Letters to the Editor.

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Ionisation Potential of Radon.

WE have determined the ionisation potential of radon, using the well-known method,[1] due to Hertz, of compensation of the negative space-charge by positive ions formed by accelerated electrons from a subsidiary cathode. This cathode was an equipotential one and differed only in slight details from that described by Hertz and Kloppers.[2] In the original apparatus of Hertz the accelerating grid forms a part of a box which receives the space-limited current from the chief cathode. We have modified this arrangement by introducing a separate accelerating grid which enabled us to measure directly the useful part of the subsidiary emission, that is, the number of electrons penetrating into the box. The contact potential correction of the apparatus was determined by calibrating it with pure xenon and krypton: it was found to be 2·6 volts.

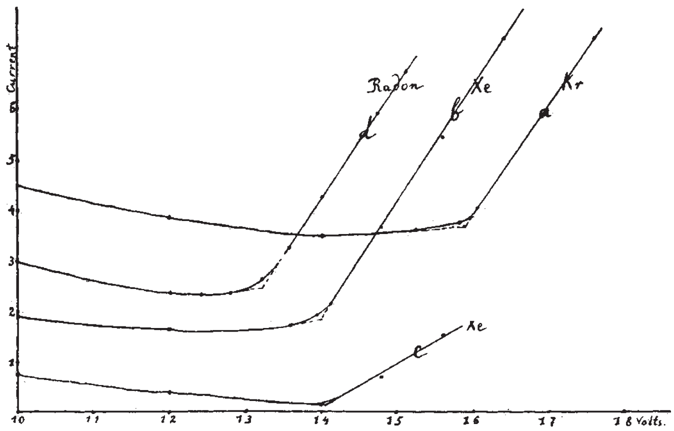

FIG. 1.

The quantity of radon used in different experiments was of the order of 300 millicuries. The volume of the apparatus with auxiliary parts being equal to about 250 c.c., the calculated pressure of radon was of the order of 0·8 bar, and one might think at first that the method would not be sensitive enough for such small quantities of gas. Preliminary experiments have shown, however, that it is quite easy to determine the ionisation potential of xenon when present at a pressure of 1 bar, and the sensitiveness of the method increases in a marked way with the atomic weight of the rare gas used for investigation. It ought also to be mentioned that at such low pressures the number of ions produced by the α-rays is negligibly small compared to the number of electrons involved in the experiment, so that radon can be treated as any other inactive gas.

Another important point was to make sure that the possible impurities of radon would not mask the appearance of discontinuities due to this gas.

We performed, therefore, a set of measurements in which special stress was laid on the purification of radon but not on the exact determination of the critical potential. The method of purification was the same as that previously described by one of us.[3] These experiments put beyond doubt the existence of an ionisation potential due to radon. This potential, in agreement with theoretical expectation, was found to be somewhat lower than that of xenon and therefore of any other permanent gas.

This circumstance facilitates essentially the work with radon. The only impurity which really matters is mercury vapour. Therefore in the final experiments we did not aim at a complete purification of radon, but used a trap kept in a bath at $-120°$, in order to get rid of the mercury vapour and a tube with caustic potash for absorbing carbon dioxide. The other details of the arrangement will be given in a later publication.

Curves obtained in the final experiments are shown in Fig. 1. In order to make the method more sensitive, the electronic current was nearly balanced against a steady current given by a potentiometer. On the curves the difference between the two currents is plotted against the accelerating potential of the subsidiary electrons. Curve *a* refers to krypton at a pressure of 7·2 bars, curve *b* to xenon at a pressure of 15 bars, curve *c* to xenon at a pressure of 1·3 bars, curve *d* to 250 millicuries of radon. The values of the ionisation potential of these gases corrected for the contact potential are 13·3, 11·4, and 10·6 volts respectively. The last value, that of radon, is in good agreement with the value 10·7 volts deduced recently by Rasmussen[4] from an investigation of the spectrum of radon.

F. HOLWECK.
L. WERTENSTEIN.

Radiological Laboratory,
Scientific Society of Warsaw,
Aug. 5.

[1] Hertz, *Zeit. f. Phys.*, **18**, 307; 1923.
[2] Hertz and Kloppers, *Zeit. f. Phys.*, **31**, 463; 1925.
[3] Wertenstein, *Phil. Mag.*, **6**, 17; 1928.
[4] Rasmussen, *Zeit. f. Phys.*, **62**, 494; 1930.

Fine Structure in the Singlet Series of Mercury.

UP to the present no fine structure has been observed in the singlet series of mercury. In a recent communication to the Physical Society of London (*Proceedings*, August 1930) a description was given of the spectrum of mercury excited at low pressures by a high frequency electrodeless discharge. Amongst other effects it was found that the singlet series and intercombination lines due to transitions beginning on singlet levels, were strongly enhanced relative to the triplets. The line $6^1P_1 - 8^1S_0$ was examined for fine structure with a Fabry-Perot interferometer and found to be single and so narrow (half width $< 0{\cdot}004$ A.) as to render it of great value in interferometric work.

As a result of recent improvements in experimental conditions, three new components have been detected, one faint and two very faint, the intervals being approximately:

$$-0{\cdot}012 \quad 0 \quad +0{\cdot}009 \quad +0{\cdot}031 \text{ A.}$$

Since these only appear when the main line is heavily overexposed, they have practically no effect on the visibility of the fringes when normal exposures are used, and therefore should not detract from the usefulness of the line as a source. The next member of the same series $6^1P_1 - 9^1S_0$ is also complex.

Many other strengthened lines involving singlet levels show a complex structure; for example,

$$7^1S_0 - 8^1P_1,\ 7^1S_0 - 9^1P_1,\ 7^3S_1 - 8^1P_1,\ 7^3S_1 - 9^1P_1.$$