An Electroscope for Measuring the Radioactivity Soils.

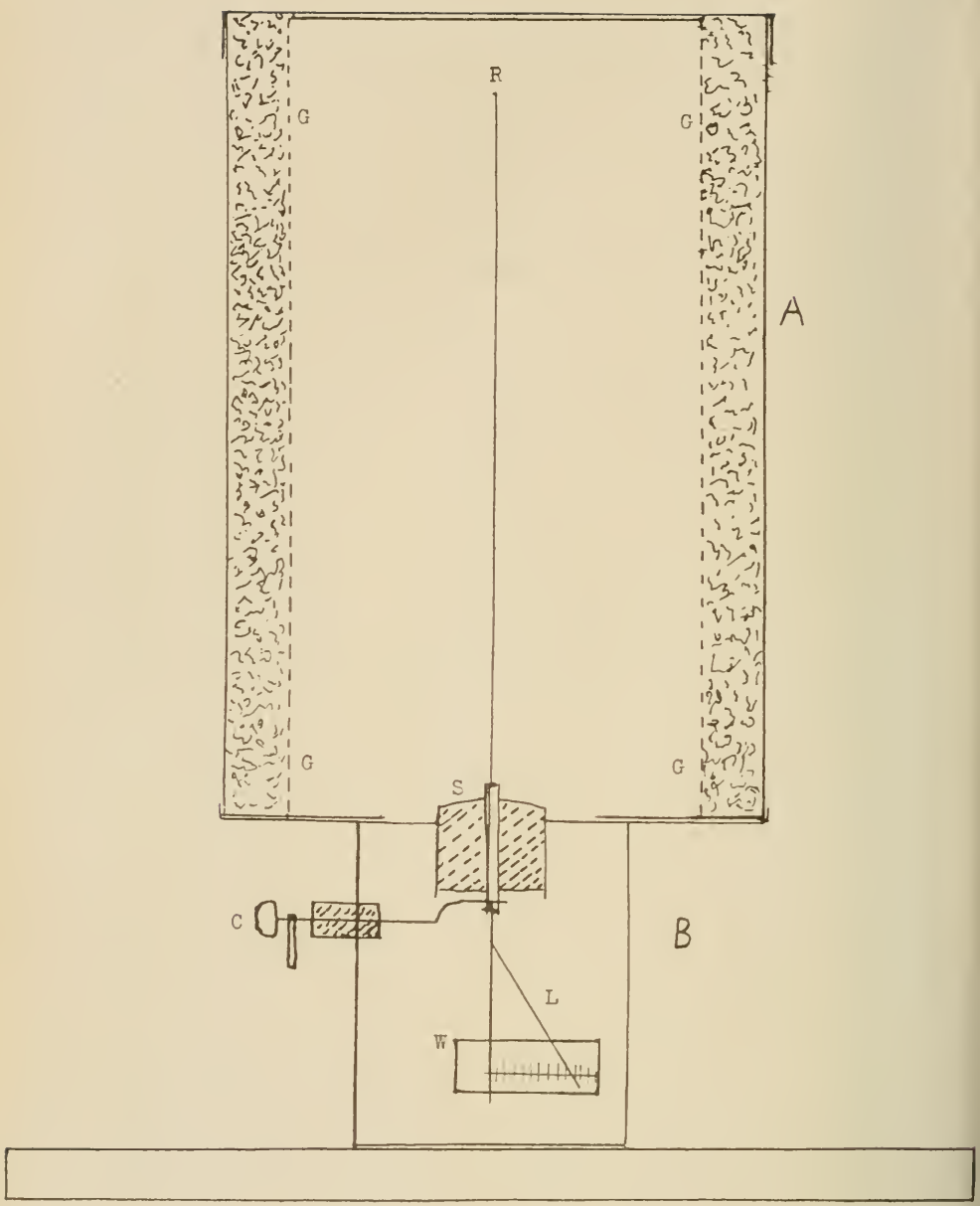
By R. R. Ramsey.

In measuring the radioactivity of soils if extreme accuracy is desired it is necessary to dissolve the sample and then determine the amount of radium or thorium by means of the emanation method. The getting the sample in solution is a long tedious process. For a description of this method I shall refer to Joly's Radioactivity and Geology.

For an approximate determination of the radioactivity one can use an α ray electroscope provided that the sample is fairly active. The standard being uranium oxide, U_3O_8, a "thick" layer, one gram to 10 square centimeters say, gives a current of 5.8×10^{-13} amperes or 17.4×10^{-4} E.S.U. per square centimeter surface if the plates of the electroscope are 4 cm. or more apart. The amount of radium in the oxide may be determined by dissolving it and then determining the amount of emanation in the solution after it has stood 30 days. The sample is placed in the α ray electroscope and compared with the uranium oxide. It will be evident that an assumption is made here that the absorption coefficient of all samples for α rays is the same as the absorption coefficient of uranium oxide for α rays. This assumption is only approximately true.

The radioactivity of soil is very slight and in order to get an appreciable current a large area must be exposed. This necessitates large plates in the ordinary form of α ray electroscope. The large plates increases the capacity of the electroscope and thus diminishes the sensitiveness of the electroscope. Instead of an ionization chamber with plates I have hit upon the plan of using a cylindrical chamber with a central rod. The material to be tested is packed between the wall of the cylinder and an inside cylinder made of wire gauze. The space between the two walls is made as small as the ease of filling will permit. One or two centimeters, say.

In this form of electroscope the amount of surface exposed can be increased at will by increasing the size of the cylinder, and as the diameter of the cylinder is increased the capacity is decreased. Thus the sensitiveness of the electroscope is increased in two ways as the ionization chamber is increased; by increasing the surface exposed and by decreasing the capacity of the instru-



Soil Electroscope.

ment. The size of the chamber will be limited only by the potential of the central rod. The potential must be at least the saturation potential, that is the potential must be great enough to pull out the ions as fast as they are formed. With the usual potential, about 300 volts, the diameter may be made 15 or 20 centimeters. The height may be made as great as is convenient to use.

The general plan of the instrument is shown in the figure. A, is the ionization chamber, B, is the chamber containing the gold leaf. L, is the leaf, W, is the window through which the leaf is read on the scale. C, is the charging system. S, is the sulphur plug and R, is the central rod. For a more detailed description of the method of making and reading an electroscope I will refer to my paper on The Radioactivity of Spring Water. (Ind. Acad. Proc. 1914.)

The top of the chamber, B, has a disc with a flange fastened to it. The diameter of this disc is such as to fit the ionization chamber. The lower end of the chamber, A, is closed and a hole is cut large enough to let the sulphur plug, S, pass. The gauze cylinder, G, is soldered to a disc which will fit the inside of the large cylinder and pass the plug, S. A disc of diameter of the gauze cylinder is soldered in the top. A lid fits over the top of the large cylinder.

To fill in the material to be tested the chamber A, is removed from off the chamber B, the gauze cylinder is placed inside and the material is packed lightly between the two walls. The lid is placed on and the chamber A, is placed on the chamber B.

Correction must be made for the absorption of α rays by the gauze. This can be determined by getting the ionization current of uranium nitrate when free and when covered with a sample of the gauze, using an ordinary α ray electroscope.

Or the electroscope may be calibrated by filling in a material of known activity between the gauze and the outside cylinder. Or uranium nitrate may be mixed with an inactive substance in known proportions and placed in the electroscope.

In testing soils the sample should be allowed to dry for a few days as fresh damp soil contains a large amount of radium emanation which has come up from the lower material.

Indiana University, December 1, 1915.