LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twenty-eighth of the preceding month; for the second issue, the thirteenth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

The Vapour Pressure of Sulphur at 50°C

Earlier workers[1] have obtained widely differing results for the vapour pressure of sulphur at 50° *viz.*, 0.00008 and 0.00036 mm of mercury. We made several determinations using a new method.

The apparatus is shown in Fig. 1. A is a drying tower containing soda-lime and calcium chloride. B is a thermostat heated and controlled electrically and maintained at 50°C. C is a glass spiral containing sulphur (purified by distillation in vacuo) while D is a Pyrex tube heated electrically to 300°C. The water jacket E cools the issuing gases which are then absorbed in $N/100$ iodine solution in wash bottle F. Bottles G, G contain potassium iodide solution to trap any iodine carried over.

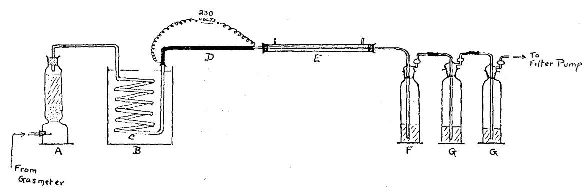

Fig. 1.

The procedure is as follows. Air is drawn through the apparatus by means of a filter pump fitted with constant leak. The air passes first through a gas meter and drying tower and then over the sulphur in the spiral which is at 50°C. The sulphur is oxidised to sulphur dioxide in the Pyrex furnace (owing to the very high partial pressure of oxygen this takes place almost quantitatively) and the issuing sulphur dioxide after cooling is absorbed in the $N/100$ iodine solution. After passing air for some time (24–48 hours) at a rate of about 10 litres/hour the wash bottles are detached and the iodine in them titrated with a sodium thiosulphate solution previously standardized against the iodine.

Thus we find the loss in iodine and hence the weight of sulphur dioxide formed. Knowing from the gas meter the volume of air which has passed and also the barometric pressure and the temperature at the meter, we can readily calculate the vapour pressure of sulphur at 50°C.

We obtained as the mean value *0.000155 mm Hg* assuming all the sulphur present as S_8.

In conclusion we wish to offer our best thanks to Mr. A. Ritchie, B.Sc for his invaluable help and advice.

R. R. H. Brown
J. J. Muir
Edinburgh University,
Chemistry Department,
April, 1932.

[1] Ruff and Graf, Z. Anorg. Chem. **58** 210 (1908); Greuner, J.A.C.S. 1399 (1907); West and Menzirs., J. Phys. Chem. **33,** 1887 (1929).

Variation of the Cosmic Rays with Latitude

Definite differences in the intensity of the cosmic rays at different latitudes are shown by our measurements, which have ranged from 47° north to 46° south. As far as they have gone, these measurements indicate a uniform variation with latitude, showing a minimum at or near the equator, and increasing intensity toward the north and south poles. At sea level, the difference between the intensity at latitude 45° and 0° is roughly 16 percent, whereas at an elevation of 9000 feet the difference is about 23 percent. This would indicate that it is the least penetrating part of the cosmic rays which varies most rapidly with latitude. No significant variations with longitude have been noted.

Our present experiments are being made with a 10 cm steel sphere filled with argon at 30 atmospheres. The ionization current is measured by a Lindemann electrometer, the readings being made in such a way that the effect of any insulation leak is eliminated. To shield from the effects of the local radiation, a spherical shell of 2.5 cm copper and two spherical shells each of 2.5 cm lead, making a total of 7.5 cm of lead and copper, are used. The effect of the local gamma-rays traversing this shield is determined by comparing the ionization with and without the outer shell of 2.5 cm lead. All the readings are referred to the ionization by the gamma-rays from a capsule of 1.3 mg of radium placed at 1 meter from the center of the ionization chamber as a standard.

TABLE I. *Cosmic ray intensity at different localities*
(Ions per cc per sec. through 5 cm Pb, 2.5 cm Cu and 0.5 cm Fe)

Location	Lat.	Long.	Elev.	Barom.	I_C	I_L	Date
1 Mt. Evans	40°N	106°W	14,200ft	17.61in	6.88 ions	0.57	9/31
2 Summit Lake	40 N	106 W	12,700	18.70	5.84	0.34	9/31
3 Denver	40 N	105 W	5300	24.8	2.93	—	9/31
4 Jungfraujoch	47 N	6 E	11,400	19.70	5.08	0.51	10/31
5 Haleakala	21 N	156 W	9300	21.47	3.35±0.05	0.60	4/32
6 Idlewild	21 N	156 W	4200	25.99	2.40±0.05	0.37	4/32
7 Honolulu	21 N	158 W	70	30.09	1.89±0.02	0.11	4/32
8 S. S. Aorangi	4 S	173 W	60	29.65	1.83±0.05	0.32	4/32
9 Southern Alps	44 S	170 E	6700	23.69	3.39±0.05	0.22	4/32
10 Southern Alps	44 S	170 E	3900	26.10	2.70±0.04	0.21	4/32
11 Dunedin	46 S	170 E	80	30.08	2.16±0.03	0.11	4/32
12 Wellington	41 S	175 E	400	29.85	2.16±0.03	0.12	5/32

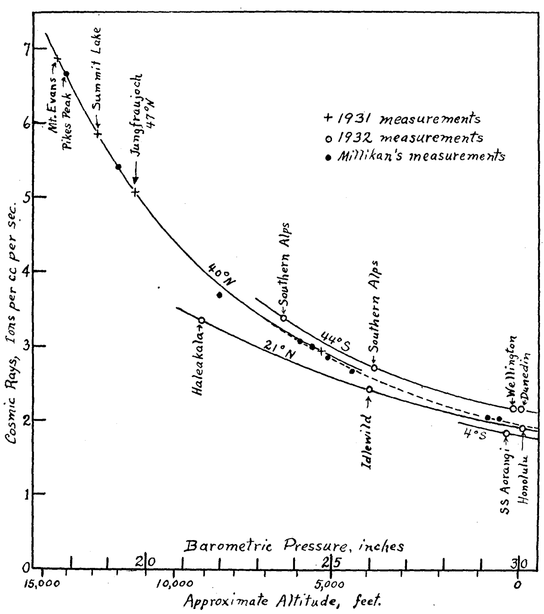

Fig. 1.

In Table I are listed the results of our various measurements. The column marked I_C represents the ionization in air at atmospheric pressure expressed in ions per cc per second due to the cosmic rays traversing our 7.5 cm filter. I_L represents the ionization due to the local rays passing through this filter expressed in the same units. Measurements 1 to 4 were made with different apparatus, using compressed air instead of compressed argon in the chamber, and lead and copper shields of different shape. These results are thus not strictly comparable with the later ones, though the difference is probably not more than 2 percent.

In Fig. 1 these results are shown graphically, and are compared with those of Millikan and his collaborators (Phys. Rev. **37**, 235 1931) as shown in the dotted line. It will be noted that for corresponding barometric pressures our measurements show consistently more intense radiation at the higher latitudes. The high altitude measurements in Hawaii are of especial interest as indicating that the difference with latitude is greater for the less penetrating rays.

Millikan's measurements were made at latitudes varying from 34°N to 59°N, most of them being at about 40°N. Our measurements near this latitude are in satisfactory agreement with his considering the slight differences in experimental arrangement. We do not however confirm the independence of the intensity of latitude which he reports.

The variation of the cosmic rays with atitude which these measurements show is of ust the kind to be expected if the rays consist of electrically charged particles which are deflected by the earth's magnetic field, the less penetrating rays being the more strongly affected.

This letter is the first report of an extensive program involving similar measurements by many physicists in widely distributed parts of the world. The design and construction of the instruments are due chiefly to Professor R. D. Bennett of Massachusetts Institute of Technology, with L. N. Ridenour, Dr. J. A. Hopfield and Dr. E. O. Wollan. Professor J. C. Stearns of the University of Denver with J. A. Longman, L. N. Ridenour and W. Overbeck made the measurements at Denver and Mt. Evans. Dr. Marcel Schein and Dr. Bernhard Frey of the University of Zürich cooperated in the measurements at the Jungfraujoch. Professor Harry Kirkpatrick of the University of Hawaii made the local arrangements in Hawaii, and with Professor W. H. Eller and Mr. I. Miyake assisted in the measurements. In New Zealand, Professor P. W. Burbidge of Auckland University College organized the various expeditions, and with Dr. C. M. Focken of the University of Otago helped with the observations. Valuable assistance has also been given by A. A. Compton and others. Without the cordial cooperation of the various universities where the work has taken us, the measurements would have been much more difficult.

ARTHUR H. COMPTON

University of Chicago,
The Tasman Sea,
May 7, 1932.

On the Production of Ultra-Short Electromagnetic Waves

In a note published in this journal, Mr. G. Potapenko gave an account of his interesting investigations in the field of the ultra-short electromagnetic waves.

The tubes that the author used in his experiments had pure tungsten filaments, as it was impossible to observe ultra-short waves with tubes having other kinds of filaments.[1]

As a result of some experiments I carried out recently, I found that, under particular conditions, oscillations of very high frequency may be obtained by using tubes with a heater element and a cathode coated with oxides.

Different tubes have been tested, namely, tubes of the type: −27 R.C.A. (American); E. 424 Philips (Dutch); R.E.N.S. 1104 Telefunken (German).

Although the common Barkhausen-Kurz arrangement may be used, that of Tank and Schiltneck[2] was found to be more suitable, the only modification being to connect the cathode to the negative terminal of the filament. The heating current must have a value which is only 80 percent−90 percent of its normal rated value.

Although unnecessary if the latter experimental arrangement is used, a slight positive

[1] Phys. Rev. **39**, 630 (1932).

[2] Helv. Phys. Acta. **1**, 100 (1928).