RED AS A DANGER INDICATION*

BY WM. CHURCHILL

Red is pre-eminently the color which throughout nature attracts attention, excites curiosity and arouses to action. Nature employs it but rarely, and generally to bring about definite effects. Most naturally, then, in the development of railway service, red was selected as the symbol of danger. Green was adopted either for a clear or for a cautionary indication, and within the past 25 years yellow, blue, purple and lunar-white have been added to the list of recognized signal colors. In semaphore signals European practice is confined mainly to the use of red and green. In America, where automatic signaling is far more extensively developed, the general practice 10 years ago was red for stop, green for caution and white for clear; now most roads have adopted yellow in place of green for caution and made green the clear indication.

The Railway Signal Association specifications recognize six signal colors: red, yellow, green, blue, purple and lunar-white. Of these, blue is the least satisfactory. The effective range of colors under average weather conditions, when used with the customary semaphore lamp and lens, is approximately as follows:

Color.	Effective range.	Approximate transmission coefficient.†
Red	3 to 3½ miles	0.20
Yellow	1 to 1½ miles	0.35
Green	2½ to 3 miles	0.17
Blue	½ to ¾ mile	0.03
Purple	½ to ¾ mile	0.03
Lunar-white	2 to 2½ miles	0.15

†For standard semaphore lamp with oil burner.

Volume of light is just as essential as correct hues, for a dense fog or smoke will cut the range of even a standard red signal down from three miles to a few hundred feet. To normal vision, red is beyond question the most effective color for a danger signal, because when the apparent size of the source diminishes, red never ceases to look red. This is not strictly true of any other color, although green approaches close to such a requirement. Red has the further advantage that the intensity can be increased by the addition of reddish orange light without a pronounced change of hue; on this account red has the longest range of all signal colors.

Yellow at best is not an ideal signal color. It can be seen as a light of indistinct color much farther than it can be definitely recognized. And most of the ordinary sources of illumination are more or less yellowish in predominant hue, and hence are more or less likely to cause confusion. The yellow signal may be mistaken for a neighborhood light close to the right of way. Some reaction-time experiments conducted by the author 12 years ago demonstrated quite conclusively that yellow requires a longer time for recognition than red or green, and that yellow and white are frequently mistaken for each other. Experience on many roads has proved during recent years that the red-yellow-green combination is distinctly preferable, provided standard colors are used.

Excepting red, green is the most effective color. It is usually somewhat below red in range, due in part to atmospheric absorption, but a bluish green gives very good results. Recently it has been found possible to increase the transmission of such a glass by 35 per cent. over the present standard without any loss in distinctness of hue, and it is probable that this new modification will show results in range of visibility nearly equal to the present standard red.

Since red, yellow and green are the three principal long-range semaphore signal colors, it is important that all should have approximately the same intensity, so that no one color will overpower either of the others when displayed close together. Illumination from the sources which are generally used (oil or incandescent lamps) are far stronger in yellow light than in either red or green. The transmission of the red and green glasses, therefore, should be kept at a maximum, while the yellow may be somewhat reduced.

Blue and purple are short-range indications, because the proportion of blue and deep red contained in the light of the sources commonly employed is extremely small. Blue light is rapidly lost by atmospheric absorption and reflection, and tends to become distinctly greenish with distance; on that account, blue never gives a really effective indication and is now seldom used.

In a standard purple signal glass the proportion of bluish green light transmitted is offset by red from the extreme end of the spectrum. The light appears ordinarily as a purple spot with a halo of deep bluish light surrounding it. Such a purple produces a signal indication which for distinctness compares favorably with the other colors. Unfortunately, its use is restricted by the fact before mentioned that its total transmission and range of visibility is low.

By means of a pale blue glass it is possible to eliminate enough of the yellow in a kerosene flame or incandescent lamp to make the yellow appear almost white, with a slight preponderance of blue. This new possibility was called "lunar-white" and has come into use as a clear indication for switches on a number of roads. In actual service it has proved to be at least as distinctive a color as yellow and to possess longer chromatic range for most observers.

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A SPECIAL STORAGE BATTERY TEST

BY R. H.

A short time ago the chief batteryman of one of the eastern roads performed a special test on "the terminal voltage at the end of a charge of storage battery"—with a charging current still flowing. Following are the observations which he noted: The terminal voltage of a newly installed cell on overcharge at the normal rate and temperature (70 deg.) was 2.70 volts; the terminal voltage of a cell which had been in service for eight years, on overcharge at normal rate and temperature, was 2.45; the terminal voltage of a newly installed cell at one-half normal rate of charging at normal temperature was 2.62, and the voltage of a cell which had been in service eight years, after charging at one-half normal rate and at normal temperature was 2.43. Also, the terminal voltage of a newly installed cell with normal rate of charging, but at a temperature of 115 deg. F. was 2.52, while that of a cell which had been in service for eight years was 2.25.

From the above observations it was concluded that the voltage at the end of a charge throughout the life of a battery is not a fixed quantity but varies with the age of the battery, the rate of charging, and the temperature of the acid. Higher rates of charging produce slightly higher terminal voltages and vice versa. The voltage varies markedly with the temperature; when the temperature is higher the voltage drops, and as the temperature is lowered the voltage increases. This is due to the effect of a decrease in the internal resistance of sulphuric acid as the temperature rises. The following are values obtained in this test. A is a new cell and B is a cell eight years old:

		Voltage	
Temp. C.	Temp. F.	A.	B.
14	57	2.70	2.45
20	68	2.65	2.40
30	86	2.60	2.33
38	100	2.56	2.28
45	113	2.52	2.25

If a curve is plotted from these values it will be found to be approximately a straight line.

Railway Crossings in Zurich to Be Eliminated.—The managing directors of the Swiss Federal railways and the Municipal Council of Zurich have finally entered into an agreement for the reconstruction by the former of the Zurich Sea Left Bank Railway, within the city limits of Zurich.