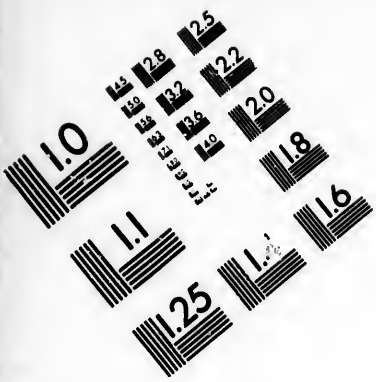

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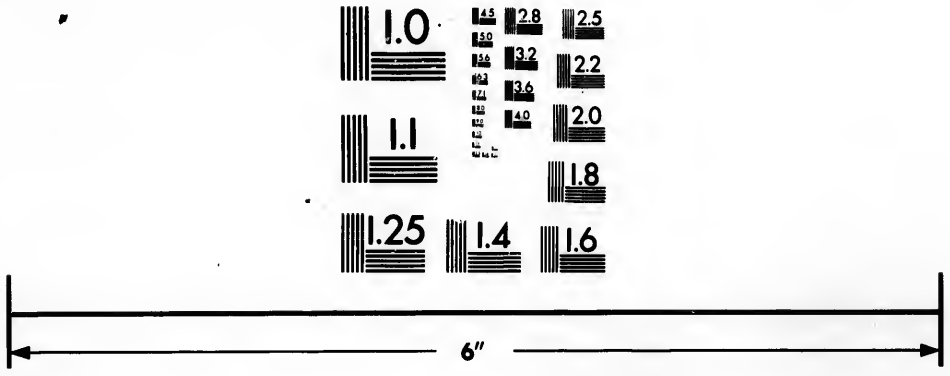

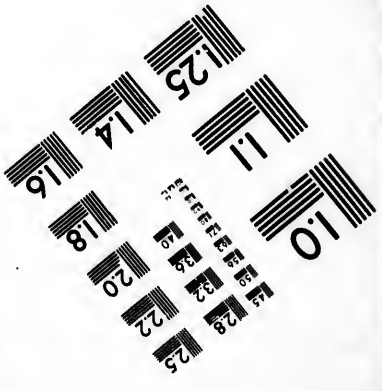

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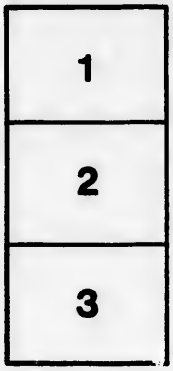

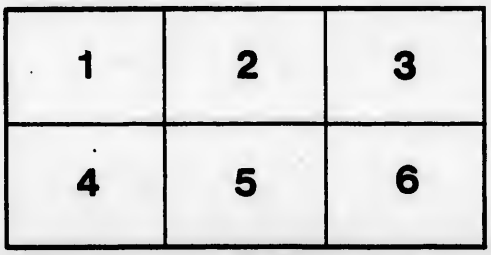

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THE FIELD OF MONOCULAR FIXATION AND ITS RELATION TO HETEROPHORIA.

Read before the Section on Ophthalmology at the Forty-seventh Annual Meeting of the American Medical Association, at Atlanta, Ga., May 5-8, 1896.

BY CASEY A. WOOD, M.D.
CHICAGO.

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THE FIELD OF MONOCULAR FIXATION AND ITS RELATION TO HETEROPHORIA.

BY CASEY A. WOOD, M.D.

So little is said in English text-books on ophthalmology about the field of fixation—monocular or binocular—and so much space is given to it in that portion of foreign works devoted to physiologic optics that it seemed worth while to bring up the subject for discussion here. We are so concerned in investigating the relations of the extrinsic ocular muscles, as they are engaged in fixing some point (doubtless the most important point) immediately in front of the eyes, *i.e.*, at the center of the field of fixation, that we are apt to lose sight of the fact that the fixing of eccentric objects and points at the extreme periphery of the field is also of great importance. It should be remembered that while binocular vision may be obtained and maintained with ease, so long as the object fixed is directly in front, this result is often difficult or impossible when looking obliquely to the extreme left, right, up or down. Not only is this true in marked paretic conditions of one or other of the straight or oblique muscles, but it is also true in the so-called insufficiencies. In other words the usual tests for heterophoria or heterotropia—the various kinds of photometric measurements especially—give us but one phase of the conditions under which the extrinsic muscles do, or fail to do, their daily work.

I wish to confine my observations to one of the means by which we may measure the excursions, in all directions, of each eye separately, as indicative of the part which eccentric excursions play in the production of muscular asthenopia.

It is to Landolt that we are chiefly indebted for utilizing the field of fixation in practical ophthalmology. The monograph written by Eperon in the *Traité complet*, taken in connection with Aubert's chapters in the Graefe-Saemisch Handbuch, tell us in a few pages about all we know of this subject.

My only apology for referring to these fundamental laws of optic physiology is that I have made a few observations which may be of use to those who are now pursuing this interesting study.

The field of fixation of an eye includes all those points which the eye can successively fix, the head being completely at rest. The limits of the field represent the extreme excursions of the eyes in all directions. At least three methods (two objective and one subjective) have been and may be employed in making these measurements. One of the objective tests consists of observing, on the center of the cornea, the image of a small flame carried along the arc of the perimeter, just as one does in determining the degree of squint. Another plan of objective observation is seen in the ingenious and excellent tropometer devised by Stevens and described by him in the *Annales d'oculistique* for July, 1895. By means of this all the movements of rotation can be exactly measured.

In the subjective method we utilize the visual acuity and the perimeter. The object is usually a letter or series of letters, which can be readily changed, attached to a carrier that is run along the arc of the perimeter as in measuring the field of vision.

Owing to the different methods employed by various observers of the limits of the normal field, authors differ somewhat in their measurements. The following, by Landolt, are as nearly correct as we can obtain them:

Directly out. . .	45°	90°	Out and down. .	47°	92°
Directly in . . .	45°		In and up. . . .	45°	
Directly down. . .	50°	93°	Down and in. . .	38°	85°
Directly up . . .	43°		Up and out . . .	47°	

These figures vary slightly in individuals, but the

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directly inferior angle is always the largest, while the infero-internal is always the smallest. The eyelids, margins of the orbit and bridge of the nose must always affect the result of these measurements just as they do in determining the extent of the visual field.

Stevens, after speaking of the importance of determining the absolute as well as the comparative rotation of the eyes, not only from side to side but up and down, says: "We have had, until quite recently, no sufficient means for determining these rotations. The judgment which we may form by watching the rotations is not to be relied upon. The perimeter is destitute of any considerable value for this purpose. By it we can not measure the downward rotation in many casses, for the pupil buries itself behind the lower lid; nor can it measure the rotation inward, for the nose interferes, and even the outward, the only one which can be generally measured, is not well measured."

While I recognize, in general, the advantage of objective over subjective tests, it appears to me that Dr. Stevens' objections to the subjective method of determining the limits of the ocular excursions are weakened by the fact that what we wish chiefly to know is not the extreme limit of rotation of the eye in various directions so much as its limit of observation. What we desire to ascertain in practice is whether the various muscles, alone and in combination, are capable of making all the excursions required for the purpose of securing and maintaining single and binocular vision. Whether an eye would be able to fix an object further to the right or left if the nose were removed, or one higher or lower if a projecting lid or orbital margin were cut away is not of essential importance.

We are usually advised, also, to make use of the candle image when the eye is amblyopic or can not read large type. Now these are just the conditions under which we are not usually concerned about the fixation field. It is the eye that sees and not the

blind eye that causes trouble in defective excursions. If an eye takes no part, or only a feeble part, in the work of fixation, why trouble ourselves at all about its rotation?

These considerations caused me to attempt to remedy what seems to be certain defects in the technique of determining the field of monocular fixation, as it is commonly applied. So far as I know, the most effective plan employed—decidedly superior to the old Helmholtz-Berthold method—is that exhibited in the modified Landolt apparatus attached to the McHardy perimeter. The head of the patient is placed in the primary position and fixed by biting a rigid crossbar of hard wood.

Lang thus describes the method of examination: "The balanced test object exhibits a single word of two or three letters printed with the smallest type that can be distinctly seen by the eye under investigation. The patient is seated at the perimeter, directly facing the fixation point, with his head erect and his chin supported on that half of the chin-rest which brings the eye that is about to be tested into the middle line, opposite the fixation spot. If the patient can not maintain this position during the whole examination, he is asked to grip the bar of the bite-fixation-apparatus between his teeth, which effectually prevents the least movement of the head. The other eye is covered with a pad and bandage, or its lids are closed and held down by the lashes with the tip of the patient's forefinger. The words in the test object, in the various sized type, are now exhibited, and one, in the finest print that the eye can read, either without or with glasses, is exposed after the test object has been moved to the end of the perimeter arc, which is extended horizontally outward. While the patient, without moving the head, turns his eye to the utmost outward toward the extremity of the arc, the observer slowly moves the test object inward toward the fixation point, but stops directly the patient can read the word, and at once records, in degrees, the

position which the test object occupies in the arc.

"The arc is now placed horizontally inward, the test object is moved back again to the extremity of the arc, a fresh word is exposed, and the observation is repeated. When the field of fixation has been tested in the horizontal meridian, which is all that is generally necessary, the examination of the remainder of the field can be ascertained by placing the arc in each 30 degrees of the circle, and recording the results on a field of vision chart.

"When the examination of one eye is completed, the head is shifted to the opposite side of the chin rest and the second eye is tested in the same manner."

On making examinations with this apparatus I long ago noticed that the continuous effort to hold the eye at its extremest rotation, in so many directions, was exceedingly fatiguing and often made it difficult to complete the examination. It was also remarked that the results varied in the same individual, and I feel certain that these different measurements are due to the fatigue incident to the attempt of the eye to fix an object whose exact position at the extremity of rotation is unknown. The nystagmus-like movements of the globe, after a number of these trials, is quite noticeable.

Instead of using an object attached to the carrier on the perimeter arm I have used an exceedingly simple device whereby the rotation of the globe in any direction is rapidly and easily measured. It may be used by all persons who can read Jaeger xii at fifty centimeters, and may even be employed for others whose visual acuity at that distance is considerably less. Four strips of unglazed parchment paper have printed on them words of two letters placed between, as well as below, figures representing the degrees of latitude on the perimeter arc. These strips are, together, placed in position on the arm of the perimeter, the patient's head being in the primary position (I usually do not consider any elaborate fixation necessary) and he is asked to read to the lower line, as

far away from the center as possible. This accomplished he is requested to give the figure placed above the word just recognized and to try and read, farther out, additional letters on the figure line. Each word beyond represents about one degree on the scale and the number of words so read added to the previous figure gives the limit, in degrees, of the field in that direction. As each quadrant of the circle is passed over, a slip of paper is removed, revealing the next paper whose lettering, being different, suggests nothing to the person under examination. I have found that instead of making the vertical letters face up and down one can accomplish the purpose of distinct vision by printing them with type of a bolder face, thus providing for those rare cases in which it is desired to test the muscles of an eye that can not read Jaeger xii, or thereabouts.

My investigations of the field of fixation have developed nothing new except that the normal field, in persons whose view is not cut off by the nose, lids or orbital margins, seems to have wider limits than those set down by Landolt, particularly in the downward direction.

The causes that determine an unusual shape or abnormal position of the whole field, as pictured on the perimetric chart are, commonly, actual paresis of one or more of the external muscles of the eye. Apart from an abnormal configuration of the face, we also recognize those influences that underlie the various forms of heterophoria, *i. e.*, general fatigue, weariness of one or more of the extrinsic muscles, age, defective innervation and, possibly, congenital defects in the muscular fibers. But in cases of heterophoria occurring during the fixation of objects directly in front of the eye, the state of the refraction exerts a very wide influence on the size, shape and situation of the whole field. Its boundaries are enlarged in moderate degrees of hyperopia, but are diminished in the higher grades, owing, as Landolt thinks, to the developed muscles acting on a not too large globe in the former instance

and to the lack of development, in the latter case, affecting the muscular elements in common with all other parts of the eye. It is restricted in the elongated and enlarged globe of the extreme myope, owing mainly to the greater size of the eye and the weakness due to the stretching of the muscles.

My former assistant, Dr. T. A. Woodruff, and I have carefully measured a large number of fields, normal and abnormal, in persons of all ages and all states of health and refraction, and I feel justified in thinking that when carefully done, using the device I have just described, the defective excursions and often the defective muscle or muscles can be readily detected by a glance at the perimeter chart. Take for example a case of simple left hyperphoria of 4 pr. diopters. Here one obtains a perimetric picture whose irregular outline covers, perhaps, as much ground as the normal field but whose directly upward and downward limits in the left eye are higher than normal. Thus we have not only an indication of the amount and kind of the heterophoria but we are enabled, by a comparison with the normal field, to arrive at a conclusion not only as to the actual direction of the muscular defect but, also, in some cases, to venture an opinion as to particular muscle or muscles involved.

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