VISUAL FIELDS

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Normal function may be described as that which tends to pass through a customary and purposeful cycle of actions. Pathological functioning, even though it exhibits a purposeful tendency, is an interruption of the accustomed order. The danger of the pathologic function is not always in the interruption itself, but in the possible results of the cause of the interruption. In a multi-cellular organism functional derangements may be unaccompanied by structural change, while pathologic changes always involve pathologic changes in function. In visual field work we deal with both those conditions. For our immediate present we will consider the conditions of perturbed cell activity without involving morphologic transformation. This condition is termed a disorder.

A disorder may be removed by elimination of the disturbing factor providing structure has not been altered as a result of the disorder before its elimination. This will be particularly evident in our study of alkaloid influence.

It is extremely difficult to explain the exact methods of much of our observable biologic activity. Frequently there is much evidence for seemingly opposing theories, as like in those concerning color vision, and for this reason no attempt will be made to promote any ideas as to why areas of chromatic vision are different for different wave-length, and why they are altered in toxemia.

Thomas G. Atkinson, in his recent book, "Visual Field Charting," takes various known and accepted facts and shows much sound reasoning. He points out that the rods of the retina are achromatic and that color is seen through cone function.

Cones are more abundant in the macular area and gradually become less compact toward the periphery. Around the periphery only untoned sensations of grayish white can be seen whatever wave-length stimulus strikes it. Inward farther where the stimulus would strike cones as well as rods a differentiation can take place between hues. He also brings to mind that where cones are sparse and given stimulus will produce no color sensation, but where they are more compact, and thus more cones are stimulated at once by the same intensity and size of color sources a hued sensation will be produced. Thus as we proceed from periphery toward center, at first a "confusion area" is encountered, called by Lloyd, a "zone of doubt," and gradually a full and complete color sense is encountered, corresponding to the "saturated" field. When the "confusion area," or "zone of doubt" is small the field is said to have "steep edges." Completing Atkinson's thought, when a disorder of function occurs, as may be produced by a toxic condition, one of two things happens: either some of the cones become non-receptive to color, or, all of them become impaired in their action so a stronger stimulus is required to produce a color sensation. In either case the color target must be brought nearer the center where it will

encounter a greater number of active cones. Thus a toxic depression registers a smaller area of color perception than if the organism were unimpaired by this kind of a disorder.

Atkinson further states that as we approach center from the periphery we first encounter an area where we have untoned sensations or no color recognition. Next inward is a zone where blue wave-lengths, falling on a blue-specific retinal zone, arouse blue color sensations, but red and green wave-lengths produce neutral sensations, or no sensations at all. Next inward is a zone from which red and blue stimuli, respectively, reach red-specific and blue-specific cones and produce their characteristic sensory reactions. Last is a central zone wherein any of the blue, red or green wave lengths reaches its' own specific nerve endings to give rise to the sensations of their colors. In other words he suggests that there are certain cones that are selective to green only and occupying a position predominantly around the macula, at least they are compact enough to react to our controlled 5 millimeter green perimetric target to about 20 degrees from center only, unless altered by a disorder. Red-specific cones, compact enough to produce a red sensation occupy an area larger than green. Blue-specific cones are compact over a still larger area. Cones that are not selective to any special wavelength, but produce only untoned sensations of white or grey in photopic vision, cover a larger retinal area than any of the color specific cones. There is much room for acceptance of the color-specific cone idea, as in the sense of hearing the nerve endings in the ear, called the Rods of Corti, are known to be pitch-specific.

If a toxic condition produces an over lapping of the colors and a general field depression with it, there will usually be a wider area of confusion before the true saturated color will be seen due to the partial impairment of the cone function or disablement of some of them. If this is so, taking the fields a second time in a dimmer light than the normal 7 foot candles, will show an even more exaggerated contraction. This condition is contrasted to overlapping fields from hysteria or pathologic structure. In the latter two, little difference will be noted in the fields taken in 7 foot candles and 4 foot candles illumination. Toxic fields do not have "steep edges" until a high degree of toxic depression exists so as to create very small fields, and not always then.

In addition to a depressive physiologic state creating abnormal fields, Atkinson elaborates that the changing of peripheral limits of color fields may be due to "mental" conditions. He is substantiated by most authors that field changes can be due to mental changes, or the psychic interpretation factor, as well as physiologic change in photo-chemical elements of the retina or its conduction paths.

Though we may accept all these facts and assumptions to be true we find that certain other phenomena exist in certain stages of intoxication, and so rather than be perturbed by the possible reasons why changes occur we are more particularly interested in the diagnostic value of this other phase.

The results in perimetric studies in intoxication have necessitated certain classifications, somewhat descriptive of the character of the toxin or other agent responsible for the anomalous effect obtained. Also perimetric studies are far more important than simply to determine whether red or blue can be seen over the larger area. This itself makes little difference but the agent responsible for the field changes is frequently also, at least potentially, responsible for other

changes in the organism that result in discomfort or inefficiency of operation. It is the diagnostic value of visual field that has given it its' importance in eye examination and visual analysis.

Clinical results obtained by elimination and control of certain alkaloids taken as habit, and poisoning from other sources outside the body, have produced the recognition of three different stages of intoxication affecting the color fields, each in a specific and distant manner. Many of these agents will first produce a stimulatively effect and according to the idosyncracy or tolerance of the person to that poisonous substance, may, by continued application of the agent, develop a depressive or degenerative effect in the course of the same day. Thus as the effect may be different at different hours of the day, comparative field tests must be made at different hours, lest the interpretation of a single field lead us astray. A single field may appear to be perfectly normal when in reality the person may be suffering from a depressive intoxicant with the diagnostic evidence concealed by a temporary stimulating effect of some drug.

Regardless of the cause of the disorder or degree of intoxication visual fields will show a return to normal within 24 hours after true causative agent us removed. This known control is the most valuable part of all visual field work to the Optometrist. Through this control he can determine which cases have toxic effects from outside sources that can be eliminated or controlled b y the Optometrist, and which cases must have the assistance of a practitioner of another profession in order to relieve the toxic interference is the patients visual comfort and efficiency. Frequently too, the fields will differentiate further whether the patients need the services of an ophthalmic surgeon, brain surgeon, general physician, etc.

Although all fields will show the return to normal within 24 hours after the elimination of the toxic source, some cases will show a return in much less time, especially if the patient has good sleep and rest. For instance, a person showing toxic effects from tobacco in the evening will most generally show no effects if the fields are taken early in the morning, or before much tobacco has been used in the new day. If a person produces toxic fields both morning and night it indicates the toxins are being produced inside his body, at night as well as daytime, even though the lowered metabolic rate during sleep will decrease its effect to some extent.

Of times drugs that are used for therapeutic purposes have a toxic effect upon the person taking it in addition to performing the desired activity. Less often, but definite in some cases, the drug what will ordinarily benefit the average person with a certain ailment will produce an opposite effect. Strictly speaking all drugs are toxic. They confer upon the individual no new power and develop no new quality. Like pathogenic agents they may alter or destroy structure, induce modifications of habitual function or evoke latent potentialities. But they do not originate, they disturb; they do not cause they provoke. They do not add energy; they merely increase or decrease its liberation for a given time so that temporarily, or permanently, they alter the chemical constitution and physical structure and vital cell activity. When we speak of the effect of drugs we mean the reaction of tissue to drug influence.

When such action is used in aid of the recovery of the sick we term it therapeutic. When the reaction is harmful to the activity of cells it is called poisonous.

In actual clinical practice drug influence is often very obscure. However, drugs, depending on individual tolerances, affect the visual color fields. The characteristic effects on the fields may be noted by the exhilarating or depressing influences, either enlarging or depressing the size of the fields, or by the interlacing or overlapping, or inversion of the colors.

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There is no given amount of any toxic substance that will produce a given stage of intoxication. The terms stimulative and depressive are derived wholly from the effect upon not only the visual field but upon other functions in the organism. Some of those that have been specifically correlated with field changes are ductions, cardiac rate, systolic and diastolic blood pressure, pulse rate, respiration rate and sensations experienced by patients while under controlled influence of drugs in the various stages. It has been found that when these supplementarily tested functions have exhibited a state of stimulation, or a state of greater irritability, the fields are increased in size and certain proportions, and interlacings and overlappings of color are manifested. When all functions tested are impeded in their activity and are in a state of depression other field phenomena are manifested.

The diagnostic points of these stages of field manifestations will be the subject of the next paper.

EDITOR'S NOTE: "It has been shown so many times that a writer that a writer may mean one thing and the reader derive another idea from a word or combination of words, that it has become almost standard practice in the preparation of test material to provide a set of definitions so that all may be talking about the same thing. For that reason, the following three definitions of terms are offered to those who are studying these papers with care – in the hope that they will contribute to the comprehension of the subject."

DEFINITIONS OF TERMS

The motion field represents the area of visual recognition in all directions from the central fixation point, (corresponding to the macula,) of a moving target regardless of it's color or shape.

> The size makes very little difference to a person with normal motion perception. A small target is recommended, preferably 3 mm. or less. Though it could be seen as part of the motion function, the average person, due to lack of training and concentration, will not see it if it is less than 1 mm. when used at the arc perimeter distance of 1/3 meter.

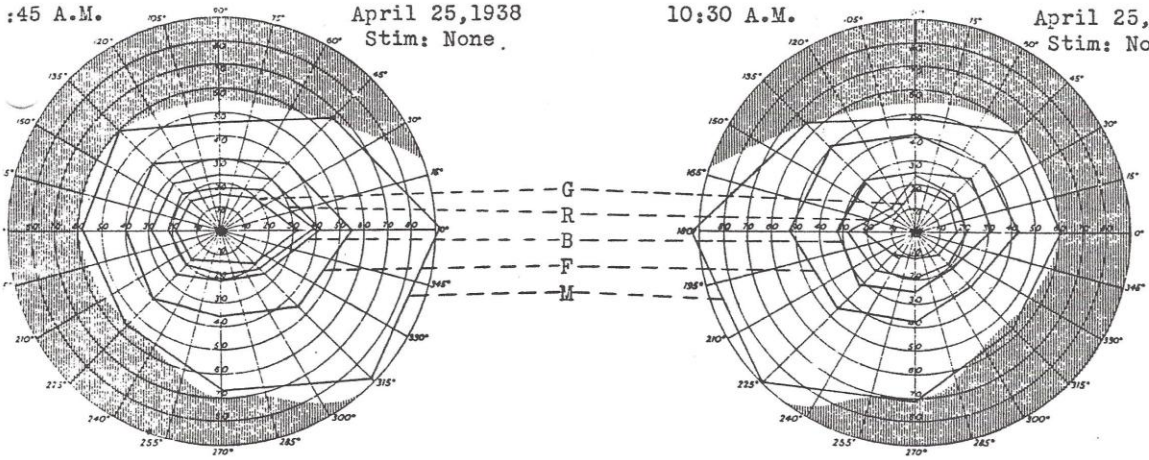
The form field represents the area of visual recognition in all directions from the central fixation point of a stationary target of white.

> Careful comparative measurements made on hundreds of clinical patients have determined that the recognition of contours and outlines of an object corresponds identically with the recognition and retention of the color white, using the same area size targets; therefore, to speed up the test, white targets are used to measure the "form" field. A 5 mm. target is standard.

The color field represents the area of visual recognition in all directions from the central fixation point of the true saturated color of the target being used while in a stationary position.

> The clinical use of color fields is restricted to blue, red and green, and the purpose is to determine when indications of toxic conditions are present. A 5mm. target is standard.

:45 A.M. April 25,1938
Stim: None.

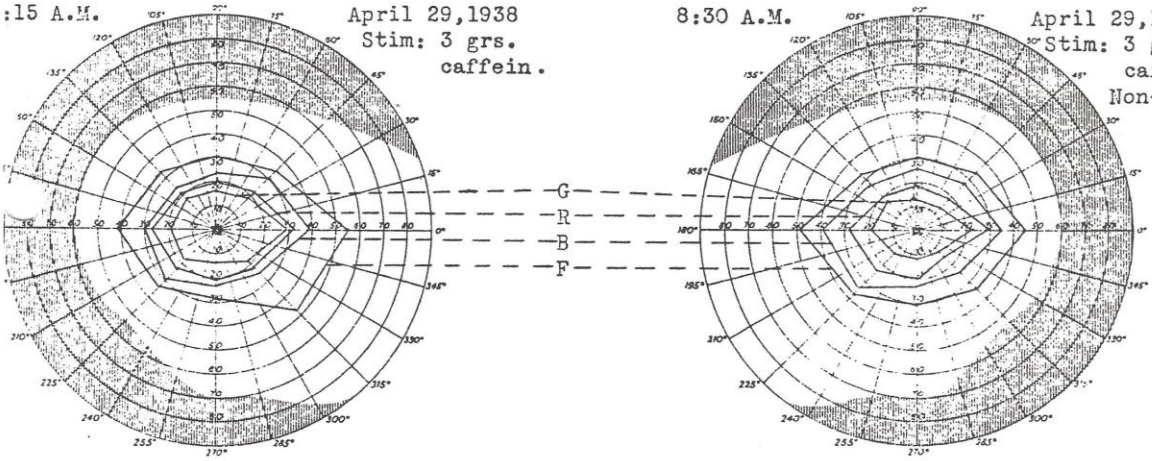


10:30 A.M. April 25,1938
Stim: None

ht Figure #1. NORMAL

Left Figure #2. NORMAL

:15 A.M. April 29,1938
Stim: 3 grs. caffein.

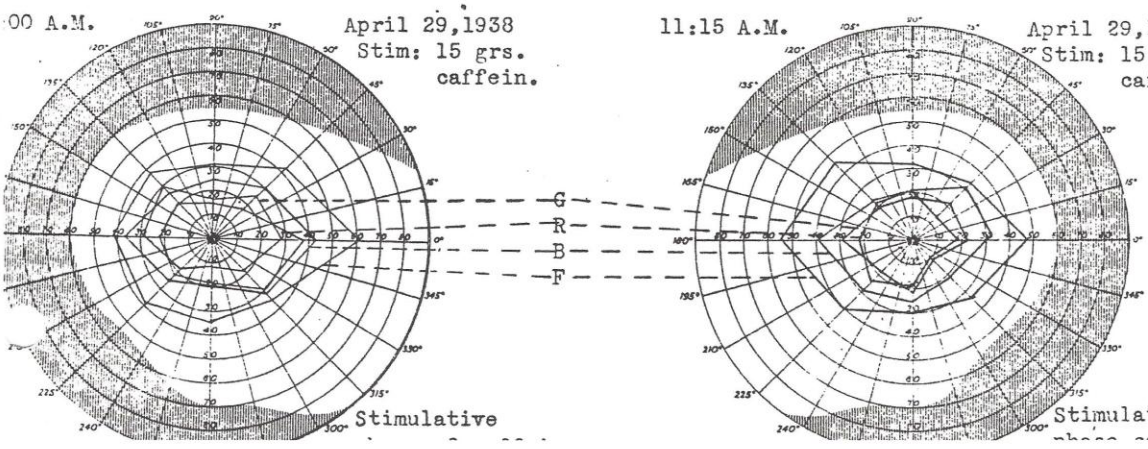


8:30 A.M. April 29,1938
Stim: 3 grs. caffein
Non-coff user

ht Figure #3. NORMAL

Left Figure #4. NORMAL

00 A.M. April 29,1938
Stim: 15 grs. caffein.

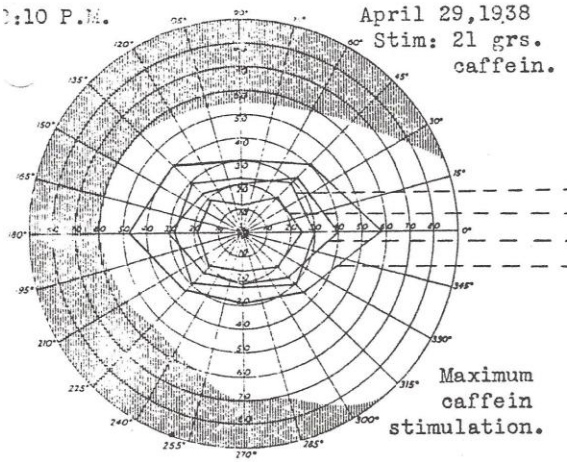


11:15 A.M. April 29,1938
Stim: 15 grs. caffein.

Stimulative

Stimulative

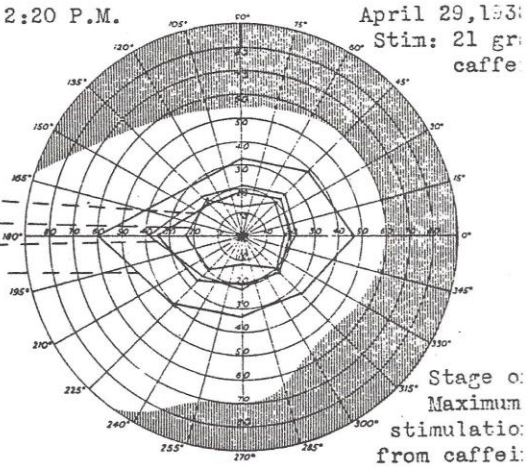
:10 P.M. April 29,1938
Stim: 21 grs. caffein.



Maximum caffein stimulation.

ight Figure #7.

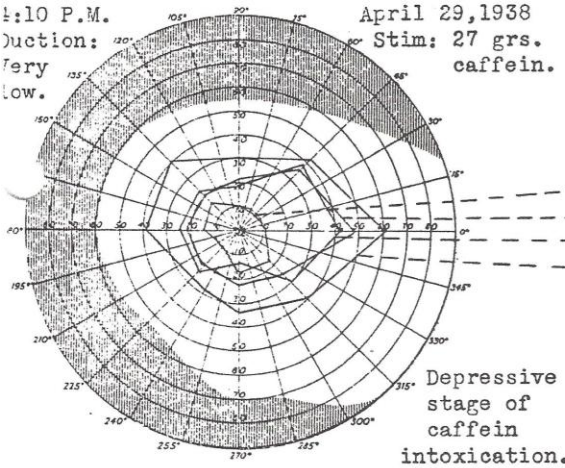
2:20 P.M. April 29,193
Stim: 21 gr caffe



Stage o Maximum stimulatio from caffei

Left Figure #8.

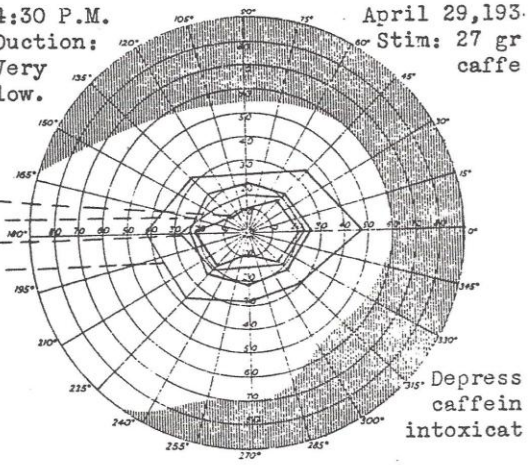
4:10 P.M. April 29,1938
Duction: Very low. Stim: 27 grs. caffein.



Depressive stage of caffein intoxication.

ght Figure #9.

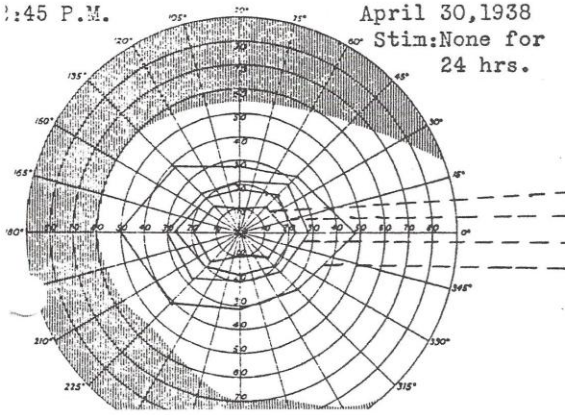
4:30 P.M. April 29,193
Duction: Very low. Stim: 27 gr caffe



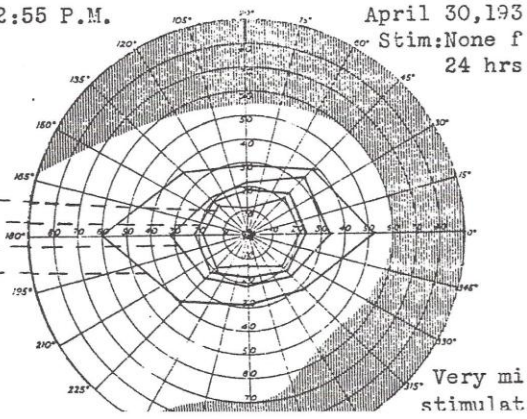
Depress caffein intoxicat

Left Figure #10.

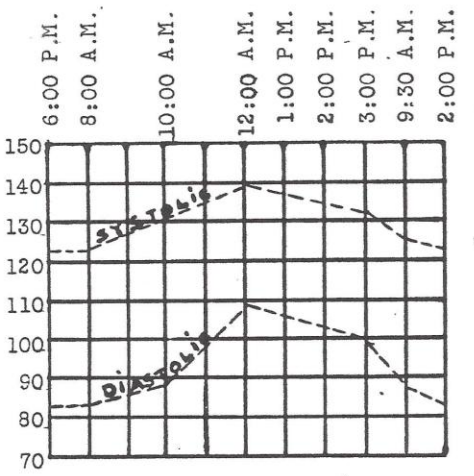
:45 P.M. April 30,1938
Stim:None for 24 hrs.



2:55 P.M. April 30,193
Stim:None f 24 hrs

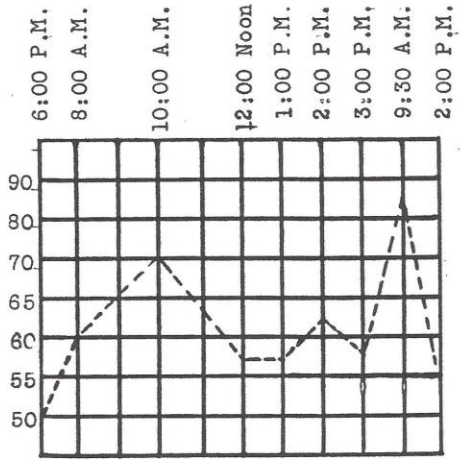


Very mi stimulat



BLOOD PRESSURE

Figure No. 13



PULSE RATE

Figure No. 14

C O D E

G .....Green

R .....Red

B .....Blue

F .....Form

M .....Motion

Any one of these functions, motion, form or color may be affected without any disturbance of the others, indicating some anatomical difference in their method of reaching interpretation centers. It is generally accepted that rods of the retina are achromatic and that the cones of the fovea are likewise achromatic. Therefore, it is not illogical to assume that we have form-specific, color-specific and motion-specific nerve endings in the retina, and further that we have certain fibres carrying each of these sensation impulses. No difference has ever been noted in nerve impulses even though they produce entirely different sensations. For instance impulses that result in the sensation of heat have not been differentiated from those that result in the sensation of blue color, etc. Then how difference in color sensations is interpreted if it isn't done by anatomical differences in conduction paths and brain areas is still a mystery. Never-the-less we make very definite use of the information that is available in visual field studies.