FLORAL COLOURS AND THE PHYSIOLOGY OF VISION

Part VIII. The Spectra of the Roses

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THERE are hundreds of varieties of roses. Indeed, there is perhaps no flowering shrub which has received more attention from horticulturists who have sought by crossing and intercrossing to create new varieties with specially desired properties, including especially the size and colour of the flowers, the habits of growth of the plant and the frequency of its flowering. It is not proposed in this memoir to deal comprehensively with the subject of the colours of roses. Our aim here is to consider it in its essentials and obtain an insight into the relationship between the spectral composition of the light which has traversed the petals of a rose and its perceived colour.

The variety listed as " Rose Edward " in books on gardening is a great favourite with lovers of roses in India and is known to them more familiarly by the vernacular name of " Gulab ". It grows without trouble, bearing freely and perpetually, the flowers exhaling the sweet scent and exhibiting the soft colour traditionally associated with roses. It is exceedingly vigorous in growth and hence is used as a stock for budding. Standards made with Edward stocks are indeed the most satisfactory and long-lived.

When a petal of " Gulab " is held against the slit of a pocket spectroscope which is directed towards a source of white light, it is seen that the part of the spectrum between 510 mμ and 550 mμ is much weaker than it normally is in relation to the regions of the spectrum on either side. There is no obvious curtailment of intensity for wavelengths less than 500 mμ or greater than 570 mμ. In other words, the absorption appears only in the green and does not extend into the regions of other colour on either side. If we view the rose-red glow that penetrates through the flower when it is held in sunlight, the band of absorption is seen very conspicuously and well-defined in its spectrum.

Numerous varieties of roses exhibit colours similar to that of the Gulab but of more saturated hues. Examining the individual petals of such roses through the spectroscope, it is found that as the hue becomes more and more saturated, the absorption band between 510 mμ and 550 mμ becomes progressively stronger, until finally this region is completely extinguished. There is at the same time an observable diminution in the intensity of the region of wavelengths between 550 mμ and 590 mμ. It is a surprising fact that even when the colour of such roses is a red of saturated hue, the blue of the spectrum continues to be seen with undiminished intensity.

Arising from the facts stated above, two issues emerge which need elucidation. Why is red the dominant colour of roses, despite the presence of the blue and violet regions of the spectrum with undiminished strength? Why does the red manifest itself as a saturated or nearly saturated colour with many roses? In other words, why does not the simultaneous presence of the orange and yellow along with blue and violet result in the presence of a great deal of white light and consequent dilution of the observed colour? It is evident that these issues are of a fundamental nature and that they have to be considered in the light of the facts set out in the earlier parts of this memoir.

That the yellow and orange regions in the spectrum play a dominating role in determining the perceived colours of polychromatic radiation emerged very clearly from the observations with various flowers recorded in the preceding parts of this memoir. Depending on the precise magnitudes and locations of the absorptions in those regions, the perceived colour may be purple, blue, or even violet. The inference is that the removal of the yellow and orange regions which connect the region of longer wavelengths with the rest of the spectrum results in suppressing or masking the sensations excited by the red part of the spectrum, the sensations excited by the blue and violet thereby gaining prominence.

If, on the other hand, the red, orange and yellow sectors of the spectrum are present together, but the green part which links them with the rest of the spectrum is taken out, the sensations excited by the blue and violet regions of the spectrum are wholly or partly masked and the red sensation gains the ascendancy. We have already had illustrations of this effect in the case of the pink blooms of the *Lagerstroemia* and the pink asters. But the roses furnish the most striking examples of the phenomenon.

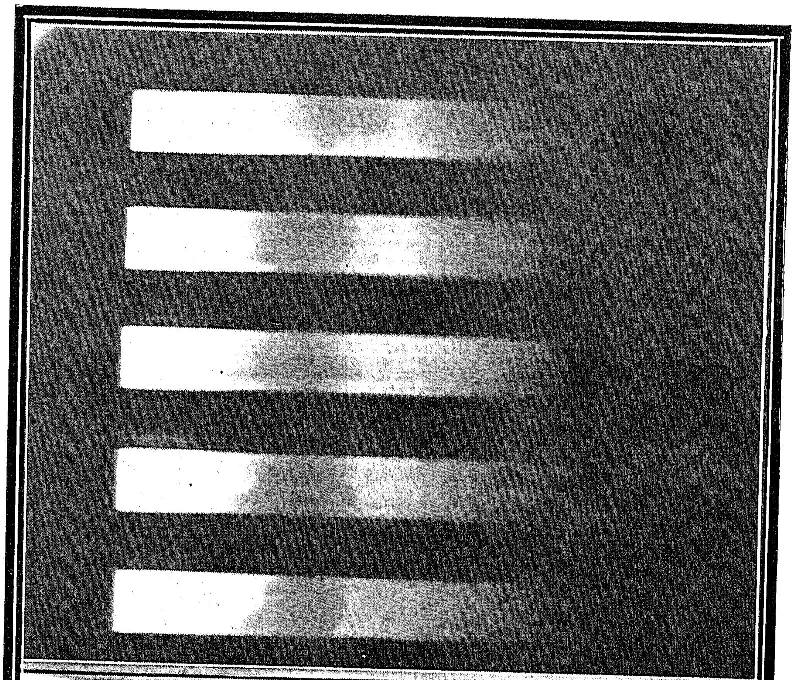
Figures 1 (*b*), (*c*) and (*d*), Plate VI are the absorption spectra of three rose-petals arranged in the order of increasing depth of their red colour, while (*a*) and (*e*) are the spectra of the light-source employed shown for the sake of comparison. It is evident from a comparison of the three spectra that the progressive increase of the depth of the perceived colour is a consequence of the progressive increase in the absorption of the green part of the spectrum, there being no other marked change in the relative intensities of the other parts of the spectrum.

We may now proceed to discuss briefly the spectral characters of the roses of other colours. The efforts of horticulturists have resulted in the development of a great variety of them. One of the most remarkable is that which goes by the name of "Crimson Glory". Examination of the light transmitted by its petals through a spectroscope reveals an extinction of all wavelengths less than 600 mμ in the spectrum. Figure 2 (*e*) in Plate VI shows the transmission spectrum of the "Crimson Glory". The petals of a rose exhibiting a scarlet colour likewise showed no appreciable transparency in the blue and violet regions. But the transmission in the longer wavelength region extended up to 570 mμ. Orange-tinted roses show an observable transmission up to 540 mμ, a band of absorption between 500 mμ and 540 mμ and a weak transmission of the blue and violet regions of the spectrum. The petals of yellow roses freely transmitted the longer wavelengths in the spectrum up to 500 mμ but showed a powerful absorption of the blue and violet regions. But this was by no means a perfect extinction unless the light passed through two or more petals in series.

SUMMARY

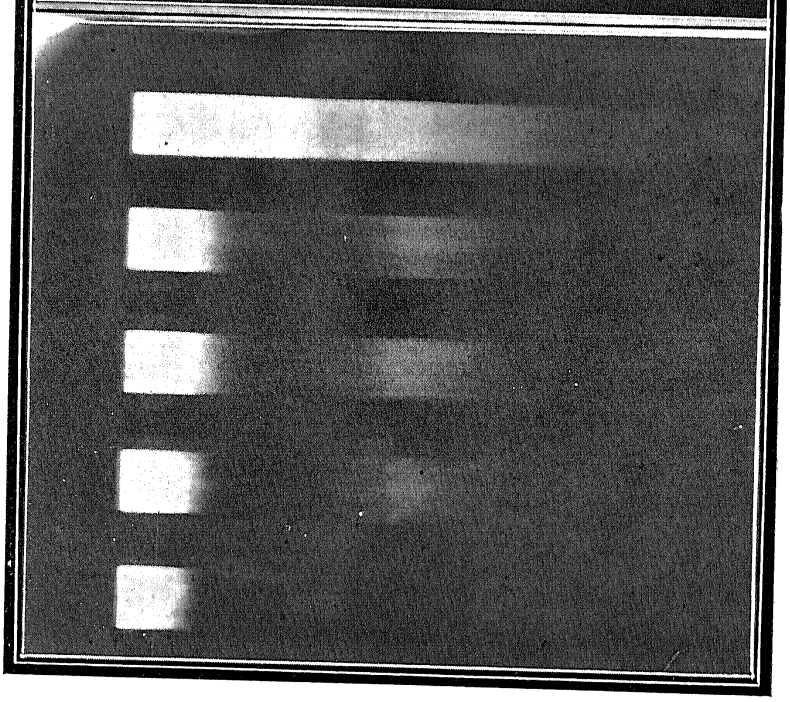
The characteristic hue designated as rose-red arises from a suppression of the green sector in the spectrum, the radiations of both longer and shorter wavelengths coming through freely. The more complete the absorption of the green is, the more saturated does the resulting hue appear. The reason for the dominance of the red sensation and the saturated hues observed in these circumstances with many varieties of roses is discussed.

FIG. 1



(a)
(b)
(c)
(d)
(e)

FIG. 2



(a)
(b)
(c)
(d)
(e)

FIG. 1. (*b*), (*c*) and (*d*). Absorption spectra of Roses: (*a*) and (*e*) comparison spectra.
FIG. 2. (*b*), (*c*), (*d*) and (*e*). Absorption spectra of Roses: (*a*) comparison spectrum.