

that of the Royal Botanic Gardens, Kew, lie within the London County boundary. The information about each of the very large number of London libraries is just what a student wants to assist him in his search for books on a particular subject. Few persons, unless they have made special inquiries, can have any idea of the immense number of books available in London for reference by the seeker after knowledge or recreation. Students owe a debt of gratitude to the Senate of the University of London for giving instructions for the preparation of this guide, and to Mr. Rye for his complete understanding of their needs.

LETTERS TO THE EDITOR.

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The Spectrum of Radium Emanation.

IN NATURE of July 9 a letter from Prof. Rutherford appears giving an excellent corroboration of measurements of the spectrum of radium emanation which we communicated to the Royal Society on July 1. There can, therefore, be no doubt of the accuracy of Prof. Rutherford's measurements. When Mr. Watson, who is engaged in measuring accurately with a 10-foot grating the secondary spectrum of hydrogen, has finished his task, we shall be able to introduce some small corrections in our figures.

WILLIAM RAMSAY.

A. T. CAMERON.

University College, Gower Street, London, W.C., July 9.

The Kinetic Energy of the Ions emitted by Hot Bodies.

IN a paper communicated to the American Physical Society at the New York meeting on February 29, the writer, in collaboration with Dr. F. C. Brown, showed that the part of the translational kinetic energy of the negative ions emitted by hot platinum, which depends on their component of velocity normal to the emitting surface, has the same mean value as the corresponding quantity for a molecule of gas at the temperature of the metal, and, further, that that component of the velocity is distributed among the different ions according to Maxwell's law of distribution of velocity among the molecules of a gas. Since then Dr. Brown has succeeded in showing that the same laws hold for the positive ions emitted by hot platinum.

Using a different method, the writer has succeeded in measuring the portion of the kinetic energy of the ions which depends on their component of velocity parallel to the emitting surface. Within the limits of experimental error, this quantity has the same mean value, for both positive and negative ions, as the corresponding quantity for a molecule of gas at the temperature of the metal, and is distributed among the different ions according to Maxwell's law.

Taken together, these investigations show that the ions emitted by hot platinum, under normal conditions, are identical, as regards their kinetic properties, with the molecules of a gas of the same molecular weight, at the temperature of the metal. It follows, by an application of the kinetic theory of gases, that the same thing holds for the free electrons inside the metal. This result has an important bearing on the electron theory of metallic conduction and of the emission of electromagnetic radiation by hot bodies.

This is the first direct experimental confirmation of Maxwell's laws relating to the distribution of velocity among a collection of moving particles in a state of statistical equilibrium.

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The full account of these researches will shortly appear in the *Philosophical Magazine*. O. W. RICHARDSON.
Princeton, N.J., July 3.

Absorption of X-Rays.

SOME of the most interesting observations made in the investigation of the properties of homogeneous beams of Röntgen radiation are those exhibiting the connection between the absorption of X-rays and the emission of secondary X-rays from the absorbing substance. Many elements—probably all—when subject to a suitable primary beam, are the source of a homogeneous Röntgen radiation which is characteristic of the element emitting it. The following conclusions concerning the emission of this radiation have been found to be perfectly general, so far as experiments have been made.

When a very absorbable primary radiation is incident on a given element, the homogeneous radiation characteristic of that element is not emitted in appreciable intensity.

As the general penetrating power of the primary radiation is gradually increased, the absorption decreases only up to a certain point. When the penetrating power becomes greater than that of the radiation characteristic of the absorbing element, the absorption of that primary radiation begins to increase, and a secondary homogeneous radiation begins to be emitted. Then there is a rapid and considerable increase in both the absorption of the primary rays and in the emission of secondary rays. When the general penetrating power is increased still further, the absorption decreases again in the usual way, and the intensity of secondary radiation decreases at the same rate—in some cases at least—as the ionisation produced by the primary beam in air.

The special absorption of the primary rays thus connected with the emission of secondary rays is a considerable fraction of the total absorption—thus in iron the increase is about double the absorption previous to the emission of the rays.

Experiments have not been made to determine if all the extra energy absorbed appears as energy of secondary radiation, but from observations of the absorbability of the secondary radiation and of the ionisation it produces, it appears probable that a large proportion is re-emitted.

The energy re-emitted in the form of a radiation of more absorbable type is in some cases sufficient to make the total ionisation produced in an electroscope placed immediately behind a thin absorbing sheet of metal greater than that produced by the direct unabsorbed primary beam.

The emergent radiation is then a mixture of two homogeneous radiations, the proportions of which depend principally on the coefficients of absorption of the incident radiation, and of the radiation characteristic of the metal in the metal itself, the coefficient of transformation of one into the other type of radiation, and the thickness of the absorbing plate. A copper radiation may, by transmission through an iron plate, be transformed so completely as to be almost indistinguishable from pure iron radiation, but it does not then proceed in the direction of propagation of the incident radiation; it is emitted from the atoms in approximately equal intensity in all directions.

What has previously been described as the special power of a homogeneous radiation of penetrating the element emitting it and elements of neighbouring atomic weight (*Phil. Mag.*, September, 1907, p. 408) may be more precisely stated thus:—A radiation which is more absorbable, equally absorbable, or only slightly more penetrating to most substances than the radiation characteristic of the element upon which it is incident, is absorbed much less than one of more penetrating type. It also produces little or none of the characteristic secondary radiation which is produced by the more penetrating radiation.

The special power of an ordinary heterogeneous primary radiation after transmission through an absorbing substance of penetrating further layers of that substance is due to two causes—(1) the special absorption of those radiations capable of stimulating a homogeneous secondary radiation, (2) the superposition on the primary radiation of that secondary radiation.

A full account of these experiments and a discussion of the results will be published shortly. C. G. BARKLA.

Liverpool, July 8.

C. A. SADLER.