

Journal notes

■ Pale Orange to Bluest Blue

When the International Commission on Illumination adopted its colour metric in 1931 the possibility of calculating a numerically exact specification of certain aspects of colour reacted strongly on the imaginations of workers in many fields. It seemed to the present author, for instance, that it would be interesting to subject to calculation the question "How blue is a mountain?" and a paper entitled "On the Colours of Distant Objects" originally appeared in the 1935 *Transactions of the Royal Society of Canada*. The subject was not quite so academic as the above remarks might indicate because it was also found that this work obviated the need for a separate theory of the visual range of coloured objects.

During the years since 1935 a great deal of research has been done on the theory of the visual range and on the general effect of the atmosphere on light. The paper reported here has much the same content as the previous paper but uses the results of these later investigations to render the theory of the colours of distant objects more concise. It is difficult to summarize the results very briefly but in general it turns out that the apparent colour of a distant dark object in very clean air approaches that of the bluest blue sky. Increasing amounts of impurity in the air bring the resulting colour near to white. The apparent colour of a brightly illuminated snow field, on the other hand, is a pale orange almost exactly complementary to the colour of the sky.

These calculations have a natural application in camouflage studies and are also of some interest in the inverse problem of what colour to paint an object so that it will be most easily seen at a distance. W.E.K.M.

The Colours of Distant Objects. By W. E. K. Middleton. *J. Opt. Soc. Am.*, 40: 374, June, 1950.

■ Luminescent Counting

Statistical variations in a counting system which consists of a source, a luminescent crystal, and a photomultiplier are analysed in this paper by the method of the generating function. It is assumed that the source is constant for a fixed period of time, although it emits particles at random. For definiteness, and to provide a maximum degree of statistical variation, it is assumed as well that the source is a gamma emitter and that only a fraction of the gamma rays fall on the luminescent crystal and are absorbed.

As is to be expected, the results show that the effectiveness of the system depends upon the ability of the crystal to receive energy from the source. They also show that a measure of the effectiveness of the remainder of the system is provided by the number of photoelectrons emitted by the photocathode for each pulse of energy absorbed in the crystal. This quantity, which depends upon

the luminescent efficiency of the crystal, the geometry of the multiplier-crystal arrangement, and the efficiency of the photocathode, should be at least 5 for faithful counting of the radiation pulses absorbed in the crystal. The number of photoelectrons must be much larger than 5 for good statistical accuracy if the current from the photomultiplier is measured. The results of Schiff and Evans for the statistical variations in the voltage of a condenser which is charged with the pulses from the multiplier are generalized to cover the case in which the size of pulses varies. F.S.

On the Statistics of Luminescent Counter Systems. By Frederick Seitz and D. W. Mueller. *Phys. Rev.*, 78: 605, June 1, 1950.

■ - - escence

The luminescence of a phosphor is emitted in a spectral band whose identity is clear even in the presence of a complex structure. The luminescence is due to an activator element at low concentration. In some phosphors a second, distinct band appears when the concentration of the activator is changed. A decrease in its content intensifies and ultimately isolates the shorter waveband and suppresses the longer waveband.

An increase in temperature has been found to have the same effect. In five common phosphors activated with manganese, there is a minimum concentration at which only the shorter waveband appears. Increase in temperature has no effect upon its spectral position. As the concentration is raised above the minimum, a second band appears and becomes progressively intensified. This band is reduced and eventually suppressed by a rise in temperature, with isolation once more of the shorter waveband. The position of the latter remains constant, whether isolated by reduction in activator content or by increase in temperature. Three other phosphors showed the temperature effect only.

The two-band emission is probably due to the occurrence of the activator element in two different luminescence centers, as single ions and as pairs of associated ions. Either a decrease in activator content or an increase in temperature would favor dissociation of the ion pairs into single ions. The shorter waveband would accordingly be ascribed to the centers with single ions.

Although this is the most reasonable explanation for the effect, it can be accepted only after definite proof for the existence of two centers. A criterion would be furnished by careful measurements of the spectral distribution of the phosphorescence as compared with the fluorescence. If one of the two bands should decay more rapidly, this would constitute definite proof that there are two luminescence centers. G.R.F.

Dependence of Emission Spectra of Phosphors upon Activator Concentration and Temperature. By Gorton R. Fonda. *J. Opt. Soc. Am.*, 40: 347, June, 1950.

■ Nuclear Emulsions

Developments in the past decade have made possible the use of emulsions sensitive to particles in accurate nu-