A SIMPLE FORM OF C. T. R. WILSON'S ALPHA-RAY TRACK APPARATUS

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About two years ago considerable interest was excited among scientists by the appearance of the Shimizu modification of C. T. R. Wilson's cloud apparatus for making visible the tracks or traces of alpha particles thrown off from radioactive material. The essentials of an alpha-ray track apparatus are: (1) a closed chamber in which alternate compressions and expansions of the air may be made to take place, (2) means for setting up an electrostatic field across the chamber, (3) a suitable device for cutting off this field at the proper time with reference to the changes in volume inside the cylinder, and (4) a source of alpha-rays inside the chamber. In the Shimizu apparatus these essentials are elaborately and efficiently provided for by (1) a cylinder of metal and glass in which an airtight piston, whose length of stroke is adjustable, is moved up and down by an eccentric crank on a shaft rotated by hand or by a small motor, (2) a conducting film of moist gelatine carrying some $CuSO_4$ placed on the under side of the glass cover of the chamber and a similar film of gelatine carrying India ink placed on the top surface of the piston, between which surfaces an electrical potential may be applied, (3) a suitably shaped, adjustable commutator attached to and rotated by the crankshaft, so connected that it serves to apply and withdraw the electrostatic field between the gelatine films at the proper times with reference to the compression and expansions inside the cylinder, and (4) a trace of radioactive material carried on the tip of a metal pin which projects into the chamber through a ground-in, airtight bushing.

It occurred to the writers that the alpha-ray tracks might be effectively revealed by an exceedingly simple apparatus built along the lines of a modified cloud apparatus described by one of the authors a number of years ago[1], and which is at present being made by the

[1] Science III, Dec. 24, 1909, p. 930.

Central Scientific Company of Chicago, Illinois. The simplified form of the ray track apparatus was made entirely of glass,—of Pyrex glass. Fig. 1 shows a vertical section through the axis of the compression chamber and bulb, while Fig. 2 is a view from the top downward, as the observer would view the apparatus. Several ray tracks are indicated as issuing from the tip of the plug

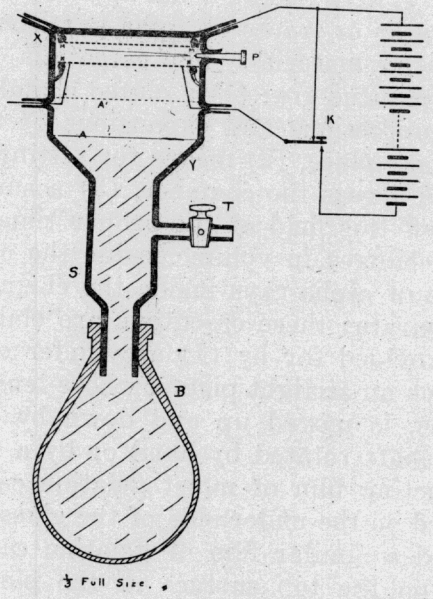

Fig. 1

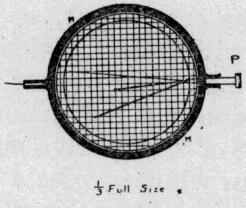

Fig. 2

P. In Fig 1 also are shown the electrical connections. The main body of the apparatus was made of a 150 cc Pyrex beaker, one being selected with a clear, smooth bottom so that anything taking place within the chamber could be seen easily and without distortion, the bottom

of the beaker forming the top of the chamber as shown in Fig. 1. The two electrostatic field plates MM and NN were made of coarse-mesh copper gauze and were held in place and kept flat by being wired to large rings made of small Pyrex glass rod. The upper ring with its plate MM was held in place against the top of the chamber simply by the tension of the two lead-in wires as shown. The lower ring with its plate NN was held in place by having three small legs of solid pyrex glass fused to the ring and the lower ends of these in turn fused to the walls of the chamber. Two only of these legs are indicated in the figure. Wires for electrical connection to the plates were carried into the chamber through capillary openings in the walls of the chamber as shown. In the experimental forms of the apparatus, these wires were held in place by filling the capillary tubes with "Bank of England" sealing wax. The plug P, on the tip of which the radioactive material was carried, was ground into a glass seat placed midway between the two plates. Finally, the mouth of the beaker was drawn down and sealed to a tube of smaller diameter, which was in turn drawn down to accommodate the stout walled rubber bulb used in actuating the apparatus. A small side branch tube, T, was provided for the introduction of water into the apparatus. The necessary electrical connections are shown in Fig. 1.

The procedure in operating the apparatus is, briefly, as follows: Fill the bulb and tube with water up to the level A. Insert the plug P. Connect the plate MM to, say, the positive pole of the source of DC potential and to the top contact of an ordinary two-contact tapping key, K, the tongue of the key being connected to the plate NN. Next connect the negative pole of the source of potential to the bottom contact of the key K. These connections are shown in Fig. 1. Then upon depressing the key the full potential of the source is applied across the plates, while upon releasing the key, the potential is removed and the plates are short-circuited together. For ease in observation the space between the plates MM and NN should be strongly illuminated. This may be done by means of a projection lantern, using a hori-

zontal slit to confine the light to the region between the plates.

To observe the ray-tracks, compress the bulb B with the hand until the water level reaches point A, Fig. 1. Considerable pressure will have to be exerted on the bulb to do this. At the same time depress the key K, throwing the potential across the plates MM, NN. Then release the bulb and the key at the same time, and if everything is working properly, ray tracks should be seen in the space between the plates. The function of the electrostatic field is to sweep away the ions formed by the impact of alpha-particles, except those that are formed just as the expansion takes place and which form the nuclei for the wisps or tails of cloud which are the alpha-ray tracks. By repeated trials, the proper amount of compression and the timing of the withdrawal of the electrostatic field with reference to the start of the expansion will be found which give the best results. With the field plates spaced about 1 cm, a potential of 110 volts across the plates has been found to give satisfactory results. Five to eight blocks of 22.5 volt Radio B batteries may be used for this purpose, or the voltage from a 110 volt DC supply circuit may be used.

The ray tracks produced by this apparatus are, for the most part, clear-cut and distinct. The unavoidable turbulency of the air in the chamber, due to the presence of the gauze plates and supporting rings, causes the tracks to move slightly from their initial positions. However, this drift of the tracks after they have formed is not serious when the extreme simplicity of the apparatus producing them is kept in mind. Another point in the operation of the apparatus is that after a dozen or so expansions have been made, the under side of the top surface of the chamber becomes clouded due to condensation of water droplets upon it. However, this surface may be cleared readily by tilting the apparatus from time to time so as to wet the entire top end of the chamber.