Modern Trends in
Ophthalmology—5

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Preface

Textbooks, monographs, review articles and the special journals all have clearly defined characteristics of their own. They do not, however, reflect well the steady, barely perceptible but all-important ground swell and fluctuations of clinical practice. *Modern Trends in Ophthalmology* has aimed over the past 30 years at providing authoritative critical assessments of the formative influences in such movements. It is hoped that the 17 chapters in this fifth volume in the series deal adequately with current issues.

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Part I
Diagnostic

1 Exploration of the Central Field

J. GLOSTER

ADVANTAGES AND LIMITATIONS

Any procedure for exploring the central visual fields should be quick, sensitive, reliable, simple and not too expensive, but any one of these requirements may be dependent upon or in conflict with another. In field-testing instruments, some of these requirements have been achieved by abandoning the use of a moving target as in the conventional tests (kinetic perimetry) and substituting the presentation of stationary stimuli as flashes in different positions in the visual field (static perimetry).

The value of any such test depends greatly on its sensitivity. If this is too low, significant field defects will pass undetected (i.e., the 'false negative' rate will be high); if the sensitivity is too high, irrelevant abnormalities, such as small opacities in the media, will affect the result (i.e., the 'false positive' rate will be high). The sensitivity of the test depends not only upon the intensity and size of the stimuli that are presented, but also upon the number and distribution of these stimuli in the area of field examined.

The reliability of a field test depends not only upon the sensitivity of the test but also upon the reliability of the patient himself. This latter factor is too well known to require further comment except that it should be pointed out that the presentation of stimuli as flashes in unexpected positions in the field is often more conducive to the patient maintaining fixation on a central point than is the use of a moving target. Also, if some audible cue is given with the flash it is possible to present 'blanks' (i.e., no visible stimulus appears) and these can be used to check the patient's reliability, while the presentation of stimuli in the region of the physiological blind spot provides a further check.

The test must be simple for the patient to do, for the examiner to operate and for the clinician to interpret. The simplest visual task is to present a single stimulus as a flash in a series of different positions in the visual field, asking the patient each time whether he saw it or not. Presenting several stimuli in different parts of the field simultaneously and asking how many are seen gives the patient a rather more difficult visual task, and there is also the possibility that he may learn the patterns of stimuli presented which would detract from the follow-up value of the test. One advantage of presenting groups of stimuli instead of single stimuli is that the same area of field may be covered more quickly. This advantage is not always as great as might be expected. If the field is full and the patient responds by giving the correct number of stimuli at each presentation the test can be done very quickly. On the other hand, if the field is defective, then the positions of the unseen stimuli in the various groups have to be determined and this lengthens the test by an amount depending on the size and complexity of the defect and the patient's ability to describe the positions of the stimuli quickly and accurately.

As regards the operation of the test, the simpler this can be made the less training and expertise is required by the examiner, but it is the author's opinion that, if the test is delegated by the clinician, a trained technician or nurse should always be in charge of it. A simple but accurate method of recording the result is essential if the test is delegated and, if possible, recording should be automatic and the records should bear some resemblance to conventional charts of the visual field.

The duration of the test must be short and, as far as the apparatus is concerned, it depends upon the extent of the field examined, the number of positions in which stimuli are presented, and whether the stimuli appear one at a time or in groups of two, three or four simultaneously.

The question of cost involves not only the initial capital outlay but also maintenance and operating expenses. With regard to the latter it has to be remembered that medical manpower is expensive, so that if field testing can be delegated to a technician using suitable apparatus, the expense may be less than would appear at first sight.

From the above considerations, it can be seen that for the ideal field-testing apparatus a compromise has to be reached between various factors. From the purely clinical point of view the most important balance is between reliability and sensitivity on the one hand and simplicity on the other, and, as will be seen, the point of balance varies between one apparatus and another.

AVAILABLE INSTRUMENTS

The Harrington–Flocks Screener

The apparatus is contained in a small case the lid of which, when opened, forms a vertical screen placed 330 mm from the patient's eye. This screen supports a series of white cards, each of which bears a central black fixation point and a simple pattern, printed in white fluorescent ink and thus normally invisible. The patient's head is supported by a chin rest, beneath which and shielded from the patient's direct view, there is an ultra-violet lamp provided with a shutter so that the radiation can be released as a flash of 0·2 to 0·3 second duration, thus making the pattern on the card momentarily visible. In the later versions of the apparatus the patterns consist mostly of dots, no more than four being present in any one pattern. The dots nearer fixation are smaller than those farther away. Some patterns are regarded as particularly suitable for hemianopia, others for chiasmal lesions, while another provides evidence as to whether fixation has been adequate. Thirty-one areas of the field within 25 degrees of eccentricity from fixation are tested. No rigid standards are laid down for the ambient illumination. It is suggested that three to four minutes should be allowed for each patient. The result of the test is recorded by the examiner marking on a chart the position of any stimuli not seen by the patient (Harrington and Flocks, 1955).

The Fincham–Sutcliffe Screening Scotometer

This is a grey screen placed one metre from the patient and having a central white button for fixation. There are two white crosses on the screen in positions corresponding to the physiological blind spots; these are used to ensure that fixation is correct. The screen is perforated by a number of holes behind each of which is a small lamp. The lamps are illuminated in groups of up to four to produce patterns in the visual field. There are 67 stimulus positions in the central 25 degrees of the field. The stimuli are presented as flashes, usually of 0·25 second duration, a sequence of 18 patterns being obtained by varying the electrical connections to the lamps through a multi-way switch operated by the examiner. An ambient illumination of 1 to 2 lumens/ft^2 has been found suitable (Sutcliffe and Binstead, 1961).

A rather similar instrument, known as the Feedback Screening Scotometer, has been described by Burns (1966), one feature of this apparatus being an automatic adjustment of the intensity of the stimuli to compensate for variations in ambient illumination.

The Friedmann Visual Field Analyser

This instrument also presents patterns, as flashes, made up of two, three or four small points of light in various parts of the field (Friedmann, 1962; Bedwell, 1967). The patient's head is supported one-third of a metre from the screen on a chin-rest, arising from which and surrounding the patient's face there is a circular structure which not only limits the view mainly to the screen, but also holds eight small lamps supplying the external illumination to the screen. The latter is black and has a central fixation point. The screen is perforated by 46 holes and behind it is a rotating disc which also has holes in it. Behind the disc is a diffusing screen which can be illuminated by an electronic flash tube. According to the degree of rotation of the disc, coincidence of holes in the disc and in the screen produces the series of patterns. Thus all the holes are illuminated from the same flash tube, the light from which is diffused by a series of white surfaces. Neutral density filters can be interposed immediately in front of the flash tube so as to vary the intensity of the stimuli.

Fifteen patterns are presented, the positions of the stimuli being shown in *Figure 1*, in which stimuli presented together are marked with the same letter. The more peripheral holes in the screen are larger than the central ones in order to compensate for the average variation in sensitivity in different regions of the retina. Thresholds also vary with age and suitable settings of the neutral density filters are recommended to compensate for this.

The patient is put in position and allowed to adapt to the level of illumination, the test being done in a darkened room, if possible. One eye is occluded in the usual way. The stimulus intensity is set to a level appropriate to the patient's age by adjusting the neutral filters. The 15 patterns of stimuli are presented and the patient is required to say how many lights he saw at each presentation. If all his answers are correct, it may be presumed that he has no field defect. If at any time his answer is incorrect, he must indicate the positions in which he did see the stimuli; when all the patterns have been presented, the stimulus intensity is increased by reducing the neutral filter by 0·2 log unit and the patterns are repeated, and, if there are still incorrect answers, the test is repeated again with further reduction of the filters. In this way a chart can be drawn which shows where stimuli were seen at the intensities expected for age, where they were seen at higher intensities, and where even the brightest stimuli failed to evoke a response.

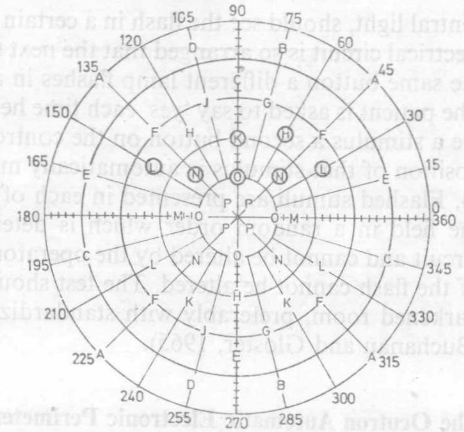

Figure 1. Chart drawn from results of a test with the Friedmann Visual Field Analyser. The letters on the chart indicate the positions of the various stimuli. Stimuli marked with the same letter are presented simultaneously. This patient had an upper arcuate scotoma; the positions of the stimuli which he did not see have been marked by putting rings around the appropriate letters

The Globuck Screen

This apparatus differs from those just described because it presents stimuli singly instead of in groups. A black screen, one metre square and one metre from the patient, is perforated by 74 small holes, arranged around a central fixation light and distributed up to 25 degrees therefrom. Behind each hole is a lamp which can be lit independently of the others. The apparatus is worked by a push-button unit held in the operator's hand. When the appropriate button is pressed one of the lamps flashes, and the patient, seated before the screen with one eye occluded and the other maintaining fixation on the

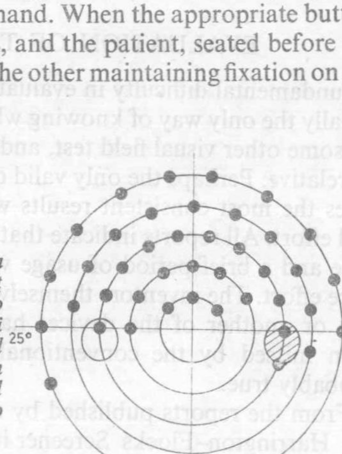

Figure 2. Chart drawn from results of a test with the Globuck screen. This patient had extensive loss in the upper field due to glaucoma and the positions of the stimuli which he did not see have been marked with solid black circles. The distribution of unmarked stimuli in the lower field (which the patient did see) is similar to that in the upper field

central light, should see the flash in a certain position in the field. The electrical circuit is so arranged that the next time the operator presses the same button a different lamp flashes in another part of the field. The patient is asked to say 'yes' each time he sees a flash. If he fails to see a stimulus a second button on the control unit is pressed and the position of that stimulus is automatically marked on a chart (*Figure 2*). Flashed stimuli are presented in each of 74 different positions in the field in a random order which is determined by the electrical circuit and cannot be altered by the operator. Similarly, the duration of the flash cannot be altered. The test should be done in a partially darkened room, preferably with standardized ambient illumination (Buchanan and Gloster, 1965).

The Ocutron Automatic Electronic Perimeter

This apparatus is not yet widely available and there is at the time of writing no published work about it; therefore a critical account cannot be given. It appears to be derived from a device described by Gans (1962) which consists of a bowl perimeter perforated by holes through which flashes of light are presented to the patient one at a time. Provision is made for automatic recording of the results. The patient responds by using a push-button unit and it is claimed that he can test himself without any other person being present.

EVALUATION OF THE INSTRUMENTS

A fundamental difficulty in evaluating this type of instrument is that usually the only way of knowing whether a field defect is present is to do some other visual field test, and therefore the evaluation can only be relative. Perhaps the only valid question is to ask which procedure gives the most consistent results with the least expenditure of time and effort. All reports indicate that the instruments described do save time and a brief period of usage would convince most that they reduce effort. The inventors themselves are unanimous in claiming that one or another of the devices has detected field defects that have been missed by the conventional methods, and these claims are probably true.

From the reports published by a number of independent users of the Harrington–Flocks Screener it seems that the instrument was generally satisfactory although the false positive rate was reported as 5 to 20 per cent. By comparison with newer field-testing instruments, or with the Goldmann and Tubingen perimeters, the Harrington–

Flocks screener seems somewhat crude as regards the photometric standardization of its stimuli.

The Friedmann Analyser and the Globuck screen have been used in glaucoma, not only for diagnosis but also for the follow-up of cases. As far as can be judged, the performances of the two instruments have been approximately equal, and the impression has been gained that both instruments are more reliable than the Bjerrum screen (Buchanan and Gloster, 1965; Friedmann, 1962).

The chief differences between the various instruments concern the number of stimuli presented at a time and the distance between the patient and the screen. The first factor affects the simplicity and duration of the test and the possibility of automatic recording, while the second determines to a great extent the size of the apparatus and the importance of accurate correction of refractive errors. The present position seems to be that there is no instrument with outstanding advantages and the choice of instrument depends upon the particular circumstances under which it is to be used.

Possible Applications and Future Development of Field-testing Instruments

Although various problems remain, the proven value of field-testing instruments means that further developments are worth while. Greater adaptability is perhaps required. For example, it might be useful to switch from one sequence of stimulus patterns to another when looking for evidence of one particular disease, although this would have to be weighed against the disadvantage of being able to vary the conduct of the test.

This raises the questions of which disorders are particularly worth looking for and whether field-testing instruments have any part to play in screening populations for unsuspected disease. Judging from the results obtained with the Harrington–Flocks Screener, one would say that it is useful to look for unsuspected cases of glaucoma, optic nerve lesions and neurological disorders. In the past, glaucoma surveys have depended upon tonometry as the main screening procedure, and the visual field has usually been examined only when indicated by the level of intraocular pressure or by the appearance of the optic disc. Field-testing could never become as quick or easy as tonometry but its use as a screening procedure could be expected to reveal early field defects in a small proportion of persons tested; *Figure 3* is an example of an upper arcuate scotoma detected with the Globuck screen in such a survey. Similarly, evidence of optic nerve lesions or of other unsuspected neurological disorders may be found.

With regard to the latter, Wilson and Falconer (1968) have stressed the importance of examination of the central field in the diagnosis of pituitary tumours and have given the opinion that field-testing instruments should be adequate for this purpose. In support of this view, *Figure 4* shows a Globuck screen chart indicating field loss mainly in the upper temporal quadrants; this result was obtained in a patient who had radiological evidence of a pituitary tumour but in whom no defect had been found on the Bjerrum screen. Apart from their use in particular disorders, such as those just mentioned, it is reasonable to hope that instruments of the type described above will

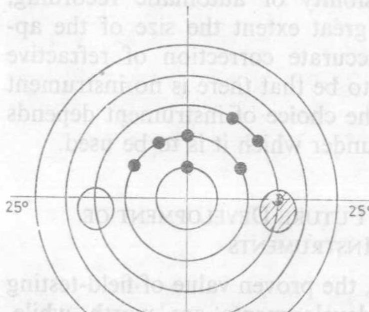

Figure 3. Globuck screen chart showing upper arcuate scotoma found in patient attending a glaucoma survey

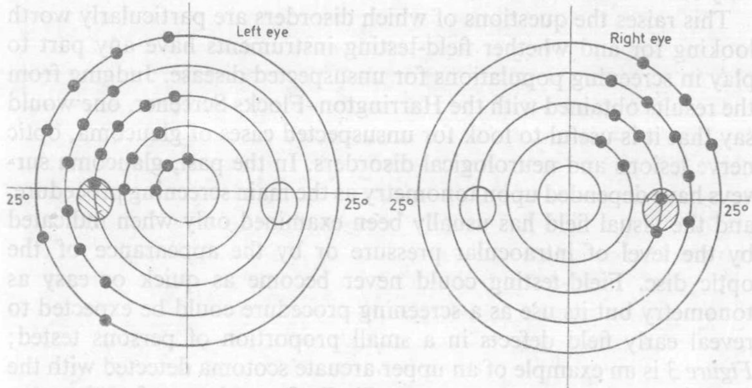

Figure 4. Globuck screen charts obtained on a patient with a pituitary tumour