CHAPTER 15

DISORDERS OF THE EYE

THERE were no disorders of the eye that were strictly peculiar to the armed Services, or to any single Service, but the conditions of work called for in a mobilised force, particularly under action conditions, made them more prominent. Disorders of the eye from the Service point of view could be divided into: affections of function that might have a structural or a metabolic basis; infections; disturbance or loss of visual capacity or acuity due to nutritional defects; and trauma caused by radiation. Certain of these conditions were of special importance in naval officers and ratings whose duties exposed their eyes to more than average hazards.

Adequate night vision was necessary in all members of a ship's complement who were engaged in duties requiring the keeping of a lookout. The extent of dark adaptation varies in different persons, apart from considerations of age, which, by reason of its influence on circulation, lowers the capacity of the eye to restore its rhodopsin after exposure to bright light. Complaints of difficulty in seeing in a darkened environment were not uncommon in all the armed Services, and special methods were necessary to disclose the objective state of the eyes of these men, apart from psychological factors. Surgeon Lieut-Commander J. A. F. Flynn, the ophthalmic consultant to the Royal Australian Navy, published a description of a simple adaptometer which enabled an accurate test to be made of the power of seeing in poor light, and of adapting the vision for this purpose.[1] This apparatus consisted of a box containing a light, the intensity of which could be varied by apertures of 16 different sizes. At one end was a frosted glass screen, outside which was attached a movable shape which cast a silhouette on any desired part of the periphery of the screen. This was observed by the subject at a distance of six feet. As the intensity of the light decreased, the silhouette became more difficult to see. When accuracy in observing the silhouette fell to one half of the total number of attempts, the aperture was read on a scale and the results so obtained were classified as average, good, bad, or better or worse than average. Care was taken to secure uniform illumination, and control subjects were used for tests before other readings were taken. Tests were carried out in a darkened room after an adaptation period of half an hour. As would be expected, the silhouette was most easily distinguished by using the part of the visual field slightly off the centre.

A test of 332 members of the company of an Australian cruiser showed that the average and better-than-average degrees of adaptation made up 242 of the total. Flynn thought that such a test could be advantageously used to gain more experience of the factors influencing dark adaptation,

[1] J. A. F. Flynn, "Night Vision", *Transactions of the Ophthalmological Society of Australia* (BMA), Vol 3 (1941).

and that it should be of practical value in making a comparative classification of men carrying out duties which required good vision. He stressed that the tests were comparative only and could not be considered as absolute values; they were designed simply to provide a useful working basis for ships' commanders. No observations could be made at the time of the possible influence of various factors such as fatigue, nervous strain, and a deficiency of vitamin *A*.

A somewhat less elaborate test was made by Major C. S. Colvin to ascertain the frequency of defective dark adaptation among repatriated prisoners of war previously held by the Japanese. Of the 62 men carefully examined, 13 showed deficiency in dark adaptation ranging from 10 to 60 per cent of the average. It would probably be impossible to obtain reliable figures, as the ocular picture among captives of the Japanese was further complicated by the presence of nutritional amblyopia. Members of all Services in captivity in the eastern zones complained in many instances of poor night vision at some stage of their experience, but most of them recovered their adaptation at a later date when they had regained reasonable health.

Solar radiation was the most important type of radiant energy likely to affect the eyes, at least during the 1939-45 War period. Since the sun is so abundant a source of energy it may affect the eyes by short-wave, that is ultra-violet radiation, or by infra-red and visible radiations of a relatively longer wave-length.

Solar photophthalmia may be seen when ultra-violet rays affect the anterior structures of the eye; owing to the limited penetration of these rays the deeper structures are unharmed. This type of radiation trauma was not very significant in the navy; a certain degree of conjunctival inflammation was seen in susceptible men exposed to glare, but extraneous factors such as were in evidence in the Western Desert and similar terrain were absent at sea. For example, the conjunctival irritation common among transport drivers in Central Australia, with attendant scleral congestion and blepharospasm,[2] and the similar state observed in men at a ski school in Syria, were aggravated by atmospheric drying.

It may be noted that prolonged or constant exposure may cause chronic conjunctivitis in those whose skin structures are not resistant to this kind of radiant energy. Burn and blast injuries to the conjunctiva were greatly relieved by ol ricini, which was instilled either by such a device as the Bellamy Gardiner dropper or by a cork with a stem applicator.

Trauma caused by the more penetrant radiations was much more serious because of the effect of heat from the sun, which was concentrated by the refracting media of the eye on the retina. In a lecture in August 1942 Flynn drew attention to the serious nature of the lesions of photoretinitis sometimes found in anti-aircraft lookouts. This form of damage

[2] J. M. Dwyer, "Solar Photophthalmia", *Medical Journal of Australia*, 26 Apr 1947.

to the eye was important in civil life also, and could follow exposure to the blaze of the sun's light during an eclipse, or of an intense electric flash. In navy and air force practice photoretinitis was observed, and as the end results of the retinal damage might not always be ascribed to its true cause, recognition was important. Diagnosis was made more difficult because of the absorption of the short-wave radiations by the cornea and lens; the essential lesion was a burn of the retina. Flynn described several cases in a published article.[3] One of the patients was not referred for opinion until six months after the exposure of his eyes, when the nature of the lesion might not have been identified without an accurate history.

Most instructive was the case of two men each of whom had a solar injury of the eyes, and who noticed blurring of sight immediately owing to burning of an area of the macula. They were two anti-aircraft spotters, who while serving in the Solomons had been given the sun sector to watch. They had arranged between themselves to look out for 10 minutes alternately. At first they found it difficult to look at the sun because the glass in their protective screen was not nearly dense enough, but after the first 10 minutes a big dark disc with a narrow bright ring around it, appeared on the face of the sun and made it easy to watch. When they looked at other objects the black patch was still there, and covered the middle part of the picture. They continued to do this job for two hours. They did not have any pain. When examined later one of the men said: "The black blob still hides things, and when studied on the horizon, the blob appears like a burning match when dropped on shining brass or copper—a sort of blue colour running into yellow, and then a purplish black in the centre." Both men were found to have a central positive scotoma in each eye, and similar, clearly-defined round red areas with tiny spots of pigment in them. Both cases were diagnosed as photoretinitis and were kept under observation; they were given dark goggles to wear and were excused all upper-deck duties.

Another case quoted by Flynn was that of a rating who reported a blur in the middle of the sight of his right eye after he had been acting as anti-aircraft lookout during a battle when aircraft had been approaching his ship down the line of the bright tropical sun. He stated that he thought he had used his green smoked-glass screen properly. Examination with an opththalmoscope revealed on the macula a white area surrounded by a pigmented circle. A week later the vision was still the same; the white area on the macula had become very red. Twelve days later there was no change in his vision and the area on the macula had become pigmented and black. When he was examined eight months later his vision was the same but now he was also suffering from metamorphopsia. The lesion on the macula had developed into a pigmented scar.

The ineffectiveness of the glass screen used by these men on lookout work was obvious from their history. Flynn pointed out the necessity for

[3] J. A. F. Flynn, "Photoretinitis in Anti-aircraft Look-outs", *Medical Journal of Australia*, 31 Oct 1942, p. 400.

standardisation of protective goggles, screens and binoculars, to ensure that the dangerous parts of the spectrum were excluded. With J. C. Eccles he carried out some important investigations on the eyes of rabbits experimentally exposed to a midsummer sun through an appropriate aperture.[4] The solar energy, amounting to 1.49 calories per square centimetre per minute, had the visible rays for its larger component, but was reduced by absorption in the anterior part of the eye, and was further reduced at the retinal surface by the size of the pupil. Lesions were produced by exposure as short as 10 seconds; the most severe ones destroyed the whole depth of the retina and most of the choroid. Experiments were also made with protective filters. By comparison, the human eye would suffer a lesion from an intensity of radiation of 100 calories per square centimetre applied over a few seconds.

The importance of these considerations lay in the particular type of work done by aircraft lookouts, which necessitated looking directly into the sun in order to detect enemy aircraft attacking "out of the sun". A momentary glance of even unprotected eyes will do no harm, but a direct gaze can produce irremediable damage. The only type of glass that would prevent such a lesion was one that conformed to high standards, and exact standardisation was therefore needed to ensure that the protection offered was complete. Welders' goggles conforming with British Standards Specification 679 (1936) were suitable, and prevented troublesome afterimages. Investigation of the sunglass screen used by lookouts was called for if a lesion was suspected or discovered. It was recommended that warning of the risks entailed should be given to men engaged in lookout work, and to those who did not realise the danger of looking direct at a highly luminous source of radiation such as the sun's disc in an eclipse or the point of blaze in welding. Recognition of the condition was important, as the sufferer was entitled to a war pension.

Finally, it should be pointed out that it was not only severe burns of the retina that caused loss of central vision. Cases were encountered in the Royal Australian Navy in which anti-aircraft watchers were found to have blurring of vision, especially in the central area, but without a visible retinal scar. Surgeon Commander L. Lockwood, R.A.N., and Surgeon Lieut-Commander Flynn have described illustrative cases. One rating had a history extending back four years, to when he was an anti-aircraft lookout in the Mediterranean. Therefore when focal interference with vision was demonstrable, the history needed to be carefully explored as the absence of a visible retinal scar did not preclude the possibility of photoretinitis.

Visual acuity could be roughly tested under Service conditions. One eye was tested at a time; a "pin-hole" test with a stenopaeic disc was used as an approximate test of acuteness of vision, as any refractive error was largely eliminated and thus excluded as a cause of poor sight. The

[4] J. C. Eccles and J. A. F. Flynn, "Experimental photoretinitis", *Medical Journal of Australia*, 15 Apr 1944, p. 339.

application of a simple "cover" test was also used to detect a loss of binocular fixation, simply by covering one eye by an opaque screen. Minor degrees of fixation loss were disregarded.