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Anomalous dispersion and multiplet lines in spectra

Recently, H B Dorgelo has carried out a series of measurements of the intensities of the components of multiple spectral lines (Dissertation, Utrecht, 1924) and obtained results of great interest. He found that the doublets of the sharp series of the alkalies had a 2:1 ratio of intensity, the triplet components of the sharp series of the alkaline earths had a 5:3:1 ratio, the triplets of the sharp series of a sextet system had a 4:3:2 ratio, and the triplets of an octet system a 5:4:3 ratio. The theoretical interpretation of this result has been discussed by Sommerfeld ("Atombau", Fourth Edition, p. 649) and by Ornstein and Burger (*Z. Phys.*, **24**, 41 (1924)). As illustrations of Dorgelo's work may be quoted the case of the triplets of manganese 6021, 6016, 6013, which show a 4:3:2 intensity ratio.

Probably the best known case of the existence of simple intensity relationships of this kind are the two D-lines of sodium, for which a 2:1 ratio has long been shown. The anomalous dispersion of sodium vapour has been extensively studied, notably by Roschdestwensky, who found (*Ann. Phys.* (*Leipzig*), **39** (1912)) that of two constants a_1, a_2 in the dispersion equation

$$n = 1 + \frac{a_1\lambda^2}{\lambda^2 - \lambda_1^2} + \frac{a_2\lambda^2}{\lambda^2 - \lambda_2^2},$$

where λ_1 and λ_2 are the wavelengths of the two D-lines, a_1 was just twice as large as a_2. Dorgelo's work suggests that, in the case of multiplet lines, similar numerical relationships between the constants of anomalous dispersion should be found. Unfortunately, very little in the way of quantitative data on anomalous dispersion is available except in the case of the alkali metals.

Perhaps the best work in this direction is that of A S King at Mount Wilson, who with the electric furnace studied the anomalous dispersion of iron, chromium, titanium, and manganese lines (*Astrophys. J.*, **45**, 254 (1917)). An enlarged photograph of the anomalous dispersion due to the manganese triplet 4031, 4033, and 4035, which belongs to the sextet system, reproduced with King's paper, has been examined, and it is found that the dispersion constants a_1, a_2, and a_3 of the lines deduced from the photograph agree closely with the 4:3:2 ratio to be expected on theoretical grounds. In the case of the chromium triplets 5208, 5206, and 5204, Dorgelo obtained experimentally an intensity ratio of 100:72:45, while King's photographs give the ratio of anomalous dispersion to be roughly as 100:75:50, which is a fair agreement. A careful study of the original negatives secured at Mount Wilson may be suggested as likely to furnish further data regarding these interesting spectral relationships.

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