VISUAL FIELDS

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As you will readily note the material presented thus far in this series on visual fields has been the classical data of all investigators, medical and non-medical. No attempt has been made to introduce any new material, or even relatively new material, as the aim has been to lay a solid foundation on already established phenomena. Long years of acceptance and profitable use, and numerous special investigators arriving at the same conclusions, have proven beyond question the truth and value of the phases of perimetry presented to date. The many authors referred to in past lessons have encouraged additional research which has given us even more knowledge on the subject, and too much credit cannot be given them for their work and encouragement.

We believe that though the classical material already given is indisputable, and of great value, that there is yet another part of perimetry that will be more useful to Optometrists in daily practice. If it is not useful and practical in practice, then it has little value to us. A theory may be provable, but a theory has not yet been proven to be true. The work in visual fields we speak of has been tested over a period of thirty years, and an average of about one thousand controlled cases for each of these years has established the value of the work. This special investigation regards the changes that occur in the size and proportion of the outlines of color vision.

ESTABLISHING A "NORM"

In order to determine whether any finding is “abnormal” we must first establish the limits within which the finding can be still classed as “normal." For instance, one man can be five feet seven inches tall while another is five feet nine, and both are accepted as "normal.” They are normal because they both fall within a certain percentage of deviation from a mean or average of all individuals. A person being four feet ten inches tall, and a person being six feet five inches tall would be classed as "abnormal" because they are nearer the extremes rather than the means. These abnormals, however, do not signify there is anything “wrong" with them to have caused their departure from average.

Let us take another kind of rating where a departure from normal, or average, does indicate something dangerous as a cause, for instance, body temperature. In this the "normal variance” is small, and if a person develops a high or low temperature it serves as a warning to the physician. The real task was to determine the limits of the "variable norm," or limits of fluctuation that might occur without an indication of disorder. The second problem was to find and eliminate the agent responsible for the change in temperature.

So far as visual fields is concerned the first step has been found and pretty accurately established long since. What the size and proportion of the area of the various color sensations should be, has been agreed upon by many reputable men. The thing that was left to be discovered was “what is indicated if

there is a deviation from the normal field?" It is to this we referred when we spoke of thirty years research with control over thirty thousand cases.

It has been found that slight variations can take place that have no meaning in and of themselves. To the physician slight variations in body temperature mean little or nothing unless he has a record of temperature at other times, under controlled conditions, for comparison. Through this comparison trends can be noted in an individual where one reading alone has no value. To the perimetrist slight variances in the outlines of color fields will have no meaning unless a succession of charts are made to note the changes and trends. There are, however, some very definite limits to the variations that may occur without undue alarm. It is because of this we will discuss the limits of a "variable norm" as well as the exact average.

The average color field will have certain general characteristics that are unmistakable. Among these are that the field for green will be smaller than that for red, or any other color. Red will be seen over a larger area than that for green, that is red can be seen farther from the central fixation point in all meridians. Blue will be seen larger than red in all meridians. Yellow ordinarily is seen *ov*er an area larger than blue, but for routine practice no special value has been attached to this color, and so is omitted. Form recognition coincides very closely with the field for white recognition and is larger than the field for any and all colors. Vision for a moving object will be over a larger area than for the form of a stationary object.

While making the test the patient will be fixing on a central spot. The targets are brought in from the periphery to a point of full saturation of the color while it is in a stationary position. This point is recorded on the chart in all meridians and the points are connected together by straight lines. After the points are connected and an enclosure is formed, it is easy to note any overlappings of one color over another, etc. If desired the areas for various colors may be filled in solidly on the chart for a better appearance and ease in reading. When this is done all the green will be filled in solid. The area between the green outline and red outline will be colored solid red, and the area from here to the blue outline, solid blue. The white is left white, but from the white outline to the limits of motion is filled in solid with black. This is a standardized procedure. (See last page)

Now let us see what various investigators have found to be the average normal, and let us consider, too, the technique used to find these answers.

Lloyd has the following to say regarding the technique of obtaining color field outlines:

"Color sense is mostly a central function. Recognition of most colors, like red or green, as it is moving from the outer limits toward the center, is not, at first true color recognition.

Green will appear colorless at first, then white before it takes on a real green tint. Red is first colorless, then sort of a terra-cotta tinge followed by a yellow before it appears as red. Blue is first colorless then sort of gray, and finally blue."

He also says there is sort of a "doubtful zone" wherein the results vary widely, according to the quality of the colors used, illumination, background, etc. He gives as average fields the following, when using a black background:

Blue . . 54 degrees from fixation point
Red . . 42 degrees from fixation point
Green . . 35 degrees from fixation point

and as follows when using a white background:

Blue . . 36 degrees from fixation point
Red . . 32 degrees from fixation point
Green . . 43 degrees from fixation point

From his work it will be noted that using a white background red and blue are decreased while green is increased. He does not give target size, though, nor illumination.

Traquair gives one table that shows results very similar to Lloyd's conclusions, but his material is based on only six patients, three male and three female. His light source was "daylight on an average winter day." This, then, is of little value, in fact Traquair said in 1928 that so little is known about color fields that he has not done much with it. We quote him as follows:

" ----------examples suggest the possibility of establishing some degree of correlation between the toxins and the field changes they produce, by recognition of the character of the defects, and show that perimetry has, in this respect, a definite role to play, though its value cannot yet be correctly estimated. The whole subject of relationship between different toxic substances and their specific effect upon the visual function forms a field full of interest and as yet little explored."

It is this specific thing, effect of toxins on the visual field, suggested by Traquair, with which we wish to deal.

Traquair’s measurements using 5mm target at one-third meter:

	Blue	Red	Green
out	80°	53°	28°
in	35°	23°	14°
up	30°	22°	12°
down	33°	31°	12°

Luther Peter writes that his average color fields are slightly different in proportion than these given so far. His table using 5mm targets at one-third meter follows:

	Blue	Red	Green
out	65°	40°	30°
in	39°	25°	19°
up	39°	26°	18°
down	48°	30°	25°

Hirschberg's measurements of the normal color field though no size of target nor distance are given.

	Blue	Red	Green
out	65°	40°	30°
in	39°	25°	19°
up	39°	26°	18° .
down	48°	30°	25°

Notice that Hirschberg's compare identical with Peter's. Evidently there is some correlation between them; or one took his from the other.

DeSchweinitz gives his table of the normal field when using a 10 mm disc at 13 inches. The distance is the same but the targets are twice as large. It gives a much larger field.

	Blue	Red	Green
out	80°	65°	50°
in	45°	30°	25°
up	40°	33°	27°
down	58°	45°	30°

Brombach's work with color fields has been for the specific purpose of developing methods and data for diagnosis from the color fields, consequently greater care has been exercised in establishing controls. He says a background of flat black or flat neutral gray are equally satisfactory, providing the same background is always used. Light sources have been better controlled for uniform results. A technique for obtaining the true saturated field, not including the "zone of doubt" referred to by Lloyd, has meant for more uniformity. The hour of the day, fatigue factors, accuracy of the operator and patient, physical prominences of eyelids, brows, etc., all have a part in influencing the field. Under these controlled factors the average normal color field is found to be slightly smaller than those of other investigators.

One fact remains: no one has ever found healthy subjects, free from toxins, to have any colors overlapping or interlacing with other colors. A proportional increase in size from green to red, from red to blue and blue to form is found to be normal. This does not vary in normal persons when the advocated technique is used.

The accompanying diagrams show two methods of recording color fields. The second is most generally used as shown in figures 2 and 3, which show normal and abnormal fields. Figures 5 and 6 demonstrate how coloring the outlines in solidly aids in showing diagnostic points. For routine practice outlining will suffice.

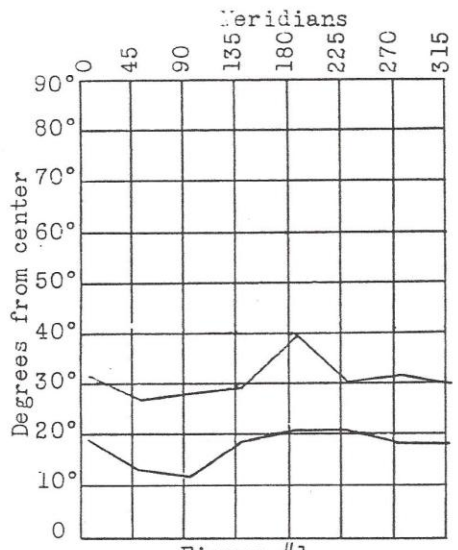


Figure #1.

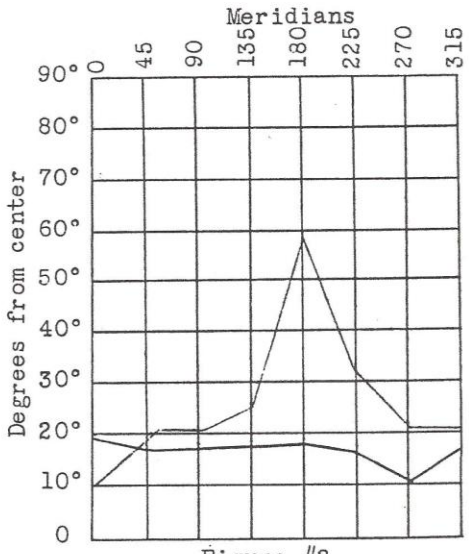


Figure #2.

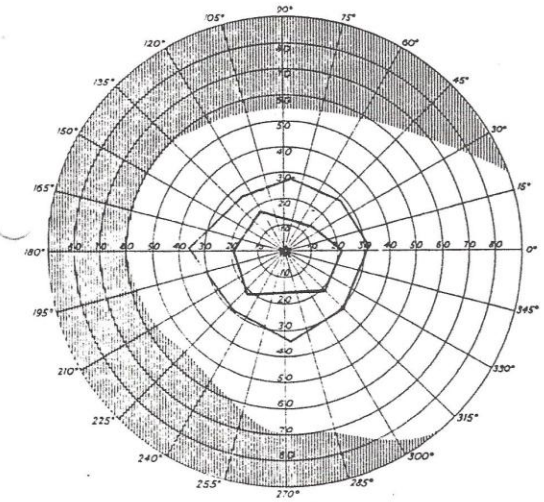


Figure #3.

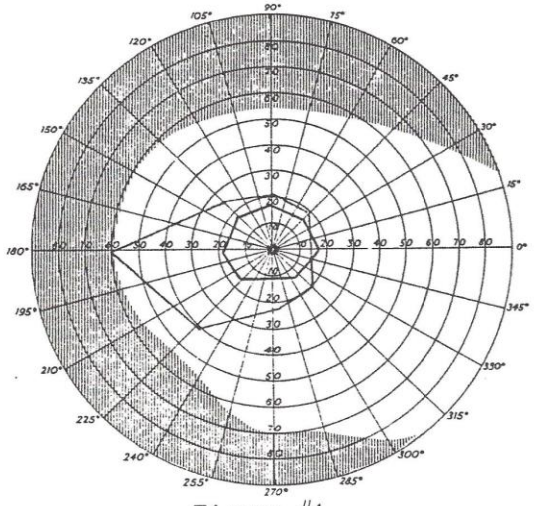
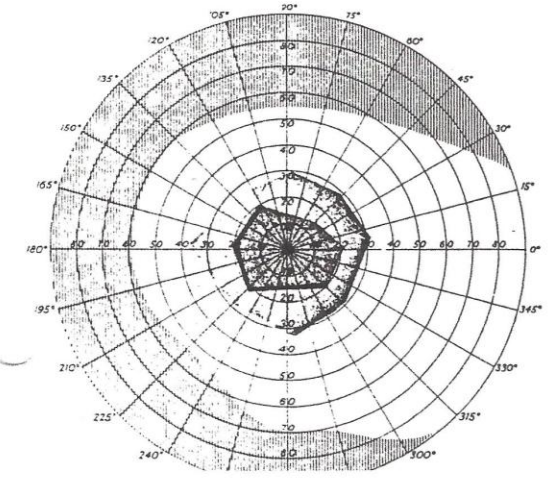
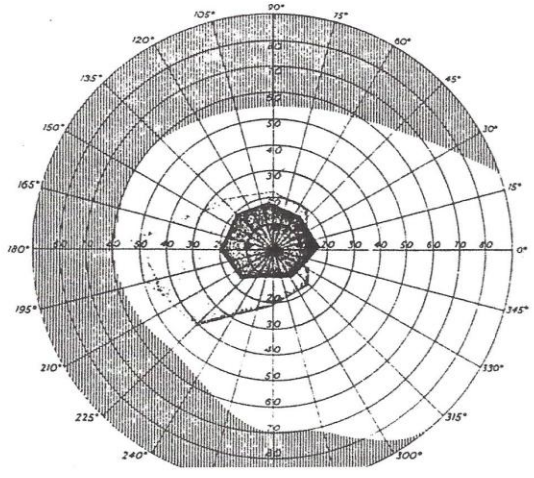


Figure #4.





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Until recently perimetry meant little more than charting form and color fields with the intention of searching for concentric contraction and sectorial defects in the peripheral region. Little attention was paid to the interlacing and overlapping of the outlines of the various colors which are the real basic facts in the perimetric analysis of the stages of intoxication. This has probably been due to the wide variations found with imperfect illumination of the arc and target, the types of instruments employed and the lack of sufficient clinical data correlating color field changes with specific toxic agents.

We refer again to Traquair's statement suggesting the possibility of correlation of visual field changes with different toxic substances, and that in such correlation perimetry has a definite role to play. We believe positively that that prophecy has been fulfilled and has become a reality.

STAGES OF INTOXICATION

Toxic amblyopia has been known for many decades. It has been reported as a central scotoma, sometimes absolute; so all light perception is lost, and sometimes as relative, affecting only certain visual stimuli such as a specific color. It must be obvious to every student of physiology that activities of cells of a living organism do not ordinarily change from normal-function to an almost lethal stage without certain preceding indications. We can safely leave all sudden losses of part of the visual field to trauma, retinal detachment, vitreous hemorrhages, and the like, and assume that toxic conditions do present definite signs during their various stages of development. In medical investigation the finding of early symptoms materially increases the chance for preventive and corrective therapy overcoming the disease In perimetry recognizing early changes in the field will be of just that much more value in prevention and correction than waiting for final stages to appear.

With an average and normal color field already well established for us we can readily detect deviations. Finding the reasons why these deviations exist has been the making of perimetry. To the average perimetrist we can say unhesitatingly that during the past years you have found overlapp1ng and interlacing of colors to be very common. Part of this can be explained, perhaps, by the kind of perimeter you were using as to targets light source, etc. Also the fact that perhaps you did not always get the full saturated color field will account for some discrepancies. It is assumed, however, that these factors have been corrected and you are now ready to incorporate into your methods the knowledge of new Optometric perimetry.

In keeping with all scientific investigation it has been found that toxic effects go in stages. Visual field changes have been recorded and correlated with changes in ductions, heart beat, respirations, muscle tonicity, etc., in toxic conditions and the fields that are manifest when these other functions are stimulated are classed as stimulated fields. Fields that are found when the other controls are in a state of

depression are classed as depressed fields, etc.

Peter claims that the green field may extend beyond the red in hysteria and that the green-red, reversal, or interlacing, may be looked upon as functional, organic in origin, and due to circulatory disturbance.

DeSchweinitz has found the blue-red inversion as common as the red-green inversion.

Cushing, and others, have found color inversion, and interlacing, in brain lesions.

The first authentic information on record regarding the definite relationship between the various toxic agents and the interlacing and overlapping color effects, associated with the variable tonicity of the ductions, demanding comparative examination of the eyes at different hours of the day was presented by Brombach to the University of California in a volume entitled “The Optometric Analysis and Interpretation of Auto-Intoxication" during 1928.

The disturbance of function caused by the activity of poisons is termed intoxication. Intoxication, then is a condition of poisoning, or rendering toxic, and has a much broader meaning than that ordinarily applied in relation to inebriety from alcohol intoxication. A clear understanding of this will be necessary as we refer so frequently to intoxication in its true meaning.

Alcohol has been classed as a stimulant, depressant medicine, food, etc. but such terms are variable in meaning and misinterpreted more often than not. Almost any substance administered in sufficient quantity, under given conditions, is capable of causing death of the organism. Substances are considered toxic, though when a relatively small dose is followed by damage to the organism. Individual susceptibilities vary greatly, that is, it requires different quantities of a toxic agent to produce like signs in different persons. What is toxic to one person may not be to another, or at least, not in the same degree. Some persons seem to have greater resistance ability to certain toxins than others.

Whatever may be said of alcohol may be said of tobacco, coffee, tea, and other toxic agents and it is with these alkaloids and their specific effect on the color fields, the tonicity of ductions, and general visual efficiency that the theories based on color field interlacing and inversion has been developed.

When a patient applies for care he knows little about his ills except that he experiences certain symptoms of distress, or inefficiency. He leaves it to the practitioner to discover the character and cause of such failures, and to properly analyze them so he may confer benefit through his professional ability and service to the patient. The recognition of pathology of tissue by a physician is based upon signs indicating the condition to him. These signs may be immediately manifested, or may be recognized only after personal observation and record of long duration. Pathologic and chemical changes affecting vision, therefore, are vastly important to the eye examiner. He must differentiate between ocular dysfunction excited by toxic influence and those caused by fatigue in the visual reflex per se. Because pathology and intoxication do often cause visual dysfunction to the extent that patients seek aid from Optometrists, the former cannot be safely ignored in practice. Fortunately certain correlations have been made between the state of toxicity and the visual f1eld.

When patients apply for help it is our responsibility to administer relief through ophthalmic lenses,

orthoptic training, hygienic advice, or in the case of impending or active pathology, the patient is to be referred promptly to the dentist or physician with a report of the findings of the ocular and visual examination.

HOW FIELDS CHANGE

Through the continued investigation of field changes in relation to toxemia, it has been found that wherever there is produced an overlapping or interlacing of the color field outlines, under the technique advocated, it is a positive indication of the presence of a toxic substance at the time of the test. Because an earlier, or later test, proves to be different, or "normal" does not mean the other test was inaccurate, or wrong. Where a variation in field findings once was a source of confusion, tending to create disbelief in the value of color field work, it now becomes one of our chief aids in perimetric analysis.

When toxic substances are created in the body, or taken into the body, they are circulated in the blood stream. Just exactly how the toxins in the blood effect the areas of vision for some colors is not known. Just as certain details regarding electricity are not known, though we do have some knowledge about its actions and how to control it, so do we know certain things regarding toxemia.

Toxins circulating in the blood stream will be eliminated in a very short time. If the source of production is stopped the complete elimination will be effected in a very short period. In the case of nicotine from tobacco complete elimination time is about eighteen hours according to Hilario G. Marquez, Ph.D. Elimination of other toxic substances may take more, or less, time. This, of course, is the free toxin in the blood. If it has been stored in liver; or other tissue, it may take much longer as it would have to first be freed into the blood and then eliminated.

Because the kidneys, skin, lymph nodes, etc., withdraw toxins from free circulation in the blood, the visual fields may show a decided change from day to day, or from morning until evening. Then if we take visual fields in the morning after the patient has had rest and has not been taking poisons into his system for several hours, and find a normal field, but late in the day we find a toxic field, we assume that something taken into the body during the day has been toxic to that person. On the other hand if we find the same toxic picture morning and evening we assume that the toxic source is inside the body, producing the poisons at night as well as daytime. If the fields are normal morning and evening we assume the person has sufficient resistance to any toxic substance that he may harbor so that it creates no interference in his visual make-up.

Toxic conditions arising internally are termed endogenous (endo = inside; genesis = origin) and toxic conditions arising from outside the body but taken into it; exogenous (exo = out; genesis = origin). In this differentiation we have a very valuable aid in the diagnosing of toxic sources. The endogenous toxemias may need other professional care. Those that are exogenous often can be found by the elimination method of taking control tests with all potential toxic agents unti1 the responsible one is found.

One of the chief sources of irritation to some practitioners has been where they have suspected a toxic problem and sent the patient to a practitioner of another profession only to have the patient discouraged from returning to the original man. This condition should not exist, but being able to segregate the toxic cases who really need the help of another profession from those we can better care for ourselves will eliminate much of this source of irritation, as well as better serve the individual patient.