LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twenty-eighth of the preceding month; for the second issue, the thirteenth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Breadth of Compton Modified Line

Professors Ross and Clark of Stanford, using the ingenious balanced filter method of Ross, have investigated the shifted line in the Compton effect for antimony, $K\alpha_1$ and $K\alpha_2$, lines scattered from beryllium. In this method the scattering angle is varied so as to vary the shift of the modified line. The scattered radiation is observed with an ionization chamber after passage through a silver filter and then a palladium filter balanced against the silver filter. The difference between the transmissions plotted as a function of the scattering angles exhibits peaks or fluctuations in the curve at the scattering angles of 55° and 75° corresponding to the points at which the shifted lines from $K\alpha_1$, $K\alpha_2$, respectively cross the silver edge of the spectral region defined by the balance filter method.

In view of the fact that the author has published experimental results[1] in which the breadth of the Compton line from molybdenum, $K\alpha_1$, $K\alpha_2$ scattered at nearly 180° from beryllium is too great to permit resolving the α_1, α_2 peaks, it seems worth while pointing out that these two results are not necessarily discordant. The author's experimental results were accompanied with his theory of the breadth and structure of the Compton line according to which a prominent part of Compton line structure, due to scattering by the free or conduction electrons in metallic scatterers, has a breadth which can best be correlated with the velocities of these electrons required by the Fermi statistics and which furnishes confirmatory evidence of the correctness of the Fermi distribution of velocities for conduction electrons in contradistinction to the older Boltzmann statistics.

According to the author's theory, the breadth of the Compton line, however, depends not only on the velocity distribution of conduction electrons, but also on the primary wave-length used and on the angle of scattering. In fact, for any given velocity β of randomly moving conduction electrons, the author's theory asserts that the contribution to the Compton line is a small rectangular element having a spectral breadth given by (formula (1), page 647)

$$\Delta\lambda = 4\beta\lambda^*.$$

In this formula, which gives the breadth of the Compton line as a function of scattering angle, the symbol λ^* stands for a wave-length which is defined thus:

$$2\lambda^* = (\lambda_c^2 + \lambda_1^2 - 2\lambda_c\lambda_1 \cos\theta)^{\frac{1}{2}}$$

λ^* is most easily visualized by a diagram. Construct a triangle, one angle of which equals the scattering angle, and having the two adjacent sides to this angle proportional respectively to the primary wave-length λ_1, and the shifted wave-length λ_c, of the simple Compton theory, for initially stationary electrons. Then the third side of this triangle is proportional to $2\lambda^*$.

On the basis of this formula, the author has computed for the case of Ross' experiment

$\theta = 75°$, $\lambda_1 = 469$ X.U., $\lambda_c = 485$ X.U., $\lambda^* = 292$ X.U.

$\theta = 55°$, $\lambda_1 = 474$ X.U., $\lambda_c = 485$ X.U., $\lambda^* = 222$ X.U.

If one assumes in beryllium *one* conduction electron per atom, this would give a Compton line breadth for Ross' cases of 6.5 and 5X-units, respectively. This refers to the breadth of the line at the base of the part contributed by conduction electrons, which according to the author's calculation seems to come a little below half maximum value. Assuming

[1] J. W. DuMond, Phys. Rev., **33**, 643–658 (1929).

two conduction electrons per atom, the corresponding breadths for Ross' cases are 8.4 X.U. and 6.36 X.U. respectively. It seems, therefore, safe to conclude that Ross' resolution of the doublet in the shifted radiation is for the conditions of his experiment not necessarily inconsistent with either the author's theory of Compton shifted line structure or with his published experimental observations.

At the present writing the author, in collaboration with Mr. H. A. Kirkpatrick, has just succeeded in obtaining photographic spectrograms of the Compton shifted line, using Mo $K\alpha_1$, α_2 scattered at 90° from graphite with a maximum inhomogeneity of scattering angle of less than one degree. The unmodified doublet is completely resolved on the negative and the Compton line appears very broad and diffuse. This work is being done with the fifty-crystal spectrograph described in Review of Scientific Instruments, Vol. 1, No. 2, February 1930.

The author believes that this new instrument at last affords the possibility of investigating the whole question of Compton modified radiation under adequately pure conditions of scattering angle and spectral resolution. We feel that we can now announce with complete assurance that the Compton shifted line is more diffuse than the lines of the primary radiation.

J. W. M. DuMond

California Institute of Technology,
Pasadena, California,
June 20, 1930.

The Raman Effect in Trimethylethylene

In some experiments made a year ago on the Raman effect in trimethylethylene several diffuse modified lines were found. The stronger correspond to infrared wave-lengths $3.44 \pm 0.05\mu$ and $8.4 \pm 0.2\mu$. Several fainter lines were found between these two. An anti-Stokes line corresponding to 8.4μ was also faintly seen excited by the mercury line 4358A. It seems probable that all these lines can be matched by absorption lines belonging to the group CH although no absorption line was found recorded as long as 8.4μ.

Accidental contamination with rubber added a continuous scattering, with a marked denser band beginning near the position of the strongest line, *ca* 4600A. A continuous spectrum was obtained in about the same position when a little rubber was dissolved in carbon tetrachloride, making it probable that the effect was due to the rubber and not to a change in viscosity of less than one percent. In this case a suggestion of a second very broad band with maximum about 5500A was also found. If these bands were due to Raman scattering it would be necessary to think of the exciting mercury lines as 4046A and 3650A. The light appeared to be partially polarized.

Dorothy Franklin
E. R. Laird
Mount Holyoke College,
June 14, 1930.

Photoionization of Salt Vapors

The chief interest presented by the photoionization of the vapors of various compounds is that it may afford additional information regarding the structure of molecules. As far as I am aware no such work with the vapors of simple inorganic salts has as yet been done.

In an investigation undertaken by me on these lines with the vapors of halides of various metals, a marked photoionization of these vapors was observed. The illumination was produced by intense ultraviolet light of wave-lengths longer than 1850A. The photoeffect from the electrodes and the walls was negligibly small as compared with the photocurrent from the vapor, in some cases the latter was a hundred times as great as the photocurrent which could be produced by direct illumination of the electrodes.

On raising the temperature of the salt thermal ionization currents could be observed without illumination, an effect which has been previously extensively studied by G. C. Schmidt and his co-workers (Ann. d. Physik **82,** 664 (1927) **2,** 313 (1929)). The photoionization begins generally at much lower temperatures than the temperatures at which the thermo-current is noticeable.

The salts studied first were TlI, TlBr, TlCl. It has been previously shown in this laboratory (Butkow and Terenin, Zeits. f. Physik **49,** 865 (1928), Butkow, ibid. **58,** 232 (1929)) that the excitation energy of the first