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LETTERS TO THE EDITOR.

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Radium Emanation.

IN 1903, it was shown by Mr. Soddy and myself that the spontaneous change of the emanation from radium results in the formation of helium; this observation has been confirmed by Indrikson, by Debierne, by Giesel, by Curie and Dewar, and by Himstedt and G. Meyer. Debierne has shown that actinium chloride and fluoride also develop helium. I have also once detected helium in the gases evolved continuously from a solution of thorium nitrate, and hope soon to confirm this observation.

When the emanation is in contact with, and dissolved in water, the inert gas which is produced by its change consists mainly of neon; only a trace of helium could be detected.

When a saturated solution of copper sulphate is substituted for water, no helium is produced; the main product is argon, possibly containing a trace of neon, for some of the stronger of its lines appeared to be present. The residue, after removal of the copper from this solution, showed the spectra of sodium and of calcium; the red lithium line was also observed, but was very faint. This last observation has been made four times, in two cases with copper sulphate, and in two with copper nitrate; all possible precautions were taken; and similar residues from lead nitrate and from water gave no indication of the presence of lithium; nor was lithium detected in a solution of copper nitrate, similarly treated in every respect except in its not having been in contact with emanation.

These remarkable results appear to indicate the following line of thought:—From its inactivity it is probable that radium emanation belongs to the helium series of elements. During its spontaneous change, it parts with a relatively enormous amount of energy. The direction in which that energy is expended may be modified by circumstances. If the emanation is alone, or in contact with hydrogen and oxygen gases, a portion is "decomposed" or "disintegrated" by the energy given off by the rest. The gaseous substance produced is in this case helium. If, however, the distribution of the energy is modified by the presence of water, that portion of the emanation which is "decomposed" yields neon; if in presence of copper sulphate, argon. Similarly the copper, acted upon by the emanation, is "degraded" to the first member of its group, namely, lithium; it is impossible to prove that sodium or potassium are formed, seeing that they are constituents of the glass vessel in which the solution is contained; but from analogy with the "decomposition-products" of the emanation, they may also be products of the "degradation" of copper.

A full account of this research will shortly be communicated to the Chemical Society. WILLIAM RAMSAY.

July 11.

Effect of Pressure on the Radiation from Radium.

I HAVE, during the last eighteen months, been engaged in an investigation on the effects of pressure on radio-active phenomena. In designing the apparatus necessary for the purpose, it was necessary to consider that if any change in the rate of production of the emanation occurs through pressure, effects would not be noticeable at once, as a new state of equilibrium would only be reached after several days. Similar considerations hold if any of the slowly decaying products is affected. A special pressure pump was therefore constructed according to the designs of Mr. J. E. Petavel, and this pump allowed me to keep up a pressure of about 2000 atmospheres almost indefinitely without sensible leak. The time of the experiments was not, however, extended beyond four or five days. The results have been entirely negative, and I estimate that a change in the activity of one-third per cent. would have been noticed.

During the course of the investigation several fictitious effects made their appearance, and it was the elimination of these which necessitated a gradual improvement in the methods of observation and took up the greater part of the time occupied in the experimental inquiry.

In addition to the help of Mr. Petavel which has already been mentioned, I have had the assistance of Mr. Makower in the early stages of the work. The final experiments were conducted by my assistant, Dr. Hans Geiger.

ARTHUR SCHUSTER.

Victoria Park, Manchester, July 12.

IN order to ascertain if the rates of disintegration of radium and its successive products (the emanation, A, B, and C) are affected by high pressure, we have placed about 1 gram of barium chloride, containing 1·04 mg. of radium, completely sealed beneath lead, in a thick-walled cylinder of nickel steel, and compressed the radium by a tight-fitting chromium tungsten steel piston 1 cm. in diameter. The greatest pressure applied has been $3{\cdot}2 \times 10^5$ lb. to the square inch, which is the estimated pressure at a depth of fifty miles beneath the surface of the earth. The penetrating radiation arising from radium C was observed by two large electroscopes placed on either side of the radium, and at a distance of about 30 cm. from it. The γ rays produced a deflection of about twenty-eight divisions a minute in an electroscope, the natural leak of which was 0·4. The pressure on the radium was gradually increased from zero to that at ten, twenty, thirty, forty miles beneath the earth's surface, and was maintained for four days at about the forty-mile value. The pressure was then taken off, and observations were continued for three days more. During all these variations of pressure, no change was detected in the γ radiation, although a variation of 1 per cent. could have been observed without difficulty.

The pressure was then rapidly carried from zero to the fifty-mile value and back, and also maintained at fifty miles for two hours. Again there was no change, certainly not 1 per cent.

It is therefore clear that the transformation from radium to radium C continues in a normal manner at pressures equal to those at forty to fifty miles beneath the earth's surface; and this important conclusion seems inevitably to follow—that *radium generates heat by disintegration equally at the surface of the earth and at pressures which obtain at depths forty to fifty miles beneath the surface.*

The Hon. R. J. Strutt has proved that the quantity of radium in rocks near the earth's surface is greatly in excess of that required to compensate for the loss of heat by conduction and radiation from the earth's surface. Dr. Bronson has proved that the disintegration of radium is unchanged by wide variation of temperature. It appears from our experiments that the transformations take place in the usual manner even under a pressure of 160 tons to the square inch. If radium were distributed throughout the earth in the same amount as at the surface, a higher temperature gradient than that actually found would be expected. A possible explanation of the paradox has been put forward by Strutt and supported by Milne. He supposes that the constituents of the earth some twenty to forty miles beneath the surface are different in character from those near the earth's surface, and that they do not contain radium, or contain it to a smaller extent. This seems to carry with it the conclusion that igneous rocks, which contain considerable quantities of radium, have their origin nearer the surface of the earth than some geologists have supposed.

A. S. EVE.
FRANK D. ADAMS.

McGill University, Montreal, June 28.

The Æther and Absolute Motion.

THE particular objection to identifying magnetic force with velocity of the æther, which has been discussed recently in the columns of NATURE by Prof. O. W. Richardson, Sir Oliver Lodge and Prof. W. M. Hicks, Dr. C. V. Burton and Mr. E. Cunningham, must depend on some point of view which is foreign to my ways of thinking. Such a hypothesis involves, of course, that the