RECENT EXPERIMENTS WITH THE RADIATIONS OF POLONIUM AND RADIUM.

The discovery of M. Becquerel, that the radiation given off by certain bodies called radio-active could be deflected by the action of a magnetic field, has brought out a number of new observations in connection with these phenomena. The radiations given off by substances containing the newly discovered elements, radium and polonium, although having the same effect upon a photographic plate or fluorescent screen, are shown to be of a different character.

Thus M. Becquerel, in his previous experiments, found that while the radiations of radium could be deflected by a magnetic field, those of polonium are not so deflected. M. and Mme. Curie, to whom is due the discovery of these two new elements, have brought before the Académie des Sciences a series of experiments which show the difference between the forms of radiation given off by the two elements. In the first series of experiments made by M. Curie with the element radium, advantage was taken of the fact that, when made to pass between the two plates of a condenser, these rays cause a certain current to pass from one to the other, and by measuring this current the intensity of the radiation may be estimated. The experiment was made in the following manner.

At *A*, Fig. 1, is placed the body containing radium, whose radiations pass between the condenser plates, *PP'*; it is surrounded on three sides by the masses of lead, *BB*. A magnetic field, represented by the area, *EE*, may be caused to pass in a direction perpendicular to the plane of the diagram. The condenser plate, *P*, is charged to 500 volts, and the plate, *P'*, is connected to an electrometer and to a sensitive current-measuring instrument. The region traversed by the rays is surrounded by the masses of lead and by the extremities of the pole pieces. When the distance to the condenser, *AD*, is over 7 centimeters, it is found that upon exciting the magnet none of the rays strike the condenser, these being deflected and absorbed by the masses of lead. If *AD* is less than 6½ centimeters, it is found that only a part of the rays are deflected by the field. The proportion of non-deflected rays is found to be greater as *AD* is smaller, and for very small distances the proportion is only a small fraction of the total. The table shows the quantitative results obtained. The upper line gives the distances, *AD*, and the lower, the percentage of non-deflected rays, supposing 100 to be the current which passes in the condenser when the field is not excited.

Distance, *AD*, centimeters.	7·1	6·9	6·5	6·0	5·1	3·4
Percentage of non-deflected rays	0	0	11	32	56	74

It thus appears that the radium gives off two kinds of radiation, one of which may be deflected by the field, while the other is unaffected. It is found that the rays present other differences in character; thus, the deflected rays possess a greater penetrating power than the others. When a screen of aluminium or black paper is placed before *A*, the deviable rays only are allowed to pass, and thus by exciting the field the whole of the radiation may be suppressed. A sheet of aluminium of $\frac{1}{100}$ millimeter is sufficient to cut off all the non-deviable rays from the condenser when it is at a sufficient distance; when it is brought within 5 centimeters, two sheets are necessary. A number of experiments were made with different substances containing radium, with analogous results. A remarkable phenomenon is observed in all these cases, namely, that the non-deviable rays do not pass in air beyond a certain distance from the source, this being about 67 millimeters. It was also observed that the proportion of the deviable and penetrating rays was only a small percentage of the whole.

The compounds of polonium experimented upon give only the non-deviable rays, as M. Becquerel has already found. When the distance, *AD*, is varied, no action upon the condenser is observed until it is brought to within a certain distance (40 millimeters for the sample in question); the radiation then suddenly reveals its presence by a marked action upon the condenser, and this increases regularly as it is approached, the magnetic field having no effect. It seems that the rays of polonium are thus limited in space and surround the active matter in a kind of layer. In this respect there is a marked resemblance to the non-deflected rays of radium, both possessing little penetrating power and being limited in their action by the distance.

A series of experiments has been carried out by Mme. Curie to show the differences in the two forms of radiation given off by radium. The non-deviable rays have much less penetrating power than the others, and a study of their comparative penetration shows that their nature is entirely different, thus confirming the results obtained with the magnetic field. In the previous experiments made with the rays of radium, their action was found to resemble that of the X-rays. They have greater penetrating power according as they have traversed a greater thickness of matter, and this has been attributed to the presence of rays whose penetrating power was unequal. It is found that while for the deviable rays the co-efficient of absorption decreases or is perhaps constant as the thickness of matter is increased, on the contrary the non-deviable rays are more easily absorbed according to this thickness. This singular law of absorption is contrary to those which are known for all other forms of radiation; it gives the idea of a projectile which loses a part of its vis viva in traversing an obstacle. The experiments were carried out as follows: *PP* are a pair of condenser plates arranged and connected as before. They are surrounded by the metallic box, *B B*, connected to earth. The active matter, *A*, is placed in a metallic box, *C*, back of the plate; the rays may then act upon the condenser through the metallic screen, *T*, the distance, *A T*, being variable. By putting different screens upon the polonium compound at *A*, the absorption is noted. The results obtained are as follows: For certain values of *A T*, above 4 centimeters, no current passes; thus, the rays do not penetrate into the condenser. As this distance is diminished, the appearance of the rays in the condenser is somewhat sudden, so that for a small variation in distance one passes from a small to a large current. This action then increases regularly as *A* approaches *T*. When *A* is covered by a sheet of aluminium $\frac{1}{100}$ millimeter thick, a greater absorption is produced as *A T* is greater. If a second sheet is placed upon the first, each absorbs a certain fraction of the rays, and this absorption is greater for the second sheet than for the first.*

Distance *A T*	3·5	2·5	1·9	1·45	0·5 centimeter.
Percentage of rays transmitted by one sheet	0	0	5	10	25 per cent.
Percentage of rays transmitted by two sheets	0	0	0	0	0·7 per cent.

It is seen that the radiation is diminished in greater proportion in the farther than in the nearer regions.

The experiment was then made with the non-deviable rays of radium, the others being suppressed by a magnetic field. The rays which travel farthest in air are the most absorbed by the aluminium, as will be seen in the table.

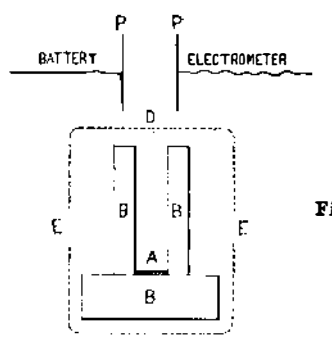

Fig. 1.

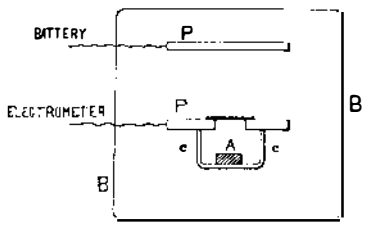

Fig. 2.

Distance *A T*	6·0	5·1	3·4 centimeter.
Percentage of rays transmitted by the screen	3	7	24 per cent.

There is thus a striking analogy between these corresponding radiations of radium and polonium. In view of the special properties of the non-deviable rays the question arises as to whether they are rays of rectilinear propagation. M. Becquerel has made an experiment which shows the affirmative. The compound of polonium is placed in a narrow linear cavity made in a piece of cardboard, thus giving a linear source of radiation. In front of this was placed a copper wire, 1½ millimeters in diameter, at 5 millimeters distance, and a photographic plate at 9 millimeters from the wire. After ten minutes' exposure the geometrical shadow of the wire was produced, of the expected dimensions, with a very narrow penumbra corresponding to the width of the source. The same effect was observed when a double sheet of aluminium was placed before the wire, which allowed the rays to traverse it. It is thus shown that the new form of radiation is propagated in straight lines, and is not diffused in passing through the screen.

* A series of quantitative measurements are shown in the table. The distance, *P P*, equals 3 centimeters.

An Ancient Stone City Discovered in New Mexico.

In excavating a number of large stone ruins in New Mexico, between Bland and Espanola, some remarkable discoveries were recently made by Messrs. George S. Cote, F. C. Cote, R. W. Bullock and G. S. Madden. The building discovered measured 560 by 400 feet. It was two or three stories high originally, but the walls are only from 6 to 10 feet high at the present time. It is probable that the upper story was opened to the sky, and upon this the dwellers spent both night and day. A remarkable find was made in a room which measured 9 by 12 feet. An old furnace for smelting iron was found, near which was a large iron bar deeply incrusted with rust; also pieces of copper ore, gold ornaments, and a piece of turquoise. Twenty-five beautiful pieces of pottery were also found in the room. They were decorated. One of the designs represented the picture of a building with a smokestack and smoke curling out of it. Around the fireplace in the room which was excavated stood a dozen large pots, each with bones in it, showing that when the inhabitants abandoned the room they were preparing a meal. Baskets, iron knives, stone battle axes, musical instruments and other objects were also found. There are also estimated to be from 1,200 to 1,500 rooms in the building, only one of which has been excavated. There are said to be hundreds of similar ruins in the twenty-five miles from Bland to Espanola. This would seem to indicate that at some time more people lived in New Mexico than reside there to-day. Rev. Mr. Madden's theory, says The New York Times, is that about five or six hundred years ago the dwellers in that region were driven out either by an earthquake or by an invasion of a stronger race. The relics were sent to the Northwestern University at Evanston, Ill.

Photographic Paper.

M. Van Loo, a Belgian photographer, gives a method of preparing a photographic paper somewhat resembling platinotype, but much less expensive. The paper is coated with the following solution:

Water	1,000 parts.
Ferric oxalate	15 "
Oxalic acid	3 "
Nitrate silver	3 "

The above proportions should be adhered to as nearly as possible to secure good results. The printing is carried out in the same manner as with platinum paper; that is, until the image is well distinguished. After printing, the paper is placed in a developing bath made up as follows:

Water	1,000 parts.
Borax	60 "
Tartrate soda	60 "

Dissolve, and add several drops of a 5 per cent solution of potassium bichromate; a greater proportion of bichromate gives an image hard and full of contrast; by using less, the image becomes gray and feeble. A certain latitude is thus given, which is of advantage for negatives of different intensities. After the development, which lasts five or six minutes, the prints are washed for a few moments in running water and the toning is carried out with the following bath:

Water	1,000 parts.
Potassium chloroplatinite	1 "
Common salt	10 "
Citric acid	10 "

The prints are left in the bath until the desired intensity is obtained, and are then fixed in a 2 per cent solution of ammonia; the fixing lasts about 10 minutes. They are then washed thoroughly, as usual.

The Building Edition for August.

The Scientific American Building Edition for August is a beautiful issue of this notable periodical. It has the usual colored cover and the first page is occupied by a view of the Pavilion of Belgium at the Paris Exposition. "Belcourt," the residence of O. H. P. Belmont, at Newport, is the subject of three pages of engravings. "Some Picturesque Bits of Unknown Italy" illustrates three attractive features of that country. There are a number of cottages and residences of various prices scattered through the number. "Prismatic Lighting for the Illumination of Dark Interiors" is by Dr. William H. Green, and is accompanied by several illustrations.

The Current Supplement.

The current Supplement No. 1284 has many articles of unusual interest, the chief of which is "Sanitary Equipment and Power Plant for Modern Lodging Houses." This is a specially prepared article for the Scientific American Supplement, and gives an elaborate description of all the interesting engineering and sanitary features of Mills Hotels Nos. 1 and No. 2, the best planned and equipped workmen's hotels in the world. "Iron and Steel Rails in America" is by Robert H. Hunt. "Egyptian Temples" is by Alexander Payne. "Legislation for the Protection of Birds Other than Game Birds" is a profusely illustrated article. "The Development of Agricultural Libraries" is also of much interest.

Contents.

(Illustrated articles are marked with an asterisk.)