COMMUNICATIONS

AUTOMATIC DEVICE FOR RAPID ASSESSMENT OF THE CENTRAL VISUAL FIELD*

BY

W. M. BUCHANAN AND J. GLOSTER

*From the Department of Experimental Ophthalmology, Institute of Ophthalmology,
University of London*

THE examination of the central field of vision on the Bjerrum screen, by the traditional method, makes considerable demands on the mental concentration of the patient and on the time of the examiner. Moreover, variations in technique make assessment of the results difficult, particularly when the tests are conducted by technicians. An apparatus† which partly overcomes these difficulties has been developed for the routine testing of central fields and also for certain research projects, in one of which its use has been reported (Tsamparlakis, 1964). It must be emphasized that the apparatus is not intended as a substitute for the Bjerrum screen, which is indispensable for a detailed study of the central field, but that it is to be regarded as a quick means by which an assessment of the field may be obtained by non-medical personnel.

In designing the apparatus, attempts were made to meet the following requirements: (1) The visual task for the patient should be as simple as possible. (2) The method of operating the test should be such that it could be used by those having no previous experience of testing the visual fields. (3) The test should be rapid and should incorporate a recording device.

In the Bjerrum test the subject fixates a central point around which a test-object may be moved into any position on the screen. In the usual method of examination the test-object is moved from an insensitive to a sensitive area of field and the patient is required to say when he first perceives it. There are, unfortunately, several adventitious clues to the position of the test-object; it is almost impossible to make invisible the rod on which the test-object is carried, and the intelligent patient can often guess the direction of movement of the test-object from the position of the examiner, the way the latter moves his arm, and so on. Elimination of these factors has been achieved either by optical projection of the test-object on to the screen or by presenting separate stimuli in a series of fixed positions. Each method has its own merits; for example, in the former the entire central field can be covered, as in the Bjerrum test, whereas this cannot be done in the second method. On the other hand, when stimuli are presented in fixed positions, the duration of their presentation can be rigidly controlled, this being impossible by the first method.

* Received for publication May 21, 1964.

† The apparatus is being made and will be distributed by Clement Clarke Ltd., 16 Wigmore St., London, W.1.

In the Multiple Pattern Test of Harrington and Flocks (1954) and in the Fincham-Sutcliffe screening scotometer (Sutcliffe and Binstead, 1961) various patterns of dots, lines, and crosses are presented tachistoscopically in different parts of the visual field. Other methods, similar in principle though differing in their mechanical and optical details, have been developed. With all these methods the patient may have to give two answers; at each presentation he has to state how many stimuli he has seen and, if this does not correspond with the number presented, he has to indicate the positions of the stimuli which he has seen.

In the apparatus to be described the visual task demanded of the patient has been reduced to a minimum. He fixates a central red light on a black screen and a single point of white light is presented in a series of different positions in the visual field. The advantage of presenting one stimulus at a time is that the only decision the patient has to make is whether or not he sees a light and his answer is thus reduced to "yes" or "no".

In order to facilitate the examiner's task the test is conducted by push-button control, which automatically presents stimuli consecutively in the required positions in the field and records the results of the test. It is important that the examiner should be able to influence the conduct of the test as little as possible and therefore the duration of presentation of the stimulus has been made independent of the time for which the push-button is pressed.

It will be appreciated that this apparatus is intended to simplify and accelerate examination of the central field, rather than to increase the precision of the test.

APPARATUS

FIG. 1.—General view of apparatus.

The entire apparatus is shown in Fig. 1. The central fixation light is red, 2 mm. in diameter, and remains alight during the test; it can be varied in brightness to suit varying fixation abilities and degrees of ambient illumination. Seventy-four holes, drilled in a metal screen, are arranged around the fixation light in a uniform pattern over the entire area of the central field; each hole is backed by a piece of opal glass behind which is a small lamp, enclosed in a metal case. The holes are 1 mm. in diameter, but could be of any required diameter as the metal sheet is readily changed.

The apparatus is operated by a unit held in the examiner's hand and provided with three push-buttons. When the uppermost of these, the "O" button, is pressed, one of the 74 bulbs lights up for a fixed duration (usually 0.2 sec.). The patient, fixating the central red light, thus sees a brief flash in the surrounding field. He is instructed to say "yes" every time he sees such a flash. If he thinks he has missed a flash because he happened to blink at that moment, or if he is uncertain for any other reason, the flash may be repeated in the same

Br J Ophthalmol: first published as 10.1136/bjo.49.2.57 on 1 February 1965. Downloaded from <http://bjo.bmj.com/> on April 26, 2023 by guest. Protected by copyright.

Br J Ophthalmol: first published as 10.1136/bjo.49.2.57 on 1 February 1965. Downloaded from <http://bjo.bmj.com/> on April 26, 2023 by guest. Protected by copyright.

Br J Ophthalmol: first published as 10.1136/bjo.49.2.57 on 1 February 1965. Downloaded from <http://bjo.bmj.com/> on April 26, 2023 by guest. Protected by copyright.

Br J Ophthalmol: first published as 10.1136/bjo.49.2.57 on 1 February 1965. Downloaded from <http://bjo.bmj.com/> on April 26, 2023 by guest. Protected by copyright.

Br J Ophthalmol: first published as 10.1136/bjo.49.2.57 on 1 February 1965. Downloaded from <http://bjo.bmj.com/> on April 26, 2023 by guest. Protected by copyright.

Br J Ophthalmol: first published as 10.1136/bjo.49.2.57 on 1 February 1965. Downloaded from <http://bjo.bmj.com/> on April 26, 2023 by guest. Protected by copyright.

Br J Ophthalmol: first published as 10.1136/bjo.49.2.57 on 1 February 1965. Downloaded from <http://bjo.bmj.com/> on April 26, 2023 by guest. Protected by copyright.

Lamp Circuits

The lamps are ordinary 12-volt 2.2-watt, clear M.E.S. type, and the arrangement of these behind the holes in the screen is as shown in Fig. 4.

It was found that commercial lamps are not of uniform brightness and therefore each lamp has a 10-ohm variable resistor in series with it, thus enabling the brightness of all lamps to be equalized when run off a given voltage.

FIG. 4.—Sectional diagram of each lamp-mounting.

FIG. 5.—Sectional diagram of each element in the burning unit of the recording device.

The Burning Unit

This consists of an asbestos board having a series of 8 BA screws emerging in counter-sinks, as shown in Fig. 5. Small loops of 30 S.W.G. nichrome wire are placed over these screws and secured with round slotted nuts. The whole nut lies below the surface of the board, but the nichrome wire crosses the "land" between the holes and is therefore slightly proud of the surface. A scotoma chart is placed on the board and is located by metal strips round the edge. It is then pressed on to the elements by a lid, which has, on the inside, a layer of sponge rubber covered by a thin sheet of asbestos. Good contact with the elements is thus assured. The 8 BA screws carry the power to the burner from the uniselector.

Sequence of Operation

Assuming that the uniselector is in its "home" position a green "homing" lamp will be alight indicating that the apparatus is ready for use. The central fixation lamp will also be alight and the patient will be seated 1 metre away from the screen.

The O button is then pressed. This closes relay R_1 which is slightly slugged by a 25 mfd capacitor, making it slow to open. R_{1A} and R_{1B} close. R_{1A} operates the Uniselector Drive Magnet (U.D.M.) and steps the uniselector forward one position. The green "homing" light L goes out. R_{1B} closes R_2 , also heavily slugged by a 250 mfd capacitor and therefore very slow to open. R_{2A} and R_{2B} close. R_{2A} charges one or other of the "Duration" capacitors via the selector switch S, and the slow-to-break of R_2 ensures that the charge is complete. When R_2 releases, R_{2A} connects the charged capacitor across R_3 , which therefore closes R_{3A} for a time depending on which of the "Duration" capacitors is connected. R_{3A} lights the first lamp on the test board. If the patient sees the lamp, he says "yes" and the O button is pressed again. If the R button is pressed in order to repeat a stimulus, R_2 closes directly, flashing the lamp again without stepping the uniselector.

It has been arranged that positions 2 to 10 on the uniselector form a preliminary test and accustom the patient to the procedure. To accustom him to the possibility of missing a flash, positions 5 and 7 are not connected to any lamp and therefore provide no stimulus.

When position 10 is reached the preliminary run is finished and when the O button is next pressed the uniselector steps to position 11, which is earthed. This operates the U.D.M. via its own contacts and the uniselector continues to step until it encounters a non-earthed position. This is number 15. All this causes a buzzing noise indicating to the examiner that the preliminary run is finished and the main test about to begin. The next pressure on the O button will step the uniselector to the first lamp of the main run, and this can continue until all 74 lamps have been flashed. After this the uniselector again encounters earthed contacts and will self-operate until it homes, lighting the green homing lamp, which, together with the buzzing, indicates that the entire test is finished. Should the examiner wish to discontinue a test and begin again the uniselector can be "homed" at any time by a homing button on the control panel. If the patient does not see a flash he says "no" and the operator presses the B button, whereupon R_4 closes. R_{4A} then closes, causing the appropriate burn on the chart to be made. It will be seen from Fig. 3 that R_4 is in series with a 500 mfd capacitor and, therefore closes only until the latter is charged; this takes about 2 seconds, and so limits the burning time, thus preventing excessive burning. At the same time it is important that an adequate burn should be made, so R_{4B} holds R_4 closed, irrespective of how short a pressure is made on the B button. As long as the capacitor is charged the B button has no further effect. When, however, the O button is again pressed, R_{2B} discharges the capacitor and R_4 is once more ready to be operated if required. While the burning operation is actually in progress R_{4C} is open, and the O button is inoperative.

The uniselector and relays are operated from a 24-volt D.C. supply obtained from a metal rectifier supplied by the mains transformer, which also supplies 10-volt A.C. for the lamps, and 3-volt 2-amp. A.C. for the burners.

PROCEDURE

In the present study the following procedure was used. The patient was seated at a distance of 1 metre from the screen and the eye not under examination was covered with an occluder. The usual room lights were turned off and a single electric lamp was so arranged to give a level of ambient illumination of 1.5 lux. The test was then explained to the patient. He was told that he was to keep looking steadily at the small red light in the centre of the screen and that other lights would appear momentarily in the surrounding area; he would see some of these, but he might not see others, and he was to say "yes" if he did see a light and "no" if he failed to see one. He was also told that, if he wished, he could have a light repeated

if he was uncertain whether he had seen it or not. After this explanation, the ten positions constituting the preliminary trial run were used in order to accustom the patient to the procedure. Not only must he become familiar with the test before starting the main part of it, but he must also become aware of the possibility of not perceiving a stimulus. Therefore the trial series of flashes includes two true "blanks" in which the operator presses the O button in the usual way, the sound of the relays operating is heard, but there is no flash of light. The trial series consists of 8 flashes and 2 blanks, and at its conclusion the apparatus gives a brief buzzing noise to indicate that the main part of the test has been reached.

It was found that most patients responded quickly, so that one had only to wait about a second after the exposure of a light before pressing the O button in order to move on to the next position. If the patient did not answer immediately after the presentation of a light, the R button was pressed, and if he still did not see the light, the B button was operated in order to burn the chart in the position of the light which had not been seen. In practice the entire procedure ran smoothly and it was usually possible to complete a test satisfactorily on one eye in about $3\frac{1}{2}$ minutes, after which the procedure was repeated on the opposite eye.

The duration of the stimulus, although independent of the length of time for which the O button is pressed, can nevertheless be varied between 0.1 sec. and 0.4 sec. In practice, a duration of 0.2 sec. was found most suitable, this being long enough for the patient to make up his mind whether or not he had seen a flash, but not so long that he could shift his gaze from the fixation point to the stimulus. In addition, the brightness of the stimuli could be varied over a wide range, but in the present series of tests it was adjusted to be approximately equal to that of a white screen illuminated with a 40-watt pearl lamp giving an illumination of 32.5 foot-candles over a field size equal to that of the stimulus. Duration and brightness of the stimulus were not varied in the course of any one test.

Results

Most patients quickly understood the test and considered it easier than the usual examination on the Bjerrum screen. They also thought it more reliable, the general feeling corresponding with the opinion of one patient who said: "You cannot cheat because you do not know where the next light is going to be."

The present study was conducted in the Glaucoma Clinic at the Institute of Ophthalmology, London, and therefore most of the field defects encountered were of the glaucomatous type.

Group A. Persons with Normal Fields

Twenty-five subjects (40 eyes) were tested, comprising members of the staff of the Institute and patients. All 40 eyes in this group were healthy with no evidence of raised tension or fundus lesions and showing no defect when examined on the Bjerrum screen.

The positions of the stimuli missed by all the subjects tested were combined and recorded on one scotoma chart (Fig. 6), the results for right and left eyes being combined by regarding the visual field of one eye as the mirror-image of that of the other.

In this way it was possible to determine the frequency with which stimuli in certain positions were missed by subjects with normal Bjerrum fields (Fig. 7). In the upper part of the area examined there were five positions in which stimuli were missed by 7.5 per cent. to 15 per cent. of the eyes examined, while three positions in the region of the physiological blind spot were missed by 30 per cent. to 75 per cent. It should be noted that in each of the 40 eyes tested in this group a stimulus was missed in at least one position corresponding to the physiological blind spot. This finding in a test in which no other stimulus was missed gives some measure of the reliability of the subject, indicating that he is not simply answering "yes" every time he hears the relays operating.

From the results shown in Fig. 7 it is reasonable to define an area within which failure to perceive a stimulus may be regarded as indicating a "probably defective" visual field; this area is the unshaded portion of Fig. 8. Comparison with Fig. 7 shows that there are 8 positions where 2.5 per cent. to 5 per cent. of normal eyes may be expected to miss a stimulus presented in the unshaded area; in other words, the incidence of "false-positive" tests would be in the region of 1 in 20. Similarly, we can define a "certainly defective" field as one where a stimulus is missed in a position

FIG. 6.—Standard scotoma chart on which results were recorded.

FIG. 7.—The frequency with which normal subjects failed to perceive stimuli in certain positions.

FIG. 8.—The "probably defective" area. If a stimulus is not perceived in the unshaded area, the visual field is to be regarded as "probably defective".

in the unshaded area shown in Fig. 9; according to the data shown in Fig. 7 this criterion should eliminate "false-positive" tests completely. The above definitions of "probably defective" and "certainly defective" have been adopted in the ensuing description of the results of tests carried out on glaucomatous patients.

Group B. Cases of Chronic Glaucoma in which the Bjerrum Screen revealed an Arcuate Scotoma as the Principal Field Defect

There were 11 eyes in this group, in 4 of which the arcuate scotoma was demonstrable with the 2/2,000 white targets but not with the 10/2,000, and in 7 of which the scotoma was found with both targets. In all patients the diagnosis of glaucoma had

TABLE I
GROUP B. GLAUCOMA PATIENTS WITH AN
ARCULATE SCOTOMA ON THE BJERRUM SCREEN

Group	Number of Stimuli not Perceived		
	In "Probably Defective" Area	In "Certainly Defective" Area	In Bjerrum Area
B (I) Arcuate scotoma with 2/2,000 but not with 10/2,000			
Patient 1 R E	28	17	13
2 R E	9	7	5
3 L E	5	3	2
4 L E	19	13	11
B (II) Arcuate scotoma with 10/2,000			
Patient 3 R E	20	10	9
5 R E	11	10	8
6 L E	30	23	18
7 R E	19	13	8
8 L E	21	17	17
9 L E	15	13	12
10 L E	18	14	10

FIG. 9.—The "certainly defective" area. If a stimulus is not perceived in the unshaded area, the visual field is to be regarded as "certainly defective".

FIG. 10.—Patient with simple glaucoma; upper arcuate scotoma. Comparison of result of new test with examination on the Bjerrum screen (2/2,000 white object). ● = positions in which stimuli were not perceived in the new test; shaded area shows scotoma found on Bjerrum screen.

been made on the grounds of raised tension and pathological cupping of the disc; the majority were diagnosed as simple glaucoma, the remainder as chronic closed-angle glaucoma. Table I is an analysis of the results.

A comparison between the field obtained on the Bjerrum screen and the result of the new test for one of these patients is given in Fig. 10.

Group C. Cases of Chronic Glaucoma with Extensive Loss of Visual Field

The criteria for diagnosis were as in the previous group, but loss of the visual field has proceeded further than the stage of arcuate scotomata. Twenty eyes (15 patients) are included in this group; in 14 the condition was simple glaucoma, the remainder being cases of chronic closed-angle glaucoma. The result for one patient is shown in Fig. 11 and an analysis of the findings for all eyes in this group is presented in Table II. An attempt was made to compare the size of the field defect as found by the new test with the amount of loss to the 2/2,000 and 10/2,000 targets on the Bjerrum screen; the comparison was made only when it could be made with certainty and was recorded as "indeterminate" in doubtful cases. It can be seen

FIG. 11.—Patient with simple glaucoma; extensive loss of upper field. Comparison of result of new test with examination on the Bjerrum screen (10/2,000 white object). ● = position in which stimuli were not perceived in the new test; shaded area shows scotoma found on Bjerrum screen.

TABLE II
GROUP C. CASES OF CHRONIC GLAUCOMA WITH
EXTENSIVE LOSS OF VISUAL FIELD

Patients	No. of Stimuli Missed in "Certainly Defective" Area	Defect on New Test		Defect on New Test
		Equal to Bjerrum 2/2,000	Greater than Bjerrum 2/2,000	Greater than Bjerrum 10/2,000
A L E	16	indeterminate		0 *
B L E	37	+		+
C L E	28	indeterminate		0
D R E	12	+		+
E L E	6	+		+
E R E	25	+		+
F L E	35		+	+
F L E	14	indeterminate		0
G L E	40		+	0
H R E	23	indeterminate		+
I L E	9	indeterminate		+
I R E	24	+		+
J R E	33	+		+
K L E	29		+	+
K L E	47	+		0
L R E	17	+		0
M L E	30	indeterminate		+
N L E	41		+	+
O R E	9	indeterminate		+
O L E	7	indeterminate		+

* 0 signifies that no 10/2,000 Bjerrum field was available for comparison.

that all these eyes gave results indicating fields which were "certainly defective". Also, when adequate comparison could be made, the defect indicated by the new test was either equal to or larger than the defect obtained on the Bjerrum screen with the 2/2,000 target. The new test always indicated larger defects than were obtained with the 10/2,000 target.

Group D. Patients with Glaucoma and Cupped Discs in whom no Defect was Found on the Bjerrum Screen

The diagnosis of glaucoma in these eyes depended on the presence of raised intraocular pressure and pathological cupping of the optic discs. The patients were tested carefully once on the Bjerrum screen in the usual way, but no defect in the visual field was found in the eye concerned, although one might have been expected from the appearance of the disc. The results are given in Table III.

TABLE III
GROUP D. GLAUCOMATOUS PATIENTS
WITH NO FIELD LOSS DETECTED ON
THE BJERRUM SCREEN

Patient	No. of Stimuli Missed in "Certainly Defective" Area
D 1 R	0
L	0
D 2	5
D 3	4
D 4	10
D 5 R	14
L	4
D 6	5
D 7	0

TABLE IV
GROUP E. PATIENTS WITH
SUSPICIOUS DISCS

Patient	No. of Stimuli Missed in "Certainly Defective" Area
<i>Group E a</i>	
E a 1 LE	0
E a 2 RE	0
LE	0
E a 3 RE	0
LE	0
E a 4 RE	0
LE	0
E a 5 RE	2
LE	0
E a 6 RE	0
LE	0
<i>Group E b</i>	
E b 1 LE	9
E b 2 RE	1
E b 3 LE	3
E b 4 RE	2
E b 5 RE	4
E b 6 RE	4
E b 7 RE	1
LE	0
E b 8 RE	2

Thus in 6 out of 9 eyes, or in 5 out of 7 patients, the new test revealed a field defect not found on the Bjerrum screen. Patient D 3 was blind in his other eye, but patients D 2, D 4, D 6, and D 7 all gave evidence on the Bjerrum screen of a field defect in the opposite eyes to those recorded in Table III, suggesting that they were not simply unsatisfactory subjects for the Bjerrum test.

Group E. Patients with Suspicious Discs but with Full Fields on the Bjerrum Screen

These were patients who had been referred to the Glaucoma Clinic for further investigation because the appearance of one or both optic discs aroused a suspicion of glaucomatous cupping. At the conclusion of the tests they were divided into two groups:

Group E a.—Patients in whom no confirmatory evidence of glaucoma was found.

Group E b.—Patients in whom the suspicion of glaucoma was strengthened by:

- (i) The presence of undoubted glaucoma in the opposite eye; or (ii) by the results of repeated applanation tonometry on the eye under investigation; or
- (iii) by the results of tonography on the eye under investigation.

Table IV summarizes the results.

There is a clear difference between the results for the two groups, patients in whom the investigations suggested the presence of glaucoma showing more evidence of a field defect with the new test than those in whom no such evidence was obtained.

Group F. Patients tested Several Times

Group F *a*. Those tested on different days.

There were 15 patients (28 eyes) in this group. Two patients had been tested on four separate occasions in the course of twelve months, 3 had been tested at three, and the remainder at two attendances.

In one patient the first test on both eyes was completely normal, but in the second test three stimuli were missed in the "certainly defective" area by both eyes. In one eye of each of two other patients, one stimulus was missed in the "certainly defective" area in the first test, but not in a subsequent test. Apart from these discrepancies there was always agreement between the first and subsequent tests as to whether stimuli were or were not missed in the "certainly defective" area. However, agreement as regards the number of stimuli missed in the "certainly defective" area was often imperfect, and in some patients the number of stimuli missed in one test was twice or thrice that missed in the other test. It is probable that a number of factors contributed to this variability; the tests were performed throughout the period of development of the apparatus when minor modifications were being made, and also the majority of tests were carried out on glaucoma patients in whom the results could be influenced by alterations in pupillary size due to changes in treatment, or by variations in the length of time between instillation of a miotic and the conduct of the test. Furthermore, it is to be remembered that in some patients results obtained on the Bjerrum screen on different occasions show a considerable degree of variability, but it is impossible to estimate from the present data whether there is more or less variability with the new test.

Group F *b*. Those tested on the same day.

The test was carried out four times on one or both eyes of 8 patients (15 eyes) on the same day, over a period not exceeding three hours. From the four sets of results a composite chart was prepared showing the positions in which stimuli were missed in one out of four tests, in two out of four, and so on. The result of this "cumulative test" is shown for one patient in Fig. 12 and individual results are given in Table V (overleaf).

It can be seen that when a stimulus was not perceived this was a consistent happening in a high proportion of the 74 positions. This was not true for the patient F 3, but her poor performance

FIG. 12.—Patient with simple glaucoma; loss of lower field. "Cumulative test", i.e., pooled results of four separate tests on same day. ○ = positions in which stimuli were missed in 1 out of 4 tests; ● = 2 out of 4 tests; ● = 3 out of 4 tests; ● = 4 out of 4 tests.

TABLE V
GROUP F *b*. RESULTS OF CUMULATIVE TEST IN PATIENTS TESTED SEVERAL TIMES

Patient	Eye	Total Number of Positions where Stimuli were Missed (i.e. in at least One out of Four Tests)	No. of Positions where Stimuli were Missed			
			In all 4 Tests	In 3 out of 4 Tests	In 2 out of 4 Tests	In 1 out of 4 Tests
F 1	RE	44	16	9	7	12
F 2	RE	38	13	13	3	9
	LE	31	19	7	2	3
F 3	RE	5	1	0	1	3
	LE	42	2	11	15	14
F 4	RE	1	1	0	0	0
	LE	3	1	0	1	1
F 5	RE	1	1	0	0	0
	LE	1	1	0	0	0
F 6	RE	40	19	5	10	6
	LE	43	24	5	2	12
F 7	RE	46	31	4	1	10
	LE	57	41	3	4	9
F 8	RE	30	9	10	8	3
	LE	70	49	12	6	3

with the left eye is to be attributed to the fact that she had a central scotoma, making fixation inadequate. All the other results showed that in one-third or more of the positions where a stimulus was missed in at least one test, it was also missed in the other three tests. Patients F 4 (R E) and F 5 missed stimuli in one position only in all four tests, this position coinciding, of course, with the physiological blind spot.

Discussion

The general impression gained from the present study was that the new test was regarded by patients as being less arduous and less confusing than examination on the Bjerrum screen, and that it gave results comparable with those of the conventional method of examining the central field. The new test could be performed relatively quickly by persons not specially trained in examination of the visual fields.

It is obvious that certain criticisms of the test can be made on theoretical grounds. Since the stimuli are in fixed positions a scotoma lying between these positions would remain undetected. This could be avoided by increasing the number of positions in which stimuli are presented, a solution which would have the disadvantage of prolonging the test. With this type of test it is always necessary to reach a compromise between the risk of missing a small scotoma and the simplicity and duration of the test. The evidence presented suggests, however, that field defects revealed on the Bjerrum screen are unlikely to remain undetected by the new test.

When a discrepancy exists between the results of two methods of examining the visual field, it is difficult to decide which method is at fault. One approach to this problem is to use other observations as a basis for deciding whether or not a field defect is likely to be present and, for this purpose, patients with glaucoma or suspected glaucoma are particularly suitable. From the ophthalmoscopic appearance of the optic disc it is possible to form some impression as to whether there is or is not a field defect. Group D consisted of patients with established simple glaucoma in whom the discs were cupped; examination on the Bjerrum screen revealed no abnormality, whereas in a proportion of these patients the new test gave evidence of loss of field. Group E consisted of patients in whom the appearance of the discs aroused a suspicion of pathological cupping but in whom the central fields were found to be full on the Bjerrum screen. These patients were submitted to intensive

investigation, which included repeated applanation tonometry, tonography, and provocative tests, as a result of which they could be divided into those who showed no further evidence of glaucoma and those in whom the suspicion of glaucoma was strengthened; the number of abnormal results with the new test was clearly greater in the second group when compared with the first. These findings suggest that the new test was superior to the usual Bjerrum test in detecting the early field changes of glaucoma. In this connexion it must be borne in mind that the new test was conducted with a reduced level of ambient illumination, whereas the Bjerrum test was carried out with full standard illumination of the screen. Had the Bjerrum test been conducted under conditions of reduced illumination, more defects might have been revealed.

A serious criticism of the apparatus described concerns the equality of the stimuli. While one may feel reasonably certain about their equality as regards the duration of presentation, doubt may arise about the equality of brightness. To supply an equal current to a series of mass-produced electric lamps is no guarantee of uniformity of brightness of all the stimuli. In an initial attempt to overcome this difficulty a standard stimulus was constructed and this was placed on the screen close to each stimulus in turn. The variable potentiometer in the circuit of the lamp under examination was then adjusted until the stimulus appeared to be of the same brightness as the standard, the procedure being repeated for all 74 lamps. Such a method gives only a rough adjustment and has been superseded by the use of a small photo-cell connected to a galvanometer, which is placed over each lamp in turn in order to give an objective measure of brightness. While there can be little doubt from physiological considerations that gross inequality of the stimuli could be disastrous for the validity of the test, it seems probable that minor variations in brightness from one stimulus to another have no marked influence on the test, the factors of mental concentration, fatigue, and the anxiety of the patient to "do his best" being perhaps of greater importance.

An important advantage of the new test is that it can be repeated several times with no variation in the duration, brightness, or order of presentation of the stimuli; to achieve a comparable degree of repetition would be virtually impossible on the Bjerrum screen. This advantage makes possible the "cumulative test" (p. 67) in which one may determine with a high degree of certainty those positions in which stimuli are not perceived.

The apparatus appears therefore to fulfil its intended purpose of giving a rapid assessment of the central field when operated by technicians, and it also holds out some promise of being useful in the detection of early glaucomatous field defects and in follow-up examinations of glaucoma patients.

Summary

A device is described for rapid assessment of the central field. Stimuli of fixed duration and brightness are presented, one at a time, in each of 74 positions evenly arranged over the area of the central field. The order of their presentation is pre-determined and invariable. A recording device produces a chart on which the positions of the stimuli not perceived by the patient are marked.

The test can be operated satisfactorily by technicians.

Tests were conducted on healthy subjects in order to determine the area within which failure to perceive a stimulus suggested that the visual field was defective.

Results obtained with the new test on glaucomatous patients showed general agreement with the findings of the conventional test on the Bjerrum screen, when the latter was conducted with the 2/2,000 white object.

Evidence was obtained that the new test revealed field defects in early glaucoma more readily than the standard Bjerrum test.

There was good agreement between the results of repeated tests on the same patient when carried out on the same day.

REFERENCES

- HARRINGTON, D. O., and FLOCKS, M. (1954). *Amer. J. Ophthal.*, **37**, 719.
SUTCLIFFE, R. L., and BINSTEAD, H. C. (1961). *Transactions of the International Ophthalmic Optical Congress*, (British Optical Association), p. 379.
TSAMPARLAKIS, J. (1964). *Brit. J. Ophthal.*, **48**, 237.