RADIOACTIVITY OF 'FRESHLY FALLEN SNOW.'¹

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C. T. R. WILSON has shown that freshly fallen rain is radioactive and that its activity decays rapidly with time. It seemed probable that freshly fallen snow would also show this effect. During the first snow storm of the season about a liter of snow was quickly collected from a thin layer on the surface, and evaporated down to dryness in a shallow tin dish. This dish which before filling with snow had been tested, and found to contain no trace of radioactivity was now able to ionize the air in its immediate vicinity quite strongly.

The apparatus used to test the presence of the activity is shown

Fig. 1.

in Fig. 1 and consisted as follows: Two parallel zinc plates were suspended one above the other and both insulated. The upper plate was connected to one pair of quadrants of a sensitive electrometer, the other pair being earthed. The electrometer was of the usual type with upper and lower quadrant plates. The needle was of thin aluminium suspended by bifilar silk fibers. It was kept continually

¹ Communicated to American Physical Society January, 1903.

charged to 300 volts by a battery. When charged to this potential the electrometer needle gave about 600 scale divisions per volt, the scale being about 2 meters from the mirror.

The lower zinc plate was connected to one pole of a battery of small accumulators from which any voltage up to 300 could be obtained. The other pole of the battery was earthed. These two plates were enclosed in a zinc box connected to earth, which served as a guard ring. By operating a key from a distance, by means of a string, the quadrants could be separated. The radioactive vessel was placed on the lower plate. The rate of movement of the needle was thus a measure of the activity present. There was always a small leak, due to the natural ionization within the apparatus. As this was only .2 of a scale div. per sec., any increase in the ionization current, due to a radioactive substance being present could easily be detected. A specimen of uranium was kept as a means of standardizing the apparatus.

A great many tests were made extending over about six weeks. The snow was always collected from a thin layer on the surface, so as to get that which had recently fallen. It generally took from twenty to thirty minutes to collect, evaporate down and test. The activity had thus fallen in value during this time.

Two of the best methods of distinguishing between the various types of radiations are the rate of decay and the penetrating power in various substances. These two methods were therefore tried. Numerous tests on the rate of decay showed that it followed closely a geometrical progression with time, falling to half value in about thirty minutes. This rate of decay was never found to vary appreciably. Some of these results are plotted in the accompanying curves (Fig. 2). Curves *A* and *B* are from observations taken on the same day, *A* from one liter of snow and *B* from one half liter. The fall of snow on this day was heavy and thick, and gave the greatest amount obtained during any snow storm tested. Curve *C* shows one taken on another day when the fall of snow was much lighter. It is the amount obtained from one liter. In some of the tests the snow had been falling for several hours and in others only a short time. All of these curves show the activity to fall to half value in about thirty-two minutes. In curve *D* are plotted results,

taken from a test on the rate of decay of excited activity on a negatively charged copper wire in the open air. These are plotted on the same scale for sake of comparison. It will be seen that this falls to half value in about forty-eight minutes. There is thus a distinct difference in the rate of decay of the two activities.

Tests were made on the penetrating power of the activity from snow. For this purpose the activity was rubbed off onto a piece of leather, moistened with ammonia. The leather was then covered with sheets of thin aluminum foil, and the rate of leak taken when covered and uncovered. From these results the penetrating power

Fig. 2.

could be calculated. It was found to be about the same as for the excited activity from air, half of it being absorbed in .00076 cm. of aluminum.

In many other respects this activity behaved like the excited activity from air. If the activity was rubbed off onto a piece of cotton, which was then burnt to ashes, the residue was still radioactive. It could be heated to a bright-red heat without destroying any appreciable amount of its activity. It was found that during a steady fall of snow the amount of activity that could be obtained from a given amount of snow remained about constant, and no such thing as an exhaustion of the atmosphere could be observed. Twenty-four hours after a heavy fall of snow a very small amount could be still obtained. Experiments were tried to see whether

the decay was the same in the snow as when the snow was evaporated down to dryness. Owing to difficulties encountered nothing definite could be obtained.

The amount of activity obtained from a liter of snow was about equal in effect to one fifth of a gram of uranium. It might be of interest to show the amount that could be obtained from a square mile of territory, covered with a layer of freshly fallen snow 1 cm. thick. The maximum ionization current obtained from a liter was about twenty scale divisions per second. With this apparatus each scale division corresponds to about 3×10^{-13} amperes. From a square mile we ought therefore to obtain roughly about 1.5×10^{-4} amperes per second. This is a considerable amount and could be easily measured with a galvanometer, so that during a heavy fall of snow over a territory the size of Canada, a considerable amount of energy would be represented in the activity.

From the results of this investigation two general conclusions may be drawn: either that this activity is different from the excited activity from air, or that the excited is of a more complex character than was at first supposed. We know nothing as to the mode of production of the radioactivity in air. There may be several processes going on, each manifesting itself under different conditions, of which the activity in snow may be one. The rate of decay of the excited on a charged wire may be the resultant of several rates of decay, and that from snow one of them. In all other respects the two activities give the same results, the rate of decay being the only difference. Since this paper was first communicated, investigations by the author on the rate of decay of the excited activity from air on copper wires have brought out some interesting results. The activity was rubbed off from the wire, with the aid of ammonia, on to various materials, such as leather and felt. The activity on the leather fell to half value in thirty-eight minutes, whilst on a piece of absorbent felt it took sixty minutes to fall to half value. If a piece of cotton was rubbed over the wire, and then reduced to ashes, the activity on it fell to half value in forty-five minutes, the same as on the wire itself.

Investigations are at present being continued on the rates of decay of the activities from air, snow and rain. These may throw

some light on the difference between the rates of decay of the radioactivity obtained from the air by these methods.

It seems probable that there is in the atmosphere some process going on producing positive radioactive carriers, since they are only collected on a negative wire. The particles of snow would act as collectors for the radioactive carriers, removing them from the air. The amount of activity which reached the ground with the snow would depend on the closeness together of the snowflakes, and on the rate at which they fell.

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MCGILL UNIVERSITY, MONTREAL, January, 1903.