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On the Bunsen Flame Spectra of Metallic Vapours.

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[PLATE 9.]

1. *Introduction.*

In seeking to solve the problem of the structure of atoms, especially of the more complex ones, it is of great importance to know what are the simplest or fundamental spectra which such atoms are capable of emitting. Information regarding such fundamental frequencies for the atoms of some metals has been obtained from investigating the characteristics of both the absorption and emission spectra of vapours of these metals. For example, McLennan and Edwards* have shown that, with the non-luminous vapours of mercury, zinc and cadmium, narrow absorption bands are obtained, using moderate vapour densities, with lines whose frequencies are given by $\nu = (1{\cdot}5, \mathrm{S}) - (2, p_2)$,† and $\nu = (1{\cdot}5, \mathrm{S}) - (2, \mathrm{P})$. The first of these is the frequency of the first member of Paschen's‡ combination series $\nu = (2, p_2) - (m, \mathrm{S})$, and the second is the first member of the singlet series $\nu = (1{\cdot}5, \mathrm{S}) - (m, \mathrm{P})$. Moreover, one§ of us has also more recently shown from absorption experiments that for magnesium atoms the frequencies $\nu = (1{\cdot}5, \mathrm{S}) - (2, \mathrm{P})$, $\nu = (1{\cdot}5, \mathrm{S}) - (3, \mathrm{P})$, and possibly also those of still higher members of the series $\nu = (1{\cdot}5, \mathrm{S}) - (m, \mathrm{P})$, are the fundamental ones. With this metal the frequency $\nu = (1{\cdot}5, \mathrm{S}) - (2, p_2)$, does not appear from experimental evidence as yet available to be fundamental.

It has also been shown by McLennan and Henderson‖ that the simplest spectrum which the vapours of mercury, zinc, and cadmium in a vacuum can be made to emit under bombardment by electrons consists with each of the metals of the single spectral line whose frequency is given by

* McLennan and Edwards, 'Phil. Mag.,' vol. 30, p. 695 (November, 1915).

† In the symbolic equation $\nu = (n, \mathrm{X}) - (m, \mathrm{Y})$, the frequencies are given by $\nu = \dfrac{\mathrm{N}}{[n + \mathrm{X} + x(n, \mathrm{X})]^2} - \dfrac{\mathrm{N}}{[m + \mathrm{Y} + y(m, \mathrm{Y})]^2}$, where N is Rydberg's number, n has a fixed value, either integral or one of the numbers 1·5, 2·5, 3·5, etc., and m has successive integral values, each one giving the frequency of a member of the series.

‡ Paschen, 'Ann. der Phys.,' vol. 35, p. 860 (1911).

§ McLennan, *supra*, p. 574.

‖ McLennan and Henderson, 'Roy. Soc. Proc.,' A, vol. 91, p. 485 (1915).