TESTING NIGHT VISION

BY

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"Test for Night Vision" is the title of a seven-page booklet¹ by Dr. W. D. Wright, lecturer in physics in the Imperial College of Science and Technology, which accompanies a test designed by him. Dr. Wright's experience as a physicist makes his consideration of the problem of night vision valuable. He writes:

"The ability to see in the dark varies from one individual to another. In normal times a test for night vision is of value as an indication of under-nourishment, as a means of measuring the development of certain visual diseases, and in connexion with scientific investigations on vision. In time of war it is important that all should know how well they can see in the dark, for both their own lives and, if they are motorists, those of other people may be at stake unless they adjust their activities in the black-out to suit their ability to see under these conditions."

There is no doubt of the truth of this statement. But in this country, at any rate up till now, experience has shown that ill nourishment has been of secondary influence in comparison with certain eye defects in diminishing the ability to see at night. But that does not affect the value of any test in these times.

Dr. Wright's apparatus is a simple one. At the ends of a baseboard measuring 8 in. by 6 in. are hinged two other boards which will stand upright. One is a support for the test cards; the other, on the side away from the patient's eyes, has a disk an inch in diameter covered with a luminous radium compound which gives a faint glow of light that serves to illuminate the test cards. These test cards are black. On each is one letter **C**, $4\frac{3}{8}$ in. in diameter and $5/8$ in. in breadth of limb. These letters are of varying shades, from pure white to a dark grey that is almost black. There are nine grades. It is recommended that the person to be tested should remain in the dark for fifteen minutes. Then the cards are exposed to the radium glow and examined at a distance of 12 inches. The test lies in the ability to see the gap in the circle of the **C**; whether this is upwards, downwards, to the right or the left. Dr. Wright has tested some 300 persons: 49% could see No. 7; 20% No. 6; 6.5% No. 5; and about 1.5% the faintest, No. 9. Young persons see better than the older.

Practical examination of the test confirms these findings. But certain criticisms arise from this examination: (1) It is evident that the radium illumination may be variable. There can be nothing "standard" about it. (2) The hands of the examiner when shifting the cards are disturbing to the examinee; this is easily prevented by the use of black suede gloves. But worse than this is the fact that examination of the more difficult cards is hindered by a sheen from the smooth black of the cards and the baseboard. (3) The test is made at 12 inches, whereas long experience of eye men has shown that any standard vision test should not be at a less distance than 5 or 6 metres.

Some years ago I made a number of tests of the light sense of patients suspected of tobacco amblyopia. The fields of vision were mapped out in varying illumination. The method was found effective.² Since then I have tried other light tests. The aim has been to use a standard illumination and a test that would need a minimum of visual acuity or form sense. A standard candle—i.e., a candle burning 120 grains in an hour—is easily got, and it does not vary. By fitting this candle inside a box (somewhat like a child's toy magic lantern, but with no lenses, a wider "snout," and the inside painted dull black) we obtain a standard beam of light which will illuminate with a glow the usual Snellen test card from a distance. Since the letters on Snellen's test require both sight and knowledge of letters I used my revolving **E** test. (This was designed for use in infant classes. There is

one **E** on each line, and each is mounted on a pivoted card so that it can be turned to any position. The child is told to look at the three fingers of the "hand" on the card, and put his own hand in the position of those fingers.)

When, in a dark room, the boxed-in candle-light is placed alongside the patient at a distance of 5 metres from the **E** test card, the light on the card is only $1/269$ of a foot-candle. Yet a normal-sighted subject in the early thirties who could see $5/5$ easily with the normally lighted test could see with the candle-glow $5/20$ and occasionally $5/15$.

In both tests—Dr. Wright's 12-inch **C** and the 5-metre **E** cards—it was noted that by a little legitimate dodging it was possible to get better vision than straightforward looking gave. If one looked a few inches away from the test card, above, below, to the right or to the left, it was possible to see the gap in the **C** or the **E** better. It is well known that the light sense of the retina away from the macula is better than that at the macula. In a sense this is a criticism of all night-vision tests, for we can see better than the record of a direct-vision test will show.

Latterly I have used a still simpler distance test card³—one that I think needs a minimum of form sense, and therefore one that relies almost wholly on the light sense, though still at the macula. The 5-metre distance test card is a board a foot square. This is covered with black velvet. The test objects are white disks half an inch in diameter, from four to seven in number, fixed on the velvet, each an eighth of an inch separate from the others.

On the board are four separate groups of white disks, each of different numbers, but arranged so as to suggest a common pattern. The groups are covered by another velvet-covered disk in which is a 3-inch hole. This cover is pivoted so that it can be turned to expose any of the four groups of white disks. The baseboard has a hanger at each corner, so that it can be hung four ways. This gives sixteen variations of the test. Before testing, the patient should be in the dark for fifteen minutes or, more conveniently, have a black velvet band clipped round the head so as to cover the eyes. Distance glasses, if needed, must be worn during the test.

The candle-box is fitted at 5 metres from the test card, so that the test is lighted by $1/269$ foot-candle. The light that reaches the patient's eye is much less: ignoring loss by reflection, 1 m. from the test = $1/393$; 2 m. = $1/527$; 3 m. = $1/688$; 4 m. = $1/871$; 5 m. = $1/1075$; 6 m. = $1/1302$ of a foot-candle. The room is dark except for the candle rays. The patient stands beside the candle-box and looks towards the test card. A group of white disks is exposed. Most can see the massed white blur, and many can count the number of disks at 5 metres. A few can count at even 6.5 metres. If the patient cannot count at 5 metres he steps forward a foot at a time until he can count the disks. By recording the position of patients in half-metres thirteen grades, from 6.5 metres to 0.5 metre, are obtained. The average of four trials is enough usually. The value of this test is shown by the maximum distance at which one can both see and count the separate white spots. I find a fair average for normal-sighted persons is 5 metres. Those with 4-metres range should be safe at night. Those with 3-metres range or less had better stay indoors. Night-flying men should have a range of at least 6 metres.

It was of interest to check the relation of these indoor tests with outdoor conditions. One night after half an hour in the dark with these tests we stepped into the open air. The night for a moment seemed brilliant by contrast. Yet it was a dark night. There was a slight high mist; a few stars were to be seen, but no moon. There was so little light that with the **E** test the vision of normal persons (with $6/5$ full-light vision) ranged only from $1/50$ to $3/50$. Yet it was easy to walk about, though the ground was on different levels and there were steps.

Experience shows that variations in night vision do not depend wholly upon a light sense. Apart from this there are many conditions that diminish night vision or vary it. Chief among these are: (1) the size of the pupils; (2) the

¹ "Test for Night Vision," designed by W. D. Wright, D.Sc., A.R.C.S., made by the Pitman Press, Bath. London: Sir Isaac Pitman and Sons. (25s.)
² *Lancet*, 1904, 2, 821.

³ Disk Spotting Night-vision Test, made by Theodore Hamblin, Ltd., 15, Wigmore Street, London, W.1.

condition of the crystalline lens; and (3) the retinal integrity. Young folk, with their larger pupils, get more light into their eyes than older folk. This was well demonstrated by a doctor colleague: he had vision of 6/5 in each eye; the left pupil was larger than the right, and the left eye did better with all the night tests. Another colleague showed poor night vision; this was due to lens opacities, even though in normal light the vision was 6/9. Retinal disease has a serious effect upon the light sense; even excessive smoking affects the retina and reduces the night vision.

A paper on testing fitness for night vision⁴ and another on night blindness⁵ give detailed consideration of variations of sight, and include full biographies. The Report on Wartime Street Lighting (see p. 635) should be considered in this connexion.

There is no doubt that tests for night vision are of use. Dr. Wright has done good service by his designing. But some standard test that could be set up by an ophthalmic surgeon for himself, and yet would be the same for all, would serve still better.

AIR-RAID SHELTER POLICY

VIEWS OF A DOCTOR AND AN ARCHITECT

A Chadwick Lecture on air-raid shelters was delivered on April 8 jointly by Dr. S. L. Wright, who discussed hygienic considerations, and Mr. Philip O. Reece, an architect, who dealt with design and construction. Dr. WRIGHT said that large shelters raised problems of hygiene most difficult of solution, chief of which was the spread of communicable disease, whether air-borne (which was the most important) or by direct contact, inanimate objects, or insect vectors. In hospitals for infectious diseases the only effective method of countering droplet infection was to nurse the patients in separate cubicles. It was out of the question in shelters to provide cubicles for each person, but he suggested that a cubicle should be provided for each family unit, with the ventilation so arranged that the air from one cubicle could not enter another. The edges of the bunks should be at least 3 ft. apart, and the air turnover the maximum possible. The walls and floors should be smooth-finished so that they could be mopped down and dusted, the furnishing and bedding should be retained by the family and used only by them, and the cubicle be disinfected for new occupants.

A method of sterilization of air had not yet been discovered which, while completely innocuous, would bring the enclosed atmosphere up to the standard of fresh air. Air should approximate in standard of purity to the standard now expected in water supply, instead of being something equivalent to a sterilized sewage effluent. Spraying would be sufficient in corridors, sanitary annexes, and canteens. There was a danger of infection in the use of common sanitary conveniences, which could be met by proper supervision, an adequate supply of wash-basins, and elimination of the common roller towel. The necessity for washing the hands after visiting the lavatory and before eating must be emphasized. The habit of undressing at night, which would be possible in family cubicles, should be encouraged as a means of dealing with the problem of infestation.

One reason why not all people brought into contact with infection developed disease was the state of the general bodily health, closely related to the mental attitude, so that without undue exaggeration it might be said that in resistance to infection the dirty but cheerful were as safe as the clean but miserable. To encourage cheerfulness the shelters should be lighted to a reasonable standard—not less than 3 foot-candles in corridors, 4 to 5 in cubicles, 4 to 6 in sanitary annexes, and 7 to 9 in the canteen or communal dining room. Cubicles gave unlimited facilities for sick bays, medical officer's surgery, and first-aid points.

Those in charge of aid posts would be the first to admit that without the sanitary provisions he had described their work was little more than a placebo. Although the last winter had been got through without epidemics, the same immunity might not persist. Pestilence followed in the wake of war and famine, and when it started could not be confined within national boundaries, so that all the weapons of environmental hygiene would be required.

Mr. P. O. REECE, from the architectural point of view, developed Dr. Wright's theme further. He said that in eighteen months of war shelter ideas had run the whole gamut from the Anderson with its maximum protection and minimum comfort to the indoor Morrison with its minimum protection and maximum comfort. There was no universal form of shelter equally suited to all conditions. Even the most enthusiastic supporter of deep shelters would have to review his proposals on account of the time and labour required. Instead of designing shelters having in view the effect of bombs of certain weight falling at certain distances, consideration should be given to the disintegrating effect of earth tremors caused by bomb explosions, and it might be wise to follow the methods employed in designing earthquake-resisting structures, whereby a shelter free to slide on the surface would be inherently safer than one embedded in the earth. This ideal shelter would be multicellular in form, made of reinforced concrete, each block holding, say, sixteen cubicles and each cubicle accommodating six persons—a family unit—with the sanitary annexe at one end. Bunks would be supported between cleats embedded in the concrete, with a table between the tiers, and lighting would be so provided in the walls as to give light in each bunk, not to throw a deep shadow, as at present, into the bottom bunk. These blocks, with their sixteen cubicles for ninety-six persons, should be arranged in a radial fashion around a central eating room, which would afford the maximum centralization of services, with consequent economy in drainage, electricity, and water supply. Independent mechanical ventilation would be supplied to each block, and such a system lent itself to easy gas-proofing. In one block provision should be made for surgery and sick bay. The number of houses destroyed by enemy action would probably steadily increase, and the rehousing of homeless people was likely to become one of the major problems of domestic policy; again, the possible outbreak of epidemics would necessitate the isolation of large numbers of people; and, thirdly, imminent threat of invasion would entail movements of troops to areas where extensive accommodation was not available. All these requirements, as well as mere protection against air attack, might be met by this type of shelter. Once constructed, the shelters could be set apart for any of these uses as circumstances might require, and even as they could be adapted during the war for a number of uses, they could be designed for the fulfilment of useful purposes after the war. Smaller shelters with four or eight cubicles could be constructed on the sites of demolished houses and converted into new houses when the war was over, while larger shelters would lend themselves to conversion as sports pavilions, club rooms, and for use for the increased social services that would be demanded when peace came. It was estimated that these shelters could be built for approximately £9 10s. per head—the estimated cost of the present mostly unsatisfactory shelters. Only cement, steel, and shuttering need be considered in their construction.

A. B. Baker (*Amer. J. Path.*, 1941, **17**, 39) concludes that in cases of long-standing hypertension there is very little structural alteration in the average small cerebral artery, while the larger arteries often show arteriosclerotic changes with marked narrowing of the lumen. He believes that the narrowing of the larger vessels reduces the wear and tear on the smaller ones. In so-called "malignant hypertension," however, there are extensive changes in the small arteries, the elastica interna becoming reduplicated and the media undergoing rapid fibrosis and patchy hyalinization.

⁴ Ferree, C. E., and Rand, G. (1938). *Arch. Ophthalm.*, Chicago, **20**, 58.

⁵ Tansley, Katharine (1939). *J. Ophthalm.*, **23**, 161.