in the forthcoming Proceedings of the American Academy of Arts and Sciences for 1902-3. More condensed accounts will appear elsewhere. A demonstration of the effect of radiation pressure upon the torsion balance used in the experiments was made before the society.

A vacuum tube in the form of an hourglass containing calcined puffball spores mixed with emery sand, was exhibited to illustrate the application of light pressure to the repulsion of comets' tails by the sun. In the preparation of the tube the exhaustion by a good Geissler mercury pump was continued for two days and after sealing off the tube from the pump, mercury in a connected flask was frozen for an hour in solid carbon dioxide and ether. Finally the mercury flask was sealed off from the hour-glass. It was thought that the traces of mercury vapor in the system might thus be frozen out and a very high vacuum obtained. The hour-glass was heated to the point of softening during the entire pumping and freezing process. When the glass was placed in an upright position, and the concentrated beam from an arc light directed horizontally on the falling stream of particles just below the neck of the glass, the small spores were driven off to one side in the direction of the beam while the sand was not deflected from its vertical path.

A hasty computation of the magnitude of the deflecting angle of the spores, due to radiation pressure, was made from the energy of the beam, roughly known, and the size of the spores. The observed deflection was approximately equal to that predicted by computation and the writers believed, for a time, that the forces due to the action of the residual gas constituted only a fraction of the total deflecting force. A later review of the computation disclosed an error in the numerical work which had made the predicted deflection due to radiation pressure much too large. The conclusion, therefore, was that the action of the residual gas in the tube considerably outweighed the pressure due to radiation. The writers purpose to make further experiments in which it is hoped the gas effects may be greatly reduced and the radiation pressure remain alone evident.

THE MAGNETIC AND ELECTRIC DEVIATION OF THE EASILY
ABSORBED RAYS FROM RADIIUM.1

BY E. RUTHERFORD.

The greater portion of the energy radiated by the natural radioactive substance is in the form of α or easily absorbed rays. Two other types of rays are also emitted, viz.: the β rays, readily deviable by a magnetic field and similar to high velocity cathode rays, and the γ rays non-deviable by a magnetic field, and very penetrating in character.

Abstract of a paper presented at the meeting of the Physical Society held on December 31, 1902.
By employing strong magnetic fields and arrangements to detect a minute curvature of the path of the rays, it was found possible to show that the \( \alpha \) rays are, like the \( \beta \) rays, completely deviable by a magnetic field. The deviation is in the opposite sense to the cathode rays so that the rays consist of positively charged particles projected with great velocity.

The general method employed was to pass the rays from the active substance (radium chloride activity 19,000) through a number of narrow slits placed in parallel and to observe the effect of a magnetic or electric field on the ionization produced by the issuing rays by means of a special gold leaf electroscope.

A current of hydrogen gas passed through the electrometer and through the slits in order to prevent the diffusion of any emanation into the testing vessel.

The rays were also found to be partly deviated by passing through a strong electric field.

By combining the results of the magnetic and electric deviation in the usual way it was found that

\[
V = 2.5 \times 10^8 \text{ cm. per sec.}
\]

\[
\frac{e}{m} = 6.1 \times 10^5
\]

where \( V \) is the velocity of projected particles, \( e \) the charge on the particle and \( m \) its mass. These results are only approximate and merely indicate the order of the results obtained.

The rays thus consist of positively charged bodies projected with a velocity about one tenth that of light and of mass of the same order as the hydrogen atom and large compared with the electron. The \( \alpha \) rays are thus very analogous to the "Canal Strahlen," which Wien has shown to consist of projected particles, atomic in size, carrying with them a positive charge.

The projective nature of the \( \alpha \) rays offers a satisfactory explanation of the characteristic properties of these rays. Since all the active bodies and also excited bodies give rise to \( \alpha \) rays, it seems probable that they consist in all cases of heavy positive particles projected with great velocity.

The projection of \( \alpha \) rays is probably the underlying cause of the series of chemical changes occurring in radioactive bodies, for each change is accompanied by the projection of positively charged bodies.

This continuous and spontaneous emission of heavy bodies from the natural radioactive substances must cause a gradual diminution in their weight.
A Penetrating Radiation from the Earth's Surface.

By E. Rutherford and H. L. Cooke.

It has been shown by Rutherford (Phys. Zeit., 1902) that the radiations from the naturally radioactive bodies and also the excited radiations include some rays of an extremely penetrating character, which are able to pass through great thicknesses of matter. Since the excited activity obtained from the atmosphere is very similar in character to the excited radiations from thorium and radium, it was thought possible that some penetrating rays might be given off from the surface of the earth and walls and rooms on which excited activity from the air is distributed.

In order to test this point, the amount of ionization was observed in testing vessels of about 1 liter capacity. The method used by C. T. R. Wilson in his experiments on the "spontaneous" ionization of air was employed. The rate of discharge of a well insulated gold-leaf system served as a measure of the ionization. The effect of placing metal screens outside the testing vessel was observed. Screens of thickness of 2 mm. of lead had very little effect on the rate of discharge. A thickness of 5 cm. of lead, however, was found to cut down the rate of discharge by 30%. A greater increase of thickness had no effect, although 5 tons of pig lead was placed around the apparatus. A thickness of 5 cm. of iron and 70 cm. of water also cut down the rate of discharge about 30%.

On removing the screens the discharge returned to the original value. These results show that about 30% of the ionization inside a closed vessel is due to an external radiation of great penetrating power. This radiation appears to come equally from all directions and is probably due to excited activity on the surface of the room in which the observations were made.

These effects could not be due to the presence of thorium or radium in the laboratory, for similar results were observed in the library which was free from all possible contamination by radioactive substances.

A decrease was also observed with metal screens when the testing vessel was placed down on the frozen earth at some distance from the laboratory. Under the conditions of the experiment, the effect was not quite so marked as inside the laboratory.

In brass vessels which had been thoroughly cleaned the rate of discharge corresponded to a rate of production of 10 ions per c.c. per second. This number was reduced to about 6 by the addition of a thick metal screen. This value is much lower than the value found by C. T. R. Wilson in a glass vessel silvered on the inside.

1 Abstract of a paper presented at the meeting of the Physical Society held on December 31, 1902.