the necessary apparatus (an ordinary 'Forbes bar') available in almost any laboratory.

In this case the expression for the temperature at any point distant x along the bar at time t after removing the source of heat is:

$$T_{x,t} = 2\,T_0\,l\,\sqrt{(RG)}\,\tanh l\,\sqrt{(RG)}$$

$$\sum_{m=0,1,2\ldots} \frac{\cos\{(1-x/l)\,m\pi\}.\exp\left(-\frac{m^2\pi^2+GRl^2}{CRl^2}.t\right)}{(m^2\pi^2+GRl^2)\,(\cos m\pi+\sin m\pi/m\pi)}$$

where T_0 is the initial steady temperature at the end of the bar, R the heat resistance per unit length of bar, C the heat capacity per unit length of bar, G the rate of heat loss from surface per degree per unit length of bar, l the length of bar, and m is zero or any integer.

The bar used was of brass, and was furnished with eight holes, distant apart 10·15 cm. between centres. At one end there was a right-angled elbow joint, so

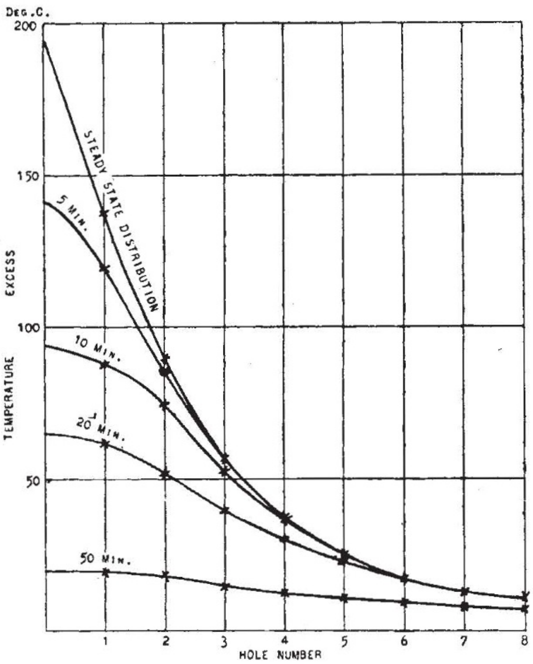

FIG. 1

that this end could be dipped vertically into a bath of molten solder while the main part of the bar was horizontal. The temperature observations were made on ordinary thermometers dipping into mercury contained in the holes along the bar. The mean distance from the centre of the first hole to the solder level was 9·4 cm. and the length of bar immersed 9·5 cm. The section of the bar was a square of 2·50 cm. side.

After keeping the end immersed for three hours in the solder bath, a uniform heat distribution was obtained and the heat source was withdrawn. The temperature at the various points along the bar was observed at regular intervals, giving the results shown in Fig. 1. This family of curves is of the same form as that obtained from theoretical considerations and shown in Fig. 1 of the paper referred to above.

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[1] *Proc. Phys. Soc.*, **44**, 494; 1932.

Radiations from Radium D and E

DURING the past eighteen months, experiments have been carried out by Mr. W. J. Henderson and myself, so designed as to give us certain information about the radiations emitted by radium (D + E).

The first experiment, the initial results of which were reported at the 1931 meeting of the Royal Society of Canada, has shown that there is no evidence, in the case of radium E, for what have been called β-rays of high energy. We have used a suitable mixture of cardboard and lead, of total mass/cm.[2] somewhat greater than the range, in order to reduce the ionisation in a cardboard-lined electroscope to one ninety-thousandth of its initial value. It is not a difficult matter to show that less than one per cent of this ionisation can be due to primary β-rays and hence that not one β-ray in 1,500,000 can belong to the group, with values of HR between 7000 and 10,000 reported by Curie and D'Espine.[1] This result gives a strong indication that β-rays of high energy are not emitted by any substance.

Henderson has examined the ranges of the β-rays of radium E in various substances and has found much larger values than previous observers. In cardboard the range is 0·52gm./cm.[2] and in aluminium, tin and lead somewhat greater than 0·60gm./cm.[2]. Among other things, these results indicate that if β-ray ranges are to be used to determine the end points of β-ray spectra, some convention must be adopted. One that might be useful would be to use aluminium as absorbing material and take the range as that mass/cm.[2] which reduced the ionisation due to β-rays to one fifty-thousandth of its initial value and then calculate the end point from the data of Varder[2] on homogeneous rays. Applying this to radium E, the end point comes out at about HR = 5500. Further work is being done on this problem.

We have measured the absorption of the γ-rays in lead and have obtained estimates of the relative numbers of atoms emitting the different types of radiations, using the method of Gray and O'Leary[3]. A very soft type of γ-ray, presumably the M rays characteristic of atomic number 83, has been detected. L rays are emitted by about thirty per cent of radium D atoms and primary rays by somewhat less than four per cent, a value in fair agreement with those obtained by Bramson and Stahel and Sizoo[4]. The primary rays consist apparently of a band extending from $\lambda <$ 0·28A. to $\lambda >$ 0·30A., the average mass absorption coefficient in lead being 12. An initial attempt to detect this band by crystal reflection was unsuccessful. The bearing of our results on problems connected with the emission of β-rays from radium D will be discussed elsewhere.

The properties of the hard γ-rays of radium E are so similar to those of the X- or secondary γ-rays produced in other elements by the β-rays of radium E that I am of the opinion that they are entirely secondary in character, that is, that they are excited by some of the β-rays after their escape from the nucleus. They are emitted by about one per cent of the disintegrating atoms.

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[1] *C. R.*, **181**, 31; 1925.
[2] *Phil. Mag.*, **29**, 726; 1915.
[3] NATURE, **123**, 568, April 13, 1929.
[4] *Z. Phys.*, **66**, 721, 741; 1931.