Letters to the Editor.

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Fluorescence of Mercury Vapour under Atomic and Molecular Absorption.

It is familiar that mercury vapour under pressures of a few centimetres of mercury gives a green fluorescence when excited by wave-lengths near the resonance line $\lambda 2537$. Proceeding away from the resonance line, I have observed the fluorescence with wave-lengths so long as $\lambda 3450$, though at this extremely low excitation dense vapour is needed. This note deals with excitation near the resonance line.

The fluorescence is much brighter near the entrance than elsewhere, due to rapid exhaustion of the most effective constituents of the exciting radiation. I have emphasised that there is a *discontinuity of intensity* as we proceed along the beam, and this is attributed to the existence of two kinds of absorption, atomic and molecular. Atomic absorption is dominant at first. The radiation capable of this kind of absorption is limited to about 0.05 Å. on either side of the resonance line. I call the fluorescence from it the *core effect*, and the much weaker fluorescence, due to outlying radiation, the *wing effect*. The latter does not suffer rapid extinction as the beam traverses the vessel. Some continental physicists who have been interested in the question are unable to accept this point of view, and consider the apparent discontinuity an illusion, regarding the fluorescence-absorption as molecular in every case.

A full discussion will be published later. I write now to record that the reality of the distinction between the wing and the core effect is confirmed by observing what happens when a suitable addition of hydrogen gas is made to the mercury vapour. It is easy to adjust the hydrogen admixture so as to extinguish completely the core effect, leaving the wing effect almost unaltered. I have obtained the latter with hydrogen pressures so high as 10 cm.

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Evidence for a Stellar Origin of the Cosmic Ultra-penetrating Radiation.

WHILE in former years all observers were agreed that the sun does not contribute any noticeable amount to the total intensity of the cosmic ultra-radiation, the increase in the sensitivity of the apparatus used within recent years, and the increase in the number of observations made at different stations and under different experimental conditions, makes it possible to investigate once more whether the influence of the sun is altogether negligible.

Very accurate and trustworthy registrations of the cosmic radiation have been carried out with Prof. G. Hoffmann's high-pressure ionisation chamber at Muottas Muraigl (2456 m. above sea-level) in the Engadine. These measurements show, beyond any doubt, that the average intensity of the radiation is somewhat greater in daytime than during the night. G. Hoffmann and F. Lindholm¹ give the average difference between day and night intensities as 0.12 mA., ~0.0125 ions per c.c. per sec. while the apparatus was unscreened from above, and 0.04 mA., ~0.0042 I with a lead-screening of 6 cm. and 9 cm. thickness. (The letter 'I' always denotes "ions per

c.c. and sec.") F. Lindholm,² with the same apparatus, found from longer series of observations (8 months) the values in the accompanying table (see Table 6 of his paper).

In Hoffmann and Lindholm's apparatus a compensation current of one milliamperere corresponds to an ionisation of 0.104 I. Therefore the total intensity of the ultra-radiation with the apparatus unscreened from above was about 2.50 I at Muottas Muraigl.

The difference between day and night intensity can be taken, provisionally at least, as the actual intensity of the solar penetrating radiation. One can see at once that at Muottas Muraigl, 2456 m. above sea-level, about one-half of this solar radiation component is able to penetrate through 10 cm. of lead. This component is therefore far more penetrating than the gamma rays from radioactive substances. If we assume that all of the above-mentioned 0.011 I is of solar origin, we can compute the absorption coefficient in lead μ_{Pb} (it will suffice to take the case of perpendicular incidence) from the equation

$I = I_0 e^{-\mu_{Pb} d}$ taking $I_0 = 0.011$, $I = 0.0058$, and $d = 10$ cm.; thus we obtain $\mu_{Pb} = 0.064$ cm.⁻¹ and the mass absorption coefficient $\left(\frac{\mu}{\rho}\right)_{Pb} = 5.7 \times 10^{-3}$ cm.²/gm.

This value is almost exactly equal to the mass absorption coefficient value of the total cosmic radiation at the same altitude $((\mu/\rho)_{Pb} = 6.3 \times 10^{-3}$ cm.²/sec. as found by Büttner on the Eiger glacier 2.3 km. above sea-level).³ If we assume that part of the (0.011 I) difference between day and night values with unscreened apparatus is due to an increase in the average content of radium emanation and its products in the air during daytime, then we should get an even more pronounced hardness of the solar penetrating rays, that is, a smaller value for their mass absorption coefficient. Therefore we are justified in concluding that *the sun emits penetrating rays of at least the same penetrating power as the well-known cosmic ultra-radiation. The total amount of the solar penetrating rays (at 2456 m. above sea-level) is about one-half per cent of the total intensity of the cosmic radiation, as it is seen from the accompanying table.* Of course, one might think it possible to explain the increase in the total radiation during daytime as due to an indirect influence of the sun (that is, an increase in the scattering of the ultra-rays by the heating of the atmosphere during the day). In this case, however, one would expect that this scattered radiation, represented by the difference between the day and night values, would be much softer than the general cosmic radiation; but this is in contradiction to the experimental results analysed above.

Recent observations of R. Steinmaurer⁴ on the summit of the Sonnblick (3100 m. above sea-level) in the summer of 1929, made with three different instruments (two of the Kolhörster double loop-electrometer type and one of the Wulf-Kolhörster type), also show clearly that the total ultra-radiation in daytime is slightly higher than at night; the difference amounts to about 0.7 per cent (0.06 I, average difference for the three forms of apparatus mentioned above, the total intensity on the Sonnblick being about 8.7 I with the screening open on the top). The increase of radiation was also observed with apparatus screened with 7 cm. iron all around, but the number of these observations on the Sonnblick is not sufficient for quantitative calculations. It may be mentioned that even in the old observations on the summit of the Obir (2000 m. above sea-level), made by V. F. Hess and M. Kofler,⁵ the solar influence is noticeable (the total intensity of the ultra-radiation plus earth-radiation during the day being 11.11, during the night 11.09 I, in the average for 13 months), although at that