FLORAL COLOURS AND THE PHYSIOLOGY OF VISION

Part VII. The Aster and Its Varied Colours

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THE findings recorded in the earlier parts of this memoir find a striking confirmation in the results of the studies made with asters of various colours which will presently be described.

The aster is well known everywhere as one of the most showy of flowering shrubs. Each individual flower with its large feathery head and a gaily-coloured centre is a picture in itself, while the calyx with its numerous leaflets is also a decorative feature. The array of small serrated leaves on the stalk crowned by the flower is not unduly obtrusive and is indeed itself rather attractive. The massing of the blooms on an assembly of stalks growing around a single woody stem makes the whole an impressive floral display.

The opportunity for the present study arose from the fact that asters are grown extensively in and around Bangalore, and being much in demand for decorative purposes are despatched daily to various cities in India and are also marketed at Bangalore. Ample material is, therefore, available for examination. The asters exhibiting marked colour fall clearly into two distinct classes. On sorting out a large quantity of the material, it becomes evident that each class could further be subdivided into three groups, the flowers in each group exhibiting a high degree of uniformity of colour, while those in different groups could be sharply differentiated from each other. Thus, finally the coloured asters could be arranged and listed as follows: Class A: (1) Purple-blue, (2) Purple-violet and (3) Violet. Class B: (1) Pink, (2) Bright Pink and (3) Rose-Red. Spectroscopic examination reveals that Class A and Class B are totally different in the nature of the absorptions which give rise to their perceived colours, while the three groups in each class exhibit similar features in their spectra, but with very different intensities.

The perceived colours of the asters in Class A have their origin in a readily observable extinction of the yellow sector in the spectrum. The absorption exhibits a well-defined edge at about 600 mμ, longer wavelengths having their normal intensities, while the absorption in the region of shorter wavelengths falls off progressively and becomes insensible at about 560 mμ. This absorption is moderately strong for the asters which appear purple-blue, quite strong for the asters which appear purple-violet and is total for those which appear of a violet colour.

Apart from the strong absorption in the yellow, there are also indications of a minor absorption at 650 mμ which results in the red sector of the spectrum appearing bifurcated. This is a feature which is just noticeable in the purple-blue asters. But it is more clearly evident with the asters which appear purple-violet and is conspicuous with the asters of a violet colour.

The asters in Class B show a spectrum in which the violet, blue, yellow, orange and red sectors in the spectrum appear with their usual intensities, while in the green sector, there is a sensible weakening, especially between 530 mμ and 560 mμ, the maximum of absorption appearing at about 545 mμ. This absorption is noticeable with the pink asters; it is quite strong with those which appear as a bright pink, and nearly complete with the rose-red asters.

Owing to the lack of sensitivity in the green of the available panchromatic films, it is not easy to obtain spectrograms exhibiting the differences between the spectra of the differently coloured asters in a satisfactory manner. Nevertheless, it is possible to show that the differences referred to above exist. Figure 1 in Plate V shows three spectra recorded with a pink aster and three different exposures, the first and the last in the group of five spectra being records made for comparison with the light source alone. Likewise, Fig. 2 in the same Plate exhibits the spectra of a purple aster together with comparison spectra recorded in the same manner.

Comparing the spectra appearing in Fig. 1 and in Fig. 2 respectively, it will be seen that the absorption appearing in the latter has advanced further to the left towards the red end of the spectrum than in Fig. 1. Actually, in Fig. 2, it has covered the yellow sector and there exhibits a sharp cut-off, while in Fig. 1, the yellow has come through freely, the absorption being only in the green. No other differences between the spectra recorded in Fig. 1 and Fig. 2 are noticeable. In particular, the red and orange regions show relatively to the blue and violet regions of the spectrum, no obvious differences of intensity in the two sets of spectra.

It will be recalled that in the fourth part of this memoir, studies of the pink and purple varieties of the flowers of *Lagerstroemia Flos Reginae* were described, and the differences in their colours were shown to arise in the same

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FIG. 1

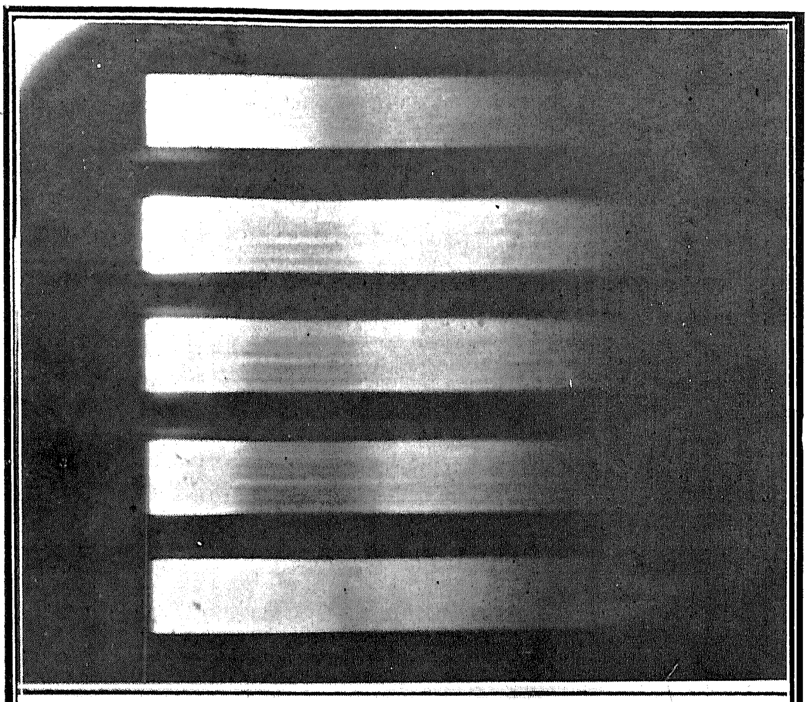

FIG. 2

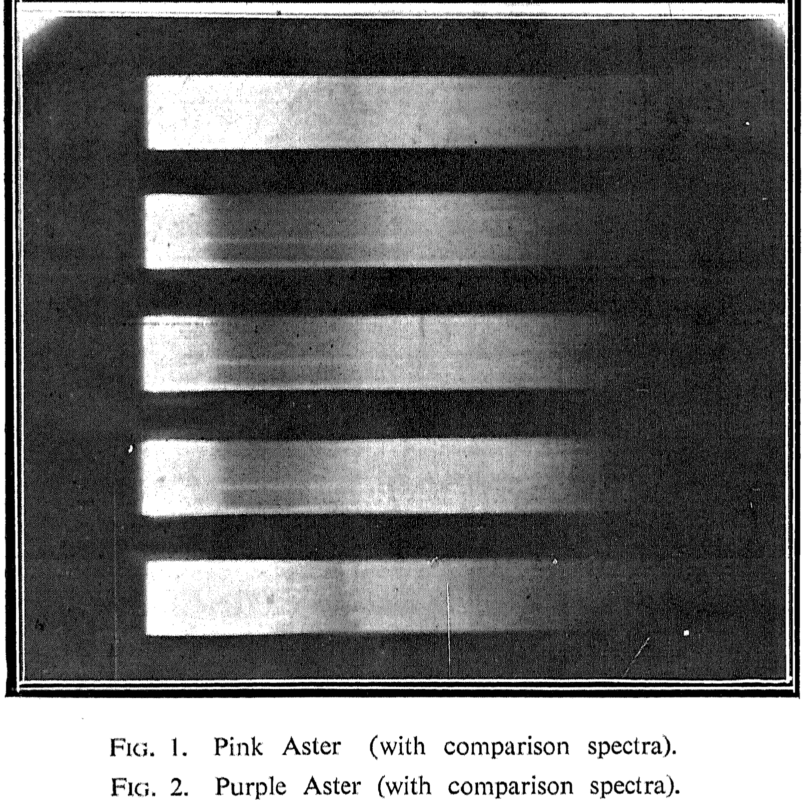

FIG. 1. Pink Aster (with comparison spectra).

FIG. 2. Purple Aster (with comparison spectra).

manner as in the present case, *viz.*, an absorption of the yellow rays of the spectrum only exhibited by the purple flowers, and an absorption in the green sector shown only by the pink flowers. The differences in colour of the asters in Class A and Class B though of the same general nature are of a much more striking character, and this may reasonably be ascribed to greater intensities of the absorptions of the respective kinds in the two cases. The question may well be asked, why do the two classes of asters differ so strikingly in their observable colours ? A casual observer looking at the flowers would be led to imagine that the asters of Class A completely absorb the longer wavelengths in the spectrum and therefore appear blue or violet, while the asters of Class B absorb the shorter wavelengths completely and, therefore, appear red. Actually, in neither case, does any such absorption exist. We are obviously dealing here with an effect of purely physiological origin. It may be suggested that the cut-off of the yellow by the asters of Class A results in a suppression of the visual sensations excited by the red and orange sectors of the spectrum. Likewise, when the green is suppressed by the asters of Class B, the visual sensations excited by the violet and blue radiations are more or less completely masked by the combined effect of the yellow, orange and red sectors.

Summary

Asters exhibiting vivid colours may be placed in two strikingly contrasted groups, each containing three sub-groups. Spectroscopic examination shows that the perceived colours of one group ranging from purple to violet arise from an extinction of the yellow, while the colours ranging from pink to rose-red of the other group are the result of an absorption in the green.