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SNOW-BLINDNESS:

Its causes, effects, changes, prevention, and treatment*

BY

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THESE observations on snow-blindness are from actual experience of this affection, first in the Antarctic in 1911-13, later, and, to a less extent, in France during the winter of 1916-17, and again in Russia, on the Northern Front, in 1919.

The following investigations are due to experiments made during these periods.

It would be as well to contrast with this affection the results on other workers whose occupation necessitates their dealing with strong lights, whether sunlight or artificial, and whether the excessive exposure is sudden or prolonged. The two conditions used for contrast are in telescopic observations of the sun, and in welding operations with high power electricity. In the former, there is prolonged exposure to intense illumination, and in the latter, a blinding flash. In either case, the effect occurs only with the unprotected or insufficiently protected eye. In telescopic blindness the complaint is of an immediate positive central scotoma, and this may be absolute. The colour vision is affected centrally, and this may extend peripherally. There is an oscillatory

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movement and metamorphopsia, with usually a loss of light reflex at the macula and some pigmentation at the fovea. With the loss of a quarter of the vision complete recovery is seldom obtained.

Electric Ophthalmia.—This comes on within twenty-four hours after exposure to excessive light.

There is conjunctivitis and oedema of the lids, the pupils are contracted, and later there is a muco-purulent secretion. Recovery is complete.

Blinding of the Retina.—The effects may be due to excessive stimulus from the rays; a coagulation of tissue elements is caused, probably due to the heating effect of the red rays.

Snow-blindness.—On the Barrier the conditions causing snow-blindness vary, and give rise to different symptoms.

(*a*) The effects in the first class of case to be described are due to exposure to excessively strong illumination by the sun at certain maximum altitudes. There is a selective capacity also for the ultra-violet and violet end of the spectrum, by means of reflection and refraction of the light, from and through the surface of ice-crystals. On such days the actinometer time is as low as 1.25 seconds, in California the lowest recorded time by this same actinometer is one second. On these days exposure of the unprotected eye for 15 minutes was sufficient to bring on an attack. The first symptoms occurred on entering the tent, when there was immediately a feeling as of grit in the eye, with lacrymation, photophobia, chemosis and, if prolonged exposure had taken place, corneal ulcers. There was a hyperaemia of the retina and blurring of colour vision. With treatment the condition lasted 48 hours and recovery was complete.

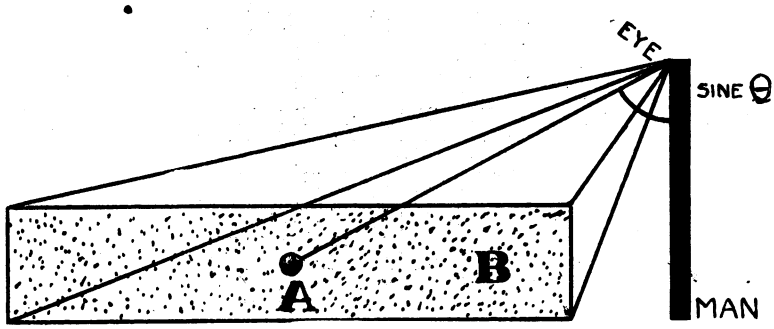
(*b*) In the second form the effects are partly due to selective illumination, but in addition, a diplopia lasting several days occurs. This is probably due to tiring of the internal and external ocular muscles, and is caused by difficulties of vision through lack of contrast. Lacrymation, photophobia, and chemosis are less marked and there are no retinal changes. The diplopia persists for several days, but recovery is complete. On the calm overcast days giving rise to these latter conditions, the strength of light, measured by actinometer, varies from 2 to 12. The atmosphere is filled with countless numbers of ice-crystals falling slowly downwards with a side to side dipping movement. They cause such diffusion of light that often one can be standing alongside a 9 feet cairn built of slabs of snow, and visually one cannot appreciate the fact, but only by touch. On such days the sun may be invisible. The horizon, barrier surface, and sky are blended by the greyish white colour, and the impression is that of progress within a globe of this solid colour.

The conditions described above will show clearly that on these days the effects caused cannot be attributed to direct action from glare. There is, however, the same selective capacity of the ice-crystals for the violet end of the spectrum, and this furnishes further presumptive evidence that these rays are the cause of snow-blindness.

Efficient protection against either condition is given only by glasses such as red and amber glasses which cut out definitely the violet and ultra-violet end of the spectrum.

Beyond the slight hyperaemia occurring in the first form there are no retinal changes; this hyperaemia may also be reflex. The onset of the initial symptoms varies in period of time. It has been stated that the ultra-violet ray is incapable of passing the lens. The violet ray, however, can pass the lens and impinge upon the retina. The intensifying of this ray under the conditions described would cause snow-blindness. In addition, the actual number of the rays of light entering the eye is increased with the maximum altitude of the sun, and a part of the affection may be due reflexly again to the intensity of illumination from any wave-lengths impinging upon the retina.

The following diagram will serve to show the cause of this increase of intensity of illumination under the circumstances.



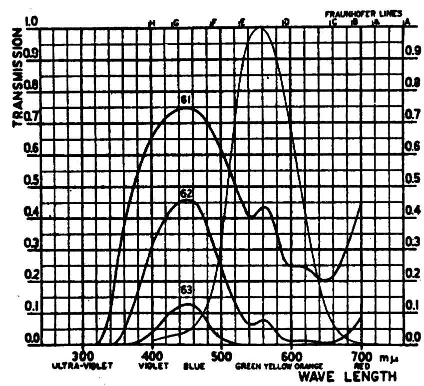
Contrast between image of Sun A on a perfect surface and B a perfect distributing surface.

B Represents a collecting field of vision composed of barrier surface, the rays of light reflected from this being collected at the eye.

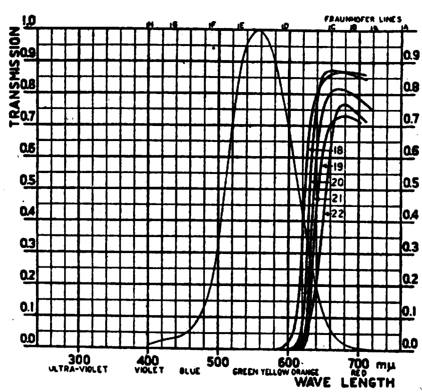
If B were a perfect reflecting surface the sine of the angle θ does not change.

Given, however, a perfect distributing surface such as is formed by the felted masses of ice-crystals, forming the barrier surface, the number of rays collected at the eye will increase directly with the increase of the altitude of the sun.

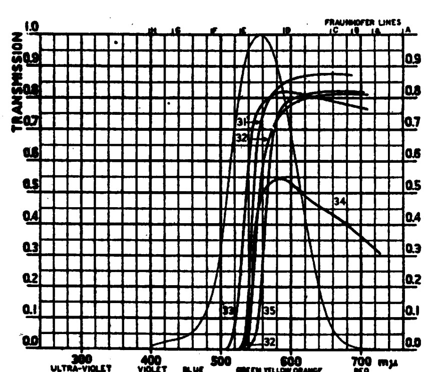
This was proved by experience to be the case. Travelling across the barrier was done at night, the coldest time, so that the animals could rest during the warmer day. During these times the sun was at its lowest altitude, no glasses were worn, and there were no cases of snow-blindness.



Blue glasses.

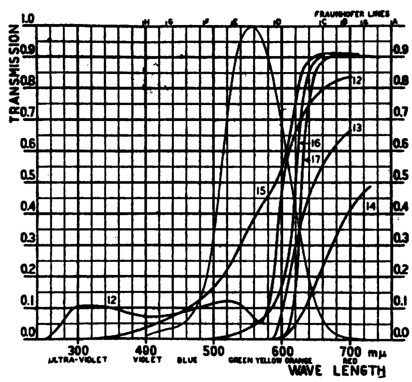


Red glasses.



Orange yellow glasses.

On reaching the foot of the Beardmore Glacier the routine was changed to day marching. No glasses were worn, and by night 50 per cent. of the party were snow-blind. It is presumed that the causation was mainly due to the effect of the violet end of the spectrum. Glasses giving best protection always occlude this end;

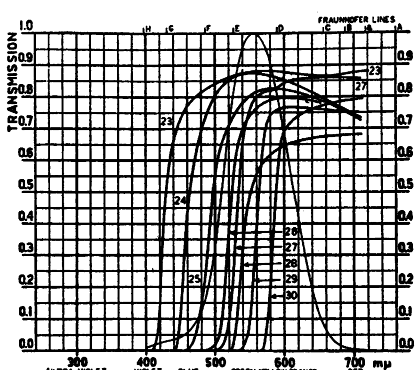


Variation in samples of red glasses

with light blue glasses, which do not do so, snow-blindness can occur.

There is a well-marked selective capacity of the ice-crystals for this ray which intensifies its effect.

In the second form, attributed partly to muscle tiring through lack of contrast, the efficient use of glasses also serves to lessen the strain.



Orange yellow glasses.

Red and amber glasses will give the most efficient contrast on these dull days, and enable objects to be picked up more easily.

The tables serve to show the results of transmission of rays by numerous samples of glass. The glasses used were compared with German samples obtained before the War.

The variation between some of the glasses will serve to show the importance of testing each sample before use with at least a comparative spectroscope. Efficient goggles are made of soft leather, and it is important that side protection should be ensured.

If possible the glass should be as far away as possible from the face to prevent condensed vapour being frozen on it in low temperatures.

Hemisine or adrenalin chloride 1:1000 dropped into the affected eye was found to be the best treatment so far employed.

IDIOPATHIC DETACHMENT OF THE RETINA*

BY

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IDIOPATHIC detachment of the retina as distinguished from that definitely due to trauma, new growth, or general disease is a *bête noire* of the ophthalmic surgeon and for this reason our thoughts should be constantly directed to the subject, especially in view of any new inquiry which may throw light upon it. Accordingly, in this paper I have largely followed Dr. Gonin, of Lausanne, in his recent full and careful description of the pathology and pathological anatomy of the disease.

We may take as a more or less typical case the following:

"Mr. W., age 41, clerk, first consulted me on October 27, 1920, complaining of slight failure of sight in the right eye. On examination a few vitreous opacities were noted, and it was only after careful search that I was able to make out two detachments, one above and to the inner side of the globe, and the other, smaller, below and to the outer side. No retinal tear could be seen. Vision of the right eye with glasses, $\frac{-6.00}{-2.00 \text{ ax. hor.}}$, was 6/24. The left eye appeared to be healthy although of only moderate visual acuity, 6/24 with glasses, $\frac{-3.00}{+5.00 \text{ ax. vert.}}$. I recommended complete rest and made arrangements to take him into hospital the following day. The very next morning he returned with a huge detachment in the superior region and his vision was reduced to counting fingers. Treatment consisted of complete rest with atropin drops and pressure bandage; the eye was examined ophthalmoscopically every second day. Firm pressure was not tolerated

* Read before the North of England Ophthalmological Society, Bradford, December 8, 1920.