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Shorter Communication

SOME ERRORS WITH CARBON-14 DATING

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Archaeologists selecting material for carbon-14 dating, and in interpreting the results, are well aware that many organisms can remain well preserved for many years after their carbon-14 content is fixed and before they are incorporated into their prehistoric context. Dates resulting from the submission of such materials are of course too old by an unknown margin. Consequently, where they have a choice, field-workers have selected materials which could have grown at the most a few years prior to their use. Such materials as twigs, seeds and leaves, where they are preserved, have been regarded as more reliable for dating sites, more so than large pieces of charcoal which could come from the interior of substantial trees.

Results of some recent work on the stability of the quantity of carbon-14 in the atmosphere have strongly suggested that this preference should no longer be held. Measurements on organic materials from the last 100 years, each sample well dated to a particular year, have shown an 11-year cycle of variation in carbon-14 content (Baxter and Walton 1971: 105). This is closely correlated with the well-known solar cycle as reflected in sunspots and a causative relationship is very likely. The effect of this cycle is that, on the normal calculation basis, samples of material grown five years apart at the highest and lowest points of the atmospheric carbon-14 concentration, will show on average a date difference of greater than 200 years. Figure 1 shows an approximate probability curve of the error for a sample grown in any one year.

It is unfortunate that for the last 20 years since carbon-14 dating was first applied, this effect has been completely masked by nuclear bomb contamination completely altering the level of atmospheric carbon-14. There seems little doubt of its being a continuous effect as a similar variation has been observed in dating single rings in two ten-year sequences of tree rings, one from each of the last two millenia. Materials such as twigs and seeds have grown in spaces of time far shorter than 11 years and hence must be regarded as having an associated error similar to Fig. 1.

This effect can be overcome by dating material which is slower growing and has drawn its carbon directly or indirectly from the atmosphere for a longer period, preferably 11 years, but this will not usually be known. Provided they have incorporated a similar amount of material in each year, the resulting date should show only a little more than the normal statistical variation from that which could have been determined by averaging 11 determinations, one for each year of the cycle. Materials for dating, such as wood or charcoal from sapling sized pieces showing a good number of years' growth and bone collagen from large fauna, should now be regarded as the most reliable. One reservation should be noted for, in dense forests, young trees growing close to the forest floor have been observed to incorporate relatively dead carbon from the atmosphere enriched with carbon-dioxide from the bacteriological decay of old timber. Where large trees have been incorporated into a site and the bark or outermost rings are still in place, by taking a series of dates, near absolute dates seem to be possible (Suess and Strahm 1970: 91).

Besides the materials previously mentioned, dating materials such as freshwater shellfish will be affected, as will moa crop material, as it will reflect the material on which the bird was grazing or browsing. As the relatively slow interchange of carbon from the atmosphere to the sea should have buffered the effect there, marine materials should be fairly immune from these effects.

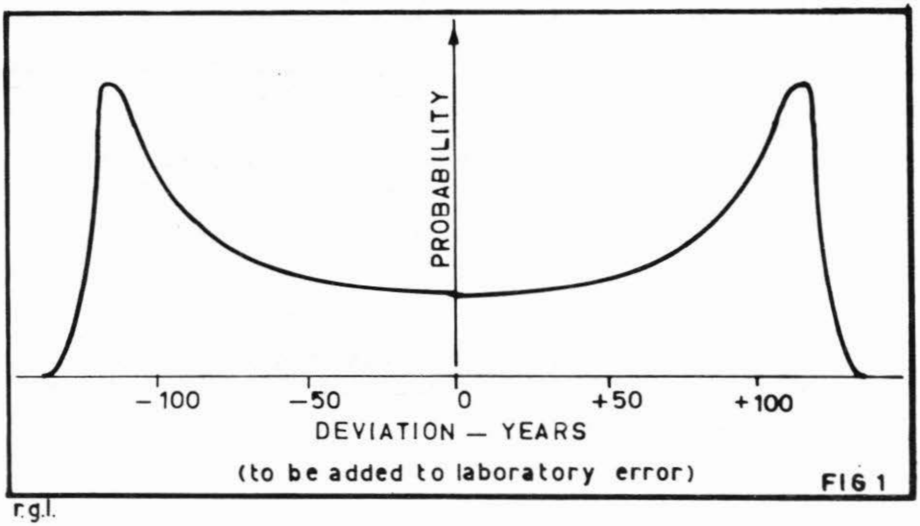

FIG 1

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Some other points are worthy of note:

1. The results of Baxter and Walton confirmed that, providentially, the N.B.S. standard now in universal use, correctly allows for the Suess industrial effect since 1890 and lies on the average for the 11-year cycle.

2. The work on bristle-cone pine, dating 10-year sequences of rings, should thus be free from this cyclic variation. The summary given recently by Neustupny (1970: 38) is still valid.

3. Some of the work on other trees uses dates from shorter sequences of rings. The scatter evident in the various curves showing the De Vries effect for the period of New Zealand prehistory may in part be due to this (see Shawcross 1969: 190).

4. Objective assessment of dates is impossible if sample descriptions have not been published. The current situation in New Zealand with so many dates in word-of-mouth circulation without laboratory numbers, sample descriptions, provenance descriptions and even standard errors is all the more regrettable.

REFERENCES

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