Note on “focus tubes” for producing x-rays

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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

to diminish the size of the source and increase its intensity, have the fault that, owing to the great heat developed, the glass is very apt to crack. I have had some success with a tube which I made in which the kathode hangs as a pendulum from the centre of a spherical bulb, by the slow rotation of which one brings a fresh and cold surface into the focus continually, thereby avoiding over-

heating. The concave kathode hangs by an aluminium wire from a short cylinder of aluminium fastened into a glass tube, through which a platinum wire passes which lies in the axis of rotation. The anode is also in the axis of rotation, so that the connexions with the coil can be easily made. My tube has the fault that many kathode rays emanate from the upper surface of the concave plate and are lost. This might be overcome by covering the kathode with a cap of glass. As a suggestion for further experimenting, this note may be of interest to persons working with the new rays.

Berlin, March 8, 1896.

NOTE ON ELEMENTARY TEACHING CONCERNING
FOCAL LENGTHS.

To the Editors of the Philosophical Magazine.

GENTLEMEN,

With respect to Prof. Lodge's question on page 152 as to the simplest convention of signs in dealing with focal lengths for junior students, it appears to me to be a matter which can be best settled by one who has had experience in teaching two or more methods. Hence, as this is a qualification to which I can lay no claim, I forbear to dogmatize.

It would seem to me, however, undesirable, apart from weighty reason, to teach an elementary student to let the algebraical sign of a given line depend, *not* upon its *direction*, but upon the *physical*