Letters to the Editor.

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The Fluorescence of Cadmium Vapour.

IN the course of the study of band spectra of cadmium and zinc, the question arose whether the vapours of these metals show a fluorescence analogous to the well-known green fluorescence of mercury vapour. To decide this problem, the following experiment was made.

A quartz bulb was thoroughly evacuated, adsorbed gases being removed by heating it to a high temperature for some days. Then a few milligrams of pure cadmium were distilled into the bulb, which was finally sealed off from the pumps. The bulb being put into a nichrome-wire furnace, a beam of exciting light from a condensed spark, an arc, or a mercury lamp was projected through the bulb by the aid of a quartz lens.

It was found that the fluorescence of cadmium vapour, in the form of a blue-coloured beam of light, strictly limited to the path of the exciting beam, makes its appearance and continues over a considerable range of temperature and density of vapour. By increasing gradually the temperature of the furnace, first traces of the fluorescence appear about 450° C.; with further increase of temperature the intensity of the fluorescence is augmented, and from 600° to about 750° it is very pronounced. At a still higher temperature the direct observation of the fluorescence is impeded by the bright glow of the furnace. Using a blue glass screen to cut out the red glow of the furnace, however, the fluorescence can be observed up to a temperature of about 950° and more, its intensity being considerably diminished.

In order to determine the exciting wave-lengths, various sources of light were employed: a condensed spark with the electrodes of cadmium, zinc, aluminium, magnesium, copper, lead, tin, carbon and iron; iron, cadmium and carbon arcs, and also a mercury lamp. Almost all these sources gave a more or less intense fluorescence. Especially strong fluorescence is produced by the cadmium spark; a very faint one by the magnesium spark; the carbon arc does not produce any fluorescence at all.

The excitation of the fluorescence being produced by such different sources of radiation proves the spectral extent of its excitation to be rather broad. It lies at any rate below 3000 Å.U., as not only a thin sheet of glass, but of uviol as well, put in the path of the exciting beam extinguishes the fluorescence completely.

An addition of small quantities of other gases seems also to have a destroying influence upon the fluorescence, as proved by the following experiment: The bulb, showing a very intense fluorescence, was heated by the Bunsen flame for fourteen hours. It was found then that its fluorescent property disappeared totally. This is probably due to the diffusion of hydrogen from the flame through the red-hot quartz into the bulb. To demonstrate the presence of hydrogen in the bulb, the latter was excited at room temperature by the electrodeless discharge of a Tesla transformer. In the spectrum were found some hydrogen lines, which were absent before the heating.

In order to examine separately the influence of temperature and density upon the fluorescence, a quartz cylinder provided with a side-tube and having two plane-parallel windows was used. The cylinder and the tube could be heated independently in two separate furnaces. First of all it was noted that during the rapid evaporation of metal drops condensed on one of the windows, the fluorescence appears particularly intense. However, the existence of fluorescence in the bulb, where a permanent distillation does not take place, proves that the evaporation is not an indispensable factor in the appearance of fluorescence.

The study of the spectrum of the fluorescence is rather difficult owing to the long exposures (several hours even when a spectrograph of small dispersion was used) which are necessary on account of a comparatively small intensity of light. It is also difficult to remove the exciting light scattered by the walls of the bulb.

The photographs of the spectrum and the curves got from these by a self-registering microphotometer show, however, that the spectrum has the appearance of a broad continuous band extending approximately from 5000 to 3950 Å.U. The decrease of intensity, especially towards the more refrangible end of the spectrum, is very gradual. The maximum of intensity falls about 4630 Å.U. This type of spectrum is analogous to the fluorescence spectrum of mercury vapour.

Further detailed investigations of the phenomena described are in development.

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The Band Spectra associated with Carbon.

THERE are now so many as thirteen band groups associated with carbon and its compounds. Some of these, such as the violet CN group, have been studied exhaustively, both empirically and upon the basis of the quantum theory. I have endeavoured to arrange in progressions and to assign vibrational quantum numbers to all of these groups, where such work has not yet been done, and several interesting new relations have resulted.

Lemon (Proc. Nat. Acad. Sci., 11, 41, 1925) has found that the first negative group and the comet-tail bands (low pressure CO bands) appear and disappear under the same experimental conditions, and Blackburn (*ibid.*, 11, 28, 1925) has made a quantum analysis of the former group. Simultaneously, Baldet (*Comptes rendus*, 180, 271, 1925) published measurements of the four heads of each of the 30 bands of the comet-tail group. Using the data for all four heads, I find that the first head is given by the equation

$$\nu = 20485{\cdot}4 + (1550{\cdot}46n' - 14{\cdot}07n'^2 + 0{\cdot}043n'^3) - (2198{\cdot}6n'' - 15{\cdot}00n''^2).$$

The remaining three heads are then given by substituting for the constant term 20471·6, 20359·1, and 20346·1 respectively. Using the older data quoted by Jevons (*Phil. Mag.*, 47, 586, 1924) as well as Blackburn's data, I obtain similarly for the heads of the first negative group

$$\nu = 45655{\cdot}4 + (1704{\cdot}42n' - 29{\cdot}3n'^2 + 0{\cdot}7n'^3) - (2197{\cdot}03n'' - 15{\cdot}17n''^2).$$

The assignment of the final vibrational numbers (n'') is very certain in the case of each of these groups, and it is evident that well within limits of error both groups correspond to the same final state, and are therefore due to the same molecule. The experimental evidence indicates that the comet-tail bands are due to CO, while, as the name indicates, the first

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