Letters to the Editor.

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Bands in the Absorption Spectrum of Mercury.

In a paper just published in the Royal Society's *Proceedings* for May, it is shown that excited mercury vapour from a low-current discharge gives, in addition to the better-known feature of the mercury band spectrum, a series of bands which were observed from λ3055 to λ2697. I find that these bands converge to a point very near the resonance line 2537.

I have now obtained bands of the same system in absorption by a long column of the vapour of boiling mercury, which shows that they involve transitions to or from the unexcited electronic state. These bands are allied to, but not identical with, the emission bands, and converge towards a point in the spectrum somewhat more refrangible than the resonance line λ2537. I have obtained about fifty of them. They are seen to best advantage on the border of the region of intense absorption which starts from the resonance line and extends towards the red. As the density of mercury vapour is increased, the region of intense absorption extends farther towards the red, and a part of the band system mentioned is blotted out by the intense general absorption. At the same time the increased quantity of mercury allows them to be traced farther towards the red, and the distinctness is improved. This is very like the behaviour of ozone in the absorption at the limit of the solar spectrum, and also in laboratory experiments, as traced in 1917 by Prof. Fowler and myself.

The mercury bands have not yet been satisfactorily analysed for classification by the quantum theory. There are certain suggestive differences in detail between the emission and the absorption bands. The spacing of these bands is of the order of 10 Ångströms.

In addition to this new system in the absorption spectrum of mercury, it is already known that there are diffuse absorption bands at λλ2345, 2338, 2334 and 2339, thus with a spacing of the order of 5 Ångstroms. Closer examination of these has now shown that superposed upon this structure there is a much finer one, of the order of 1 Ångström. This occurs in and between the conspicuous bands named, and extends beyond them as far as λ2300 and possibly farther. The spacing becomes closer, and with the instrument at present available I have not been able to resolve the structure any further. In the paper cited I have shown the intimate connexion in *emission* between this part of the band spectrum and the 'forbidden' line λ2270. Neither this nor the other forbidden line at λ2656 can be detected in absorption.

The mercury absorption spectrum has often been examined before by experienced observers, and it may cause surprise that the features above described have not been noticed. It is due, I think, partly to insufficient length and density of mercury vapour, and partly to the use of an unsuitable bright source for observing the absorption. Bright lines in the source are very baffling.

It is hoped to examine exhaustively these and the remaining portions of the mercury band spectrum with adequate resolving power.

Rayleigh.

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May 16.

Modified Scattered X-Radiation due to Super-Position.

May I place on record what is, I think, the most direct evidence that the modified scattered radiation is due to the super-position of unmodified scattered radiations? When using a certain primary X-radiation, the scattered radiation from air was found to be totally unmodified radiation, *i.e.* a radiation with accurately the same absorbability as the primary radiation exciting it. The radiation scattered from paper or paraffin-wax was very definitely a modified scattered radiation, or contained a modified radiation, *i.e.* differed considerably in absorbability from the primary radiation. Also these two radiations scattered from paper and from paraffin-wax were equally modified—within a small possible error.

Such results have frequently been obtained in this laboratory. As previously recorded, we have even obtained modified scattered radiation from thick sheets of scattering material, when the radiation from thin sheets was an unmodified radiation as tested by absorption measurements.

In our recent experiments, however, we made a systematic examination of the radiation scattered from various thicknesses of scattering substance. It was found that with a certain primary radiation, when the sheet of paper or paraffin-wax was made gradually thinner, the difference between the primary and scattered radiations became smaller, and ultimately almost vanished, indicating very definitely a vanishing difference for an infinitely thin layer of scattering material.

The possibility of this effect being due in some way to a mere variation of the intensity of ionisation is quite ruled out of consideration by the facts that:

(1) A large variation of output of the Coolidge tube was entirely without influence on the measured difference between primary and secondary radiations, and that

(2) Equal degrees of modification of the rays scattered from paper and from paraffin-wax were produced by scattered radiations of quite different intensity. Thus the slab of paraffin-wax used as scattering substance had to be seven or eight times as massive as the slab of paper in order to produce an equal degree of modification in the scattered radiation as measured by absorbability. Under such corresponding conditions, the intensity of the scattered radiation from paraffin was, roughly, seven times the intensity from the paper.

Plotting the change of absorbability on scattering against mass per unit area of the scattering sheet, we obtained curves of form precisely like the familiar ionisation-pressure curves showing saturation current. In our experiments what was shown was a saturation amount of modification by scattering from thicker layers of scattering material. The maximum amount of modification was shown much earlier for a paper than for a paraffin-wax scatterer, but the two measures of modification were finally equal. Other experiments on this phenomenon—for it of course raises many questions—will be described elsewhere.

It should, however, be added that all X-radiations are not equally sensitive to a change in the amount of scattering substance. The scattering radiation was evidently near the critical condition for a change of its level of activity such as we have described in papers on the *J*-phenomenon. It afterwards settled down to a state in which thick sheets, thin sheets, and even air itself all produced a scattered radiation showing the full amount of modification such as had previously only been given by thick sheets. It is, of course, possible—indeed I think probable—that it was then