Simple Equipment to Estimate Radiocarbon

We have built a low-pressure argon-alcohol counting tube of very satisfactory performance for radioactive carbon dioxide (Fig. 1). The cathode is a brass cylinder of 16 mm. diameter, 0·5 mm. thickness and 80 mm. length. A wire is soldered to the cylinder and sealed into the glass with a thermosetting plastic ('Araldit', Ciba). The anode, tungsten wire of 60 μ, is kept taut by a steel spring, and again sealed in with 'Araldit'. 'Pyrex' is used.

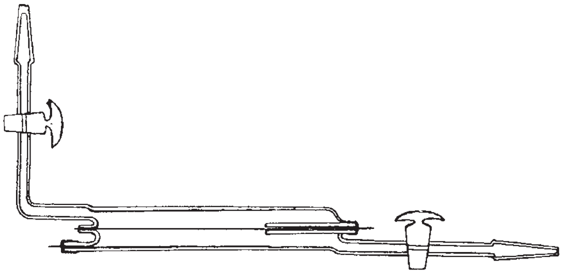

Fig. 1

The active carbon dioxide is generated in an all-glass vacuum line (Fig. 2) from barium carbonate and perchloric acid. The gas is dried by silica gel, and the carbon dioxide frozen out in a U-shaped capillary with liquid air. (No carbon dioxide is found to be held back by the silica gel.) After freezing the carbon dioxide, taps *A* and *B* are closed. Alcohol vapour is introduced into the filling line and the attached counting tube to a pressure of 15 mm. mercury. Now the liquid air is removed and tap *B* is opened again, until the desired pressure of carbon dioxide is attained. Finally, 3 cm. pressure argon is let in, and the counting tube is shut.

The length of the plateau is 250 volts with a gradient of 1–2 per cent/100 volts up to a carbon dioxide pressure of 5 cm. (Higher pressures could not be tested for want of a source of sufficiently high voltage; at carbon dioxide pressures of 1, 3, 5 cm. the plateau voltages were 1,150, 1,450, 1,800 volts.) The background of the counter, under 3 cm. of lead, is 28 min.$^{-1}$; it does not increase with time, that is, no radiocarbon is held back by the counter. Extreme differences in measured activities between repeated fillings, supposed to be identical, are 3 per cent. This reproducibility is at present limited only by the precision of the mercury manometer. The measured activity is strictly proportional to carbon dioxide pressure. The total time required to generate carbon dioxide and fill the counter is about two hours.

Loss of activity in air (through exchange) on heating barium carbonate, prepared as described below, for one hour, was found to be zero at 100°, 5 per cent at 300°, 11 per cent at 500°, and 15 per cent at 700° C. The rate of loss rapidly decreases with time: at 400° C., the losses after 1, 2, 4, 8 hr. were 8, 10, 11, 12 per cent respectively. In view of the fairly small losses at elevated temperatures, losses at room temperature are curiously high: 7, 9·5, 16 per cent after 7, 10, 18 days. Apparently a different mechanism operates at low temperature. At 100 per cent relative humidity, the losses at room temperature even reach values as high as 9·5, 16, 17, 17·5 per cent after 2, 6, 9, 11 days. Marked loss (3 per cent) has also been observed, after one hour, on stirring freshly precipitated barium carbonate with water.

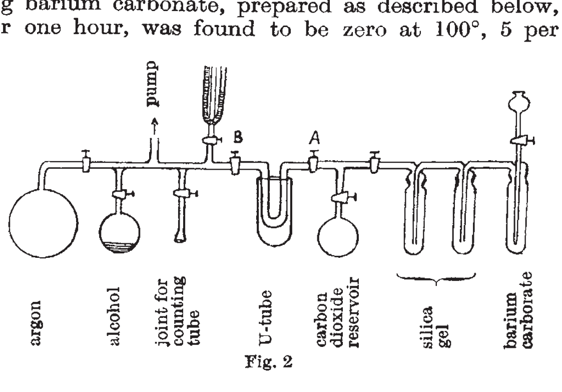

Fig. 2

It follows that no loss need be feared if samples are handled reasonably quickly in air; but kept in an atmosphere free from carbon dioxide for longer periods. In fact, no specific activity was lost at all in a cycle involving generation of carbon dioxide from barium carbonate, absorption in caustic potash, reprecipitation as barium carbonate—after addition of ammonium chloride to reduce alkalinity—with barium chloride, and drying in an oven in air at 140° C. for half an hour.

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A New Radio Method for Measuring the Electron Density in the Solar Corona

Present estimates of the electron density in the solar corona are based on the measurements during an eclipse of the optical radiation which originates in the photosphere and is scattered in the corona[1]. These measurements and their interpretation present considerable difficulties, particularly when attempts are made to determine the electron density in the outermost layers of the corona[2,3]. In this communication a possible method of determining the electron density at different heights in the corona is suggested, which should allow the exploration of regions where the density is as low as 10^4 cm.$^{-3}$.

It can be shown that if the radiation from a remote source passes near a spherical transparent body in which the refractive index increases outwards, and the angular separation between the source and the centre of the sphere is less than a certain value, no radiation from the source can reach the observer. At larger separations, a deviation of its apparent position occurs. If, therefore, a radio star is situated in a direction near that of the sun, the radiation on certain frequencies may be 'occulted' even when the radio star is at a considerable angular distance from the visible limb. Using the existing data on coronal electron density, it can be shown that, for frequencies of 210, 81·5 and 38 Mc./s., the effective radii of the sun for occultation are of the order of 2·9 $R_\odot$, 3·6 $R_\odot$ and 4·5 $R_\odot$ respectively, where $R_\odot$ is the photospheric radius. A precise determination of the values of the radii for a number of frequencies would allow the distribution of electron density with height to be deduced.