"Note on the Effect of Extreme Cold on the Emanations of Radium." By Sir WILLIAM CROOKES, F.R.S., and Professor JAMES DEWAR, F.R.S. Received and read May 28, 1903.

As it seemed advisable to examine the action of extreme cold on the action of radium, the following experiments have been made, in continuation of work formerly done by either of us separately.

The first endeavour was to ascertain whether the scintillations produced by radium on a sensitive blende screen were affected by cold.

A small screen of blende with a morsel of radium salt close in front was sealed in a glass tube, and a lens was adjusted in front so that the scintillations could be seen. On dipping the whole into liquid air they grew fainter and soon stopped altogether. Some doubt was felt whether this might not have been caused (1) by the presence of liquid, (2) by the screen losing sensitiveness, or (3) by the radium ceasing to emit the heavy positive ions. To test this two tubes were made, in one of which the radium salt could be cooled without the screen, and in the other the screen could be cooled while the radium salt was at the ordinary temperature. The accompanying sketch explains their construction.

FIG 1.

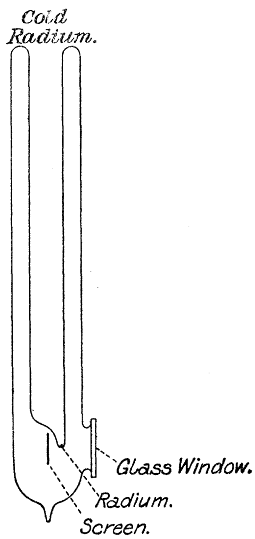
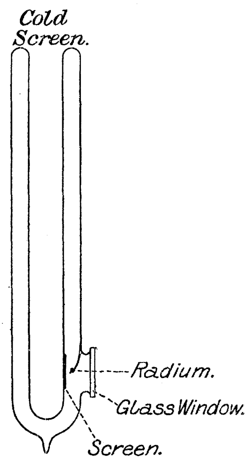


FIG. 2.



1. Radium salt cooled by liquid air, fig. 1. Screen at ordinary temperature. Scintillations quite as vigorous as with radium at the ordinary temperature, the screen and radium being *in vacuo*.

2. Radium at the ordinary temperature and screen cooled in liquid air, fig. 2. As the screen cooled the scintillations became fainter and at last could not be seen. On allowing the temperature to rise the scintillations recommenced.

3. A screen with a speck of radium salt in front of it was sealed in a tube. Water was put in the other end of the tube and the tube sealed on the pump. A good exhaustion was kept up and the water boiled away, the vapour being condensed in phosphoric anhydride. The tube was sealed off when a few fine drops of water were still remaining in the tube. The scintillations were well seen in this saturated aqueous vapour. The lower end of the tube was dipped in liquid air, which instantly condensed the aqueous vapour and left a very good vacuum. On now examining the scintillations they were if anything brighter and more vigorous than at first. When liquid hydrogen cooling was used instead of liquid air the action was equally marked, showing that the highest vacuum that can be obtained by the action of cold does not diminish the scintillations.

In the upper part of the tube, away from the radium and screen, two platinum wires were sealed to show the state of the vacuum. The spark passed easily at the ordinary temperature, showing a reddish line of aqueous vapour. When the other end of the tube was in liquid air the spark refused to pass.

4. It was thought that perhaps the passage of the induction spark might have liberated some occluded hydrogen, so another tube similar to the above was made without the platinum wires. Here also immersion in liquid air, if it had any effect, brightened the scintillations, and on replacing the liquid and cooling by liquid hydrogen no change was observable.

In order to test the activity of radium in rendering air electrically conductive, some radium bromide was sealed up in a glass tube and heated to the highest temperature the glass would stand, during the production of as high a vacuum as the mercurial pump would give. The whole tube was then immersed in liquid hydrogen contained in a vacuum vessel. On bringing the radium in such a vessel into a room in which a charged electroscope was placed, it began to leak when the tube of radium surrounded with liquid hydrogen was some 3 feet away, and was very rapid in its action when a foot away from the electrometer. On immersing the tube containing the liquid hydrogen with submerged radium in another large vessel of liquid air and bringing the combination near the electroscope the action was the same.

The luminosity of the radium salt in liquid hydrogen was much

more marked with the pure compound than had been formerly observed with the diluted mixtures containing large quantities of barium salts.

Professor Rutherford and Mr. Soddy have made the important discovery that a condensible emanation is diffused into gases from solutions of radium salts, which is capable of condensation from the gas mixture at the temperature of liquid air. As it was important to ascertain what was taking place in this respect with the anhydrous radium bromide when isolated in the highest vacuum, the following experiment was arranged:—

A glass apparatus of the shape represented in fig. 3 was constructed. The part marked C is a fine capillary drawn out tube some 5 or 6 inches in length, the B portion, about 2 inches long, being filled with hard-pressed purified asbestos. The radium salt was located at A, and the whole was most carefully heated, exhausted to the limit of the mercurial pump, and sealed off. In the dark no trace of phosphorescence could be seen in any part of the apparatus unless from the pieces of the radium bromide. The fine tube C was now immersed in liquid air in a large flask, so that distillation might proceed undisturbed for days. After 24 hours of this operation, on looking at the part C while covered with the liquid air, a marked phosphorescence was recognisable owing to some condensed emanation. The luminosity became naturally more marked the longer the time the action was allowed to proceed, and it is our intention to continue the experiments for a lengthened period of time, and then seal off the fine capillary part so that the condensed product may be thoroughly examined.

Fig. 3.