strong enough to work the receiving instruments. Now circumscribe both stations with circles having a radius equal to the distance *A B*. It may be seen that no other two independent stations can be worked within these two circles without

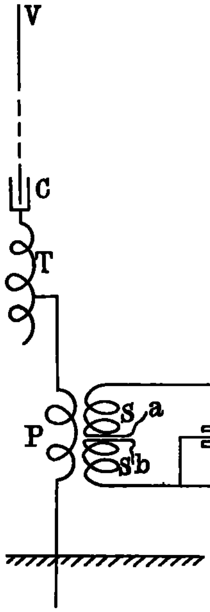

FIG. 29.

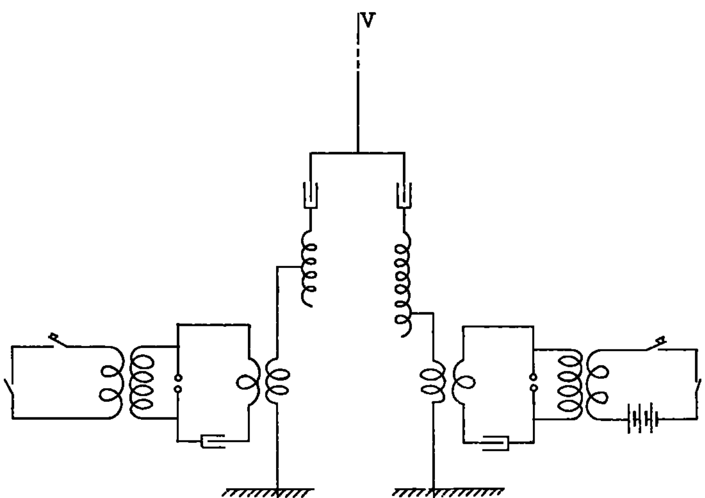

FIG. 30.

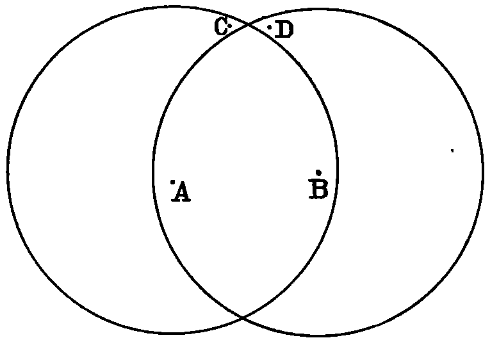

FIG. 31.

confusion unless they have receivers which can not be affected by the feeble waves from *A* and *B*. For example; two independent stations may be erected at *C* and *D* with less sensitive receivers and weaker transmitters than those at *A* and *B*. The waves sent out by the transmitters at *A* or *B* can not affect the less sensitive receiver at *C* and *D*, and the waves sent out by less powerful transmitters at *C* and *D* will affect receivers at these points, but on arrival at *A* and *B* they will be so weak that the receivers at these points will not be affected. Thus, stations properly placed, with instruments properly selected as to power and sensitiveness, may be worked "open" simultaneously and without confusion.

RADIOACTIVITY OF FRESHLY FALLEN SNOW.[1]

By S. J. ALLAN, M. Sc., dated McGill University, Montreal, January 27, 1903.

C. T. R. Wilson has shown that freshly fallen rain is radioactive, decaying with time. The author was led to believe that snow freshly fallen would also show this property. So during the first snowstorm a quantity of snow was gathered from a thin layer on the surface. This was then quickly evaporated down to dryness in a shallow tin vessel. This vessel which before filling with snow was tested and found to contain no trace of radioactivity, was now quite radioactive and was able to ionize the air in its immediate vicinity quite readily.

The apparatus used to test the presence of radioactivity consisted of two parallel zinc plates, insulated, a certain distance apart. The upper one was connected to one pair of quadrants of a sensitive electrometer, the other pair being earthed. This electrometer, when the needle was charged to 300 volts potential, gave about 500 divisions per volt, the distance between scale and mirror being about two meters. The lower plate was connected to one pole of a battery of accumulators, from which any voltage up to 300 could be taken. The other pole of the battery was earthed. The radioactive vessel was placed on this lower plate. There was always a slight ionization in the apparatus due to the natural ionization of air. As this only amounted to one-tenth of a division per second any increase could easily be detected. The ionization current as shown by the rate of movement of the electrometer gave a measure of the radioactivity present on the tin vessel. A standard specimen of uranium was kept as a means of standardizing the apparatus.

A great many tests were made extending over about six weeks and taking in four or five snowstorms. The snow was always collected from a thin sheet on the surface so as to get that which had recently fallen. It generally took from twenty to thirty minutes to evaporate down to dryness and test, so that the radioactivity had fallen a good deal in value during that time.

Two of the best methods of distinguishing between the various types of radioactive bodies were tried, viz, the rate of decay, and the penetrating power. Numerous tests made on the rate of decay showed that this radioactivity followed very closely a geometrical progression, falling to half value in about thirty minutes. The rate of decay was never found to decay though taken on different days and under different weather conditions. Three of these results are plotted in the accompanying curves, fig. 1. Curves *a* and *b* are results 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 very heavy and damp. This was the greatest amount obtained on any day. Curve *c* shows a curve taken on another day, when there was a much smaller fall of snow, and is the amount from one liter. All of these curves show that the radioactivity falls to half value in about thirty-two minutes. Curve *d* shows the rate of decay of the radioactivity produced on a copper wire charged to a high negative potential in the open air. This is plotted on the same scale for sake of comparison. This falls to half value in about forty-eight minutes. The two rates of decay are thus distinctly different.

Tests were made on the penetrating power, and it was found

[1] Read before American Physical Society, January 3, 1903.

to be about the same as for that excited from air. Half of it was absorbed in two layers of aluminium foil 0.00038 centimeters thick.

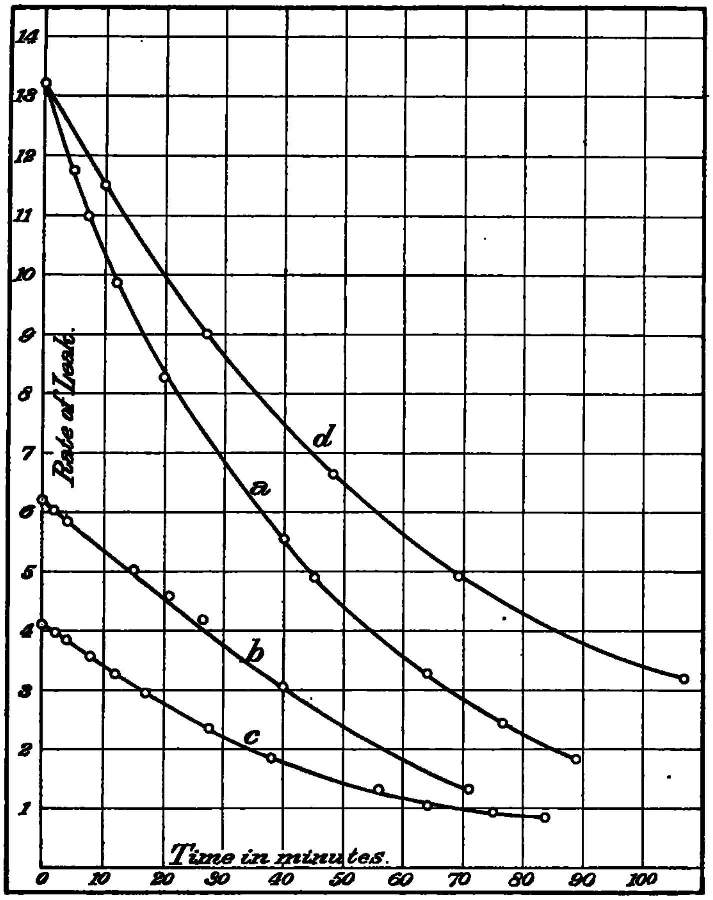

FIG. 1.

This radioactivity could be transferred by rubbing from the surface of the tin vessel on to leather or cotton, etc., moistened in ammonia. When the cotton thus treated was burnt to ashes the residue was still radioactive. Heating to a bright red heat destroyed only a very little of the radioactivity.

It was found that during a snowstorm the amount of radioactivity present kept quite constant so long as the fall of snow remained the same; twenty-four hours after the fall had ceased only a trace of radioactivity could be obtained. The amount of radioactivity obtained on the best day from a liter of snow was about equal in effect to one-fifth of a gram of uranium. It might be of interest to calculate the amount that could be obtained on such a day from one square mile of snow covered territory one centimeter thick. Taking 20 divisions per second as the amount obtained from a liter, we would get about 5×10^8 divisions per second. One scale division with this apparatus corresponds roughly to an ionization current of 3×10^{-13} amperes per second. Therefore a square mile ought to give something of the order of 1.5×10^{-4} amperes per second. This is an amount which could easily be measured by a galvanometer. Over the whole territory of Canada when it is snowing a considerable amount of energy is being radiated. From these results two conclusions may be drawn, either that this radioactivity is different from that excited from air, or that the excited air is a much more complicated substance than was at first supposed. There may be several processes going on, and this may be one of them. Each process may have different rates of formation and decay, and each radioactivity be the superposition of one or more of the processes. Recent experiments by the author rather support this latter view. These points are under investigation and will form the subject of a future paper. It seems beyond doubt that there is a radioactive substance in the atmosphere; how produced, at present, is not known. The falling snow acts as a sort of filter for it and tends to remove portions of it from the atmosphere.

This subject seems to me to be of great importance and interest, and future investigations along this line may greatly extend our knowledge of the physics of the atmosphere.

NOTES AND EXTRACTS.

METEOROLOGY AT THE AMERICAN ASSOCIATION.

At the meeting of the American Association for the Advancement of Science and its affiliated societies held at Washington, January 3–10, 1903, a number of papers were read which, judging from their titles, should have some bearing upon meteorological problems. We make the following selection of authors and titles and hope that in some cases we may be able to print the papers themselves:

S. P. Langley. The solar constant and related problems.

E. O. Lovett. Special periodic solution of n bodies. On the integrals of the problem of n bodies.

A. S. Mitchell. The new gases neon, krypton, and zenon in the chromosphere.

S. R. Cook. (Case School.) On the distribution of pressure around spheres moving with constant velocity in a viscous fluid.

H. W. Springsteen. (Case School.) On the thermal conductivity of glass.

A. L. Rotch. Atmospheric circulation near the equator.

Edwin H. Hall. (Harvard University.) Is there a southerly deviation of falling bodies?

J. R. Benton. (Washington, D. C.) Elasticity of copper and steel at —186° C.

J. R. Benton. (Washington, D. C.) Experiments in connection with friction between solids and liquids.

J. S. Shearer. (Cornell University.) The heat of vaporization of oxygen and nitrogen.

E. Rutherford and H. L. Cook. (McGill University.) A penetrating radiation from the earth's surface.

S. J. Allen. (McGill University.) Radio-activity of freshly fallen snow.

Carl Barus. (Brown University.) The excessive nucleation of the atmosphere.

Carl Barus. (Brown University.) Certain data bearing on the occurrence of lightning.

Carl Barus. (Brown University.) The electrical charges of water nucleii.

A. F. Zahm. Theory, construction, and use of a pressure tube anemometer.

H. Parker Willis. (Washington, D. C.) Requisites in crop reporting.

Prof. Willis L. Moore. Economic work of the Department of Agriculture, especially of the Weather Bureau.

Edwin G. Dexter. The psychology of weather influence.

A. H. Pierce. The apparent form of the heavens and the illusory enlargement of heavenly bodies at the horizon.

T. C. Chamberlin, William H. Welch, and others. How can endowments be used most effectually for scientific research?

Stanley Coulter. (Purdue University.) The changes of fifty years in a local flora.

C. Abbe. Observations on the cause of the rollers and double rollers at the island of Ascension.

E. F. Nichols and G. F. Hull. The pressure due to radiation.

R. W. Wood. Screens transparent only to ultraviolet light.

L. R. Jones and A. W. Edson. Pressure and flow of sap in the sugar maple.

H. C. Cowles. The relative importance of edaphic and climatic factors in determining the vegetation of mountains with especial reference to Mount Katahdin.

D. T. MacDougall. Plant growth as effected by light and darkness.

Peter Fireman. (Washington, D. C.) Motion of translation of a gas in a vacuum.

THE BECQUEREL RAYS IN METEOROLOGY.

In Harper's Monthly Magazine for January, 1903, Prof. J. J. Thomson has a short and suggestive article on the Becquerel rays, in continuation of his preceding article on Cathode rays