



Notes of observations on the Röntgen rays

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structed my apparatus with the Röntgen tube projecting to one side, as shown in the side view, fig. 2. This makes a support for the pump so that it will stand alone. A pump of this description in connexion with an ordinary "Dark-space" tube makes a very convenient piece of lecture-room apparatus for showing the character of the discharge at different pressures. By tipping the pump far enough the upper trap can be emptied, and the air stored in B returned to the discharge-tube again, showing the phenomena at higher pressure.

Owing to the absence of rubber connexions and stopcocks, the mercury remains always clean and there is no leakage.

I am now constructing a pump on this principle on a large scale for general laboratory use in which the rocking motion is to be effected by water-pressure, which, if found serviceable, will be described in a subsequent paper. The chief objection, of course, is that the entire pump is in motion, which makes its connexion with a stationary receiver somewhat difficult. This can perhaps be done by bringing the exhaust-tube into coincidence with the axis of rotation, and using a rubber tube surrounded with mercury as a joint.

The small pump can be ordered with or without the Röntgen tube from Herr Glasbläser R. Burger, Chaussee-str. 2 E, Berlin, Germany.

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XL. Intelligence and Miscellaneous Articles.

NOTES OF OBSERVATIONS ON THE RÖNTGEN RAYS.

BY HENRY A. ROWLAND, N. R. CARMICHAEL, AND L. J. BRIGGS.

THE discovery of Hertz some years since that the cathode rays penetrated some opaque bodies like aluminium, has opened up a wonderful field of research, which has now culminated in the discovery by Röntgen of still other rays having even more remarkable properties. We have confirmed, in many respects, the researches of the latter on these rays and have repeated his experiments in photographing through wood, aluminium, cardboard, hard rubber, and even the larger part of a millimetre of sheet copper.

Some of these photographs have been indistinct, indicating a source of these rays of considerable extent, while others have been so sharp and clear cut that the shadow of a coin at the distance of 2^{cm} from the photographic plate has no penumbra whatever, but appears perfectly sharp even with a low-power microscope.

So far as yet observed the rays proceed in straight lines, and all efforts to deflect them by a strong magnet either within or without the tube have failed. Likewise prisms of wood and vulcanite have

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no action whatever so far as seen and, contrary to Röntgen, no trace of reflection from a steel mirror at a large angle of incidence could be observed. In this latter experiment the mirror was on the side of the photographic plate next to the source of the rays, and not behind it as in Röntgen's method.

We have, in the short time we have been at work, principally devoted ourselves to finding the source of the rays. For this purpose one of our tubes, made for showing that electricity will not pass through a vacuum, was found to give remarkable results. This tube had the aluminium poles within 1^{mm} of each other, and had such a perfect vacuum that sparks generally preferred 10^{cm} in air to passage through the tube. By using potential enough, however, the discharge from an ordinary Ruhmkorff coil could be forced through. The resistance being so high, the discharge was not oscillatory as in ordinary tubes but only went in one direction.

In this tube we demonstrated conclusively that the main source of the rays was a minute point on the *anode* nearest to the cathode. At times a minute point of light appeared at this point but not always.

Added to this source the whole of the *anode* gave out a few rays. From the cathode no rays whatever came, neither were there any from the glass of the tube where the cathode rays struck it as Röntgen thought. This tube as a source of rays far exceeded all our other collection of Crookes' tubes, and gave the plate a full exposure at 5 or 10^{cm} in about 5 or 10 minutes with a slow-acting coil giving only about 4 sparks per second.

The next most satisfactory tube had aluminium poles with ends about 3^{cm} apart. It was not straight but had three bulbs, the poles being in the end bulbs and the passage between them being rather wide. In this case, the discharge was slightly oscillatory but more electricity went one way than the other. Here the source of rays was two points in the tube, a little on the cathode side of the narrow parts.

In the other tubes there seemed to be diffuse sources, probably due in part to the oscillatory discharge, but in no case did the cathode rays seem to have anything to do with the Röntgen rays. Judging from the first two most definite tubes, the source of the rays seems to be more connected with the anode than the cathode, and in both of the tubes the rays came from where the discharge from the anode expanded itself towards the cathode, if we may roughly use such language.

As to what these rays are it is too early to even guess. That they and the cathode rays are destined to give us a far deeper insight into nature nobody can doubt.—*American Journal of Science*, March, 1896.

NOTE ON "FOCUS TUBES" FOR PRODUCING *x*-RAYS.

BY R. W. WOOD.

The tubes for producing the *x*-rays which are furnished with a concave kathode for focussing the kathode rays on the glass, in order