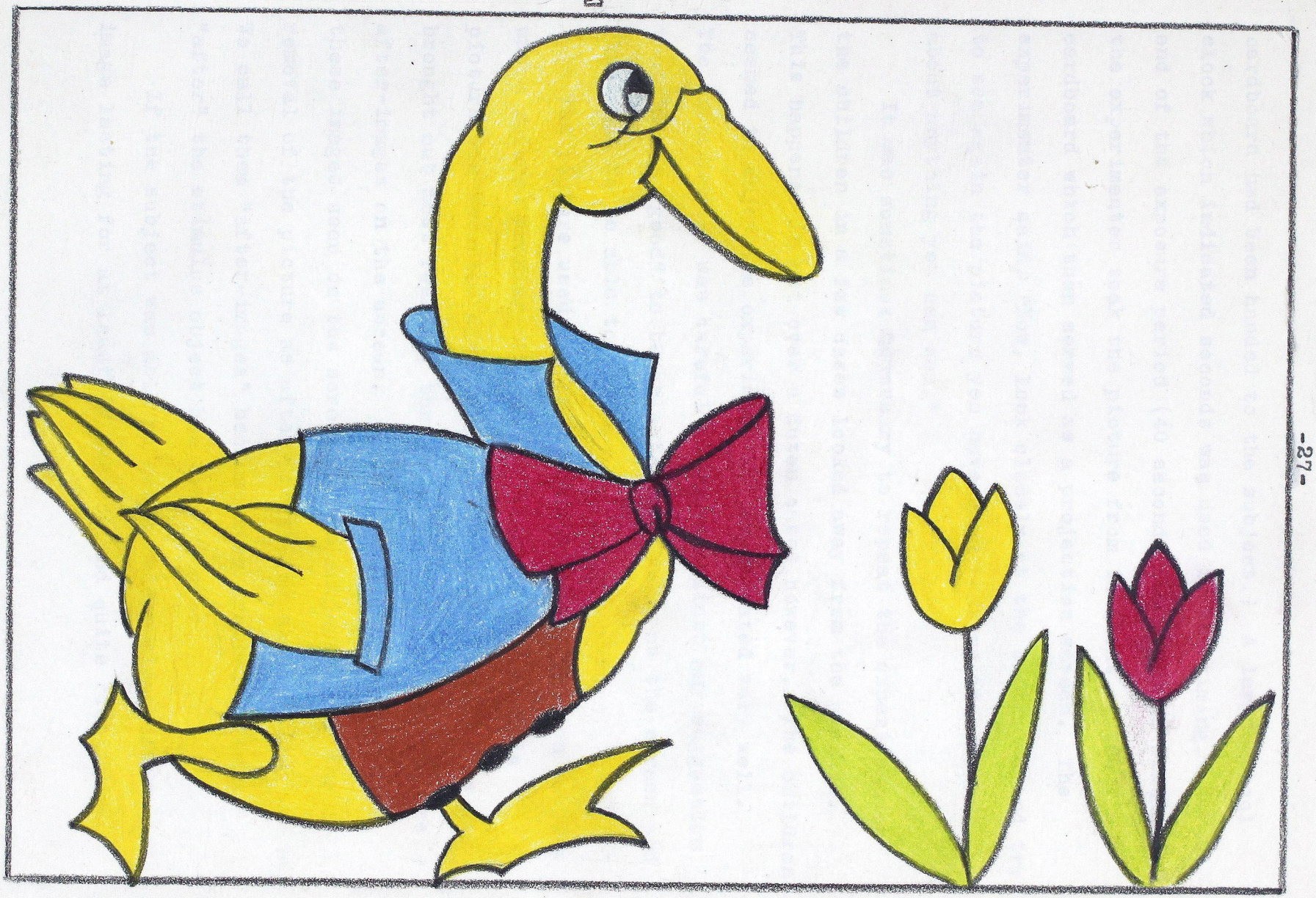
Experiments with Pictures

In our later investigations we used 256 public school children of both sexes from grades five to twelve and ranging in age from 10 to 19. The average age of the group was slightly over 13 years. The subjects were all living in or around White Rock, a sea-side village near Vancouver. The experimenter knows most of them quite well.

There was no selection of subjects on mental, physiological or achievement ratings. The experiments were conducted in the school in a pleasant room where distracting factors were reduced in number. The subjects were tested one at a time, no other persons being present in the room besides the experimenter and the subject. All experiments were carried on in daylight. Strong sunlight was excluded.

The subject on entering the room had had no previous intimation of what was to follow other than what he may have been told by children who had previously been tested. The class teacher simply instructed her pupils to go to the experimental room one at a time to look at some pictures. The experimenter seated the subject at a desk near the windows so that the light fell upon the picture which the subject held in his hands at approximately arm's length. The experimenter said, "I want you to hold this picture in your two hands and look at it without looking away until I tell you to stop. Soon I shall take the picture away and you will be holding the blank piece of cardboard." (The picture had been lying on a light gray cardboard 12 by 17 inches. Both picture and card-

Figure 1



cardboard had been handed to the subject.) A large school clock which indicated seconds was used in the timing. At the end of the exposure period (40 seconds for the duck picture) the experimenter took the picture from in front of the cardboard which then served as a projection screen. The experimenter said, "Now, look closely at the cardboard and try to see again the picture you have been looking at. Tell about anything you can see."

It was sometimes necessary to repeat the experiment as the children in a few cases looked away from the picture. This happened in not over a dozen cases however. The children seemed to enjoy the experiment and co-operated very well. The experimenter was careful to guard against any suggestion that it was "good" to be able to get images on the screen and "bad" not to be able to do so.

The picture used in the first instance with each subject was a colored drawing of a duck. (Fig.1, p.27.) This picture was selected after many others had been tried as it brought out most readily, the ability of the subject to see after-images on the screen. Henceforth, we shall speak of these images seen on the screen by the subject after the removal of the picture as after-images (or simply AI). We call them "after-images" because they are images seen "after" the stimulus object has been removed.

If the subject was able to get a fairly clear after-image lasting for at least 40 seconds and quite rich in

Figure 2

"IF I COULD ONLY BE A POLICEMAN!"

content he was given the police picture (Fig.2, p.29) with a 10 second exposure. The instructions and general method were the same as before.

As the subject reported the experimenter wrote, so far as possible, the exact words he used. The experimenter also made note of the behaviour of the subject in relation to the image on the screen. Such behaviour included: eye-movements, pointing, looking away from the screen, facial expressions, tone of voice, muscular tension, movement of body. The experimenter questioned the subject regarding exact details of the image on the screen while the experimenter checked by looking at the original picture. The experimenter watched for eye-movements as a further check on what the subject was actually seeing. Often the subject spontaneously pointed or hunched forward to get a closer look. If the subject blinked his eyes and gazed aimlessly about the room while he spoke about his "image" the experimenter took this to be a sign that the subject was remembering rather than seeing. Often the subject would look puzzled to see a green tie when he remembered that the tie was red. One boy stated that his duck was "like" the one in the picture but faced in the opposite direction.

After the subject indicated that he could no longer see the image, the experimenter placed the original picture beside the screen and asked the subject to tell how his "picture" had differed from the real picture. Since some subjects could apparently see the image indefinitely the experimenter did not always wait for subject to report that

the image had faded completely. The subject was told to point out any differences in position, size, shape, objects present, and color.

The "police" picture is in silhouette and outline, done in black and white. It has as significant details a small "5" on the policeman's hat, stripes on the arms and legs, the word "POLICE" on the cart, the words under the picture, and windows on a building at the left. Since the picture, was exposed for only 10 seconds, the experimenter felt quite sure he could tell when the subject was actually seeing an image. This picture was shown to some subjects who had done poorly with the duck picture. The subjects were invariably poor with both pictures. On the other hand no subject who had good imagery with the duck picture failed to get some after-image of the police picture.

In dealing with the results of the experiments it was found desirable to group the subjects according to their ability to get after-images. Accordingly the experimenter decided on the factors to be used in the classification. These were: number of details or elements of the image, vividness or distinctness of form, and duration. A grading scale as illustrated (Table I, p.32) was devised and each subject placed in one of the five groups A,B,C,D or E. The assigning of a given individual to any particular group is admittedly arbitrary and there might be room for disagreement with respect to the intermediate groups as to whether a subject should not be moved from the group in which he has been placed to the next group. But there is little doubt as to

Scale for Grading After-Images

Table I

AI Group	Number of Details	Time	Distinctness	Exposure
E	Zero (0)	No time	Nothing	40 sec.
D	Few (1-2)	0-40 sec.	No shape	40 sec.
C	Fair (3-6)	40 sec. -2 min.	Shape va vaguely	40 sec.
B	Good (6 or more)	2 min. 2 died out	Quite clear	40 sec., 10 sec.
A	Excellent (most details)	Still going	Sharp outlines	40 sec., 10 sec.

As a check, those subjects falling within groups A and B were tested with the more detailed picture shown in (Fig. 2) with an exposure of 10 seconds.

accuracy of placements at the extremes. Some subjects report seeing nothing, while others report seeing almost all the details clearly, vividly, and for lengthy durations.

There are all shades of ability apparently. While long duration usually goes with clear outlines and rich content, occasionally a single detail such as the bow tie on the duck may be the only content, yet it may be seen clearly and last for as long as four minutes. On the other hand the content may be rich yet extremely fleeting in character lasting only a few seconds. This indicates the difficulty of applying the grading scale. However, by using the scale only as a rough guide, and more by comparing the overt behavioral data of one subject with those of another, the experimenter was able to place each subject in a group with others approximating his own imagery ability.

After scaling, the data were studied in an effort to detect some factors possibly involved such as age, sex or intelligence. Lastly, a study was made of the correlation between ability to obtain after-images and ability in some school subjects which might involve imagery such as English composition, spelling, and art.

Chapter VI

Experimental Results

Of the 256 boys and girls tested for after-imagery by means of the pictures of the duck and the policeman, there were 77 subjects or 30.1 per cent of the whole group who reported seeing no after-image at all. There were 179 subjects or 69.9 per cent of the total number who experienced some after-image. Twenty-two subjects or 8.6 per cent saw greys only, that is, no colors appeared in their after-images. For 34 subjects or 13.3 per cent the after-sensations appeared either entirely or partially in complementary colors. In some cases all the

Table 2

Reports of 256 School Children on After-Image of the Duck (Fig. 1).

Type of Images Observed	Number	Per cent
No after-image	77	30.1
Some after-image	179	69.9
Greys only	22	8.6
Some complementaries	34	13.3
Only positive after-image	123	48.0

colors of the after-image were complementaries of the colors seen in the original picture. In other cases some of the colors were complementary while others were like the original colors. Occasionally a color which covered a large area of the picture (such as the yellow of the duck in Fig. 1) would be extended in the after-image to cover adjacent areas not so colored in the stimulus picture. One hundred twenty-three

subjects or 48 per cent of the total saw only positive after-images. That is, their images appeared in hues simmilar to those in the picture. Those who could get a clear after-image of the policeman (Fig. 2) almost invariably obtained a positive after-image. The 22 subjects who saw grey after-images were given the Ishihara Test of Color Blindness. All but three of these showed definite indications of weakness in color discrimination.

With the grading scale shown in Table 1 as a guide we were able to classify the subjects into five groups according to their relative abilities in the field of after-imagery. We designated the groups A, B, C, D and E in order from strongest to weakest ability. All but one of the subjects placed in the superior group (A) of after-image ability saw positive after-images. The exception was a ten-year old girl who reported greys only. She was shown to be weak in color discrimination by the Ishihara Test. Groups A and B each contained about one tenth (24 and 25) of the total number of subjects, group C contained about one fifth (49), and groups D and E each contained approximately three tenths (81 and 77) of the total. Thus as after-imagery grew less the frequency of subjects increased. (See Table 3.) Tables 3 to 8 showing distributions of after-image groups are based on the duck test shown in Fig. 1.

In order to study the relationship of age and after-imagery the subjects were placed in three age groups, ages 10 to 12 years, 13 and 14 years, and 15 to 19 years. These data are

summarized in Table 3.

Table 3

Distribution by After-Imagery and Age of 256 School Children

	Age							
	10-12		13-14		15-19		Total	
Imagery Group	No.	% of 86	No.	% of 76	No.	% of 94	No.	% of 256
A	16	18.6	7	9.2	1	1.1	24	9.3
B	9	10.4	6	7.9	10	10.6	25	9.8
C	15	17.4	15	19.7	19	20.2	49	19.11
D	22	25.6	18	23.7	41	43.6	81	31.7
E	24	28.0	30	39.5	23	24.5	77	30.1
Total	86	100	76	100	94	100	256	100

Table 3 shows that 23 out of the 24 subjects in A group were between 10 and 14 years old. Sixteen of these 23 subjects were 10 to 12 years of age. Thus in the highest grade of after-image ability the youngest subjects were most numerous. In the A group only one 15 to 19 year old subject was found. Nearly 40 per cent of the 13 and 14 year old subjects were in the E group. Over 43 per cent of the subjects aged 15 to 19 years were in the D group. No such concentration of subjects was discovered in the youngest group.

The chi-square test of probability of association, and the contingency coefficient, measure of degree of association, were worked out for the data shown in Table 3. The formulae employed were those described in Garrett. (10, p.377 ff.)

For these data chi-square was 25.5, while P, the probability of a chance chi-square of such a value, was less than .01. Garrett says, "A P of .02 or less may be taken as indicative of a significant deviation from expectancy." (10, p.380) In this case there are more than 99 chances out of 100 that association exists between age and after-image ability. The coefficient of contingency (C) was .301. Thus while there is strong statistical evidence of association between age and after-image ability, the degree of correlation is not great. There is, however, a definite tendency for after-imagery to be of a superior type in younger children.

The distributions of boys' and girls' after-image ratings were studied in order to discover any sex differences which might exist. Of the 256 subjects, 105 were boys and 151 were girls. Table 4 shows what percentage of the total for each sex were found in each after-image group.

Table 4

After Image-Ability of 105 Boys and 151 Girls.

	Boys		Girls		Totals	
AI Group	No.	% of 105	No.	% of 151	No.	% of 256
A	11	10.5	13	8.6	24	9.3
B	10	9.5	15	10.0	25	9.8
C	16	15.2	33	21.8	49	19.1
D	32	30.5	49	32.4	81	31.7
E	36	34.3	41	27.2	77	30.1
Totals	105	100	151	100	256	100

As shown in Table 4 there was again a tendency for the frequencies of subjects to increase as the after-image ability decreased. The boys, however, appeared to be slightly more frequent than the girls at both ends of the scale. In the A group the boys constituted 10.5 per cent and the girls 8.6 per cent. In the E group the boys made up 34.3 per cent while the girls numbered 27.2 per cent.

The chi-square equalled 2.79 with P approximately .60. This value being greater than .02 is not significant. The contingency coefficient was .104. Thus there was little indication of any association and the correlation was very low.

Since our results had indicated that the children aged 15 to 19 were rarely found in the A group of after-imagery we studied the results of only the younger subjects for the relations of this ability with intelligence and with certain achievement ratings. Unfortunately we had no data on intelligence for children below grade seven. Consequently we investigated the relationship of after-imagery and intelligence on only 95 children of grades seven and eight whose average age was 13 years.

Table 5 shows that when the subjects were distributed into the five groups according to after-image ability each group contained a wide range of intelligence. The smallest range occurred in the A group and the greatest in the D group. There was no subject of intelligence rating higher than 109 in the A group. The highest median I.Q. was found in the C group. In the direction of both extremes the median dropped.

The highest percentage of each after-image group was found to have average intelligence except in case of group C.

Table 5

Distribution by After-Imagery and Intelligence of 95 Subjects of Average Age 13 years in Grades 7 and 8

AI Group	No. and % in I.Q. Groups						I.Q.		
	Low		Average		High		Median	Limits	Ranges
	No.	%	No.	%	No.	%			
A	3	50	3	50	0	0	90	80-109	29
B	2	28.5	3	43	2	28.5	94	80-139	59
C	1	6.2	6	37.5	9	56.2	112	80-139	59
D	3	11.5	13	50	10	38.5	101	60-143	83
E	9	22.5	26	65	5	12.5	94	70-129	59

Chi-square for this table was 18.5 and P was .02, a significant value. Hence there is strong statistical support of association between intelligence and after-image ability. The coefficient of contingency was .404. Thus a fair degree of correlation was shown.

In the studies of spelling, art and English composition in relationship to after-imagery the results of 156 children were considered. The subjects were in grades five to eight. Their ages ranged from 10 to 15 years with an average age of 13 years. Teachers were asked to rate the subjects as below average, average or above average in these three school courses. The ratings were based upon test results covering a period of six months. The children of each grade of ability in spelling, English composition and art were then distributed into their

groups according to after-image ability, as shown in Tables 6, 7 and 8.

Table 6 indicates the number and per cent of pupils of each grade of spelling ability in the after-image groups. The percentages here and in tables 7 and 8 are based upon the final figures given in the totals appearing at the bottom of this table.

Table 6

Distribution by After-Imagery and Spelling Ability of 156 Subjects Ranging in Age from 10-15 Years and Having an Average Age of 13 Years.

	AI Group											
Spelling Ability	A		B		C		D		E		Totals	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
High	9	43	5	36	6	23	8	22	7	12	35	22
Average	9	43	6	43	16	62	17	46	36	62	84	54
Low	3	14	3	21	4	15	12	32	15	26	37	24
Totals	21	100	14	100	26	100	37	100	58	100	156	100

In Table 6 the greatest percentages occur for all after-image groups at the level of average spelling ability. Although the total frequencies of the high and the low spelling ability groups are approximately equal, these two groups exhibit opposite trends. For those students of high spelling performance from groups A to E, the percentages decrease, while those of lowest ability show a trend toward an increase in the same direction. Thus, spellers of high ability appear to

represent a gradually decreasing percentage of the after-image groups in the direction of A to E, while spellers of low ability seem to show, to some extent, an opposite tendency.

Chi-square for the data set forth in this table was 13.3 and P was .10, a value too great to be significant but indicating a strong trend of association. The coefficient of contingency was .28. Thus there was a small correlation between after-image and art abilities.

The study of ability in English composition in relation to after-imagery is shown in Table 7.

Table 7

Distribution by After-Imagery and English Composition Ability of 156 Subjects Ranging in Age from 10-15 years and Having an Average Age of 13 Years.

	AI Group					
Eng. Comp. Ability	A	B	C	D	E	Totals
	No. %	No. %	No. %	No. %	No. %	No. %
High	6 29	4 28.5	6 23	9 24	9 15.5	34 22
Average	12 57	6 43	17 66	19 52	29 50	83 53
Low	3 14	4 28.5	3 11	9 24	20 34.5	39 25
Totals	21 100	14 100	26 100	37 100	58 100	156 100

In Table 7 the results are similar to those of Table 6. The subjects of average ability in English composition are most frequent in all imagery groups. Percentages of subjects of superior ability in English composition decrease toward the E or deficient imagery end of the scale, whereas percentages of subjects of low English ability show some tendency to

increase in the same direction. Subjects of high ability in English composition represent 29 per cent of the A group but only 15.5 per cent of the E group, while subjects of low ability constitute only 14 per cent of the A group and 34.5 per cent of the E group.

For this table chi-square equalled 6.88 and P was approximately .60, not a significant indication of association. The coefficient of contingency was .18. Thus there was no strong probability of more than chance relationship and the correlation was very low.

Comparison of abilities in after-imagery and art is seen in Table 8.

Table 8

Distribution by After-Imagery and Art Ability of 156 Subjects Ranging in Age from 10-15 Years and Having an Average Age of 13 Years.

	AI Group											
Ability	A		B		C		D		E		Totals	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
High	7	33	7	50	8	31	17	46	15	26	54	35
Average	10	48	6	43	12	46	10	27	28	48	66	42
Low	4	19	1	7	6	23	10	27	15	26	36	23
Totals	21	100	14	100	26	100	37	100	58	100	156	100

The results shown in Table 8 differ in many respects from those of the two preceding tables. The subjects of average art ability do not, in all imagery groups represent the highest percentages. In the B and D groups, the highest percentages are

found in the high art ability group. Nor does this group exhibit any tendency to decrease in the direction of the E or deficient imagery end of the scale.

For the data of Table 8 the chi-square was 37.45 with P so small that it went far beyond the tables in Garrett. (10, p.379.) This is practically conclusive evidence of association as there are over 99 chances in 100 that a relationship exists. The coefficient of contingency was .44, indicating a fair degree of correlation between art ability and after-imagery.

Chapter VII

Summary and Conclusions

Since reports of eidetic phenomena appeared to involve after-images we took this as a starting point in our research. We began with studies of after-images aroused by relatively simple visual stimuli in order to learn something of their nature as a basis for an investigation of eidetic images. In much of the early experimental work the "blink" method with the dark-adapted eye was used. The light from a window served as a stimulus. Later, group experiments were conducted, both by this method and by means of an exposure of 40 seconds to a window or the Union Jack.

Next we conducted individual experiments using pictures as the stimuli, adopting here the technique of Klüver (16). After testing with several other pictures we found that the duck (Fig. 1) served best to indicate the subjects' degree of after-image ability. As a further test however, the police picture (Fig. 2) was helpful, as only subjects of the highest ability were successful in getting clear after-images in this case.

All verbal reports were written down as fully as possible, together with our observations of the subjects' reactions. Next, a grading scale was devised in order to classify the subjects according to their after-image ability. It should be noted that we assumed that those subjects who were rated highest on the scale could be called "eidetikers" if one chose to make use of the term. However, for the reasons discussed in Chapter III we have used the term "after-image" throughout,

and avoided the more ambiguous "eidetic image" phraseology. After-image ability of a marked degree might be termed "eidetic" but this should not be taken to imply that any sharp difference exists between eidetikers and non-eidetikers. After-image abilities of a random group of subjects appear in a continuum of abilities.

The children were greatly interested in after-images. This accounts, to a large extent, for the success of the group experiments. The young subjects enjoyed the experiment where they experienced three after-images superimposed upon one another. They were delighted, too, at seeing the Union Jack in complementary colors.

The actual duration of the after-sensations was difficult to check. Some subjects reported after-images lasting as long as 20 minutes when they were voluntarily terminated. At just what point these images become memory it is hard for the experimenter to determine. There are many complicating factors besides memory: age of subjects, suggestion, imagination, vagueness if phenomena, and desire of the subjects to please the experimenter. It is almost impossible to check on images the subjects report, expecially in cases when the images fail to correspond with the stimulus picture. The inherent difficulties of introspective experiments are illustrated in studies of after-imagery.

The results of the individual experiments with the pictures shown in Figures 1 and 2 are summarized below.

1. By means of the rating scale shown in Table 1 the

incidence of varying grades of after-image ability was shown to be: A (highest ability), 9.3%; B, 9.8%; C, 19.1%; D, 31.7%; E, 30.1%.

2. Of 256 child subjects 69.9% saw an after-image. The after-sensations were reported as: greys only (8.6%), all or in part complementary colors (13.3%), or positive only (48%).

3. Of 22 subjects who reported grey after-images 18 were weak in color discrimination as shown by the Ishihara Test of Color Blindness.

4. In the A group 23 out of 24 subjects were between 10 and 14 years of age, while 16 of these were of less than 13 years. For the age and after-imagery relationship P was .01 and C equalled .301.

5. Boys did not differ significantly from girls in their after-image abilities. For the data concerning sex and after-imagery P was .60 and C, .104.

6. From the present data after-image ability and intelligence appear to be associated but the correlation was not high P had a value of .02 and C was .404.

7. Studies of the relationship between after-imagery and spelling, English composition and art abilities revealed that association is greatest in the case of English composition. P equalled .10 and C, .28 for spelling and after-imagery, P, .60 and C, .18 for English composition, and P less than .01 and C, .44 for art.

During the course of the experiments many problems arose,

based upon observations and reports of our own subjects and upon literature concerning the phenomena being studied. Since our investigations were necessarily narrow in scope we could not attempt to find an answer to more than a very few of these questions. Klüver gives an interesting list of suggestions for needed researches at the conclusion of his 1926 Monograph (16). In addition to these problems mentioned by Klüver the following problems are suggested for further study.

1. Can children who have great after-image ability be trained to make more use of it in school work? Does practice improve performance? It is possible to make a reliable and valid scale for rating these images?

2. To what extent do after-images play a part in false reports, especially those given by children? Does hypnosis explain any of the unusual phenomena reported?

3. What is the physiological explanation of after-images? In what respects do they not follow the usual laws of vision?

4. What produces the distortions and movements sometimes reported in after-images? What is the explanation of the way in which images may "build up" from some point? Why is a succession of images obtained by the "blink" method?

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