To what an extent my 1969 curve will require corrections and improvements was discussed previously.[6,7] For the third millenium BC, the period covered by the Belfast measurements, it can be seen that the wiggle indicated on my early curve for the twenty-second century BC does not exist. The character of the rest of the calibration curve, and in particular its stepwise character, however, is well represented by all the more recent measurements.

Professor Ferguson has supplied some 20 additional bristlecone pine wood samples from the period under consideration and these samples are being measured at present. As soon as these, and some additional measurements are completed, I intend to publish a paper that will discuss the results in detail and will propose a revised calibration curve for the third millenium BC.

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PEARSON REPLIES—I feel that to reply in detail to Suess's comments at this stage before his recent dates, statistical analyses and discussion are in print, would be of little value. It would be helpful in later discussion if Suess gives details of his experimental technique, and any corrections used to evaluate the radiocarbon dates together with relevant information which will justify drawing any curve other than the most simple, especially if the latter is as good a fit to the data as is the case presented in our article.

I have re-examined the data presented in our article and my findings are consistent with those published in that the precision on a single measurement is ± 25yr standard deviation and the linear regression gives value for $r = 0.99$ and F is approximately 3,000 giving a very good fit to the experimental data. However, as stated in the article (see discussion) fluctuation can still exist within a 3‰ limit and this is supported by P. E. Damon and J. C. Lerman in their detailed statistical analysis of the data (personal communication).

If 'wiggles' of this magnitude are to be reproduced and matched from three different sets of data, then I feel more information is required from Suess before more detailed discussion can take place.

We sincerely thank Suess for his congratulatory comments on the quality of measurement and for raising the points commenting on our paper. I reserve judgement on the relative quality of gas to scintillation counting techniques since both are in operation in this laboratory and are now being compared. We await with interest the publication of his methods and statistical analysis justifying any deviation from the derived conclusion of a straight line fit to the data as shown in our article.

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Anomalous LF radiowave records associated with meteoric ionisation

Information on the ionic constituents of meteor trains and the residual ions in the lower thermosphere is sparse. Sen and Saha[1] made the interesting suggestion that low frequency (LF) radiowave observations could provide information on meteoric ions and diffusion processes and in particular that the field strength characteristics of a 280 kHz navigational beacon were dependent on absorption by meteoric ionisation. Though such ionisation was suggested as being responsible for the anomalous signal characteristics it seems unlikely that this interpretation is correct.

A column of meteoric ionisation situated below the LF signal daytime reflection height ($\sim$ 90 km) must, in order to yield the reported attenuation of up to 8 db, provide substantial absorption over an area comparable in size with a fresnel zone ($\sim$ 10 km). Thus, for a meteor train of gaussian radial distribution (length $\sim$ 10 km and radius $\sim$ 5 km) situated along a ray path to provide an absorption in excess of 1 neper over the column cross-section, requires an axial electron density greater than about 2×10^3 cm^{-3} (train 70–80 km) or 8×10^3 cm^{-3} (train 80–90 km) (assuming an electron collision frequency increasing from 1.2×10^5 Hz at 90 km to 3.4×10^6 Hz at 70 km). The corresponding meteor train electron line densities α (cm^{-1}) are 2×10^{15} and 7×10^{15} and for a more general geometry these values certainly represent minimum requirements. The initial radii of large meteor ionisation columns are a few metres. Train expansion cannot be faster than that expected from eddy diffusion (coefficient $\not> 10^6$ cm^2 s^{-1}) so the minimum time to achieve a train radius of 5 km is 17 h (about 2 orders of magnitude greater than the reported t_f values[1]). Further, it is well known that severe meteoric ionisation loss occurs below 90 km, HF radio-meteor echo durations only very rarely[2] exceeding 10^2s. Such characteristics[2] are in good accord with theoretical models[3] which show that for large meteors the ratios $\alpha/\alpha_{t=0}$ after only 10^3 s are 2×10^{-2} and 3×10^{-4} at 85 and 75 km respectively. Clearly quite unrealistically large meteors incident in a critically small volume of the atmosphere are required to produce 474 absorption events yr^{-1}.

We may enquire as to the nature of the linear plots in Fig. 2 of ref. 1 which are attributed to the effects of ion diffusion, The lines have gradients of 1, $\frac{1}{2}$, $\frac{2}{5}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$. and $\frac{1}{6}$. Since this gradient is actually $1/t_r$ it seems very likely that the different lines (corresponding to t_r = 1, 2, 2.5, 3 s and so on) simply represent the details of data reduction and analysis.

Thus the interpretation of Sen and Saha[1] is quite incompatible with known meteor characteristics.

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