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THE EFFECTS OF ANOXIA AND INCREASED INTRAPULMONARY PRESSURE ON THE DARK ADAPTATION OF RODS AND CONES

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ABSTRACT

The writer of this paper published in some detail a number of fundamental biophysical, physiologic and clinical considerations concerning dark adaptation and night vision in the *Proceedings of the Minnesota Academy of Science,* XI, 17–27, 1943. Therefore, only a few of these essential methods and data will be presented again as a preface to the effects of anoxia and increased intrapulmonary pressure on the dark adaptation of rods and cones.

Three fundamental elements may affect dark adaptation. Briefly stated, they are (1) pigment or pigments and conditions that affect retinal photochemical reactions and changes, (2) metabolism and nutritional state, both of the body and of the retina and (3) neural and cerebral responses which are exhibited so strikingly in anoxia.

In the present investigations the first two factors are eliminated and therefore it is necessary to consider only the effects of anoxia on visual adaptation and the annulment of such effects by oxygen or, at very high altitudes, by increase of intrapulmonary pressure while pure oxygen is being breathed. In general, most subjects who are well controlled in certain particulars which will be discussed show gradual rises in the threshold levels for dark adaptation while breathing air as the altitudes are changed from approximately sea level to 12,000 to 15,000 feet. Threshold levels for rod dark adaptation are frequently from 0.5 to 0.75 log unit higher at 15,000 feet than at sea level. Such elevated threshold levels show that from three to six times as much light is required as at sea level. The use of pure oxygen restores both rod and cone dark adaptation levels to their original values. These normal levels may be maintained up to altitudes approximating 35,000 feet.

Similar procedures were followed at altitudes of more than 35,000 feet. The data obtained at increasingly high altitudes show the same type of effects on dark adaptation when the subjects are breathing oxygen as are obtained at relatively low altitudes (12,000 to 15,000 feet) when they are breathing air. In some instances, as at 42,000 feet, for example, there is exhibited a rise of threshold level in the rod adaptation of 0.4 to 0.7 log unit (2.5 to 5 fold increase in the amount of light) without the use of pressure breathing. In general, the effects on the levels of cone adaptation are much less than in the case of the rods. An increase of intrapulmonary pressure ranging from 8 to 20 mm. of mercury causes the return of the rod and cone threshold levels to the values initially obtained at ground

level. The results obtained indicate a reduction in anoxia through the uptake of oxygen under an increase of intrapulmonary pressure. Pressure breathing of oxygen, therefore, permits of the maintenance of the highest levels of light sensitivity which are possible under the conditions imposed.