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Blue delphiniums and the purple bignonia

SIR C V RAMAN

ABSTRACT

The spectroscopic behaviours of two flowers are described and discussed, illustrating respectively the optical properties of florachromes A and B.

The present article is intended to supplement the studies published in recent issues of *Current Science* on the nature and origin of floral colours. It deals with two flowers which exhibit vivid colours but which are totally different. The observations make it evident that in one of them, the colours arise from the presence of florachrome A and in the other they are ascribable to the presence of florachrome B.

Delphinium belladonna is a perennial bloomer of great beauty. Its flowers appear arranged on vertical spikes, each spike carrying several flowers. If the central spike is cut off as soon as it has finished flowering, the side shoots will flower. The material thus remains available for study for a considerable period. As the petals are not very thick, the most satisfactory procedure for observing their spectroscopic behaviour is to hold two of them together and view them against a strong light. The spectrum of the transmitted light exhibits three dark bands, the first of which centred at 630 mμ is the strongest: the second at 580 mμ is also well pronounced but not completely dark. The third band at 540 mμ is also visible but it is much feebler than the others. Under the small dispersion provided by the viewing spectroscope, the visible spectrum presents the appearance of *three bright bands*, which are respectively red, orange-yellow and green separated by the dark absorption bands in the positions stated above. The wavelengths beyond 500 mμ come through quite freely. The spectrum is thus characteristic of florachrome A, and is observed with all blue flowers.

Bignonia magnifica is a large bushy shrub which grows vigorously and bears flowers in great profusion. The flowers are of considerable size, and as each individual bush or plant can at any time carry a great number of them, it presents a magnificent sight. The colour of the flowers is a reddish-purple which is richest when the flower has just opened to its full extent. Later, the colour fades noticeably. The most satisfactory way of examining its spectroscopic behaviour is to hold two petals of the freshly opened flower together and examine light from a strong source which has passed through the pair. It will then be seen that the wavelengths greater than 600 mμ and also the wavelengths less than 500 mμ come through freely. But the region from 560 to 600 mμ is strongly absorbed and the region from 500 to 560 mμ also appears much reduced in intensity. At high levels of illumination, the wavelengths between 560 and 600 mμ which include the yellow sector are the brightest part of the spectrum. *Bignonia magnifica* thus provides an excellent illustration of the role played by the yellow sector in the perception of colour, and especially of the fact that its exclusion from the spectrum results in the production of the purple sensation. It is also evident from the observations that the floral pigment functioning in *Bignonia magnifica* is florachrome B, since the characteristic absorptions of this florachrome appear in the yellow and green sectors of the spectrum leaving the red sector entirely unaffected.

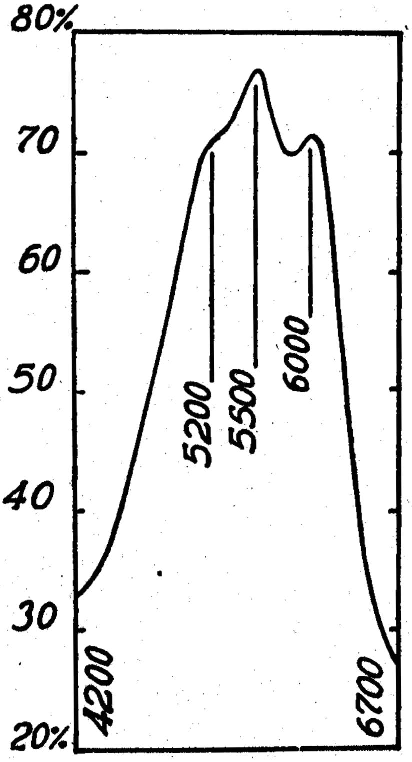

Figure 1. Absorption by delphinium extract.

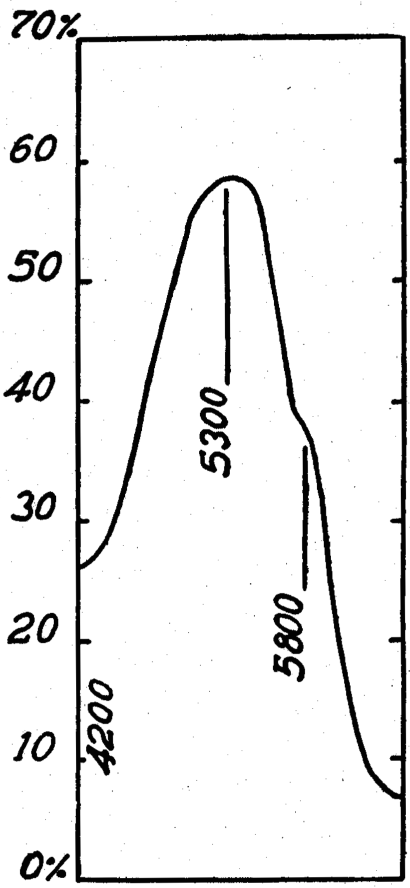

Figure 2. Absorption by bignonia extract.

Extraction of the floral pigments: Immersing the flowers of delphinium in either water or acetone produces no observable effect. It is necessary to grind the petals to a fine paste in an agate mortar using a small quantity of acetone as a lubricant. After pouring out the surplus acetone and squeezing out what is left, water is added to the paste which results from the grinding, and the mix is then stirred up and filtered through a cotton-wool plug. The result of these operations is a bright blue solution containing the material responsible for the colour of the flower. A spectrophotometric record of the absorption of light by this extract contained in a cell of 1 cm thickness is reproduced as figure 1.

The numbers shown in the figures are the wavelengths in Å units. The record exhibits a comparatively free transmission of the shorter wavelengths in the blue region of the spectrum, while the strong absorptions in the yellow and orange regions are responsible for the intense blue which is the colour actually perceived.

The colouring matter is readily extracted from the petals of *Bignonia magnifica* by the aid of acetone, with a little pressure in an agate mortar. The acetone extract is vividly coloured and a visual examination of the light transmitted through it through a spectroscope shows the absorption bands in the yellow and the green regions of the spectrum which are characteristic of florachrome B, while the blue and red sectors are freely transmitted. A spectrophotometric record of the absorption by the extract is reproduced as figure 2.

The spectrophotometric studies of the extracts were made in the Instruments Section of the Indian Institute of Science, to whose authorities the thanks of the author are due.