LETTERS TO THE EDITOR.

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Relation between Uranium and Radium in some Minerals.

IN the course of an investigation which I am conducting on uranium-bearing minerals, the detailed results of which will be published shortly, I have come upon a point which seems to be of sufficient interest to warrant immediate publication. This is the close agreement between the amount of uranium and the amount of radium present in those minerals which have been examined.

The method which has been employed is briefly as follows:—A weighed quantity of the powdered mineral is introduced into a small glass bulb, which is connected with a larger bulb by a short tube. Attached to the bulb containing the mineral is another small bulb containing a small quantity of a suitable acid. The whole apparatus is sealed up at a slightly diminished pressure, and by tilting, the acid is brought into the bulb with the mineral, and the complete decomposition of the latter effected by gentle heating. At the end of a couple of days the larger bulb is sealed off from the smaller and allowed to stand for two hours to permit any rapidly decaying emanation which it may contain to dissipate. A small quantity of strong sodium hydroxide solution is introduced into the bulb, and the walls are thoroughly wetted in order to remove the acid fumes. The air contained in the bulb is then transferred to an air-tight electroscope and the rate of leak measured. In comparing the results obtained with different minerals the rate of leak at the end of three hours has been chosen, since at this time the rate of decay of the excited activity and its rate of formation are in equilibrium, and the readings of the electroscope are constant over considerable periods. The quantity of uranium in the solution is determined by analysis, and the ratio between the volumes of the two parts of the apparatus determined by measuring their separate capacities.

The results which have been obtained are as follows:—

No.	Substance	Per cent. Uranium	Grams Uranium taken	Leak divisions per min.	Ratio leak to Uranium
1	Uraninite	82·5	0·1067	22·5	211
2	Gummite	66·1	0·0982	20·8	212
3	Uranophane	46·6	0·0671	12·1	181
4	Uraninite	83·9	0·0994	20·6	207·2
5	Samarskite	9·5	0·0292	6·4	218

Nos. 1, 2, 3 and 5 from North Carolina; No. 4 from Branchville, Conn.

The slightly low value of the constant in No. 3 can be explained by the fact that this mineral at ordinary temperature gives off constantly a small proportion of its emanation, and is therefore not in complete equilibrium.

These results show a direct variation from those obtained by Mr. Strutt (*Proc.* Roy. Soc., lxxiii., 191), which may perhaps be explained by the fact that he secured the emanation by heating his minerals. Experiments which I have made show that on heating samarskite to low redness only 10 per cent. of the total emanation is given off, and that heating to bright redness releases only 20 per cent. of the total emanation obtained when the very finely powdered mineral is completely decomposed by heating with concentrated sulphuric acid. BERTRAM B. BOLTWOOD.

139 Orange Street, New Haven, Conn., U.S.A., May 7.

The Source of Radium.

As the subject of the origin of radium is being discussed, I may perhaps be permitted to make a suggestion.

The source of radium is at present being looked for on the assumption that it is the disintegration product of a substance of higher atomic weight. If this is so, we have apparently to choose between uranium and thorium. Mr. Soddy's experiment throws serious doubts upon the former being the source. The products of the latter appear to have been sufficiently far traced to render it doubtful that it can be the source. Again, the element thorium seems to be scarce in, or even absent from, some radio-active pitchblendes, if the older analyses are to be relied upon.

I would suggest that radium may not be derived purely as a disintegration product, but as an atomic combination of radio-active products with some of the elements present in pitchblende. Thus radium would represent the synthesis of an element, not its decomposition. On this view some of the radio-active products of uranium (or thorium) can, in virtue of their great kinetic energy, enter into the atoms of intermixed substances, such as barium, bismuth, &c., giving rise to the new atom radium. The new atom is, however, not very stable, and is consequently short lived. Hence its radio-activity.

If this hypothesis is correct, we should seek to observe the genesis of radium not in any one of the radio-active elements, but in molecular intermixtures of these with the various bodies we know to be conspicuously present in pitchblende, seeking among the various combinations for a positive result. The quantities of radium (or its emanation) to be expected as generated in a given time remain, of course, the same as on the hypothesis of disintegration; thus the experimental investigation presents no additional difficulties beyond its greater prolixity. J. JOLY.

Trinity College, Dublin, May 17.

As Mr. Soddy is absent from England, it may be permitted to me to comment on Prof. Joly's letter. The idea had occurred to us; but, as remarked, the experiments would be very "prolix."

A more promising field of research appears to be to try to ascertain whether the immense amount of energy evolved in various forms during the disintegration of the radium emanation may not be able to cause chemical change of a constructive nature; for example, to change bromine into iodine. An attempt has been made to see if this was the case, but without a positive result. That iodine would be the product of an addition of energy to bromine is of course a mere guess; but iodine is easily tested for, and hence the experiment. The difficulty will be in recognising with certainty the product of any such change, for the quantity of matter to be produced is, of course, extremely small. It is only, however, by such "mad" experiments that the capabilities of the radio-active bodies can be ultimately gauged. WILLIAM RAMSAY.

Radio-activity of Russian Muds and Electrification of Air by Metals.

THE researches of Elster and Geitel (*Phys. Zeitschr.*, v. p. 11) having led to the detection of radio-active power in the fine mud or "Fango" of the Italian watering-place Battaglia, induced me to undertake a study of the Russian muds in this character. Out of the five kinds of muds hitherto obtained by me and studied in a desiccated state, two muds, viz. that of the Odessa Kooyalnitzky Liman and that of Arensburg, on the Isle of Oesel, have proved undoubtedly to possess radio-activity, the first being radio-active in a higher degree than the second. In these researches we proceeded in a manner quite analogous to that of Messrs. McLennan and Burton in studying the electrical conductivity of the air (*Phil. Mag.*, v. p. 699, 1903). The present experiments were carried out with the most active participation of Mr. Athanassieff.

We employed two cylinders, a brass one 8·3 cm. in diameter and 20 cm. high, and another of zinc, 22·5 cm. in diameter and 35 cm. high. In each cylinder there was fixed along the axis a brass wire which was supported by an amber cylinder placed in a brass guard tube. The latter was connected with the earth, and embedded in an insulating ring put into an opening of the upper base of the cylinder. The wire of either cylinder could at will be connected with one pair of quadrants of a Dolezalek electrometer, the other pair being connected with the earth, and the leaf was charged to 100 V by means of a battery of storage cells. The wire, also of brass, connecting the cylinder wire with the electrometer, and the point of connection of that wire