VISUAL FIELDS

 Duncan, Okla.

By

Hugh F. Webb, Opt. D.

With the Technical Assistance of T. A. Brombach, OPT. D.

October — 1940 Vol. 1 No. 1

INTRODUCTION

The series of findings known today as the analytical routine all deal with neuropsychological act of brain disbursing nervous impulses to various ocular functions after receiving impulses from the macular region only. This is very valuable information but it tells us little or nothing of the affection of the peri – para macular and peripheral portions of the retina. The information gained from an orderly investigation of the whole retinal area will greatly enhance an examiner's skill in solving visual problems, and in many cases will be the means of phenomenally aiding people, even to the degree of saving life.

Medical investigators have learned much about field studies but their whole purpose has been with the view-point of developing methods for diagnosis of pathology. We quote from Luther Peter, 4th edition, page 35, "It may be said of perimetry that it is a valuable aid in the diagnosis of intra-ocular disease and is the sine-quo-non in the diagnosis of disease of the visual pathway." It is granted that this statement is wholly true, but if that were all that field studies gave us there would be little value to Optometrists to taking fields. When this was all the information that was available it meant that every time an Optometrist found a deviation from normal according to those standards he was obliged to send the patient to another practitioner for treatment, and all too frequently his services to that patient were terminated then and there. He reasoned "why find these things if we can do nothing about it anyway"?

1t was noble of those who continued taking fields to do so as an added service to their patients, but it netted them nothing. This accounts for the unpopularity of field taking in the past. To- (unreadable)Surgery, medicine and dentistry have long had a graphic and demonstrable method of acquainting their patients with bodily conditions through the use of x-ray pictures. Through constant years of research and ten of thousands of case records it has been possible to establish an undeniable utility of color field charts in eye examination that will do the same for Optometry. Control tests can be made before and after therapy and the field charts will demonstrate the value received from advice given. Material has been developed wherein field studies will frequently show the cause of ocular discomfort and inefficiency and in many of these will be sufficient for diagnosis and prescription of corrective measures without correlation with the physician. In other cases the fields will show conditions where it is absolutely necessary to send the patient to a practitioner in another profession. As a matter of practice protection field studies are indispensable in cases where they alone show active pathology. A practitioner assumes a great risk in attempting to correct one phase of trouble but leaving another uninvestigated. If it were not for visual fields some serious symptoms might be completely overlooked that do not show in other routine testing or ophthalmoscopic examination.

The practical side of the problem is the frequency of visual involvements found through fields that can be handled by the Optometrist alone. On several occasions check-ups have been made on a group of a hundred patients at random, consecutive in the order of their appearance at an office, not a selected group, and it has been found that as high as half of them have a complication discovered only by field studies, and over half of these needed no other practitioner for diagnosis or treatment. The routine tests with lenses and prisms, etc. (unreadable) authors in private practice. Many other men situated over entirely different geographical sections of the country have found similarly high percentages.

Case records will be brought out later showing exactly how field measurements have been the sole means of solving vis1a1 problems. Those cases who wander from one office to another without gaining solution to their problem may finally get the answer through field studies.

A11 of us are familiar with the school chi1d who cannot read effectively but who can see the tiniest letters on a Snellen chart placed across the room, and so has had no he1p given him. How many of these will develop large blind spots after reading for a short period? Correction is simple with those who do. This will be discussed in a later paper.

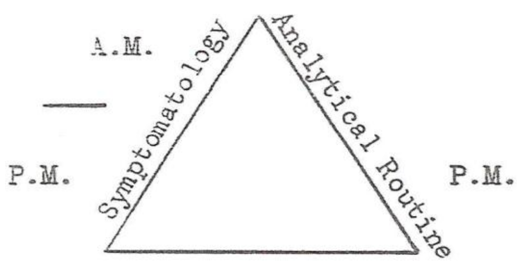
Although we know *of* the increase in blind area from the normal blind spot of Marriotte from glaucomatous pressure at the disc, do we wait for ophthalmoscopic signs of glaucoma before taking fields when they have 1ittle, except confirmative, value? We readily comprehend that there will be blind areas in a case *of* retinal detachment or multiple sclerosis. Lesions *of* the optic nerve or tract may never be found except for visual fields. Eyes are influenced by toxic conditions. Changes in the peripheral 1imits of the color field will show this long before painstaking fundus exploration can be *of* any assistance, and it shows it more graphically than any other tests. Lenses and prisms won't eliminate poisons even though they may offer temporary relief from their effects on visual fatigue. It will also be revealing to note the part that fatigue plays on the areas of visual perception and the resultant efficiency of employees in their tasks. Oh, the worlds that are open to Optometrists in industrial work if they but use the tools before their hands. Visual field measurements have a direct bearing on the growth *of* the profession and the individual Optometrist.

To the man in Optometric practice nothing is as valuable to him as being able to find the cause of the ocular complaint and a method of giving relief. This principle is what all professions dealing ……………… a foundation for their existence. Insofar as a profession can offer this service, it will grow. If it fails to do so it will cease to exist as new demands are continually placed upon it. What people expected and received a decade ago will not be sufficient for the new generations.

Of the thousands *of* people who present themselves daily for Optometric care most of them are helped by the ordinary procedures now in use in average offices, some in greater degrees than others. Some are turned away with no help offered and others may receive no benefit despite painstaking efforts in their beha1f. The latter are, of course, in minority, but nevertheless they exist. The reason may "be lack of complete information regarding the anomalies of their visual apparatus.

Great strides have been made recently in the techniques of examination in analytical procedure, and just as great have been those in the interpretive value of the information thus obtained. The result has been better visual service to patients than ever before. In this vast array of developments is that of exploration and interpretation of the findings made in the field of vision outside the macular area. It is the indirect field of vision. Developments in this phase of Optometric care have resulted in a much widened field as well as an economic asset in practice. Many years of research have simplified and standardized procedure to its present practical, usable state.

It is not claimed that perimetric and campimetric field charting is the panacea of all eye problems. It is one of the parts of a complete eye examination, and must be correlated with other data. Each part will give its own independent share of information, but all parts together will give an integrated whole not obtainable by anyone part. In analyzing a patient's ocular complaint there are three phases that must be considered to get a view of the whole picture. They are the symptoms experienced by the patient, the findings obtained from investigating the reflexes controlling focus and adduction, and information gained from investigations of the patient's ability to interpret from the periphery of the retina. It is represented in a diagnostic triangle thus:



A.M. Visual Fields
P.M. Visual Fields

The completed triangle constitutes a visual analysis. If only one or two sides are completed the examination and analysis of that patient cannot be complete.

This study of visual field work will be conducted in a simple and orderly manner giving attention to details not ordinarily resorted to in text books. Special attention will be paid to technique, for if it is not standardized results cannot be expected to be. The practitioner who has had no previous experience with perimetry will be fully able to analyze field measurements whether he takes the findings or he has a technician do it for him, if he follows the material step by step.

This course is intended to be practical. Only those things which are usable in practice will be discussed. Long dissertations on theory will be avoided. Of course the whole subject is highly integrated, but we will attempt to make each lesson stand as a unit. In the simplicity of the presentation none of its value will be lost, rather much will be gained, because through simplicity time will be saved both in study and in the use of the work. A long examination is not necessarily a good examination.

Some questions are bound to arise. When there is doubt on any point write to O.E.P. headquarters in Duncan, Oklahoma. All questions will be carefully considered and answered in the following month's lesson. This method will give an official answer and will eliminate differences from personal interpretation to individual answers.

SUMMARY

Visual field studies, that is, investigation of the responses of the patient to light and images cast on the peripheral portions of the retina is an independent phase of eye examination work. It gives added information where testing responses from macular area stops.

It is the only source of information in certain types of lesions in the brain and optic tracts from trauma or disease.

It gives added information to disease conditions of the eyeball and specifically the retina.

It give information, specific and concise about the progress and effect of toxemia, both endogenous (being generated within the body) and exogenous (being taken into the body from without), and differentiation of the two.

It shows the reasons for many reading problems in disclosing permanent or temporary blind areas not normal to the individual.

It finds the reason for many traffic accident repeaters unaccountable from the point of acuity, fusion, stereopsis, or things not even related to visual ability.

It offers a graphic representation to the patient that means much more to him than a verbal diagnosis. He can see his own deficiencies and note his own progress.

It enhances a practitioners own ability in diagnosis, and confidence in the same.

It offers a dignified means of correlation with other professions.

It adds to ones own practice by giving a more thorough and complete service that is immediately recognized in a patient’s comparison of practitioners.

VISUAL FIELDS

 Duncan, Okla.

By

Hugh F. Webb, Opt. D.

With the Technical Assistance of T. A. Brombach, OPT. D.

FIELDS OF VISION

November – 1940 Vol. 1 No.2

The field of vision is a projection into space of the areas of interpretation from the retina while the eye fixes at a steady point. In so much as the visual field is directly responsible to the function of the retina a knowledge of retinal physiology becomes very important. There are certain physical and physiological limits as to where the field may be.

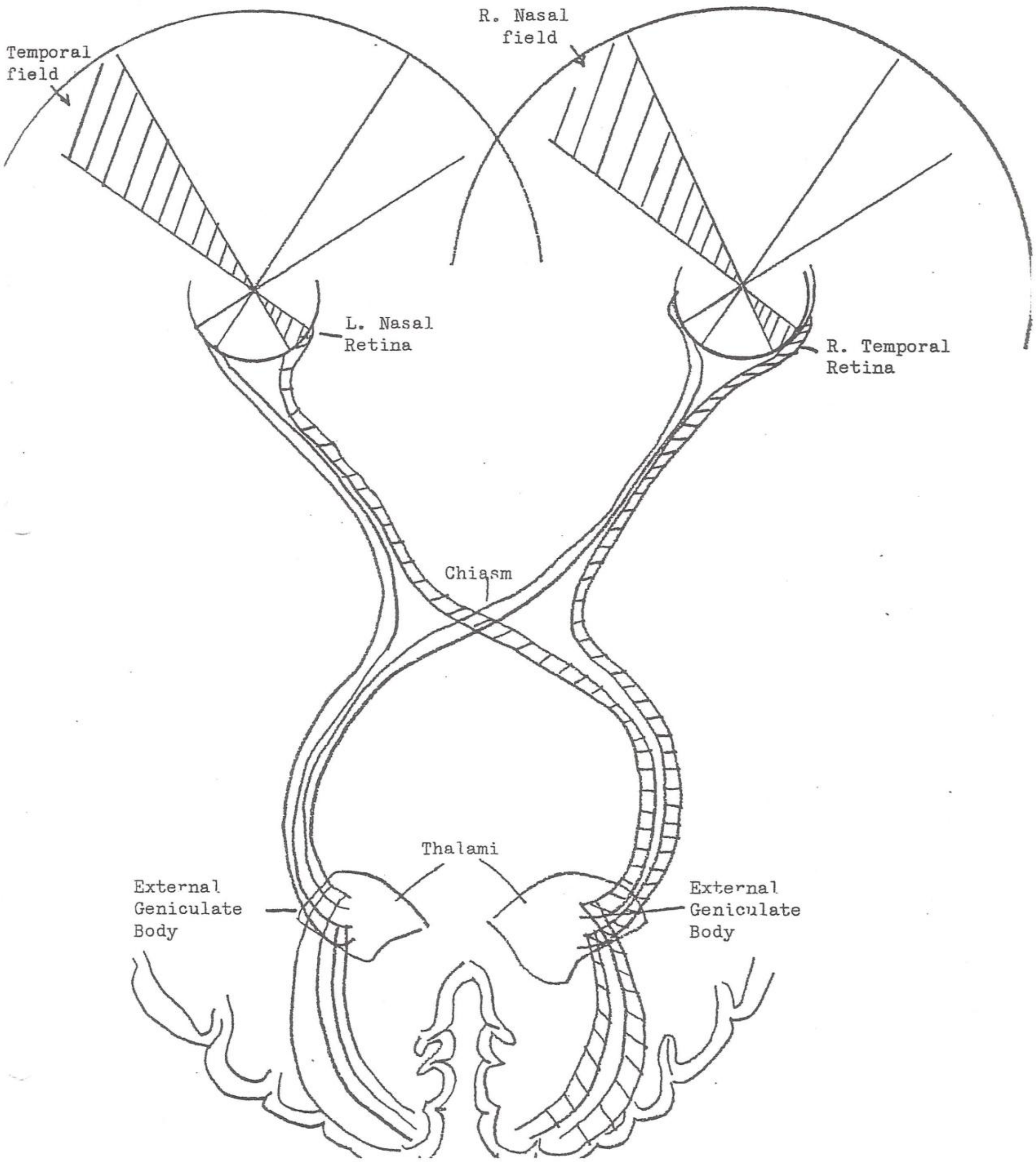
The retina has been called the inner tunic of the eyeball, that is, the inner of three layers. It is made up, roughly, of nerve endings where light energy is transformed into a nervous impulse, the nutritive cell body, and the fibres which carry this new nerve energy to the brain. We will be more concerned with the endings, or "receiving stations." At this point we would like to refer the student to any good text on physiology where profuse illustrations will add materially to the knowledge of the subject.

The nerve endings are divided into two general types called rods and cones. Their names are derived from their shapes. These rods and cones are packed very closely together, there being about 7 million cones and about 130 million rods in each retina*. Many rods, or many cones, however, may all connect with the same nerve fibre for transmission to brain, as there are only slightly more than 1/2 million fibres from each eye. This is especially true at the periphery where detail discrimination is not required.

At the fovea centralis there are no rods but all nerve endings are cones. This exists over a very small area about.2 mm in diameter and corresponds to about 1/2 degree in the visual field. At about 1 to 1 1/2 mm from the center the cones have several rows of rods between them. As the distance from the center increases the rods become more numerous and the cones less so. At 3 or 4 mm from the center the rods outnumber the cones 20 to 1, which relation holds true to the Ora Seratta, or extreme outer limits. Most investigators conclude that in the fovea centralis each cone has its own cell body and nerve fibre (axon), while at the periphery one fibre may be shared by many visual cells. (Compare the 1/2 million fibres with the 137 million rods and cones). This undoubted1y accounts for the extreme difference in visual acuity at the fovea and the area surrounding it.

Fibres from these rods and cones course over the retinal surface to an exit point about 3 mm nasalward from the posterior pole of the eyeball. The bundles of fibres leaving the eye, being covered with sheathes, individually, in bundles and as a whole, are called the Optic Nerve. As the fibres first leave the eye the arrangement of the bundles is similar to the relation of the rods and cones to each other, that is, the Optic Nerve is a miniature of the retina. As they extend further from the eyeball the bundles gather into various pathways and do not hold exactly the same position as when leaving. These pathways are pretty well known and anatomists can trace the exact place of lesions in the pathway from the areas affected in. the visual field.

W.D. Zoethoat - Physiological Optics - 2nd edition.


Temporal field
R. Nasal field
L. Nasal Retina
R. Temporal Retina
Chiasm
Thalami
External Geniculate Body
External Geniculate Body

One bundle of fibres from the macular nerve endings is called the papillo-maculary bundle. This is a very important group as they carry the impulses from central or "direct" vision.

At the point where the fibres gather to exit from the eye there are no nerve endings over an area slightly larger than the nerve itself. This blind area is about 5 1/2 degrees in width and about 7 1/2 degrees in height, and was first discovered by Marriotte in 1668 when he demonstrated it to the King. Thus it bears his name, the Blind Spot of Marriotte. The point in the retina where the blind spot occurs is called the optic nerve head, or optic disc.

The correlation that exists between corresponding points on the two retina is a marvel. Fibres from the temporal half of the left retina and fibres from the nasal half of the right retina both go to the left half of the brain, entering through the External Geniculate Body, on or adjacent to the Thalamus. Fibres from the nasal half of the left retina and tempora1 half of the right retina go to *the* right External Geniculate Body and thence radiate through the brain to the proper areas.

The place where the fibres from the nasal halves of both retina cross, or decussate, as it is called, is named the Optic Chiasm, from the Greek letter Chi, meaning a cross. It is thought that fibres from each fovea centralis go to both halves of the brain. Thus macular fibres both decussate and go direct to the same side, affording a maximum protection against loss of central vision.

SCOTOPIC AND PHOTOPIC VISION

It is common knowledge that upon entering a dark room from bright outdoors, things cannot be seen until the retina becomes adapted." Likewise going directly into the bright sunlight from a place of low illumination gives the same result.

If we wish to see detail in objects, differentiating light intensities or minimum separations, we turn our eyes to use the foveal areas. The fovea possesses power of greater discernment in light. In low illumination it is different. We can see a star in the heavens, or a dimly lighted object better by turning the macu1ar area to the side of the object allowing the image to fall on perimacu1ar elements. In fact it is wholly possible to see some dim stars with perimacular vision but not with direct macular vision. It is evident that a retina1 difference exists. When the eye becomes dark adapted we call it scotopic vision. When the eye becomes light adapted we call it photopic vision. This adaptation does not take place in foveal vision, but does in vision outside the fovea.

In daylight vision we readily recognize many different sensations called colors. Colors perception does not exist in scotopic vision, which is easily demonstrated in the following experiment: place small squares of various colored paper on a black background. In a very feeble 1ight the eyes- will dark adapt and when illumination is sufficient the colored squares will become visible only as grey. These grey patches are seen with perimacular areas. As illumination is increased and the eye light adapts, or goes into photopic vision, the colors will become apparent.

The answer to why rods can discern dimmer light than cones may be in that severa1 rods connect with one nerve fibre and summation, (building up) takes place. The Rhodopsin of the rods may also influence it. So little is known of Rhodopsin, though, that its discussion has no place here. One thing that appears certain is that rods can record motion where cones fail without more permanent and stationary stimu1ation. Rod vision, and thus motion, is the last to be lost and first to be regained in certain visual disturbances. The value of this wi11 be brought out later in the course.

The periphery of the retina is very rich in rods, and motion vision is better here. Central vision is rich in cones and detail is better in the macula. Color is conducted over most of the retina but falls off at the periphery. How and why these areas of vision are a1tered is our prob1em in visual field analysis, and will be taken up in proper sequence.

VISUAL FIELDS

 Duncan, Okla.

By

Hugh F. Webb, Opt. D.

With the Technical Assistance of T. A. Brombach, OPT. D.

December - 1940 Vol.1 No. 3

In order to have some degree of uniformity in results a uniform method of technique must be used in any scientific investigation. Taking visual field measurements is no exception to the rule. To assist practitioners in this, manufacturers of equipment have incorporated certain uniform features in their instruments for field taking. It is true that each type of apparatus has its own distinct advantages, and because of slight differences the technique herein discussed will necessarily be general. Every perimetrist will have to choose the instrument to his liking and apply the principles of orderly investigation that best suit his needs and purposes.

Let us heed the warning here that individual techniques will require individual experimentation on a large scale to establish the value of that technique, and what is expected from using it. The real value of using the technique advocated is that its expecteds are already built and correlated for you. It is then easy to distinguish an abnormal field under these controls. Keeping certain controls during the test is imperative.

ABC PERIMETERS

Most universally used in visual field measurement is the arc perimeter. This instrument constitutes a band of metal curved in a semi-circle with the patient's eye at the center of the arc. With this arrangement all parts of the arc are equidistant from the eye being examined. The arc is so fastened that its arms can be rotated so as to describe a hollow half sphere. If the sphere were complete the eye would be the center of the entire sphere. The arc is marked in degrees from the central fixation point so reading can quickly be taken and transferred to charts.

Several mechanical features are quite essential in all perimeters to gain uniform results. One is that the arm of the band be wide enough to obscure the operators hand and all moving parts except the fixation target itself. One make of equipment has an arrangement attached to the arc so even the fixation is obscured until the desired time for exposure. It is kept behind a screen the same neutral color as the background and when exposure is desired it is made to appear through a hole in the screen. Most other equipment has the fixation object in constant exposure and the operator simply brings it into the area of recognition.

A second essential feature is to have an artificial illumination source that provides constant luminosity, seven foot candles being accepted as standard. Different light intensities will produce different field sizes as proved by Drs. Feree and Rand. Daylight itself is the most variable of all light sources and so is not dependable to use. The light should fall on the arc from above and behind the patient to avoid glare and shadows.

Saturated colors for targets are necessary Varying shades, or pastels, will alter results. Pure Heidelberg colors of green, red and blue, and pure white are recommended. The white must not be in the least less pure than the fixation cross in the center of the arc. If it is, a mental comparison will be made, and the charted field will be smaller than the real area of white recognition. Wrong diagnoses have been made from this factor. Attention to details in equipment is important.

Other valuable features of good equipment are to have it as simple as possible, and free from distracting gadgets and accessories.

TANGENT SCREENS

A tangent screen for measuring visual fields is a flat surface rather than an arc semi-circling the patient's eye. From the diagram it is obvious that calibrations must be different on the tangent screen than the arc. Near the periphery the linear distance (A) is greater between 10 degree separation markings than near the center (B). In other words the concentric circles of the tangent screen must be based on degrees from the center and not on linear distance. On the arc the two are equal, but not on the flat surface.

(See figures I and 2).

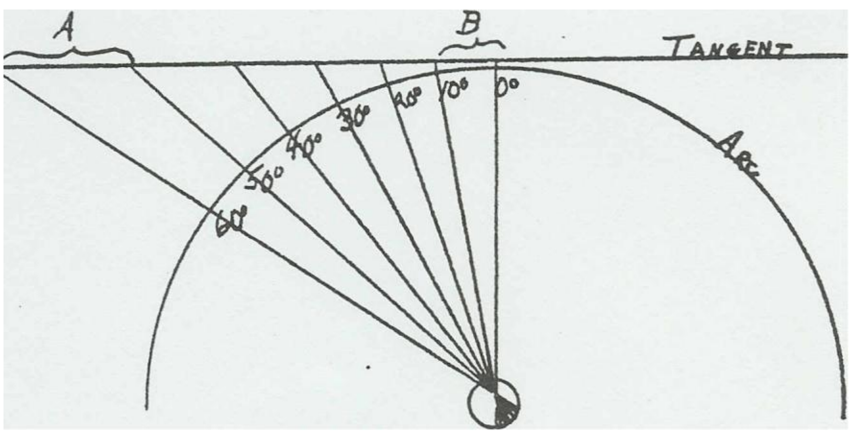
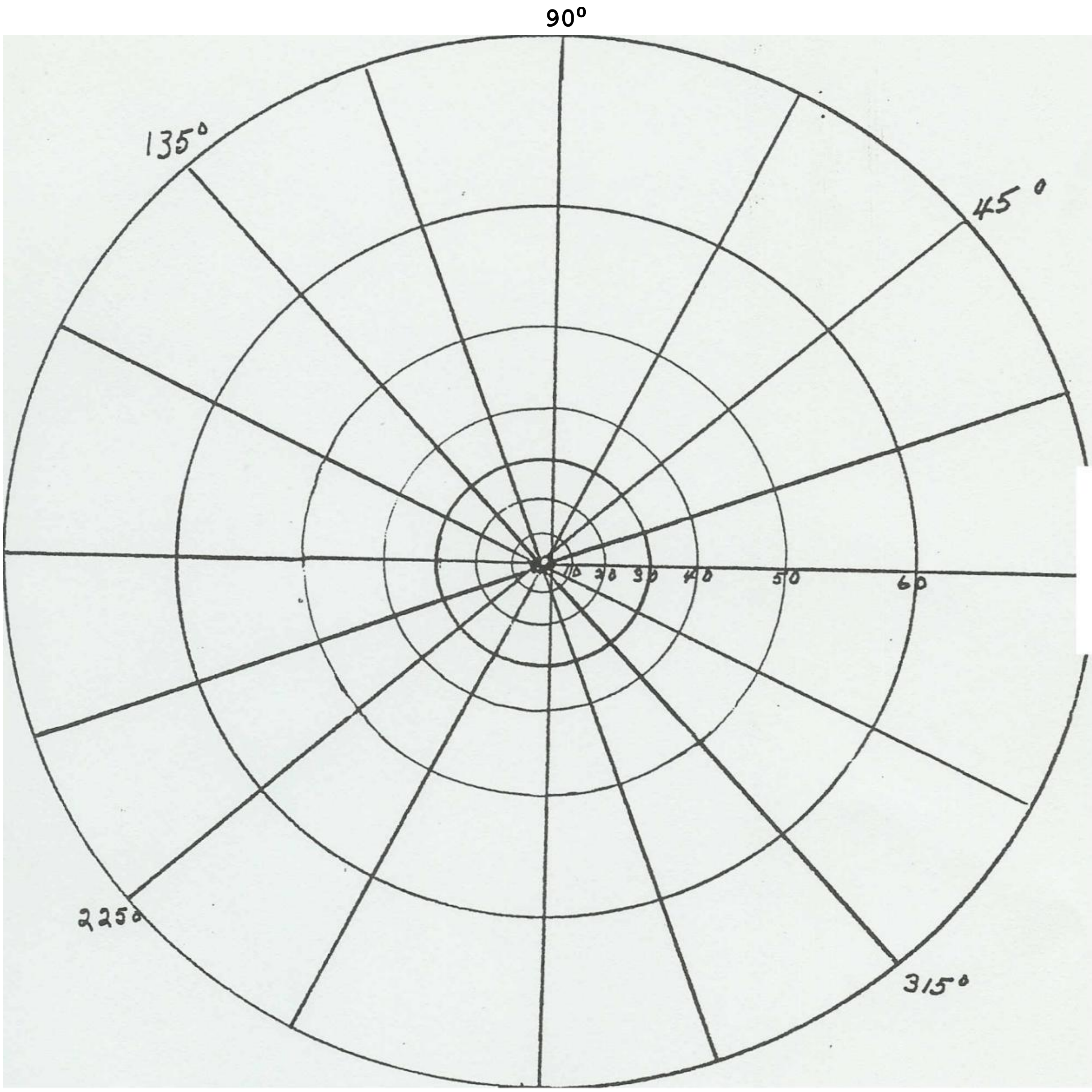


FIGURE 1. Relation of arc to tangent screen.

In making your own tangent screen the distance from the patient’s eye to the central fixation spot represents the radius of the arc from which your circles can be calculated. It must also be remembered that all tests made on a screen be made at the distance for which the equipment is built.



Most arc perimeters have tangent screen attachments with charts to fit the attachment. They are small, however, and can be used for only about 25 degrees from the center. They are adequate for central, pericentral and paracentral scatoma and for the normal blind spot of Marriotte and its enlargements. For peripheral scatoma a tangent screen for use at one meter or one-half meter is necessary.

Tangent screens can be made of black cloth felt with black stitching for lines. They can be stretched in-frames on castors or wheels, or can be hinged on the wall or examining chair and swung into place before the patient. Another convenient method is to have it on a window blind roller and fastened to the wall. It can be withdrawn during use, and rolled up out of the way and out of dust when not in use. See that it is at eye level and at the proper distance.

Instruments are available that project a tangent screen onto a plain surface, such as a screen or blackboard. They work on the same principle as instruments which project letters for visual acuity testing.

CAMPIMETER

A campimeter is a small form of a tangent screen designed for central and paracentral measurements at close range. The tangent screen attachments to perimeters are campimeters. On another type of equipment the use of stereoscopic vision can be made while each eye is separately measured for field defects. By employing a mirror the eye not under examination is allowed to see an object similar to the one the other one is seeing, being reflected from a side position. Thus fusion and even stereopsis, can be maintained during the test.

TECHNIQUE

The object of any perimetry is to have the eye being examined held in a fixed spot and while thus fixed measure the areas of vision. The examiner places various objects- in the patient's monocular projected field and asks him to report whether he sees it. One eye at a time is occluded.

To obtain the peripheral limits of the field the target is first shown to the patient and then is taken out of his visual area. It is brought silently and at moderate speed toward the center. The patient is instructed to report by word, or by tapping a pencil. etc, when it is seen. If we are measuring the field of one of the colors, he reports when that color is recognizable as he maintains fixation on the central spot. As soon as the patient reports seeing the color the target is stopped. When the target is in a stationery position he is asked if the true color remains constant, or if it fades away. If it fades the object is brought closer until he reports seeing it again and then is again asked if it remains a true saturated color. When it remains a true color in a stationary position the place on the arc is recorded and the target is taken to the other side of the arc to repeat the procedure in the opposite meridian. After this is done the arc is turned to another of the eight principle meridians and the finding made again. When all meridians are completed we start over using a different colored target.

It doesn't matter which color is taken first so long as the same procedure is used at all times. Taking them in this order is recommended: Blue, red, green, white and motion.

The central fixation object should be the same size as test object. This will vary with distance from the eye, but objects of 5 millimeter diameter for use in arc perimetry is suggested by most authorities. A 10 millimeter test object will give a field 10 to 15 degrees larger than a 5 mm. disc.* Most perimetrys have an arc radius of from 35 to 40 cm., or slightly over a third of a meter. Since the visual angle area varies with the distance the same relative target size for a tangent screen at one meter would be slightly less than three times the size for arc perimetry, or from 13 to 14 1/2 mm. At a half-meter the same proportionate size test object would be about 6 1/2 to 7 1/4 mm. In round figures the targets to be used at one-half meter would be 7 mm., and at one meter, 14 mm. The important factor would be to use the same targets at all times, and keep the distance accurate. Providing a chin rest is the most satisfactory way for this.

In arc perimetry each meridian is recorded on the chart as it is taken for each color. For instance, if the test object is being brought from the patient’s upper outside meridian, it is recorded on the upper outside meridian of the chart. The patient's lower meridian is recorded on the lower meridian of the chart, etc. The chart should represent the area of vision as the patient looks at it.

In campimetry the marks are usually recorded directly on the screen, which is a chart itself. In tangent screen work small pins with colored heads can be pinned into the screen at the time of the test and later transferred to a chart. With projection equipment, or with a tangent screen colored chalk marks can be made and later transferred to a chart.

To obtain the field for motion a 1 mm. target is used in arc perimetry, and as it is brought in from the extreme periphery it is kept in a constant wiggling motion. The patient does not have to recognize the small spot, but simply be aware that there is motion. The point so recorded on the eight principle meridians are then connected by straight lines. The enclosed are represents the patient’s visual field.

* Ralph I. Lloyd – Perimetry and Campimetry 1918 B. & L. Publishers.