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9

# The Diaphragm Test for Binocular Vision

BY  
N. BISHOP HARMAN



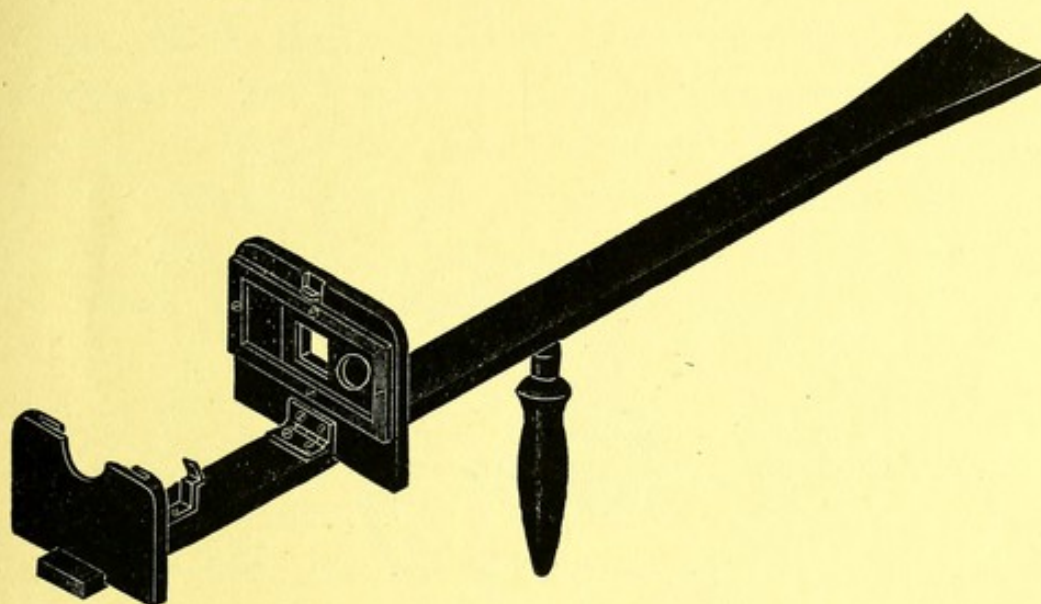
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# The Diaphragm Test for Binocular Vision



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## THE DIAPHRAGM TEST FOR BINOCULAR VISION.\*

By N. BISHOP HARMAN.

THIS test is the reverse of Javal's well-known "Bar-reading" test. Instead of a bar which the patient's eyes must negotiate, there is a screen with a single hole in it; through this hole the patient can look with both eyes, quite naturally, and without suspecting the manner in which his vision is being dissected.

The test rests on a phenomenon that occurs to everyone many times daily; when a window is looked through the man with binocular vision sees more widely than he who has but one eye. To demonstrate the principle of the test the following experiment may be made: Stand facing a wide view, hold up both hands, palms towards you, six inches from your face and on a level with the eyes, let the hands be separated so that the little fingers are distant from each other three fingers' breadth. It will be found that the hands cover the eyes, yet a perfectly clear perception of the view is obtained. But if one eye be closed half the view is lost, for the right hand obscures the direct vision of the right eye and the left hand that of the left eye; but the eyes see cross-wise through the space between the hands. The paths of the vision are shown in figure 1, and the manner in which right and left monocular and also binocular vision is arranged for.

\* Demonstrated to the Ophthalmological Society of the United Kingdom, December, 1908; United Services Medical Society, March, 1909; Royal Society of Medicine (Neurological Section), April, 1909.



The instrument made to apply this test in practice is very simple, but a series of most varied and surprising tests may be made with it. They are so simple that the operator is not likely to be tied up in examining a patient, yet they are so subtle that when an expert is submitted to the test he can only escape confusion by stating simply what he sees.

#### THE INSTRUMENT.

A length of wood like a flat ruler 44 c.m. long is fitted with a rack at one end to receive the test cards, and a

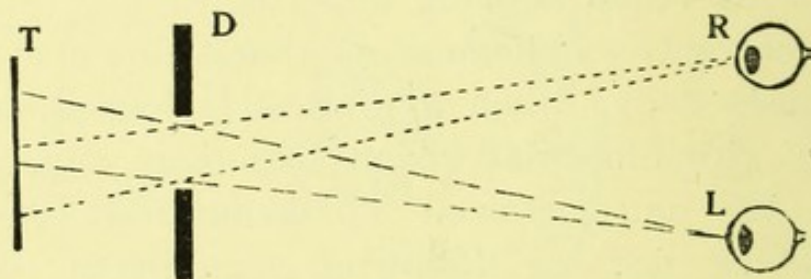


Fig. 1.

The paths of vision.

T = Test card ; D = Diaphragm with hole.

screen measuring  $9 \times 6$  c.m. fixed at 11 c.m. from the rack. In this screen, or diaphragm, a hole is cut; it is either square or round and measures 1.7 c.m. square or diameter. A moveable pin is fixed to the diaphragm so that it can be projected into the hole as a point of fixation in certain experiments. A handle is fixed beneath the base board.\*

#### *Method of Handling.*

In use the patient takes hold of the handle with *both* hands and places the free end of the rule (this is wash-

\* The instrument is made in suitable materials in excellent fashion by Messrs. George Culver, Ltd., of White Lion Street, London; it costs only a few shillings.

able) against the upper lip just beneath the nose. The surgeon stands facing his patient and holds the other end of the instrument to keep it steady. When the instrument is in position the patient is asked to look either through the hole, or at the pointer projecting into it, according to the test desired, and to tell what he sees through the hole.

### *Test Cards.*

There are three sorts: 1. Printed matter, of any size from diamond in set paragraphs to canon in paired capitals. 2. Black or coloured squares variously dis-

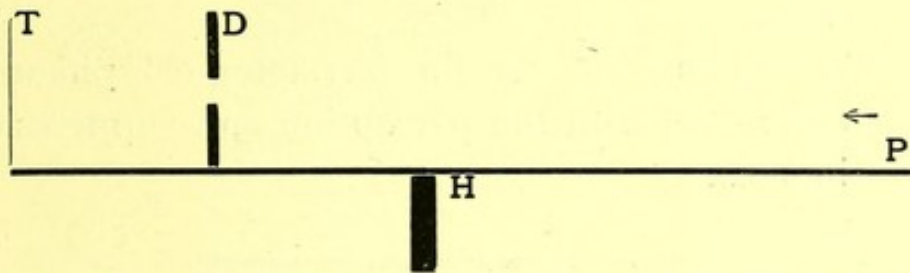


Fig. 2. Side elevation of "Diaphragm Test": T=test card; D=Screen with hole; P=position of patient, who looks in direction of arrow; H=handle.

posed. 3. Pictures for children. A number of test cards are issued with the instrument, but the surgeon can make and vary them indefinitely.

### *The Diaphragm.*

The screen with the square hole is most generally useful; for the reading tests particularly, and when we wish to demonstrate the presence of binocular vision where it is denied. When the patient looks clear through the hole at the test the margins of the hole are seen doubled, the square becomes an oblong; this change escapes remark save by the most observant. On the other hand when it is desired to demonstrate weakness



of binocular vision or in fusion experiments the round hole is the better, as reduplication of the circle and overlapping of the two images is very noticeable.

#### THE USAGES OF THE DIAPHRAGM TEST.

The test is of value for the following purposes :—

1. To determine the equality of visual acuity in the two eyes.
2. To determine the presence, the absence, or a defect of binocular vision.
3. To exercise the vision in squinting eyes.
4. To detect malingerers feigning monocular blindness.
5. To demonstrate certain physiological phenomena connected with the perception and suppression of images.

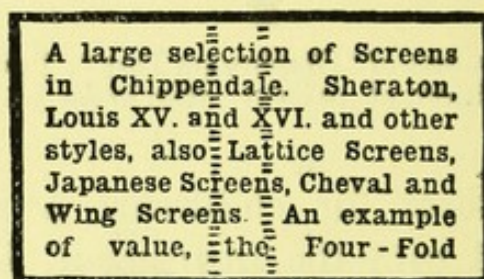


Fig. 3.

The dotted lines indicate the overlapping of the crossed images of the square hole.

#### 1. *Equality of visual acuity of the two eyes.*

A paragraph of printed matter is put in the test rack, the patient is desired to read it. The plan of the instrument is such that three kinds of vision are required to pass the test. The right half of the test is read by the left eye, the left half by the right eye, and the middle strip by both eyes (fig. 3). If the patient can detect no

difference in the clearness of the letters on the card the eyes have equal vision. The test is very delicate. Further, this cannot be passed unless there be good balance of the oculo-motor muscles.

2. *Binocular vision and its defects.*

The preceding test when small type is used is the most delicate test of this nature, a small degree of latent squint will prevent a man from reading the paragraph accurately. The phenomena produced by the various orders of latent squint can be best shewn by the use of the test card with a single line of letters or figures :—

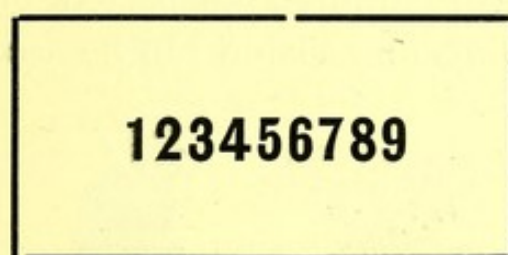


Fig. 4.

The man with good binocular vision reads 1234 with the right eye, 6789 with the left, and 5 with both eyes (fig. 4.).

In latent convergence (esophoria) the middle letters are over-lapped and are suppressed so that the man reads something like this :—

**126789**

In latent divergence (exophoria) the middle letter is reduplicated, and the man reads :—

**12345 56789**

In latent vertical displacement (hyperphoria) the parts



of the line of letters seen by each eye are on different lines or levels, thus :—

12345  
56789

All these phenomena can be seen by the surgeon himself who has perfect binocular vision, when he causes disturbance of his muscles by putting a prism before one eye, or more simply by just displacing one eye slightly by gentle pressure with one finger. It is astonishing how readily this simple device displays latent irregularities in the muscle balance of the eyes.

In the case of children suspected of squint, their capability for binocular vision can be ascertained by the

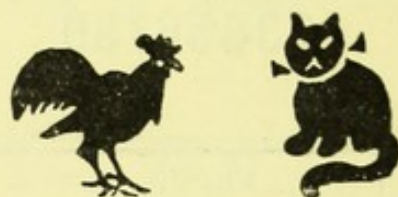


Fig. 5.

One of the test-cards for children.

diaphragm test more easily and at an earlier age than by any other means. There are a series of bold and simple drawings of familiar objects supplied with the instrument (fig. 5). The child looks at a pair of pictures through the hole of the diaphragm, if they are named promptly there is good evidence that the vision of one eye is not suppressed. The youngest patient I have yet tried with the test was a girl, aged 2 years and 5 months, she had not seen these particular pictures before, but she named them all correctly looking at them through the hole, and she wanted to see some more !

### 3. *Exercises for squinters.*

Monocular alternate fixation, and binocular fusion can be practised through a series of graded tests, from coloured patches, pictures, and large letters to small print.\* When one eye by reason of disuse has a lesser visual acuity than the other the superiority of the better eye can be reduced by paralysing the accommodation of that eye with atropine, by shading the half of the tests to be seen with that eye, or by placing such a glass before that eye as will reduce the vision to an equality with the weaker eye.

### 4. *Detection of Malingerers.*

We cannot have too many tests for the detection of feigned monocular blindness, but a good test must be

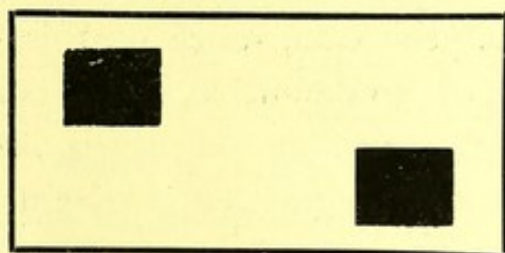


Fig. 6.

Arrangement of test-card with coloured patches.



Fig. 7.

The same test-card seen in the hole of the Diaphragm when the eyes are fixed on the pointer projecting into the upper part of the hole.

simple. Here is one that is so simple that the surgeon cannot get tied up in using it, yet it is so subtle that an expert can be trapped.

There are test cards with squares printed thereon, coloured, red and green, or black for use with the colour blind. The squares are printed right and left, any number may be used, but one each side is enough; and

\* A very cheap form of instrument with test cards is made for patients' use.



the patches are on different lines so that they cannot be fused by convergence (fig. 6).

The cards are reversible, so that the red and green cards can be exhibited four different ways : red to right, to left, above, or below.

One of these cards is put in the rack, and the patient asked what he sees. (1) He may be told to look through the hole, then he sees the patches as they are on the card and must name them. Suppose, an extreme improbability, the man knows the patches are seen by crossed vision, and correctly evades naming the patch seen by the pseudo-amaurotic eye; yet he does not escape, for the surgeon watching the man's eyes will see *the co-ordinate movements of the eyes as he looks from one to other area of crossed vision*. A man truly blind of one eye does not do this. In fact the occurrence of this co-ordinate movement of the eyes is so definitive, that it is not necessary to invite the man to perjure his soul by requiring an answer by his mouth, the true answer is given unconsciously by the movement of the eyes!

(2) He may be told to look at the pointer and so converge, then he gets homonymous diplopia for the patches and one appears above the other (fig. 7). When seen in this latter fashion it is impossible for the patient to guess whether one or other eye, or both eyes, sees the patches : even the cards may be changed so that the red is seen by the right and left eyes alternately, yet the change will not be detected.

The tests are so good that there is no objection to the patient seeing all the test cards laid out on the table before-hand. During the testing the surgeon has the man's eyes under perfect observation, at the suggestion of



a wink on the part of the man the test can be dipped and obscured. Lastly, even when the eyes differ considerably in visual acuity the test with coloured patches can be used successfully, for colour can be perceived when form is obscure.

5. *Physiological alternation of perception and suppression of diverse images.*

There is one test with which very curious results may be obtained. On one half of a test card is drawn a cross of St. George, on the other half is drawn a cross of St. Andrew (fig. 8). The crosses are placed in such relations that when the test is in position and the pointer is set in the round hole of the diaphragm and the two eyes are fixed upon it, the images of the crosses are superimposed and fused. Now for a moment the fused images of the crosses present the appearance of a star of eight points. But it will be found that this appearance is not constant for the whole time of the observation; there succeeds an alternation in the perception of the images seen by the right and left eyes, so that as though by an electric



Fig. 8.

flashing sign the crosses of St. George and St. Andrew pulsate upon the screen. The experiment can be varied by the use of a variety of geometrical figures, parts of circles, etc.

The effect is very curious, and the seemingly definite rhythm of the alternation suggests some reason for the



phenomenon. There are two possible explanations:—

1. That fixation is not constant, and that unconsciously it falls off, but is renewed when the fading of the images occurs. 2. That since in perfect binocular vision the two maculae and the two halves of the brain have learned to view and perceive but one object of fixation at a time, the brain is now incapable of retaining constantly the perception of two dissimilar objects seen by the two maculae. The brain does it for a moment, at the instant of the first attempt, but then the image of one and then of the other object is perceived and suppressed in turn. We may suppose the visual apparatus reverts to a primitive separated condition!

#### CONCLUSION.

In conclusion I suggest that the "Diaphragm Test" puts a very useful and handy every-day servant in the hands of the ophthalmic surgeon, one that will tell him many secrets with a minimum of explanation and direction to the patient, and that the test is not unworthy to be considered one of the simplest methods for the experimental demonstration of binocular vision.





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