

V. ELECTRIFICATION OF AIR BY RÖNTGEN RAYS ¹⁾.(Science, Vol. V. N^o. 108, 1897; pp. 139-141).

To test whether or not the Röntgen rays have any electrifying effect on air, the following arrangement was made.

A lead cylinder 76 cm. long, 23 cm. diameter, was constructed; and both ends were closed with paraffined cardboard, transparent to the Röntgen rays. Outside the end distant from the electrometer (see diagram) a Röntgen lamp ²⁾ was placed. In the other end two holes were made, one in the middle, through which passed a glass tube (referred to below as suction pipe) of sufficient length to allow the end in the lead cylinder to be put into any desired place in the cylinder. By means of this, air was drawn through an electric filter ³⁾ by an air pump. The other hole, at a little distance from the center, contained a second glass tube by which air was drawn through india rubber tubing from the open-air quadrangle outside the laboratory.

In one series of experiments the end of the suction pipe was kept in the axial line of the lead cylinder at various points 10 cm. apart, beginning with a point close to the end distant from the Röntgen lamp.

In every case the air drawn through the filter was found to be negatively electrified when no screen or an aluminium screen was interposed between the Röntgen lamp and the near end of the lead cylinder. The air was found not electrified at all, or very slightly negative, when a lead screen was interposed.

¹⁾ [En collaboration avec Lord Kelvin et J. C. Beattie; Ed.].

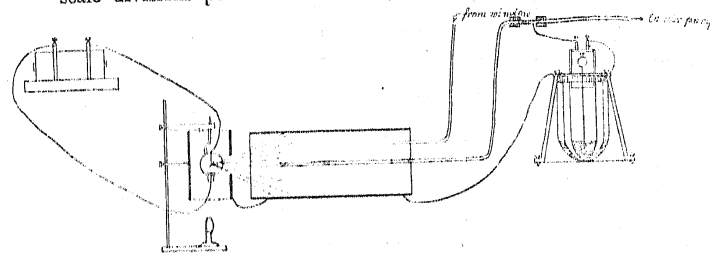
²⁾ The Röntgen lamp was a vacuum vessel with an oblique platinum plate (Jackson pattern).

³⁾ Kelvin, Maclean, Galt, Proc. R. S., London, March 14, 1895.

When the Röntgen lamp was removed or stopped, and air was still pumped through the filter, no deflection was observed on the electrometer. This proved that the air of the quadrangle was not electrified sufficiently to show any deflection when thus tested by filter and electrometer.

Similar results were obtained with the end of the suction pipe placed so as to touch the floor of the lead cylinder, or the roof, or the sides. Whether the air was pumped away from a place in the cylinder permeated, or from a place not permeated by the Röntgen rays, it was in all cases found to be negatively electrified.

The following are some of the results obtained on December 16th and 17th. The electrometer was so arranged as to give 140 scale divisions per volt.



Conditions. — Large lead cylinder metallically connected with sheath of electrometer. Röntgen lamp surrounded by a lead sheath, which latter was also connected to electrometer sheath. There was a window in this lamp sheath 2.5 cm. broad and 5 cm. high. This window could be screened by aluminium or by lead. These screens were always connected metallically to sheaths. During all the experiments a Bunsen lamp was kept constantly burning, with its flame about 30 cm. below the Röntgen lamp.

Results. — Röntgen lamp in action; air drawn from lowest point of end of lead cylinder next to the R. lamp.

December 16, 3.55 p. m.

—61	scale divisions in 2 mins.	with aluminium screen.
—63	" " " 2 " "	no screen.
—14	" " " 2 " "	lead screen.

4.20 p. m. Air drawn from point on lower line of lead cylinder 26 cm. distant from R. L. end.

—14	scale divisions in 2 mins. with lead screen.
—78	" " " 2 " " no screen.
—24	" " " 2 " " lead screen.
—83	" " " 2 " " alum. screen.
—13	" " " 2 " " lead screen.

December 17.

R. L. acting, and air drawn through filter.

10.47 a. m.		End of suction pipe kept in axial line of cylinder.
		cms.
—44 in 2 mins. with alum. screen,	68	from R. L. end.
0 " " lead " "	68	" "
—28 " " no " "	58	" "
—24 " " no " "	48	" "
0 " " lead " "	48	" "
—23 " " alum. " "	48	" "
—26 " " alum. " "	38	" "
—9 " " lead " "	38	" "
—7 " " lead " "	28	" "
—26 " " alum. " "	28	" "
—36 " " alum. " "	18	" "
—21 " " alum. " "	8	" "

We had previously made experiments with a sheet-iron funnel 1 metre long, 14.5 cm. diameter; and with a glass tube 150 cms. long, 3.5 cm. diameter; and with an aluminium tube 60 cms. long, 4.5 cm. diameter. Air was pumped from different parts while the Röntgen rays were shining along the tubes from one end, which was closed by paraffined paper stretched across it. In every case the air was found to be negatively electrified.

In those earlier experiments the air drawn away was replaced by air coming in from the laboratory at the open end of the tube. We found evidence of disturbance due to electrification of air of the laboratory by brush discharges from electrodes between the induction coil and Röntgen lamp, and perhaps from circuit-break spark of induction coil. These sources of disturbance are eliminated by our later arrangement of lead cylinder covered with card-

board at both ends, as described above, and air drawn into it from open air outside the laboratory.

We have also found a very decided electrification of air — sometimes negative, sometimes positive — when the Röntgen rays are directed across a glass tube or an aluminium tube, through which air was drawn from the quadrangle outside the laboratory, to the filter.

A primary object of our experiments was to test whether air electrified positively or negatively lost its charge by the passage of Röntgen rays through it. We soon obtained an affirmative answer to this question, both for negative and positive electricity. We found that positively electrified air lost its positive electricity, and in some cases acquired negative electricity under the influence of Röntgen rays; and we were thus led to investigate the effect of Röntgen rays on air unelectrified to begin with.

Note on diagram. — For the sake of simplicity, the screening of the electrometer is not shown in the diagram. In carrying out the above experiments, however, we have found it absolutely necessary not only to surround the electrometer with wire gauze in the usual manner, but we have had also to place a sheet of lead below it, and to screen also the side next the Röntgen lamp by a lead screen. In some cases it was even necessary to cover up the whole with paper to prevent the electrified air of the room from disturbing the instrument.

Physical Laboratory, University of Glasgow.
December 19, 1896.