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# ACCURACY IN $C^{14}$ DATING

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Radiocarbon dating, first formulated by Libby in 1946, has been constantly refined in various ways since then, and no doubt refinements will continue to be made as long as this dating method maintains its importance. Apart from major improvements in the actual counting procedure, extension of the time range, narrowing of the margin of error, reduction in sample size and diversification of materials actually dated, the system's basic assumptions have also received close attention. Results of work on one of these assumptions have suggested the need for changes in some of the earlier radiocarbon determinations.[1]

It was assumed in the early days of radiocarbon dating that Carbon 14, the relatively short-lived isotope of ordinary Carbon used in measuring a sample's relative radioactivity, was being produced by cosmic radiation at a constant rate. Allowing for a steady rate of decay and production of C14, it was thought that atmospheric concentrations of this isotope should be in equilibrium. Once this C14 is removed from the atmosphere and incorporated, with ordinary Carbon, in the structure of living organisms, it would decay so that its proportion to ordinary Carbon would reduce as the organic remains became older. Standard adjustments for the quantitive variations in atmospheric C12 (ordinary Carbon) from industrial causes and C14 from nuclear explosions are already allowed for in assessing "normal" C12-C14 ratios. However, recent results[2] indicate that long term changes for the occurrence of C14 may also need to be taken into account in arriving at an actual calendrical date. Jansen,[1] working on C14 dates of selected sets of rings from a Kauri tree section, counted by three independent workers whose results showed only a 26 year discrepancy, has shown anomalies between C14 dates and those arrived at by ring-counting. He believes these anomalies can arise from several contributory causes but not from any error in the ring counts. The anomalies could arise from: 1. The tree not having absorbed a representative sample of atmospheric C14 while it was growing. 2. New Zealand atmospheric disturbances, which are gradually being restored to equilibrium since 1030 A.D. 3. An actual change in the C12-C14 ratio since 1030 A.D. due to cosmic radiation fluctuations. As a result he has drawn up a scale of changes for previously assessed samples, the effect of which will be to reduce the age of samples from before about 1650 A.D. and to increase their age after this date.

The period necessary for C14 to be reduced to half its radioactivity is its half-life. Estimates for this half-life have been made ranging from 4700 to 7200 years, with the Libby half-life at 5568 ± 30 being the most widely used. Now the American National Bureau of Standards has announced a new half-life at 5760 +70 -30 years.[3] Thus it is of great importance to know not only the variables mentioned above, but also which of the various figures for the C14 half-life were used when comparing dates. On the other hand, despite variations in estimates of half-life and changes in atmospheric concentrations of C14, an "effective"[4] half-life can be established by dating samples of a known age. These in turn will provide the necessary data for aging samples that exhibit the same C14-C12 ratio. For this reason it will be desirable to have more readings such as Jansen's so that "effective" ages for samples from the whole range of New Zealand prehistory can be given more precisely.

References

(1) Jansen, H.S. 1962. "Comparison Between Ring Dates and 14C Dates in Kauri". N.Z. Journal of Science. Vol.5. No.1.

(2) Willis H.E. et al. 1960. "Variations in Atmospheric Carbon Over the Last 1300 Years". American Journal of Science, Radio Carbon Supplement 2,1.

(3) Ralph, E.K. 1961. "Radiocarbon "effective" Half-life for Maya Calendar Correlations". American Antiquity. Vol.27. No.2. p229.

(4) Ibid. p229.