THE MEASURE OF NIGHT VISION

BY

N. BISHOP HARMAN, M.B., F.R.C.S.

It is agreed by all that in these days there should be some assortment of men and women for the various kinds of night duty according to their ability to see in a minimum of outdoor light. Those on such duty who are good observers discover for themselves some measure of their night-light reaction. An officer of the Home Guard told me that when he went out from his house at night he could see little at first, but he knew his road and walked slowly; in five minutes he could see so well that he could distinguish the white patches of road markings. There is no doubt of the truth of this observation. When I go out into the dark after an evening of reading and look at the roof of a near-by cottage it appears to have no chimney on its ridge, the skyline seems unbroken; but on looking at the gable end of the roof three metres away the missing chimney can be seen. After staying out of doors for from 5 to 10 minutes the chimney can be seen by direct fixation. The macula has recovered its full vision.

Defect of Some Night-vision Tests

There are several tests of night vision. Some are distinctly ingenious; but with some—and to my mind this is the most important point—there is no definite measure of the minimum light necessary for vision in the particular subject who is tested. Such a measure should undoubtedly be given by a direct reference to our scientific standard of candle-power, and it should be ascertained in such a way and by such an instrument and recorded in such terms that it can be obtained by any ophthalmic surgeon anywhere—here in England or far away in Australia—by repeating the same process. All our eye work is done so far as possible according to definite measurement. We agree everywhere to the measurement of Snellen's distant daylight vision test; and the figures of that test carry with them an exact appreciation of the vision of the person examined. When a workman's compensation case is under consideration in a law court the statement of the medical witness that the subject's normal eye sees 6/6 and the injured eye 6/18 conveys a direct and fair impression to the minds of the judge and the lawyers. Some definite measure and figure of night vision are equally desirable. In an article in the *Journal* on wartime street lighting¹ this was clearly stated: "The measure of illumination provided by wartime street lighting, though so small, is of appreciable benefit, especially when applied on a wide scale."

A number of night-vision tests are now available. The earliest of them measured the time required by the individual to attain an adaptation to the dark. From one point of view, that of the general health and nutrition of the subject, this time reaction is valuable. But among subjects of equally good health and nutrition these adaptation tests do not give a direct and definite measure of the minimum light required by the individual to see an object or objects. An early test for the measure of night vision was that of Dr. W. D. Wright.² His test cards were black with a letter C thereon in varying shades—from pure white to dark grey. The cards were exposed to a radium glow, and examined at a distance of 12 inches. The test is simple, but it gives no definite measure of the light, for radium glow varies. Major B. W. Rycroft³ has reversed this test for Army use, and based his instrument on a widely used form of Snellen's test. The test mark is the letter V painted in varying positions on transparent screens, which are illuminated from behind by an electric bulb. The test is attractive and easy to use, but again there is no definite measure of the lighting, so that the results are not exactly comparable. Opal glass varies in its filtration of light (so even does plate glass!) and electric bulbs vary in their reaction. So far as I can judge the response to this test is wholly related to the particular instrument in use at the time, and it does not give a light measure that can be obtained by anyone, anywhere, and at any time.

The Disk-spotting Test

The disk-spotting test⁴ is planned on a direct measurement of light. The light is reflected from illuminated disks on a black velvet background, and the measure is gained by finding the distance at which the disks can be seen and counted. An instrument made by Theodore Hamblin is most convenient to use, but the plan of the test is so simple that it can be set up by anyone anywhere. Further, since the illumination is from "the standard candle," which is well known to all testers of lighting and all students of physics, there can be such an exactness of the light used and of its measurement that the returns of the examination are definite. The figures were given of night-vision reactions in some 700 healthy subjects with full daylight distance vision grouped as follows: (1) school children 10 to 18 years; (2) soldiers 19 to 30 years; (3) soldiers 31 to 40 years; and (4) persons over 41 years. The reactions differed slightly with age: children did the test best and subjects in group (4) least well. But there is a common average for all classes and ages which the figures showed to be 5. At a distance of 5 metres the light is only 1/1075 of a foot-candle; at 1 metre the light is 1/373, and at the greatest distance at which the disks can be counted, 8 metres, the light is only 1/1816 of a foot-candle, or 1/2000 allowing for reflection loss.

A question put to me by a colleague is one of importance. He said: "I know what is meant when the night-light reaction with this test is only 2 metres, but it would be well if there were some means of registering the reaction to this test that would be recognizable and understandable by any intelligent layman, even though he has no knowledge of how the test is made." There is, I think, a means of registering these night-vision reactions to the disk-spotting test that will meet this need. Here are the percentages of the reactions of the 700 persons examined (half-metre positions have been omitted).

Metres distant	2	3	4	5	6	7	8
% average reaction	5	12	16	21	15	4	1

The figures make it evident that night vision at 5 metres, or in light of 1/1075 candle-power, is the average for most people. If this figure 5 be taken as the denominator of a vulgar fraction of which the numerator is the reaction of the particular individual, that vulgar fraction will state the facts of the finding of the test in such fashion that any person will understand it—just as that person understands something of what 6/18 on Snellen's test implies as a fractional quantity of distant daylight vision. Returns of the disk-spotting night-vision test would be thus: 2/5, 3/5, 4/5, 5/5, 6/5, 7/5, 8/5. If, after testing a subject in this manner, the figure registered is night vision 5/5, everyone will know it is normal. If the figure is 2/5 all will know that night vision is poor; if it is 8/5 no one will doubt that it is very good.

My only criticism of such "fractional" figure returns is that they do not, and cannot, show the amazing value of the high returns. The fractions from 2/5 to 4/5 are a fair statement of the condition of the patient's night vision; but the fractions 6/5, 7/5, and 8/5 seem insufficient for the splendid condition of seeing at 6 or 7 or 8 metres. I have no doubt that in these latter cases the examiner would add a note that "the subject's night vision is exceptionally good," and the reader or examiner of the recorded returns would be duly impressed.

⁴ Harman, N. Bishop, *British Medical Journal*, 1941, 2, 347.

Griffiths, Marks, and Young have shown that the implantation of various oestrogens for periods of two to four weeks increases the insulin content of rat pancreas. H. C. Fraenkel-Conrat and his colleagues (*Proc. Soc. exp. Biol.*, N.Y., 1941, 48, 333) confirm their observation, and believe that the effect is brought about through the mediation of the pituitary. They found that oestrogen which raises the insulin content in the pancreas of normal rats fails to do this in hypophysectomized rats. Also, implantation of the pituitaries of oestrinized rats increased the insulin content of the pancreas of the host animals, an effect not observed with implantation of pituitaries of untreated rats.

¹ *British Medical Journal*, 1941, 1, 635.

² Harman, N. Bishop, *ibid.*, p. 636.

³ Rycroft, B. W., *ibid.*, 1942, 2, 576.