## Calibration:

The production rate of ^{14}C has not been constant over past time. This was recognized when radiocarbon ages were seen to be incorrect for historically dated Egyptian wood artifacts and also for wood dated by dendrochronology. Dendrochronology dates wood samples in which the pattern of growth rings is visible. These patterns are matched to library sample patterns of overlapping ages. The California Bristlecone pine and the European oak chronologies are in good agreement from the present to 7000 BC.

In 1985 a major international project produced a calibration curve based on wood samples well dated by dendrochronology. Without calibration, a radiocarbon age in the period 7000 BC - 4000 BC would be about 800 years too young. From 500 AD - 1300 AD the radiocarbon ages would be too old, by up to 150 years.

The calibration curve has numerous small and large wiggles. Some radiocarbon ages cut the curve at more than one calendar date. The dating of linen threads from the Shroud of Turin is an example. At 95% confidence, the radiocarbon age determined by experiment (by three laboratories) was 691 ± 62 years. The possible calendar dates are 1260-1310 AD and 1355-1385 AD. Figure 3 gives an approximation of the calibration curve at that age.

Contamination:

The effect of sample contamination during treatment is most exaggerated for the oldest samples. A sample of age 17 000 years which is contaminated with 1% of modern carbon will give an age of about 16 400 years. A sample of age 34 000 years which is contaminated with 1% of modern carbon will give an age of about 30 000 years. Contamination during treatment is a major limitation

FIGURE 3
A Region of the Calibration Curve of Radiocarbon Age with Calendar Date
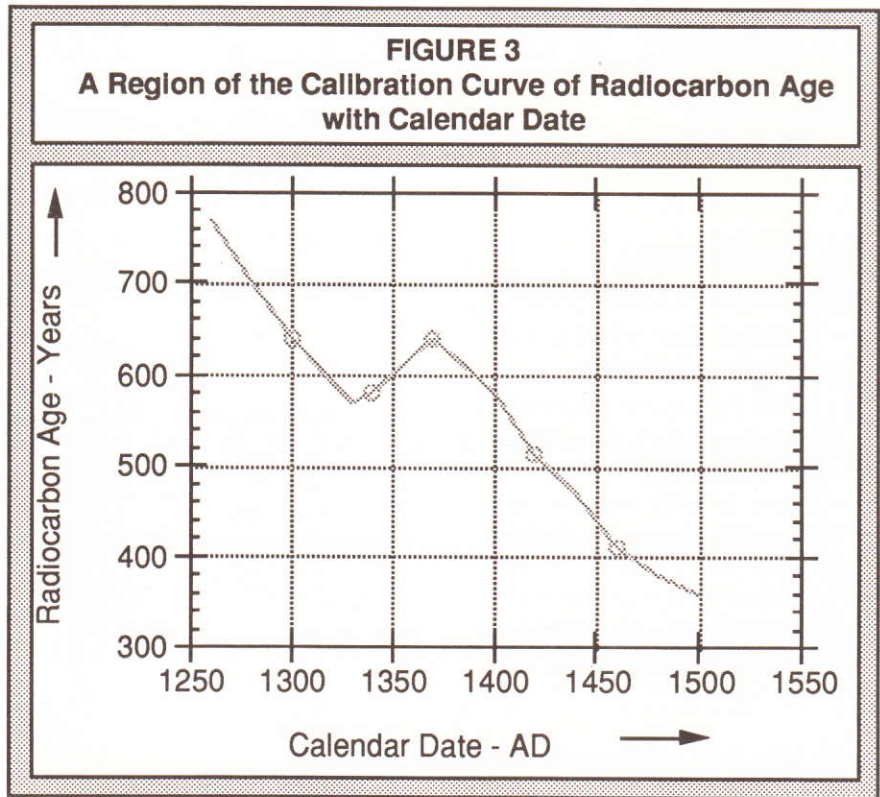
on the age of samples which may be studied (about 50 000 years old).

The same principle applies to contamination which has occurred in the past or during excavation. The AMS method, applied to different small parts of a sample, can often resolve this difficulty.

Nuclear Weapons Testing (Bomb Carbon):

Neutrons produced by atmospheric testing in the years around 1960 are estimated to have produced an extra several tonnes of radiocarbon. When this is totally mixed with the deep ocean, the excess will be only a few percent of normal. But in the mid 1970s the atmospheric loading was approximately double normal.

This has no effect on dating of pre-bomb samples, but it will perhaps puzzle archeologists in the distant future. The bomb carbon effect was used to study the rate of mixing of

atmospheric ^{14}C into the carbon reservoir, using a well dated series of malt whisky samples.