aspect of the problem; to Professor D. Dougal, Dr. G. Stewart Smith and Dr. Mary Evans for the embryos and foetuses; and to Mr. H. Gooding for preparing the photographs.

KEY TO ILLUSTRATIONS.

1. Diencephalon.	13. Tangential section of mesencephalic alar plate.
2. Mesencephalon (a) caudal level;
(b) cephalic level.	14. Oculomotor nucleus and/or nerve.
3. Metencephalon.	15. Acoustic ganglion.
4. Myelencephalon.	16. Otocyst (otic vesicle).
5. Spinal cord.	17. Alar spread.
6. Fourth ventricle and/or its taenial roof.	18. Interlaminar sulcus.
7. Alar plate.	19. Interlaminar cell-free zone.
8. Cerebellar rudiment.	20. Basal plate.
9. Superior medullary velum.	21. Basal spread.
10. Trochlear nerve.	22. Medial longitudinal bundle.
11. Decussation of trochlear nerves.	23. Isthmus rhombencephali.
12. Trochlear nucleus.	24. Lateral wall of isthmus.
	25. Intra (basal)-laminar sulcus.
	26. Trigeminal ganglion and nerve.
	27. Superior cerebellar peduncle.

The use of a hand lens is recommended in examining the photographs.

REFERENCES

- COOPER, E. R. A. (1946).—*Brain*, Vol. LXIX, (a) 50 (b) 34.
 FRAZER, J. E. (1928-29).—*Jl. Anat.*, Vol. LXIII, p. 7.
 ——— (1940).—*Manual of Embryology*, 2nd Edition, London.
 GASKELL, W. H. (1908).—*The Origin of Vertebrates*, London.
 HAMILTON, BOYD and MOSSMAN (1945).—*Human Embryology*, London.
 HARLEY, R. D. (1942).—*Amer. Jl. Ophthal.*, Vol. XXV, p. 1029.
 KAPPERS, HUBER and CROSBY (1936).—*The Comparative Anatomy of the Nervous System of Vertebrates*, New York.
 KEENE and HEWER (1931-32).—*Jl. Anat.*, Vol. LXVI, p. 1.
 KEIBEL and MALL (1912).—*Manual of Human Embryology*, Vol. II, Philadelphia and London.
 PEARSON, A. A. (1943).—*Jl. Comp. Neur.*, Vol. LXXXVIII, p. 29.
 TAHAJSKY, E. (1940).—*Anat. Anz.*, Vol. LXXXIX, p. 316.

COLOUR VISION IN THE CONSULTING ROOM

BY

FRANK R. NEUBERT

GUERNSEY

IN 1941 an analysis of the colour-vision reports on 2,484 subjects suggested that the difference in the findings on colour-plates and colour-lanterns would form an interesting subject for investigation.

Such an investigation began, and during the following four years 43,395 subjects were examined: 40,380 males and 3,015 females.

Only two defectives (both unsafe) were found among the latter, and the final figures were restricted to the male sex only.

Many subjects were seen on whose colour sense opinions had differed, and an attempt was made to determine (a) why such defects could not be assessed easily and positively (b) why results on colour plates and colour lanterns did not always agree, and (c) whether an improvement could be made in clinical examination apart from the use of laboratory methods.

Colour Perception with Aviation Model

The terms "normal," "unsafe," "safe," "green-blind," and "red-blind," although scientifically inaccurate, are understood by all, and are used in their commonly accepted meaning in this résumé of the work done.

All the 40,380 men were asked to read the original Ishihara Colour Plates, 8th Edition, and each one who made a mistake suggesting a defective colour sense—2,235 in all—was investigated on a lantern (colour perception unit—aviation model) and by other experimental methods.

A group of 1,654 subjects was first examined on plates and lantern and the results compared.

TABLE I.
Examination of 1,654 previously untested subjects on Plates and Lantern.

					Ishihara Plates	Lantern Unit
Normal	...	...	...	...	1,585	1,623
Safe	...	...	...	...	20 (1.21%)	3 (0.015%)
Unsafe	Red-Blind	...	...	8	49 (3.1%)	3
	Green-Blind	...	...	38		22
	Red and Green-Blind	...	...	3		3
Total	...	...	...	...	1,654	1,654

The difference between these findings was too great to be ignored, and a second group of 431 subjects, who were classified as unsafe by the plates, were examined on the lantern: 135 (31.3 per cent.) passed. From this it appeared that the plates were approximately one third more sensitive than the lantern in detecting defects in the colour sense.

TABLE II
Comparison of Defective Subjects by Ishihara Test and Lantern

Ishihara	Lantern	
	Colour Defective Unsafe	Colour Defective Safe
Red-Blind ... 178	131	47
Green-Blind ... 236	153	83
Red & Green-Blind 17	12	5
Total ... 431	296 (68.7%)	135 (31.3%)

The manner in which the colour plates were read made it seem advisable to record the individual mistakes, and 1,573 unselected men were asked to read, without hesitation, a group of figures in an American series of plates (mentioned later).

686 (43.7 per cent.) of them were certainly normal or definitely defective. 532 (33.8 per cent.) of them made mistakes which were corrected at a second attempt. 355 (22.5 per cent.) of them made mistakes which were not corrected after two or more attempts, although such errors did not come into the category "Colour defective" according to the explanation book.

For example, if plates Nos. 1 and 2 (figures 89 and 43) were read as 89 and 45, altered to 89 and 48, then corrected to 89 and 43, the mistakes would appear due to observation rather than a defect in the colour sense and such cases were not classified as defective. This is in agreement with the instructions.

Pseudo-iso Plates

The original Ishihara plates began to fade, and tests were commenced with the series issued by the American Optical Company: The pseudo-isochromatic plates for testing colour perception.

Each series contains a pair of plates showing the numerals 45 and 73 which are intended to be similar: Ishihara Nos. 20 and 21, A.O.C. Nos. 33 and 34. These are supposed to be read only by the majority of the red-green blind, "but the majority of the normal and the totally colour-blind can hardly see them" (Ishihara 1939). The results of 11,348 readings were analysed.

By Ishihara standards 445 (3.9 per cent.) were definitely colour-blind, 370 (3.2 per cent. Group A) read the Japanese figures, but only 193 (1.7 per cent. Group B) read the American ones, a difference of 47 per cent.

TABLE III

Comparison of 445 defective subjects by Ishihara and American Plates.

	Ishihara Plates	American Plates
Read (unsafe)	370 (83.0%) Group A	193 (43.4%) Group B
Not read (safe)	75 (17.0%)	252 (56.6%)
Total ...	445	445

The 370 subjects (Group A) were examined on the lantern and 124 (33.5 per cent.) of them were found to be safe.

The 193 subjects (Group B) were examined similarly and 55 (29.5 per cent.) were found to be safe.

Examination of these results showed that, whereas only two subjects could read the American and not the Japanese figures, 200 were able to read the Japanese but not the American. The lantern results of these cases are compared in Table IV.

TABLE IV

Classification by Lantern of subjects in Table III who read Ishihara plates Nos. 20 and 21 and American Plates Nos. 33 and 34.

Lantern Classification	Ishihara Unsafe	American Unsafe
Safe ...	124 (33.5%)	55 (29.5%)
Unsafe ...	246 (66.5%)	138 (70.5%)
Total ...	370 (Group A)	193 (Group B)

This not inconsiderable difference emphasises the exceptional difficulty in producing dyes which are suitable for colour-vision testing.

When a British reprint of the Ishihara plates was issued, a comparison was made between it and the Japanese set, but as so many normal subjects read without much difficulty the figures which only the colour-blind were intended to see, the set was not included in the investigation and only the original series was used.

The chromatic threshold

Parsons states that the appreciation of colours only occurs with lights of moderate or high intensity (photopic vision). If a spectrum of low intensity is seen with the dark adapted eye it appears as a grey band, differing in brightness in different parts (scotopic vision).

It would appear from this that, with the very low threshold for red, an exaggeration between the appreciation of red and green, or between red and yellow, would be made by a defective person if two or three colours were presented simultaneously to the photopic eye by means of a lamp with controlled illumination. A rheostat was fitted to all lanterns.

Size of lantern aperture

According to Guttman's fourth postulate, a colour defective person requires a considerably larger area of stimulation for the perception of hue.

The duplicity theory of vision asserts that the retinal cones are responsible for the perception of colour. The cones are most numerous at the fovea centralis, where rods are absent, and decrease proportionately peripheralward.

The measurements of the so-called "rod-free area" are:

Fovea Centralis	...	0.24 to 0.3 mm. in diameter	(55' to 70')
Rod Free area	...	0.80 mm.	,, , (3°3')
Macula	...	1.0 to 3.0 mm.	,, , (4° to 12°)

In order to fall within these areas, an object at a distance of 6 metres would have to be:—

Fovea Centralis	...	9.6 to 12 mm. in diameter.
Rod free area	...	32 mm. , ,
Macula	...	40 to 120 mm. , ,

In order to stimulate an individual cone 0.004 mm. diameter, an object must be 1.7 mms. at 6 metres, which is the exact size of each element of a Snellen's 6/6 test-type letter.

An examination was made at 6 metres with the 1 millimetre aperture of the lantern of 313 colour defectives who had been classified on the 5 mm. aperture.

139 had been passed as "safe." 29 (20.9 per cent.) of these failed to recognise the red or green, or both the red and green 1 millimetre aperture.

174 had been considered as "unsafe." 77 (36.8 per cent.) of these were able to recognise both the 1 millimetre red and green.

TABLE VIII

Comparison of the effect of Aperture Sizes.

LANTERN	Recognised 1 mm. aperture	Failed on 1 mm. aperture	COLOUR
Classification of Cases using the 5 mm. aperture			Analysis of Failures
C.D. Safe ... 139	97 (79.1%)	29 (20.9%)	Red ... 1 Green ... 26 Red and Green 2
C.D. Unsafe 174	77 (36.8%)	110 (63.2%)	Red ... 11 Green ... 79 Red and Green 20
Total ... 313	174 (55.6%)	139 (44.4%)	139

This supported the contention that although 1 millimetre colour targets are of undoubted value in campimetry, such small apertures are of questionable value in examinations of colour-vision outside the laboratory.

Granit supports this view when he states, "a reduction of area of the visual object, which is known to lead to disappearance of its colour with maintained brightness distribution, must do so because the "small" stimulus merely has a chance of hitting upon the common dominators.

Experimental evidence, however, shows that the recognition of a small colour light is subject to considerable individual variation.

In a series of papers published in the *Journal of Physiology* (1946), Hartridge has reported his experiments in micro-stimulation in support of his postulate that the foveal cones are frequently found grouped together into clusters by "random distribution" like the coloured starch grains on the Lumière screen.

It is not easy to see how microscopic fixation can be retained for these experiments when the eye has a constant involuntary movement over two minutes of arc of 50 per second.

These particular investigations terminated because new lanterns which were obtained had apertures varying from 1 millimetre to 0.5 millimetre and it was not possible to standardise the results.

This fact was not discovered until one group of 66 subjects

The Ishihara test claims to separate by means of plates Nos. 22, 23, 24, and 25, the "red-blind" from the "green-blind."

A detailed examination on the lantern was made of those defective classified by this means.

TABLE V

Ishihara	Lantern Test			Passed Lantern Test
	Failed to recognise Red only	Green only	Red and Green	
Red-Blind ... 116	7	53	35	21
Green-Blind ... 194	16	72	35	71
Red and Green-Blind 27	3	11	6	7
Total ... 337	26	136	76	99

Out of the Ishihara "red-blind" cases, only 7 failed to recognise only red on the lantern, whereas 35 were unable to recognise both red and green, and 21 passed the test.

Out of 194 who were Ishihara "green-blind," 72 were unable to recognise only green on the lantern, whereas 35 failed to recognise both red and green, and 71 passed the lantern test.

It has been claimed that any subject classified by these figures will eventually fail with the lantern if examined persistently, but this was not found to be the case.

TABLE VI

An analysis into "Safe" and "Unsafe" on the lantern of 368 subjects classified according to Ishihara plates as Colour Defective Unsafe.

	Red-Blind	Green-Blind	Red and Green-Blind	Total
Ishihara Plates	122	223	23	368
Lantern—Safe...	11	81	6	98
„ Unsafe	111	142	17	270

A total of 368 cases was classified, of whom 122 were found to be red-blind and 223 were found to be green-blind. 92 of these cases passed the lantern test after having been examined persistently.

During these tests a comparison was made between the aviation model colour perception unit and the Edridge-Green colour lantern; 190 defective subjects were examined on each, using the technique outlined in the respective instructions.

The comparison suggests an inherent weakness in this type of lantern.

TABLE VII

The percentage comparison between the Aviation Model and Edridge-Green Lantern.

<i>Unsafe</i> Aviation Model	<i>Unsafe</i> Edridge-Green	47.4%
<i>Unsafe</i> Aviation Model	<i>Safe</i> Edridge-Green	15.8%
<i>Safe</i> Aviation Model	<i>Unsafe</i> Edridge-Green	15.8%
<i>Safe</i> Aviation Model	<i>Safe</i> Edridge-Green	21.0%

PART II

This examination and comparison of the usual clinical methods of determining the state of the colour sense suggested that more attention should be devoted to lantern tests and a considerable number of experimental lanterns were made. The original postulates of Guttman, translated in Parsons' "Colour Vision," suggested the lines along which these experiments should develop.

Guttman found that those with defective colour perception differed in seven respects from the normal.

(1) They required a smaller difference in the yellow but a greater difference in the green for discrimination.

(2) They were more dependent upon luminosity for hue discrimination.

(3) They developed a capacity for distinguishing differences in luminosity which they translated into hue.

(4) They required a larger area of retinal stimulation.

(5) They required a longer time to make their decision.

(6) Their colour sense was more readily fatigued (successive contrast).

(7) They had an increased sense of simultaneous contrast.

gave figures which were below the average. Only six of them were able to recognise standard green and it was found that the aperture was only 0.75 millimetre in diameter, the small difference in size being apparently of much importance.

Successive contrast

In his discussion of after-images, Edridge-Green states, "the results obtained by successive contrast are similar to those obtained by simultaneous contrast, only they are more satisfactory and decided."

When a colour is looked at for a time, the sensitivity toward that colour is lowered and the eye becomes more sensitive to the complementary. In fact, when a coloured light is concentrated upon for some minutes the complementary becomes so insistent that the original light is seen with difficulty.

If a colour-vision examination is performed slowly, successive contrast is likely to complicate the findings. It was noticed, however, that this phenomenon was less in those with normal colour vision.

Successive contrast was investigated in 415 subjects whose colour vision was abnormal. 217 (61.0 per cent.) of these were "unsafe" and 139 (39.0 per cent.) were "safe."

Using the 5 mm. aperture, standard yellow was shown rapidly after standard red, then standard green. 356 (85.8 per cent.) demonstrated the phenomenon of successive contrast.

Of the total cases, 172 were unable to recognise standard yellow after standard red, whereas only 29 failed to recognise it after green. The percentage of 50 per cent. "safe" and "unsafe" was the same in each group.

155 subjects were unable to recognise yellow after both red and green. 78 per cent. of these were "unsafe."

TABLE IX

Lantern Classification	Successive Contrast after 5 mm. aperture showing			No Successive Contrast	Total
	Red	Green	Red and Green		
Safe ...	92 (53.5%)	13 (44.8%)	34 (22.0%)	13 (22.0%)	152
Unsafe ...	80 (46.5%)	16 (45.2%)	121 (78.0%)	46 (78.0%)	263
Total ...	172	29	155	59	415

It is interesting to note among those who were "safe" according to the single lantern, the proportion (22.0 per cent.) who were unable to recognise yellow after both red and green was the same (22.0 per cent.) as those who showed no successive contrast.

During this investigation it was found that whereas the phenomenon of successive contrast is exaggerated in those with defective colour vision (Guttmann, Edridge-Green) it was not marked in the normal. A number of men were found who apparently conformed to Edridge-Green's heptachromat. They read with ease the figures in the books of test-plates "not usually seen by normal persons," and after regarding the 5 mm. aperture for some time they made no mistake whatever in naming a 1 mm. yellow or white when it followed; their successive contrast was minimal.

It was not the purpose of these tests to examine such cases further.

Simultaneous contrast

Guttmann's seventh postulate, that anomalous trichromats have a marked difference in simultaneous contrast effects as compared with the normal, is supported by Edridge-Green, who states that simultaneous contrast is not pronounced in the normal person, but the phenomenon is exaggerated to the dichromat.

TABLE X

Contrasting colours	Apparent Move
Red and Blue Green	Becomes more intense Inclines to blue
Orange and Green-blue	Inclines to red Inclines to blue
Red and Orange	Inclines to rose red Inclines to yellow
Red and Yellow	Inclines to rose red Inclines to green
Red and Yellow-green	Inclines to rose red Inclines to pure green
Yellow and Green	Inclines to orange Inclines to blue

When two spectral colours are presented simultaneously, each colour appears to be moved toward that end of the spectrum further away from the other colour. Green and rose, also red and violet appear to be exceptions.

He goes on to say, "two colours, which have not changed in the slightest degree to the normal-sighted, on being contrasted have apparently altered very considerably to the colour-blind. As an example of this, let us take a deep yellow, a bright red and bright green. To the normal sighted the yellow will be altered very little by comparison with the red or the green, but a three unit would say that the colour was green when contrasted with red, red when contrasted with green."

The effect of simultaneous contrast was investigated by showing to the candidate two colour perception units 10 inches apart at a distance of 20 ft. The following pairs of colours were shown, using the 5 mm. apertures, in any combination.

Two standard green

Two standard red

Two standard yellow

A group of 52 subjects whose colour vision was suspected who had been investigated thoroughly by other means, were examined. Of 30 who had passed successfully a single-light test, 21 made errors when shown two simultaneously.

TABLE X1

Classification according to <i>Single</i> Colour Perception Unit (5 mm.)		Classification using <i>Two</i> Colour Perception Units (5 mm.)			
Unsafe	22	{	Red-blind.	15	Unsafe 22
			Green-blind ...	6	
			Red and Green-blind	1	
Safe	30				
			Unsafe	21	
			Safe	9	
Total	52		Total	52	

In this group of suspects, approximately 42.3 per cent. were considered unsafe with the single light, 82.7 per cent. with the double light.

This finding indicated that the single-light lantern was not sufficiently accurate in the separation of the "dangerous" from the "non dangerous," for a candidate could not be considered safe who was unable to recognise two 5 mm. signal lights at a distance of 20 feet.

A considerable number of lanterns was made until eventually it was found that three coloured apertures, shown simultaneously, constituted the most sensitive test and a lantern was constructed which would show any combination of reds, greens, and yellows, using apertures 10 millimetres in diameter, with variable illumination.

The method of examination was as follows: the lights in the consulting room were lowered but the room was not made dark enough, or the test continued long enough, for the patient to become dark-adapted. By means of the lantern rheostat the light was increased fairly rapidly until the three apertures were distinctly seen. At this illumination the patient was asked to name the colours of the lights as they were shown to him in groups of three.

It is considered that, under these conditions, any single error in the naming of the colours shows that the man's colour vision is unsafe.

137 subjects who had made errors in reading the Ishihara plates were classified on the single-light lantern. 28 made no mistakes and were assessed "safe."

These 28 were then tested on the new lantern and 19 made errors, an increase of 13.87 per cent. in those assessed "unsafe."

TABLE XII

	Single-light Lantern	Multi-light Lantern
Safe ...	28 (20.44%)	9 (6.57%)
Unsafe	109 (79.56%)	128 (93.43%)
Total ...	137	137

The most common error was to miscall standard yellow when it was shown together with either reds or greens, or even yellows.

The next common error was to call one of a trio of reds or greens, "yellow."

If the results of the single, double, and treble light examinations are compared, it is found that the sensitivity of the test increases.

TABLE XIII

Classification of colour defectives examined by
three types of lantern

Lantern	Colour Defective Safe	Colour Defective Unsafe
Single Aperture	31.5%	68.5%
Double Aperture	17.3%	82.7%
Treble Aperture	6.57%	93.43%

It should be observed that the percentage of defectives by the double aperture is almost identical to the Ishihara.

This series of tests is evidence against the use of the single-aperture lantern and indicates the need for a fuller investigation of the anomalous trichromats hitherto considered as "safe."

Conclusions

1. This paper reports the investigation into the colour vision of 40,380 men, of whom 1,152 (3 per cent.) were safe, and 1,083 (2.5 per cent.) were unsafe.

2. Tests by colour plates, although more sensitive than tests by a single-lantern, are unreliable and differ with different series of plates.

3. The use of small apertures serves no useful purpose in the examination of colour-vision in the consulting room (Table VII).

4. The standard single-light lantern is not sensitive enough for discriminating between the "normal" and the "unsafe" (Table XII).

5. A triple-light lantern with controlled illumination is the most sensitive and reliable apparatus for demonstrating defects of the colour sense in the consulting room (Table XIII).

BIBLIOGRAPHY.

1. BRITISH STANDARDS INSTITUTION. — Road Traffic Control (Electric) Light Signals. September, 1939.
2. BRITISH STANDARDS INSTITUTION. — Colours for Signal Classes for Railway Purposes. May, 1940.
3. BRITISH STANDARDS INSTITUTION. — Calculating the Intensities of Lighthouse Beams and Beams from Coagulate Projection Apparatus. February, 1941.
4. COLLINS, M. — Colour Blindness, London, 1935.
5. CORBETT, H. V. — Hue Discrimination in Normal and Abnormal Colour Vision. *Jl. of Physiol.*, Vol. lxxxviii, No. 2, 1936.

6. CORBETT, H. V. and ROAF, H. — Recognition of Flashing Coloured Lights. *Brit. Jl. Ophthal.*, 1937.
7. DUKE-ELDER, SIR STEWART. — Text-Book of Ophthalmology, Vol. I. London, 1942.
8. DUKE-ELDER, SIR STEWART. — Text-Book of Ophthalmology, Vol. II. London, 1943.
9. DUKE-ELDER, SIR STEWART. — Text Book of Ophthalmology, Vol. III. London, 1940.
10. GILES, G. H. — Modifications of Standard Colour Vision. *Dioptric Review and British Journal of Physiologic Optics*, Vol. I, No. 1.
11. GILES, G. H. — Colour Vision Tests. *Dioptric Review*. December, 1935.
12. GOTHLIN, GUSTAF F. — Interaction of Excitatory and Inhibitory Processes in the Synthesis of the Sensations of Colour and of White Uppsal, 1944.
13. HAY, JANETTE C. and ROAF, H. — The Blue-Green Region of the Spectrum. *Jl. of Physiol.*, Vol. xcvi, 4, 389, 1940.
14. EDRIDGE-GREEN, F. W. — Colour Blindness. London, 1909.
15. EDRIDGE-GREEN, F. W. — Physiology of Vision. London, 1920.
16. HAILWOOD, J. G. and ROAF, H. — Sensations of Yellow and Anomalous Trichromatations. *Jl. of Physiol.*, Vol. xci, 1, 36, 1937.
17. HARTRIDGE, H. — The Colour of Small Objects. *Jl. of Physiol.*, Vol. civ, 1945.
18. HARTRIDGE, H. — Visual Acuity of the Eye using Lights of Different Colour.
19. HARTRIDGE, H. — The Colour Vision obtained by micro-stimulation of the Retina.
20. HARTRIDGE, H. — Micro-stimulation of the Human Retina.
21. HARTRIDGE, H. — The Repair of the Retinal image.
22. HARTRIDGE, H. — Cluster Formation of the Foveal Cones. *Jl. of Physiol.*, February, 1946.
23. VON HELMHOLTZ, H. L. F. — Treatise on Physiological Optics. Rochester, 1924-5.
24. JOHNSON, LINDSAY. — Atlas of the Fundus Oculi. London, 1931.
25. KRAVKOV. — Acta Medica. U.S.S.R., 1939. Acta Ophthalmologica, K.M.B. xvii, 426-43, 1939.
26. MEDICAL RESEARCH COUNCIL. — (xi) Individual Differences in Normal Colour Vision. H.M.S.O., London, 1933.
27. MEDICAL RESEARCH COUNCIL. — (xii) Colour Vision Requirements in the Royal Navy. H.M.S.O., 1933.
28. MONCRIEFF, R. W. — The Chemical Senses. London, 1944.
29. OBLATH, O. — Colour Vision Tests. Studies and Reports. Series E. International Labour Office, 1929.
30. PARSONS, SIR JOHN HERBERT. — Colour Vision. London, 1924.
31. PARSONS, SIR JOHN HERBERT. — Diseases of the Eye. London, 1942.
32. PEDDIE, W. — Colour Vision. London, 1942.
33. POLYAK, S. L. — The Retina. Chicago, 1941.
34. ROAF, H. — Textbook of Physiology. London, 1936.
35. ROAF, H. — Colour Vision. Trans. Ophthal. Soc. U.K. Vol. liv, 1934.
36. ROAF, H. — Some Observations on Methods of Testing Colour Vision. Trans. Ophthal. Soc. U.K. Vol. xlv, 1926.
37. ROAF, H. — Methods of Testing for Colour Vision. *Brit. Med. Jl.* Vol. II, 1938.
38. ROAF, H. — Recognition of Colour. Trans. Ophthal. Soc. U.K. Vol. lix, Part 1, 1939.
39. TRAQUAIR, H. M. — Introduction to Clinical Perimetry. London, 1942.
40. WRIGHT, SAMSON. — Applied Physiology. London, 1945.
41. ZOLTHOUT, W. D. — Physiological Optics. Chicago, 1939.