Letters to the Editor

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The Origin of the $M\zeta_1$ and $M\zeta_2$ X-Ray Satellite Groups

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A PUBLICATION by Munier, Bearden, and Shaw[1] in September, 1940, revealed well-defined satellite groups for the x-ray lines $M\zeta_1$ and $M\zeta_2$. This very properly brings up the question of their origin. $M\zeta_1$ comes from the single electron transition $M_{\text{V}}\rightarrow N_{\text{III}}$, while $M\zeta_2$ arises from the transition $M_{\text{V}}\rightarrow N_{\text{II}}$. If, in accordance with previous work[2] on the Auger effect causing x-ray satellites, we ascribe the satellites just mentioned to initial MN ionization, we must choose a radiationless transition in the M-shells, which leaves the M_{V} shell and some N-shell ionized, and we see that $M_{\text{III}}\rightarrow M_{\text{V}}$ is the only possible radiationless transition:

$$(\text{Energy}_{M_{\text{II}}-M_{\text{V}}}) > (\text{any ionization energy for an } N\text{-shell})_{z+1}$$

for all atomic numbers (see Fig. 1); while

$$(\text{Energy}_{M_{\text{IV}}-M_{\text{V}}}) \ll (\text{any ionization energy for an } N\text{-shell})_{z+1}.$$

Hence there are no Auger "cross-overs" for the last-named bounding transitions, and the Auger effect cannot occur for them. Therefore, if the $M\zeta_1$ and $M\zeta_2$ satellites are due to the Auger effect producing MN ionization, the satellites may be accounted for by the following single electron transitions between doubly-ionized states:

$$\text{for } M\zeta_1,\quad M_{\text{V}}N_{\text{IV,V}}\rightarrow N_{\text{III}}N_{\text{IV,V}};$$
$$\text{for } M\zeta_2,\quad M_{\text{V}}N_{\text{IV,V}}\rightarrow N_{\text{II}}N_{\text{IV,V}}.$$

Then the satellites will be most prominent for atomic number 86, which is a few atomic numbers below $Z=88$, where the Auger "cross-over" occurs for $M_{\text{III}}\rightarrow M_{\text{V}}$ and the $N_{\text{IV,V}}$ shell energy curve (see Fig. 1).

It cannot be MO ionization which causes these satellites since:

For the O-shells (ionization energy)$_{z+1}\sim 2$ to 4 $(\nu/R)^{\frac{1}{2}}$ units; $(\nu/R)^{\frac{1}{2}}{}_{M_{\text{III}}-M_{\text{V}}}=5$ to 6 $(\nu/R)^{\frac{1}{2}}$ units, too great an energy; $(\nu/R)^{\frac{1}{2}}{}_{M_{\text{IV}}-M_{\text{V}}}\sim\frac{1}{3}$ $(\nu/R)^{\frac{1}{2}}$ units, too small an energy for the Auger effect. Hence there will be poor wave function overlapping in these two limiting cases, and the

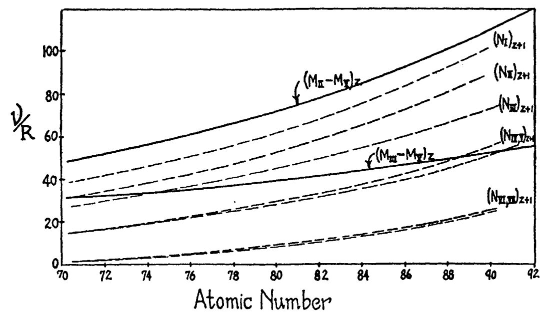

FIG. 1. Energy in ν/R units released by the radiationless transitions $M_{\text{II}}\rightarrow M_{\text{V}}$ and $M_{\text{III}}\rightarrow M_{\text{V}}$ (full lines), and ionization energies for the N-shells, plotted for $z+1$ as an M electron is missing (dashed lines).

Auger effect cannot exist, to cause MO ionization. For an illuminating plot of these data, see M. Siegbahn's *Spektroskopie der Roentgenstrahlen.*

[1] J. H. Munier, J. A. Bearden, and C. H. Shaw, Phys. Rev. **58**, 537 (1940).
[2] F. R. Hirsh, Jr., Phys. Rev. **50**, 191 (1936).

A Continuum in the 1849A Region in the Afterglow Spectrum of Mercury*

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MOORE and Garth[1] observed a continuous band in the afterglow spectrum of mercury vapor in the region 1849A which had not been previously reported. (Rayleigh[2] was unable to find either a line or a band in the afterglow in this region, even with extreme overexposure.) This same band was observed by Hamada[3] in a discharge in mercury in a Schuler tube, and was accounted for as being due to weakly bound quasi-molecules.[4]

We have further examined this diffuse band with one of the tubes employed by Moore and Garth, photographing with a small quartz spectrograph with Eastman II-O (U-V sensitized plates). A microphotometer record of this continuum is shown in Fig. 1. Trace A was made from a spectrogram taken with the spectrograph and the space between the slit and the quartz window of the discharge tube filled with nitrogen. Trace B was made from a spectrogram taken with air in the same optical path, and shows the O_2 absorption bands, which were useful in determining the wave-length scale. These spectra were made with a mercury vapor pressure of 0.8 mm. No appreciable change was observed in the distribution of the intensity