or if it is changing to furnish a means of correcting for the change and reducing all the readings to the same basis.

The electrometer should be set up ready for use in the manner described in Chapter II in a convenient permanent position near by the lead box containing the Röntgen ray bulb, so that it may be connected to any apparatus set up in front of this box.

54. Production of Current Through the Air by Röntgen Rays.—Cut two plates of aluminium about 15 cm. square and set them up on edge on clean paraffin blocks so that they stand vertical. Place these plates parallel to each other about 6 or 8 cm. apart and 8 or 10 cm. in front of the window of the Röntgen ray enclosure so that a beam of rays from the bulb *S* will pass between them as shown in Fig. 31. Over the window place

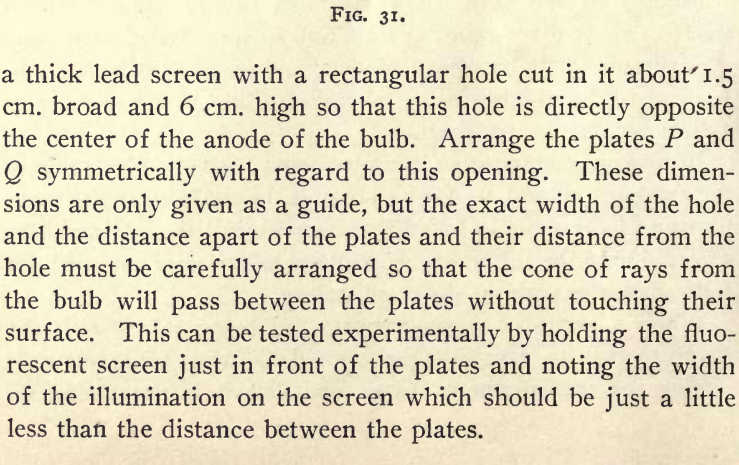

FIG. 31.

a thick lead screen with a rectangular hole cut in it about 1.5 cm. broad and 6 cm. high so that this hole is directly opposite the center of the anode of the bulb. Arrange the plates *P* and *Q* symmetrically with regard to this opening. These dimensions are only given as a guide, but the exact width of the hole and the distance apart of the plates and their distance from the hole must be carefully arranged so that the cone of rays from the bulb will pass between the plates without touching their surface. This can be tested experimentally by holding the fluorescent screen just in front of the plates and noting the width of the illumination on the screen which should be just a little less than the distance between the plates.

To one plate P connect the positive pole A of a battery of small accumulators of 20 or 30 volts, while the negative pole B is connected to earth. Connect the other plate Q to one pair of quadrants of the electrometer through a screening tube (§ 14), the other pair of quadrants being connected to earth. Connect in parallel with Q an adjustable condenser C as indicated. Also make a connection to earth through the special electrometer earthing key K (§ 16) which is worked by a cord at a distance.

Close the earthing key K, adjust the condenser to a capacity of about 0.5 microfarad and start the bulb. After running for two or three seconds open the key K. Note that the electrometer needle immediately begins to indicate that the quadrants connected with Q are receiving a charge. If the movement of the needle is too rapid increase the capacity of the condenser, or if too slow decrease it. Observe that this charging up continues as long as the rays continue to act. Stop the rays and the charging up will cease. Earth the plate Q again through K and reverse the connections of the battery so that P is connected to the negative pole B and A to earth. Repeat the last experiment and note that the needle indicates that Q receives a charge of opposite sign as the movement is in the opposite direction. Stop the rays and close K and then test the electrometer with a standard cell as to the sign of the charge indicated by the movement of the needle in either direction (§ 17). The test should show that in the foregoing experiment when P was connected to the positive pole of the battery while the rays were acting the plate Q received a positive charge, while when P was at a negative potential Q received a negative charge.

After making a number of preliminary trials of this nature carefully regulate the sensitiveness of the electrometer needle by adjusting the potential on it and also adjust the capacity C until the electrometer needle shows a movement of about five scale divisions per second. This can also be regulated to some extent by adjusting the intensity of the rays by placing a metal screen in front of the window to cut down the intensity. After

a convenient rate of movement of the needle is obtained the rate at which the plate Q charges up can be measured, as the rate of charging up is proportional to the rate of movement of the needle, that is to the number of scale divisions passed over per second. This rate may be measured with a stop watch. Having made this adjustment repeat the above experiments and observe carefully by a stop watch the time taken for the spot of light to move over a given distance on the scale. Take several readings first in one direction and then reverse the connections of the battery and take several in the opposite direction. Take the average in each case and the same average reading should be found for the two directions. Make a number of such observations so as to become perfectly familiar with the method.

These experiments indicate that the rays in some way cause a transference of electricity from the air to the plate Q and the sign of the electric charge given to Q depends upon the sign of P. The quantity of electricity transferred per second is the same whether it is positive or negative. There must be, in other words, a current of electricity through the air between P and Q and the current is of the same magnitude whether P is positive or negative with regard to Q. The direction of the current depends upon the sign of P with regard to Q.

55. Variation of Current with Voltage.—Connect the plate P to a potential of only 2 or 3 volts and measure the current through the air between the plates as above, that is, measure the rate per second at which Q receives a charge as indicated by the number of scale divisions moved over per second. Increase the potential of P by a volt or two and again measure the current. Still further increase the potential and determine the current produced. Repeat this for gradually increasing voltages and it will be found that the current rises with each increment of voltage until finally a stage will be reached at which the current will no longer increase even with a large addition of voltage. In making these observations take at least two or three readings at each voltage and take the mean as the reading at that voltage. This is necessary on account