

LETTERS TO THE EDITOR.

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Heating Effect of the Radium Emanation.

In connection with the discovery of P. Curie and Laborde that radium continuously emits heat at a rapid rate, an interesting question arises as to whether the heat emission is directly connected with the radio-activity of that element or is independent of it.

To settle this point we have performed the following experiments. The heating effect of 30 milligrammes of pure radium bromide was first measured in a differential air calorimeter. The radium bromide was then heated to a sufficient temperature to drive off the emanation, and the latter was condensed by passing through a short glass tube immersed in liquid air, and then the tubes were sealed off. On testing the de-emanated radium, the heating effect diminished rapidly during the first few hours, and fell to a minimum corresponding to about 30 per cent. of the original value and then slowly increased again. On substituting the emanation tube in the calorimeter, the heating effect at first increased for a few hours to a maximum corresponding to about 70 per cent. of the original heat emission of the radium and then slowly decayed with the time.

At any time after removal of the emanation, the sum of the heating effect of the de-emanated radium and of the emanation was found to be the same as that of the original radium. Experiments are still in progress to determine the rate of recovery and loss of heating power of the de-emanated radium and the separated emanation respectively, but so far as the observations have gone, the curves of decay and recovery are the same as those for the corresponding α radiation.

It has been shown (Rutherford and Soddy, *Phil. Mag.*, May) that, if the emanation is removed from radium, the activity of the radium decays in the course of a few hours to about 25 per cent. of its original value. This residual activity consists *entirely* of α rays. The solid radium compound regains its original activity after the lapse of about one month. Immediately after the separation of the emanation the activity (tested in a sealed vessel) rises to about twice its original value, due to the production of excited activity on the walls of the vessel, and then slowly decays with the time, falling to half value in about four days. At any time after removal of the emanation the sum total of the activity of the radium and the emanation has a value equal to that of the original radium.

There is thus an exact parallel between the variation in radiating power (measured by the α rays) and the heating effect. In order to be sure how much of the emanation was removed by heating, control experiments were made on the γ rays from the radium and the separated emanation. This was tested by observing the rate of discharge of an electro-scope after the rays had passed through 5 cm. of lead. In some preliminary experiments by one of us last year it was found that the γ rays from radium appeared at the same time as β rays, and were always proportional to them. From these results it was deduced that all but 6 per cent. of the emanation was removed by the heating.

It is thus seen that the heating effect of radium *directly accompanies* the α radiation from it, and is always proportional to it, and that more than two-thirds of the heating effect is not due to the radium at all, but to the radio-active emanation which it produces from itself. This result accounts for the variation of heat emission with age observed by the Curies, an account of which was given by Prof. Dewar at the British Association.

The amount of emanation from 30 milligrammes of radium bromide, when collected in the tube, was sufficient to cause a bright phosphorescence in the tube, but it was too small either to measure or weigh. The amount of heat emitted from the radium emanation is thus enormous compared with the amount of matter involved. It seems probable that the greater part of the heating effect of radium is a direct consequence of the expulsion of α rays. It still

remains to be shown in what proportion the radiated energy is distributed between the projected α particles and the systems from which they are expelled.

The results given here are at once explained on the disintegration hypothesis (Rutherford and Soddy, *Phil. Mag.*, May), in which the heat is considered to be derived from the internal energy of the atom. On the view held by some that radium gains its heat from an external source, it would be necessary to suppose that less than a third of the heat is due to the radium itself, and that the other two-thirds are due to the radium emanation which is being continuously produced, and the power of which of absorbing energy from an external source decays with the time.

E. RUTHERFORD.

H. T. BARNES.

McGill University, Montreal, October 16.

Papers and Procedure at the British Association.

At the recent meeting of the British Association at Southport I heard numerous complaints (repetitions of those I have heard at not a few previous meetings) by the general public, members of the Association, on the too technical character of the papers read before it. These complaints referred to all the sections except, perhaps, those of anthropology, geography, and educational science. One overheard too often to be pleasant such remarks as "I am interested in zoology, but what is the good of coming to listen to such a paper as this? I have no idea what the speaker is talking about"—the paper, in one specific instance, was cytological, and of great value undoubtedly; and, "I have not gained much by becoming a member of the Association; the papers are all over my head." These complaints are being made by well educated men and women interested in science, but not versed in its technicalities.

Believing that this feeling in reference to the subjects brought before the various sections is growing, and is, moreover, not ill-founded, I venture, as a member of twenty years' standing, to direct serious attention through your columns to its existence, and to advocate some change in the character of the papers accepted for reading before the Association, so that the objects for which this great society was founded may be more fully attained as regards the general public of the town visited, on the support of which the Association is so largely dependent.

Purely technical papers which appeal only to the specialist in chemistry, biology, engineering, or physics, are out of place before an audience the majority of whom are not specialists, but who have become members for the occasion in the hope of listening to an understandable exposition of the subject by the men who have contributed to making that section of science. Such purely technical papers should be reserved for the societies which exist for the cultivation of that particular subject. The British Association should either become a purely scientific society or become more what it was established for, an association for the advancement of science among the people, at which the results of the investigations of the year are, as it were, summed up and presented to the members, both specialists and those of the general public interested in science, in language which the whole audience can understand. An author, instead of going into the details of the various intricate investigations and experiments he has made—which can often enough be followed fully only by his fellow-workers in that particular section of his subject—should far more than heretofore deal broadly with the results obtained, indicating their value to the particular subject, and their bearing on his own or other departments of knowledge. The general public have really some cause for complaint that their subscription has been obtained from them on a misunderstanding. If the Association is to become more and more a purely scientific society, then the fact should be made more widely known, so that disappointment may not be needlessly caused to those who join it. In that case, moreover, there would be no need of the publicity with which the Association meets at the various towns it visits. It might quietly assemble at the chosen town in rooms hired or lent for the purpose, and associate itself only with the specialists of the place.

Liverpool, October 20.

HENRY O. FORBES.