

# Radiocarbon

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## HIGH-PRECISION CALIBRATION OF THE RADIOCARBON TIME SCALE, AD 1950-500 BC

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### INTRODUCTION

Radiocarbon ages of dendrochronologically-dated wood spanning the last 4500 years were determined at both the Seattle and Belfast laboratories. The combined results are reported in this issue of *RADIOCARBON* in two papers, with this paper covering the AD 1950-500 BC interval, and the twin (Pearson & Stuiver, 1986) covering the 500 BC-2500 BC interval.

Specific discussion of detail effecting only one of the two laboratories is given in the paper which has, as the premier author, the person responsible for the particular laboratory's measurement. Factors effecting both laboratories can be in either paper, but are carefully referenced to the other. Outline details are given in both papers.

The construction of a calibration curve from  $^{14}\text{C}$  ages with statistically limited precision is not a simple matter. Not only should the standard error in the determination be as small as possible, but the calculation of this error also has to be realistic in that it should account for all variability encountered in the laboratory procedures. Independent dendrochronologic calibration of the samples is also a must. Proof of accuracy has to come from a comparison of the results obtained in two or more facilities. It will be shown that the results obtained in Seattle and in Belfast on wood of the same age, but from different regions, give consistent replication within the quoted errors over the entire interval. The aspects of replication are first discussed, and are followed by the detailed calibration curves and tables.

### DENDROCHONOLOGY AND SAMPLE TREATMENT

The trees used at Seattle for the AD interval were either Douglas Fir (*Pseudotsuga menziesii*) from the US Pacific Northwest, or Sequoia (*Sequoiadendron giganteum*) from California. Dendrochronologic work on these materials was discussed in Stuiver (1982). Most of the BC material measured in Seattle was obtained from Becker's South German Donau series (Becker, 1983). The amount of wood available near 500 BC was limited, and here the Seattle laboratory measured samples from the Irish Oak

chronology (Pilcher *et al.*, 1984). All Belfast measurements are on oak wood from this chronology, except for a few samples that came from Scotland and northern England (Pearson & Stuiver, 1986).

The Seattle wood samples were either 1) treated with dilute NaOH and HCl solutions to remove resins, sugars, and a portion of the lignin (de Vries method, Stuiver & Quay, 1980) or 2) subjected to a more rigorous extraction yielding alpha cellulose. The cellulose preparation procedure is similar to the  $^{13}\text{C}$  sample treatment given in Stuiver, Burk and Quay (1984), with slight modifications due to the bulk of the  $^{14}\text{C}$  samples. The de Vries method does not remove all components added after the year of growth, but our experiments show that the influence on a  $^{14}\text{C}$  age of the incomplete removal of late additions is limited to 2 or 3  $^{14}\text{C}$  years (Stuiver & Quay, 1981). All Belfast samples were pretreated to reduce the sample to cellulose of which the details are given in the twin paper (Pearson & Stuiver, 1986). The treatment given to the Seattle samples is listed in Table 2.

### TECHNIQUE AND LABORATORY REPRODUCIBILITY

By the early 1970s the counting of large numbers of samples with improved precision (ca 30 years for the standard error based on counting statistics alone) was applied at the Universities of Washington (Seattle), Miami, and Heidelberg to ocean water samples collected on the GEOSECS and METEOR cruises. The systematic high-precision measurements (standard errors in the 12- to 20-year range) of wood samples began at Seattle (M Stuiver) in December 1973, at Belfast (G W Pearson) in 1975, and at Heidelberg (K O Münnich) and Groningen (W G Mook) in 1977.

Different techniques are applied in Seattle and Belfast.  $\text{CO}_2$  gas proportional counters are used at Seattle (Stuiver, Robinson & Yang, 1979), whereas the liquid scintillation counting of benzene is applied at Belfast (Pearson, 1983). The true error in the measurement of the  $^{14}\text{C}$  activity of a sample is only partially determined by the propagated statistical uncertainty in the number of counts accumulated for the sample and standards. This counting uncertainty is expressed as a standard deviation which is

equal to the square root of the number of accumulated counts. Other factors sometimes more significant also play a role in the measuring process and will increase the standard deviation calculated from counting statistics alone. An exhaustive study of the parameters contributing to the error in  $^{14}\text{C}$  measurements has been made for the Belfast liquid scintillation counting system (Pearson, 1979, 1980; Pearson *et al.*, 1986). Taking into account the full spectrum of known uncertainties, the mean quoted error in a set of 55 individual measurements was determined to be 15.4 years at Belfast. However, replicate analysis of these samples at varying time intervals and assuming constant efficiency based on a mean standard count rate gives a calculated standard deviation of 19.0 years, suggesting that for a long-term series of measurements the quoted error is underestimated by ca 23% (Pearson *et al.*, 1986). The ratio  $K = 19.0/15.4$  or 1.23 is designated the "error multiplier" and is a convenient, if not the most accurate method of correcting for the inability to define exactly a sample counting efficiency and/or background even after all applicable corrections have been applied. All Belfast data used in this paper include the 1.23 error multiplier.

The traditionally quoted Seattle  $^{14}\text{C}$  age error is based on the counting statistics of sample and standards only. The following estimates of the Seattle  $K$  value are available: 1) From a set of 30 comparisons of pairs of contemporaneous wood samples of different trees, all measured in the Seattle laboratory,  $K = 1.53$  (Stuiver, 1982). The 1.53 value is an upper limit for laboratory reproducibility because part of the differences may also be due to differences in tree  $^{14}\text{C}$  activity. 2) Tree-ring samples are usually counted for 4 days at Seattle. Samples are counted only once, but recounts are made when the measured sample activity deviates more than expected (eg, in a series of 6 samples the measured activity of 5 samples demonstrates a monotonic increase, but the 6th sample deviates). Seventy-five of these comparisons yielded  $K = 1.62$ . Again, this is an upper limit for laboratory reproducibility because there is a certain bias towards "outliers" in this data set.

From the above reproducibility tests we derive an error multiplier approaching 1.6 for Seattle. A rather "generous"  $K$  value of 1.6 has been incorporated in all Seattle data used in this paper. A more detailed discussion of the validity and accuracy of  $K$  factors is given elsewhere in this issue (Stuiver *et al.*, 1986).

#### SYSTEMATIC DIFFERENCES BETWEEN LABORATORIES

The samples measured in the Belfast and Seattle laboratories span, respectively, 20-year and 10-year intervals. The mid-point of the Belfast samples occasionally may change from its 20-year rhythm by 10 years because successive 20-year blocks of wood were not always available. The starting years of the Seattle decadal wood and the Belfast bi-decadal wood also may differ (eg, a Seattle decade may start at 1971 BC and the corresponding Belfast bi-decade at 1970 BC). There also has been an adjustment in dendrochronologic ages of some of the German oak samples which resulted in a shift of 71 years of "decadal" samples (Pilcher *et al.*, 1984). The differences in timing are relatively small, however, and we have been able to

average the Seattle decadal  $^{14}\text{C}$  ages in such a manner that the mid-point of a Seattle bi-decade differs only in a few instances (see Table 1) by more than 1.5 years from the mid-point of the corresponding Belfast sample.

The weighted mean  $^{14}\text{C}$  age difference of the Seattle and Belfast bi-decadal data set is  $-0.6 \pm 1.6$  years (with number of comparisons  $n = 214$ ). Positive values for the mean indicate a younger Seattle data set. For the AD interval the difference is  $2.6 \pm 2.3$  yr ( $n = 90$ ); for the BC portion it is  $-3.4 \pm 2.1$  ( $n = 124$ ). Clearly, the systematic differences in  $^{14}\text{C}$  age are negligible between both laboratories.

The wood used to construct the calibration curve was collected from three geographic regions: Ireland, southern Germany, and the west Pacific coastal region of the United States. Irish oak wood, measured in Belfast, differs from German oak wood, measured in Seattle by  $-4.2 \pm 2.4$  yr ( $n = 106$ ). Belfast-measured Irish oak wood differs from Seattle-measured US wood (Sequoia and Douglas Fir) by  $2.4 \pm 2.3$  years ( $n = 87$ ), and duplicate samples of Irish wood gave a mean difference between both laboratories of  $3.2 \pm 6$  yr ( $n = 7$ ).

The above results indicate that 1) systematic  $^{14}\text{C}$  age differences are a few years or less between the Belfast and Seattle laboratories, and 2)  $^{14}\text{C}$  ages of wood of the same age from Ireland, south Germany, and the north-west United States differ, on average, by only a few years.

#### SEATTLE-BELFAST COMPARISON OF VARIANCE

Proof was given in the preceding section that the systematic difference between the Belfast and Seattle  $^{14}\text{C}$  determinations is negligible. It remains to be proven that the laboratory standard deviation in the single measurements is a realistic one.

Histograms of analytical results from repeat analyses of the same sample usually follow the normal (Gaussian) distribution. The procedures followed in determining a  $^{14}\text{C}$  age may lead to a slight departure from the Gaussian distribution, resulting in some broadening at the top. For the calculations given here all variance is considered to be of the Gaussian variety.

The average Belfast standard deviation (which includes the 1.23 error multiplier) of the bi-decadal samples is 18.5 yr. For the Seattle bi-decadal averages the average standard deviation (which includes the 1.6 error multiplier) is 14.7 yr. The weighted average standard deviation in the  $^{14}\text{C}$  age differences of contemporaneous samples, as measured in Seattle and Belfast, and calculated from the laboratory errors, is 22.9 yr.

The actual differences in  $^{14}\text{C}$  ages ( $n = 214$ ) are given in Figure 3. The Gaussian distribution for a 22.9-yr standard deviation is given by the solid curve. The observed sample variance yields a standard deviation of 25.6 years, which is only 1.12 times the predicted 22.9 years.

A portion of the 12% difference between observed and predicted standard deviation must be due to actual differences in wood  $^{14}\text{C}$  activity. There are small differences in mid-point age of the "contemporaneous" 20-yr blocks of up to 1.5 yr. There are also differences in ring-thickness  $^{14}\text{C}$  distribution between the Belfast and Seattle samples. For instance, if the first 5

yr of bi-decadal block A are relatively narrow, but wide in contemporaneous block B, the average  $^{14}\text{C}$  activity of both samples may differ when the sample covers an interval of variable atmospheric  $^{14}\text{C}$  levels. Of course, there could also be errors in wood splitting and dendrochronology.

The variance difference of  $25.6^2 - 22.9^2 \text{ yr}^2$  gives an additional error source with a standard deviation of 11 yr that includes the differences in wood  $^{14}\text{C}$  activity. We conclude:

1) The laboratory standard deviations assigned by both laboratories account for nearly 90% of the standard deviation in the end result.

2) The remaining 10% not accounted for by the laboratory measuring process includes the variability introduced by differences in wood  $^{14}\text{C}$  activity.

The additional variance introduced by wood  $^{14}\text{C}$  differences is so small that it has been neglected in the construction of the calibration curves. Increasing the standard deviation in the bidecadal means by 12% would have increased the 12.1-yr average standard deviation to 13.5 yr only.

#### CONSTRUCTION OF RADIOCARBON AGE CALIBRATION CURVES

The calibration curves were constructed from the set of  $^{14}\text{C}$  ages obtained for samples each spanning a 20-yr interval, with some exceptions as noted in the Table 1 heading. The cal AD/BC (or cal BP) ages follow the mid-points of the Belfast bi-decadal series whenever possible, starting in AD 1840. The AD 1940–AD 1860 data set is based on the Seattle data alone; all other  $^{14}\text{C}$  ages are based on the weighted Belfast/Seattle averages except when Belfast skipped a decade. Here the gaps were filled by averaging 30-yr blocks of Seattle data (see Table 1).

As discussed previously, the standard deviations in the  $^{14}\text{C}$  age determinations of each laboratory are based on the reproducibility of the measurements within each laboratory and are larger than the errors usually quoted by both laboratories. For Belfast, where additional factors are used to calculate the routinely reported standard deviation beyond the counting statistics, the reproducibility tests indicate an error multiplier of 1.23. For Seattle, where the routinely reported standard deviations include only the error derived from counting statistics, the error multiplier is 1.6.

The standard deviation assigned to the curve (the vertical difference between center and outer curve) accounts for nearly 90% of the demonstrated standard deviation in the  $^{14}\text{C}$  age differences of both laboratories. The mean standard deviation reported with the curves is 12.1 yr and is solely based on the Belfast and Seattle measuring reproducibility. The variance in the differences in  $^{14}\text{C}$  ages of contemporaneous samples measured independently in Belfast and Seattle indicate a measure of uncertainty that is equivalent with an average standard deviation of 13.5 yr.

The wood used for the  $^{14}\text{C}$  measurements came from the western United States, Ireland, and southern Germany (Table 2). Oak wood was used for the European chronologies (Becker, 1983; Pilcher *et al.*, 1984) and Douglas Fir and Sequoia for the US portion. In the preceding sections it was shown that contemporaneous wood from these trees differed, on average, by only a few  $^{14}\text{C}$  years. Thus, although the curves are based on wood

from different trees, identical results would have been obtained if all measurements had been made on a single tree from one locality.

#### THE AGE ERROR REPORTED WITH THE RADIOCARBON DATE

The international  $^{14}\text{C}$  community follows strict calculation procedures when determining a conventional  $^{14}\text{C}$  age (Stuiver & Polach, 1977). Unfortunately, age error calculations are much less bound by rules.

The error in any laboratory determination is a composite of 1) the Poisson statistical error based on the number of counts observed for sample and standards, assuming constant counting conditions, and 2) the errors associated with factors that cause deviation from the above constant counting conditions and other non-systematic errors which affect the reproducibility of the laboratory results. The latter can be derived from replicate sample measurements. Attempts to determine systematic errors are rarely made by the  $^{14}\text{C}$  community. The reported sample age error (one standard deviation) is often based solely on Poisson statistics in the number of registered sample and standard counts. Such a substitute for a repeat-measurement derived standard deviation leads to an underestimate because it neglects other factors that add to the variance (Pearson, 1979, 1983).

When identical tree-ring samples (with approximate ages of ca 5000  $^{14}\text{C}$  yr) were measured by 20 laboratories (International Study Group, 1982) it was found that the reproducibility standard deviations in the submitted data set were substantially higher than the age errors reported by the laboratories. Systematic errors ranged from  $< 20$  yr (3 laboratories) to 200 yr (1 laboratory).

When comparing the reproducibility standard deviation (obtained after removal of off-sets from the data set) with the laboratory reported error  $\sigma$  it was found that  $\sigma$  had to be multiplied with 1.3 for  $\sigma < 20$  yr, with ca 2.0 for  $\sigma$  in the 20- to 80-yr range, and with 1.0 for  $\sigma > 80$  yr (International Study Group). These multipliers are strictly laboratory-related and in principle independent of the magnitude of  $\sigma$ . Additional information on systematic errors is available for a set of samples in the 7000 to 8000  $^{14}\text{C}$  yr range measured in Seattle, La Jolla, Heidelberg, and Tucson (Stuiver *et al.*, 1986). Off-sets of  $29 \pm 10$ ,  $27 \pm 12$  and  $52 \pm 8$  yr were found, respectively, for Seattle-La Jolla, Seattle-Heidelberg, and Seattle-Tucson comparisons.

The above studies indicate that systematic errors may exist, and that the reported standard deviation of a  $^{14}\text{C}$  age measurement is usually too low. The degree of under-reporting has only been determined so far for 20 odd laboratories for samples ca 5000  $^{14}\text{C}$  yr old. Unfortunately, the error multipliers determined in the above international group study cannot be applied to all age ranges because the multiplier values are age-dependent (Stuiver *et al.*, 1986). Error multipliers also may change from year to year (or even day to day) at a specific laboratory with improving (or deteriorating) experimental conditions. It is recommended that the user of a  $^{14}\text{C}$  date obtain additional information on reproducibility and systematic error determinations from the reporting laboratory. This information should lead to a realistic standard deviation in the age (based on repeat measure-

ments of test samples) although care must be taken in its use, particularly when determining  $2\sigma$  and  $3\sigma$  probabilities. Limitations on systematic error size also should be provided. A systematic error, of course, should not be part of the regular  $\pm$  reported with the date.

In the absence of the above information, the user can only take as the  $^{14}\text{C}$  age error the actual reported  $\sigma$ , with the understanding that this error is usually too small. In case the user would take twice the reported standard deviation it should be realized that 1) for some laboratories the actual error may be smaller than  $2\sigma$ , and 2) statistical rules (such as stating that only 1 event out of 20 would be outside  $2\sigma$  bounds) are not valid because, after all, the original  $\sigma$  is not a properly-defined standard deviation in many instances.

#### CALIBRATION INSTRUCTIONS

The Figure 1 calibration curves consist of three lines. The center line is the actual calibration curve whereas the outer lines indicate the one-sigma (standard deviation) uncertainty in the calibration curve. The calibration curve depicts the (non-linear) transformation of  $^{14}\text{C}$  ages to calibrated AD/BC (or BP) ages. The nomenclature adopted for the dendro (calendar) year time scale is cal AD/BC or cal BP. The cal AD/BC ages are plotted along the lower horizontal axis and the cal BP ages along the upper one.

Cal BP ages are relative to the year AD 1950, with 0 cal BP equal to AD 1950. The relationship between cal AD/BC and cal BP ages is simple: cal BP = 1950 - cal AD, and cal BP = 1949 + cal BC. The switch from 1950 to 1949 when converting BC ages is caused by the absence of the zero year in the AD/BC chronology (when progressing from 1 BC to 1 AD, the cal BP ages should be without a gap).

The conversion of a  $^{14}\text{C}$  age to a cal age is straightforward: 1) Draw a horizontal (parallel to the bottom axis) line (A) through the  $^{14}\text{C}$  age to be converted, and 2) draw vertical lines through the intercept(s) of line A and the calibration curve (center line). The cal AD/BC ages can be read at the bottom axis, the cal BP ages at the top. A single  $^{14}\text{C}$  age can correspond with multiple cal ages, due to past changes in atmospheric  $^{14}\text{C}$  levels (see Stuiver, 1982 for illustration).

The user has to determine the calibrated ages from the Figure 1 graphs by drawing lines. An alternate approach is the use of Table 3, where the cal ages are listed for  $^{14}\text{C}$  ages that increase by 20-yr steps. Obviously, the user has to interpolate between the 20-yr steps of  $^{14}\text{C}$  ages and sigmas if further fine tuning is desired.

The conversion of the standard error in the  $^{14}\text{C}$  age into a range of cal AD/BC (BP) ages is more complicated. The user should first determine whether he/she wants to use 1) the laboratory-quoted error (see previous section for a discussion), or 2) increase the quoted error by a known "error multiplier." Once the sample  $\sigma$  has been targeted, the curve  $\sigma$  (one standard deviation) should be read from the calibration curve by taking the difference in  $^{14}\text{C}$  years between center curve and outer curve(s) in Figure 1. The curve  $\sigma$  and sample  $\sigma$  should then be used to calculate total  $\sigma = \sqrt{(\text{sample } \sigma)^2 + (\text{curve } \sigma)^2}$  (Stuiver, 1982).

Horizontal lines should now be drawn through the  $^{14}\text{C}$  age + total  $\sigma$ ,

and  $^{14}\text{C}$  age - total  $\sigma$  value. The vertical lines, drawn through the intercepts with the CENTRAL curve, yield the outer limits of possible cal AD/BC (or BP) ages that are compatible with the sample standard deviation.

The above procedure was used to derive the "ranges" of cal AD/BC (BP) ages listed in Table 3.

The conversion procedure yields 1) single or multiple cal AD/BC (BP) ages that are compatible with a certain  $^{14}\text{C}$  age, and 2) the range(s) of cal ages that corresponds to the standard deviation in the  $^{14}\text{C}$  age. The probability that a certain cal age is the actual sample age may be quite variable within the cal age range. Higher probabilities are encountered around the intercept ages. Low, or near zero probabilities are encountered when part of the calibration curve 'snakes' outside the total  $\sigma$  boundaries. The non-linear transform of a Gaussian standard deviation around a  $^{14}\text{C}$  age into cal AD/BC (BP) ages leads to a very complex probability distribution that can only be calculated with the aid of computers. We are currently developing suitable programs for these probability calculations, and plan to make these programs available in the near future.

The calibration data presented in this paper are to be used for samples formed in isotopic ( $^{14}\text{C}$ ) equilibrium with atmospheric  $\text{CO}_2$ . Although the wood samples were collected from specific regions (Ireland, Germany, and western USA) the calibration data can be used for a large part of the Northern Hemisphere (Stuiver, 1982). However, systematic age differences are possible for Southern Hemispheric samples where  $^{14}\text{C}$  ages of wood samples tend to be ca 30 yr older (Lerman, Mook & Vogel, 1970; Vogel, Fuls & Visser, 1986). Thus,  $^{14}\text{C}$  ages of Southern Hemispheric samples should be reduced by 30 years before being converted into a cal AD/BC (BP) age.

#### SMOOTHING OF THE CALIBRATION CURVE

The Figure 1 points have a 20-yr time separation, *ie*, the calibration points are the mid-points of wood samples spanning 20 years. Samples submitted for dating may cover shorter (eg, seed samples) or longer intervals (eg, lake sediment samples). The decadal calibration results of the Seattle laboratory are available when better time resolution is needed (Stuiver & Becker, 1986). If less resolution is desired, the Figure 2 curves can be used. Here, a 5-point moving average (usually identical with a 100-yr moving average of the Figure 1 data set) was used to construct the curves. A single line is given in Figure 2 because the uncertainty in the 5-point moving average is only a few  $^{14}\text{C}$  years. The instructions for determining the cal AD/BC (BP) ages are listed in the preceding section. Samples falling outside the ranges covered by the twin papers (Stuiver & Pearson, 1986; Pearson & Stuiver, 1986) can be provisionally converted using the curves provided by Pearson *et al* (1986) employing the same method outlined above.

#### MARINE SAMPLE AGES

The calibration curves should be applied only for age conversion of samples that were formed in equilibrium with atmospheric  $\text{CO}_2$ . Conventional  $^{14}\text{C}$  ages of materials not in equilibrium with atmospheric reservoirs do not take into account the off-set in  $^{14}\text{C}$  age that may occur (Stuiver & Polach, 1977). This off-set, or reservoir deficiency, has to be deducted from

the reported age before any attempt can be made to convert to cal AD/BC (BP) ages. The reservoir deficiency is time-dependent for the mixed layer of the ocean. Model-calculated calibration curves for marine samples are listed separately in this volume (Stuiver, Pearson & Braziunas, 1986).

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## REFERENCES

- Becker, B, 1983, The long-term radiocarbon trend of the absolute oak tree-ring chronology, 2800–800 BC, *in* Stuiver, M and Kra, R S, eds, Internatl <sup>14</sup>C conf, 11th, Proc: Radiocarbon, v 25, no. 2, p 197–203.
- International Study Group, 1982, An inter-laboratory comparison of radiocarbon measurements in tree rings: *Nature*, v 298, p 619–623.
- Lerman, J C, Mook, W G and Vogel, J C, 1970, C<sup>14</sup> in tree rings from different localities, *in* Olsson, IU, ed, Radiocarbon variations and absolute chronology, Nobel symposium, 12th, Proc: New York, John Wiley & Sons, p 275–299.
- Pearson, G W, 1979, Precise <sup>14</sup>C measurement by liquid scintillation counting: *Radiocarbon*, v 21, no. 1, p 1–21.
- 1980, High precision radiocarbon dating by liquid scintillation counting applied to radiocarbon timescale calibration, *in* Stuiver, M and Kra, R S, eds, Internatl <sup>14</sup>C conf, 10th, Proc: Radiocarbon, v 22, no. 2, p 337–345.
- (ms) 1983, The development of high precision <sup>14</sup>C measurement and its application to archaeological time-scale problems: PhD dissert, The Queen's Univ Belfast.
- Pearson, G W, Pilcher, J R, Baillie, M G, Corbett, D M and Qua, F, 1986, High-precision <sup>14</sup>C measurement of Irish oaks to show the natural <sup>14</sup>C variations from AD 1840–5210 BC, *in* Stuiver, M and Kra, R S, eds, Internatl <sup>14</sup>C conf, 12th, Proc: Radiocarbon, this issue.
- Pearson, G W and Stuiver, M, 1986, High-precision calibration of the radiocarbon time scale, 500 BC–2500 BC, *in* Stuiver, M and Kra, R S, eds, Internatl <sup>14</sup>C conf, 12th, Proc: Radiocarbon, this issue.
- Pilcher, J R, Baillie, M G L, Schmidt, B and Becker, B, 1984, A 7,272-year tree-ring chronology for western Europe: *Nature*, v 312, p 150–152.
- Stuiver, M, 1982, A high-precision calibration of the AD radiocarbon time scale: *Radiocarbon*, v 24, no. 1, p 1–26.
- Stuiver, M and Becker, B, 1986, A decadal high-precision calibration curve, *in* Stuiver, M and Kra, R S, eds, Internatl <sup>14</sup>C conf, 12th, Proc: Radiocarbon, this issue.
- Stuiver, M, Burk, R L and Quay, P D, 1984, <sup>13</sup>C/<sup>12</sup>C ratios in tree rings and the transfer of biospheric carbon to the atmosphere: *Jour Geophys Research*, v 89, p 11,731–11,748.
- Stuiver, M, Kromer, B, Becker, B and Ferguson, C W, 1986, <sup>14</sup>C age calibration back to 13,300 yr BP and the <sup>14</sup>C age matching of the German oak and US bristlecone pine chronologies, *in* Stuiver, M and Kra, R S, eds, Internatl <sup>14</sup>C conf, 12th, Proc: Radiocarbon, this issue.
- Stuiver, M, Pearson, G W and Braziunas, T, 1986, Radiocarbon age calibration of marine samples back to 9000 cal yr BP, *in* Stuiver, M and Kra, R S, eds, Internatl <sup>14</sup>C conf, 12th, Proc: Radiocarbon, this issue.
- Stuiver, M and Polach, H A, 1977, Discussion: Reporting of <sup>14</sup>C data: *Radiocarbon*, v 19, no. 3, p 355–363.
- Stuiver, M and Quay, P D, 1980, Changes in atmospheric carbon-14 attributed to a variable sun: *Science*, v 207, p 11–19.
- 1981, Atmospheric <sup>14</sup>C changes resulting from fossil fuel CO<sub>2</sub> release and cosmic ray flux variability: *Earth Planetary Sci Letters*, v 53, p 349–362.
- Stuiver, M, Robinson, S W and Yang, I C, 1979, <sup>14</sup>C dating to 60,000 years BP with proportional counters, *in* Berger, R and Suess, H E, eds, Radiocarbon dating, Internatl <sup>14</sup>C conf, 9th, Proc: Berkeley, Univ California Press, p 202–215.
- Vogel, J C, Fuls, A and Visser, E, 1986, Radiocarbon fluctuations during the 3rd millennium BC, *in* Stuiver, M and Kra, R S, eds, Internatl <sup>14</sup>C conf, 12th, Proc: Radiocarbon, this issue.

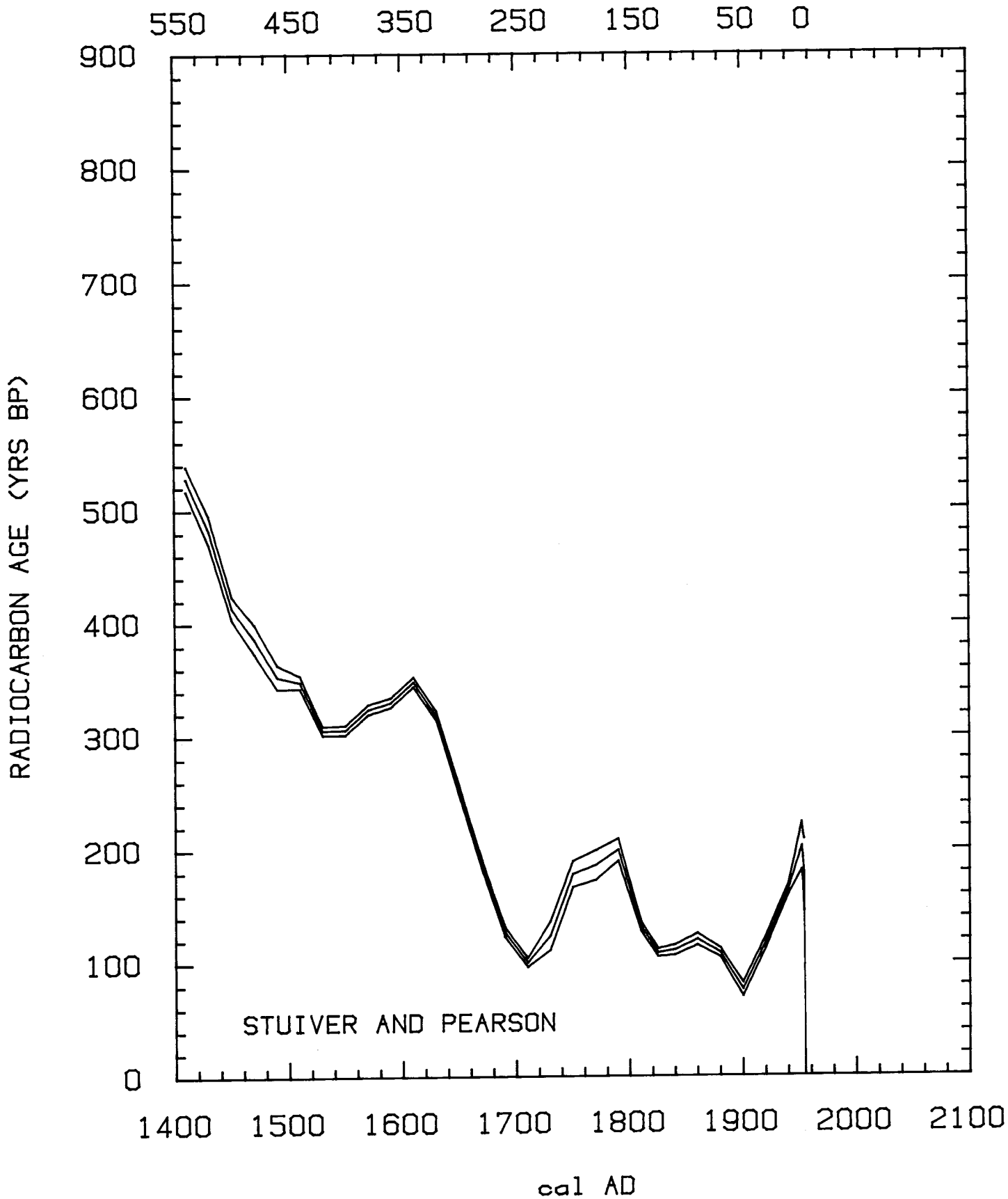


Fig 1A

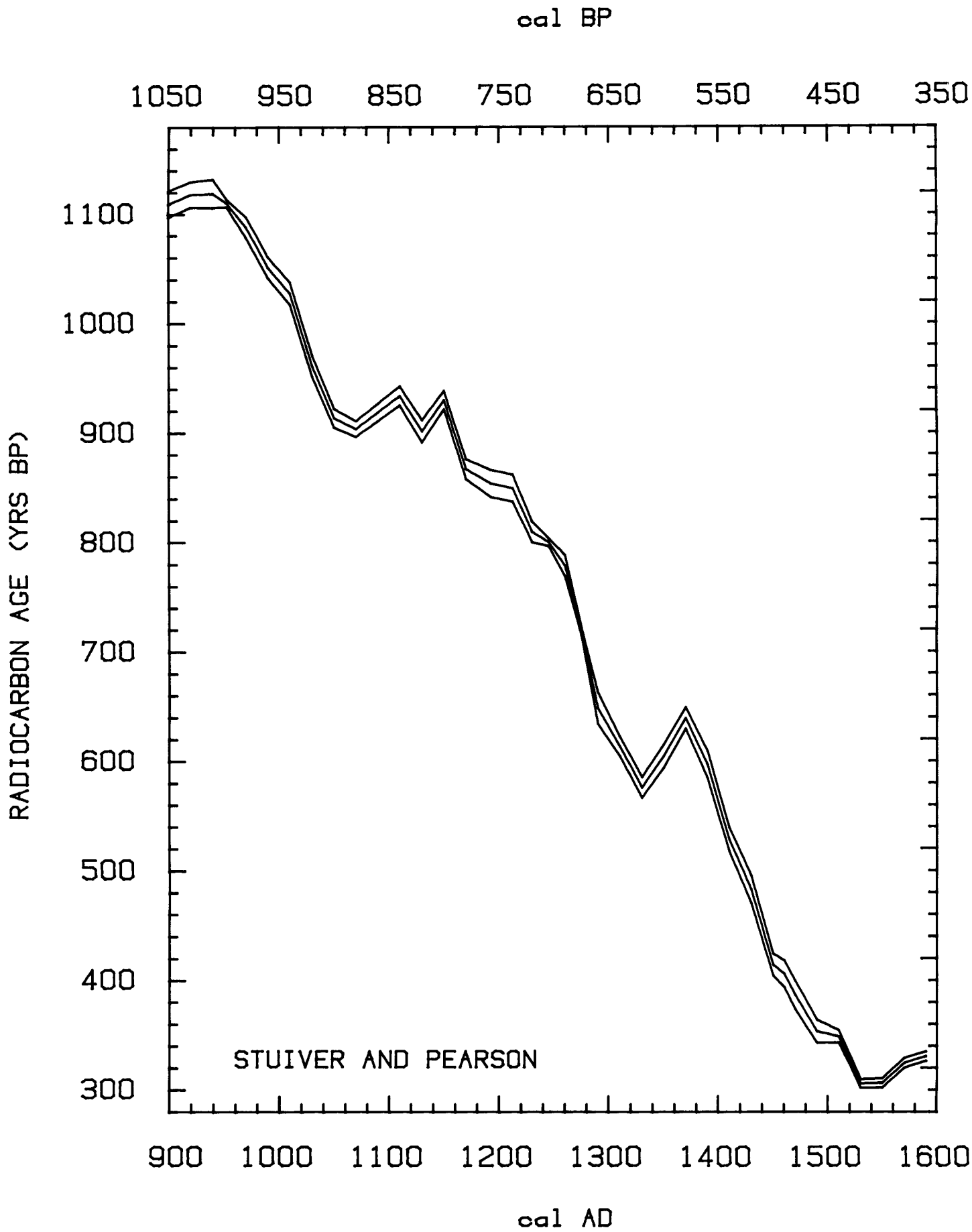
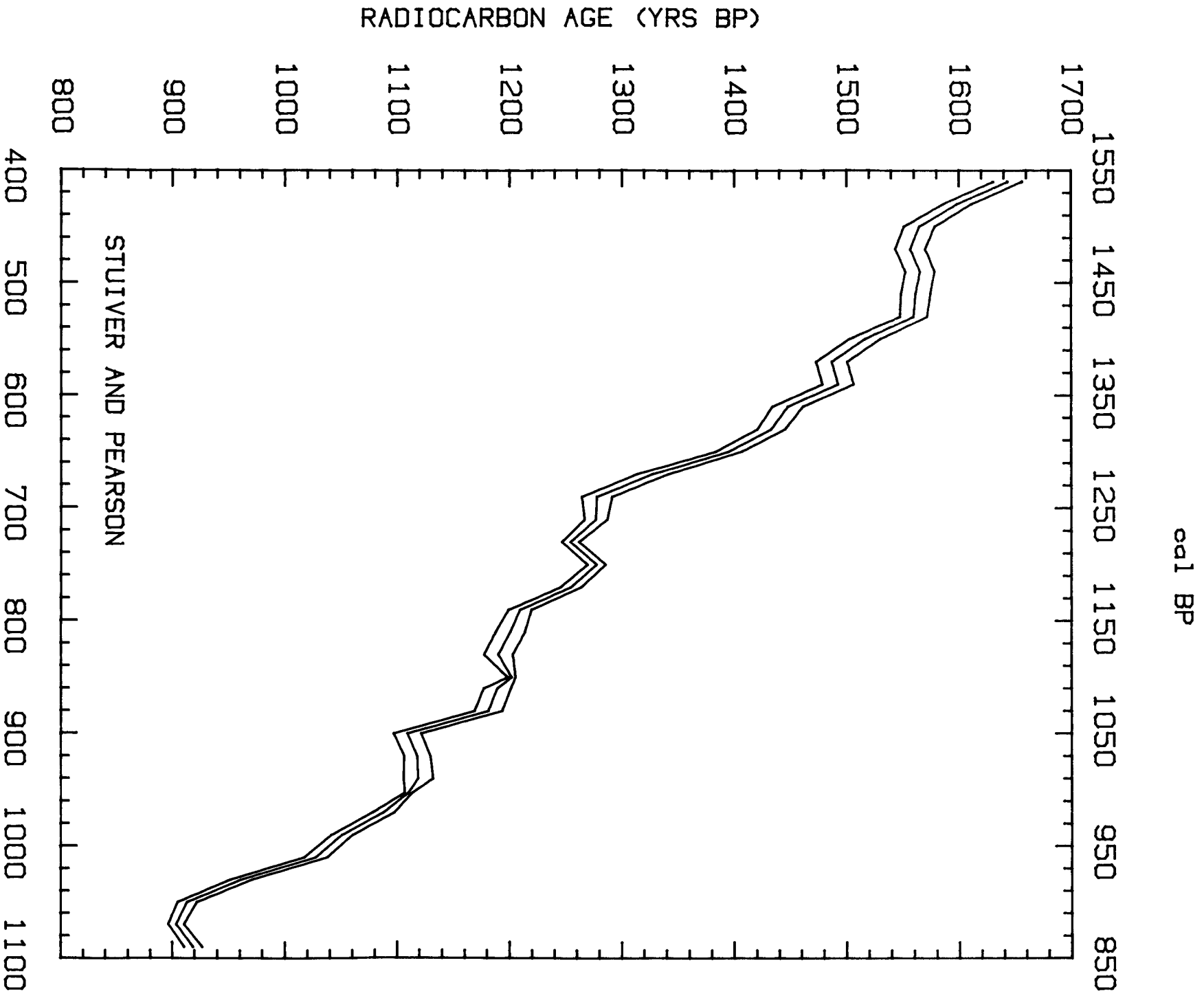


Fig 1B



od1 AD  
Fig 1C



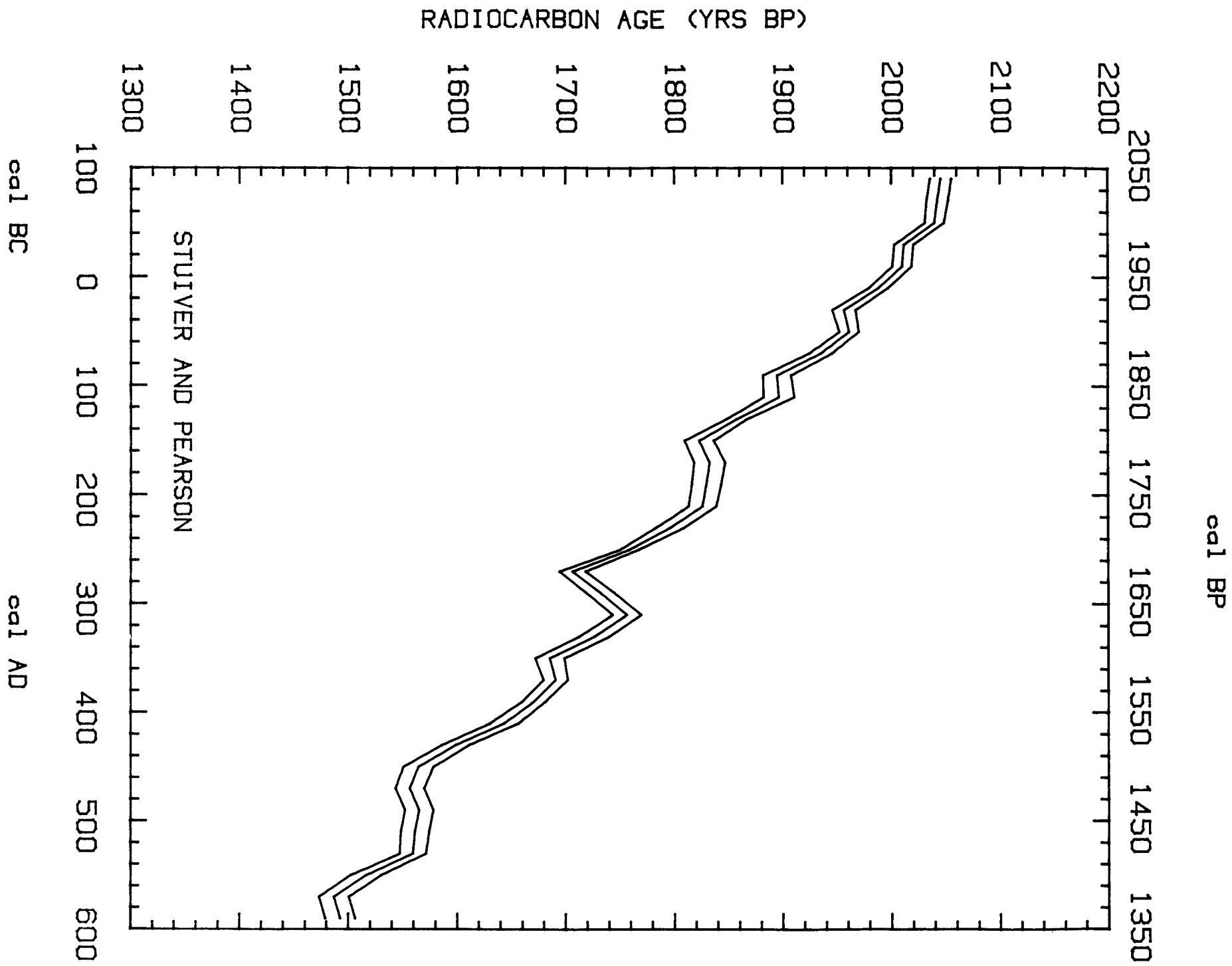
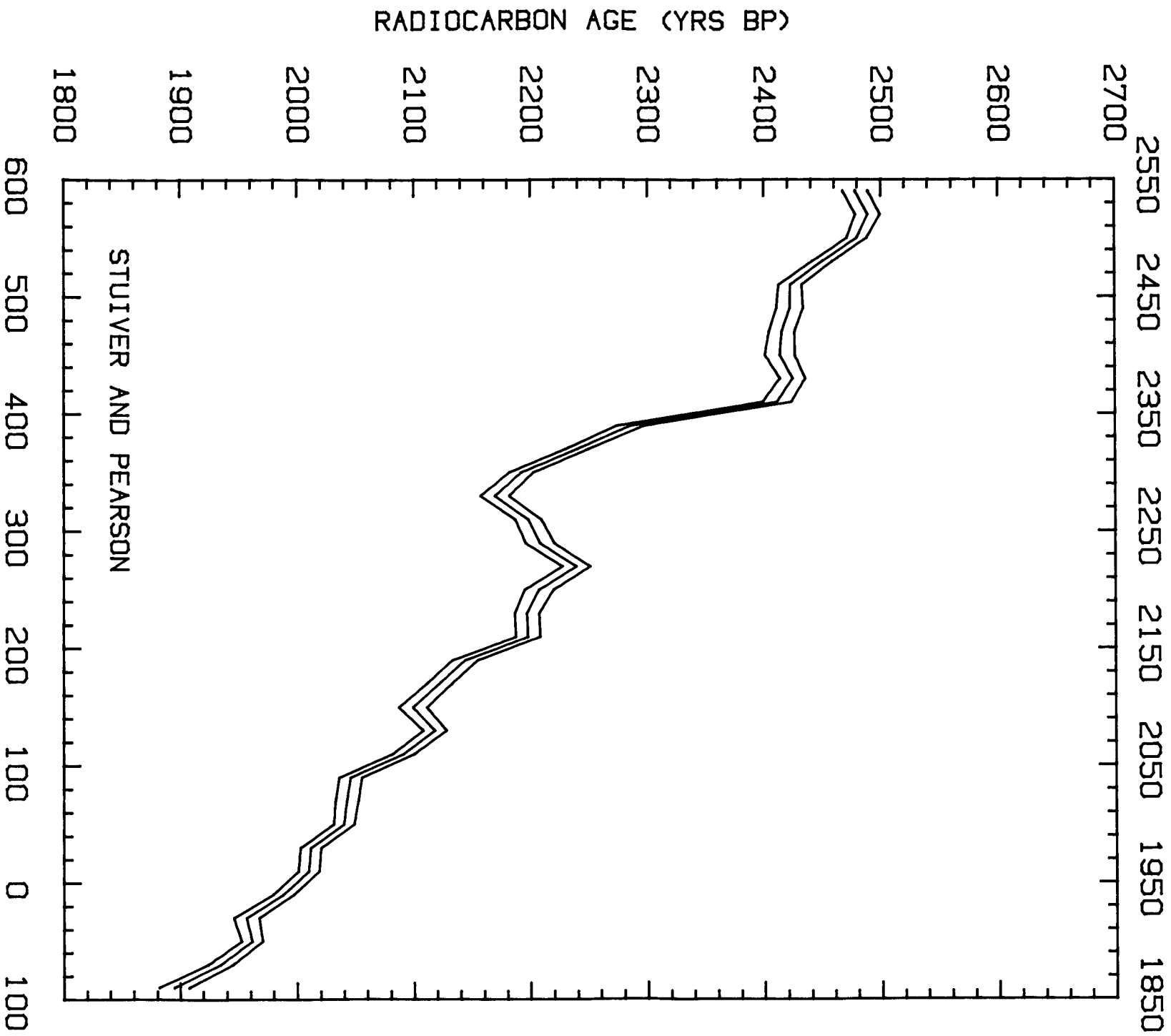


Fig 1D

cal BP



cal BC

cal AD

Fig 1E

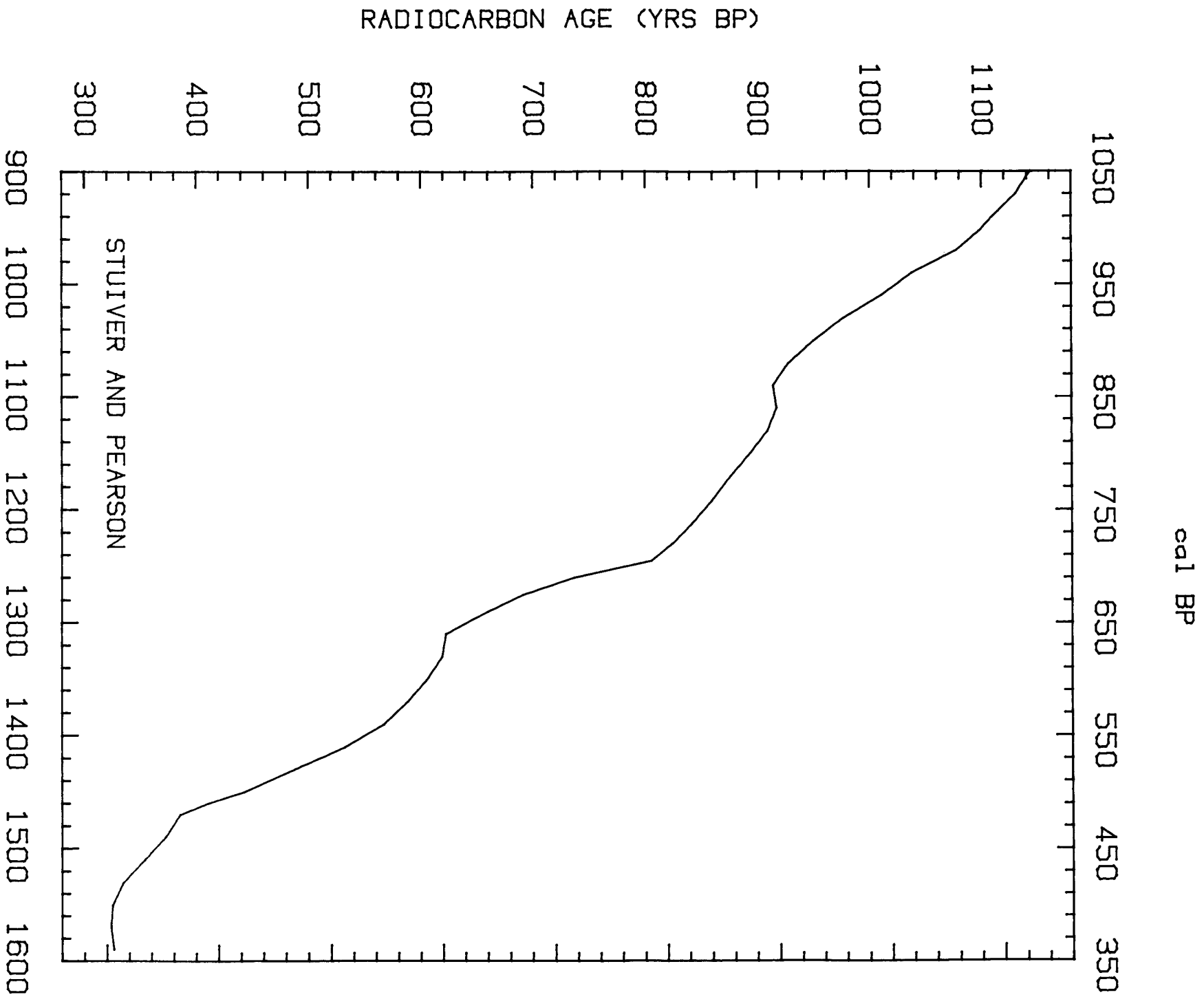


Fig 2B

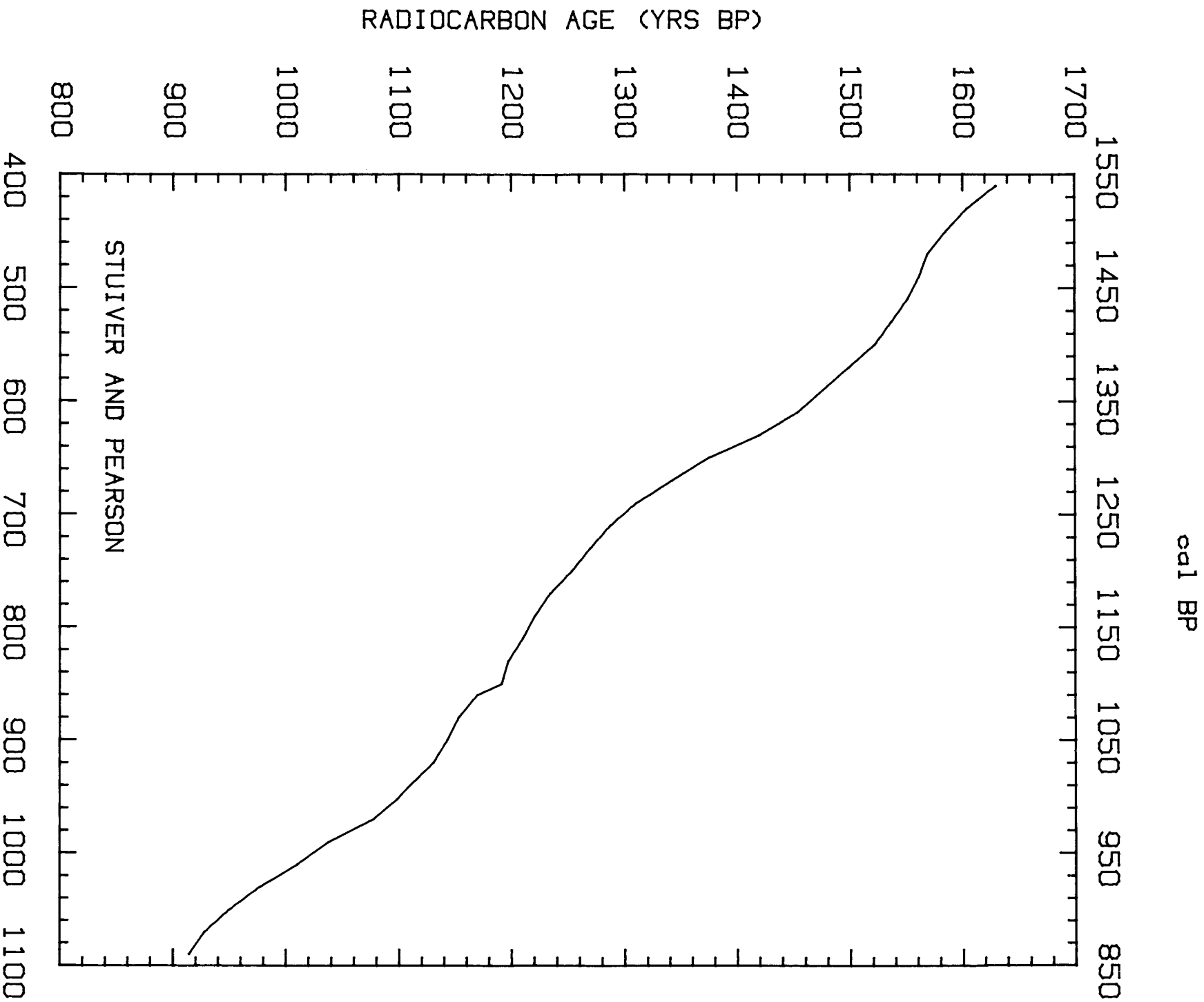


Fig 2C

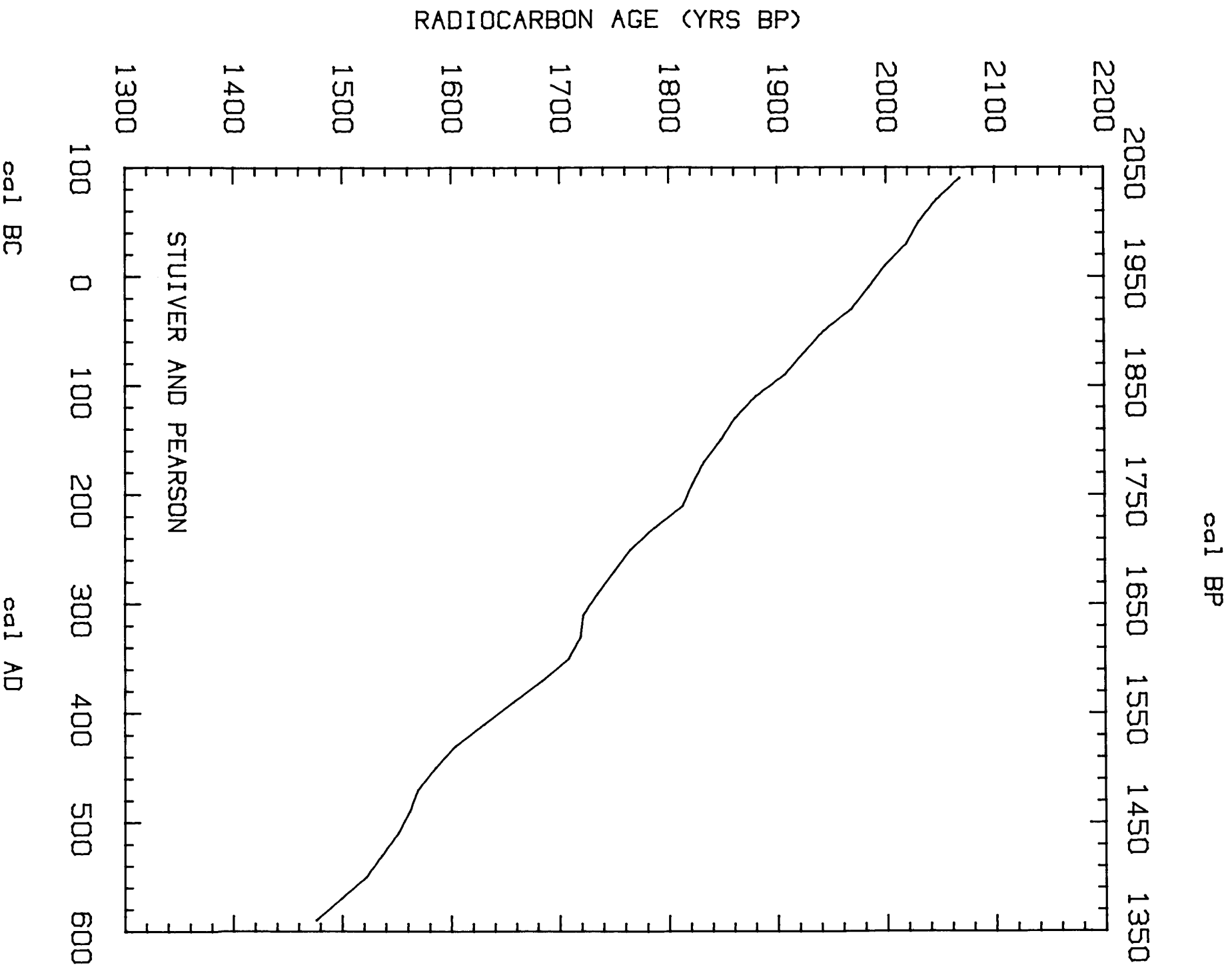
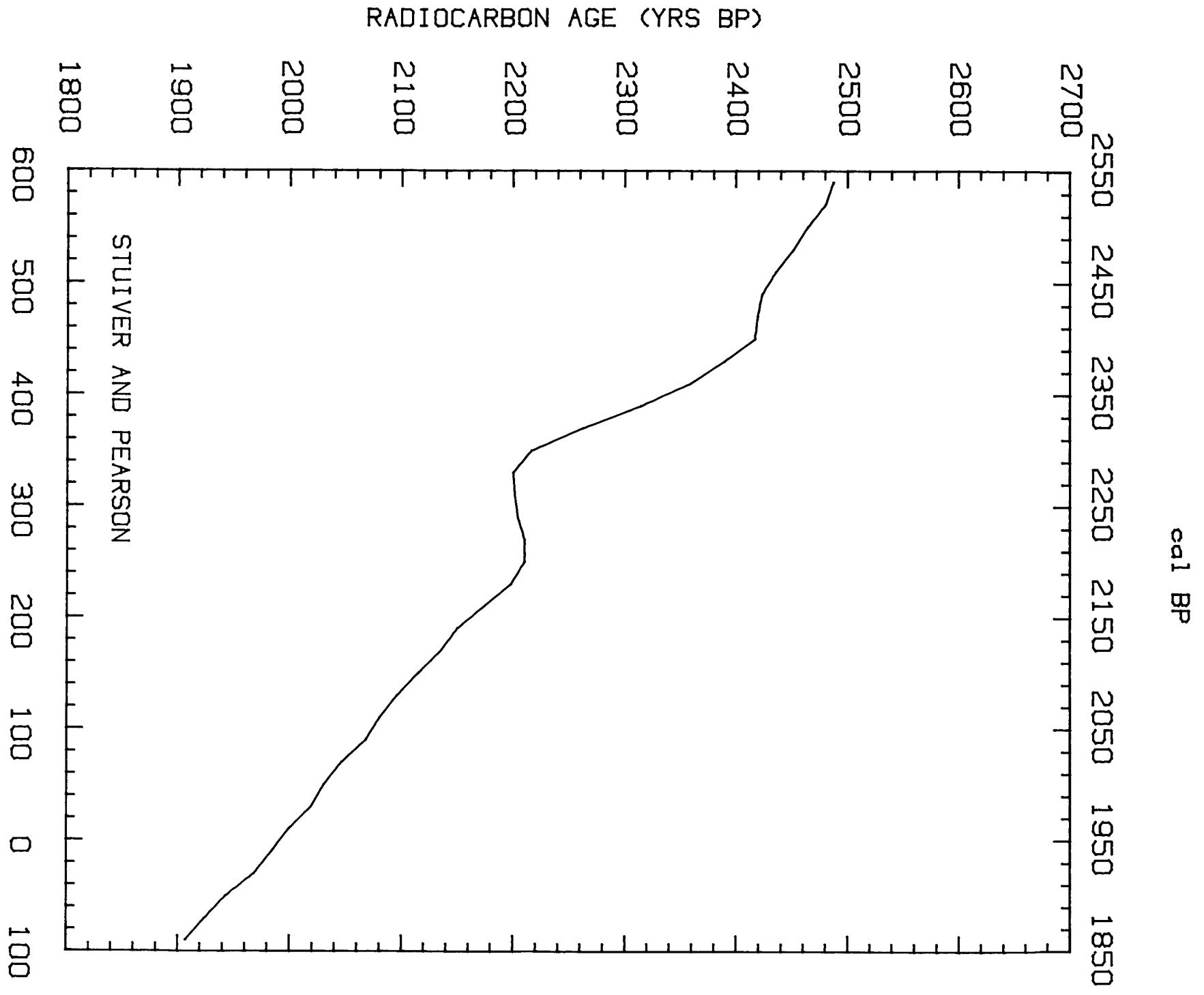


Fig 2D



cal BC  
cal AD  
Fig 2E

# BELFAST VS SEATTLE (1840 AD - 2500 BC)

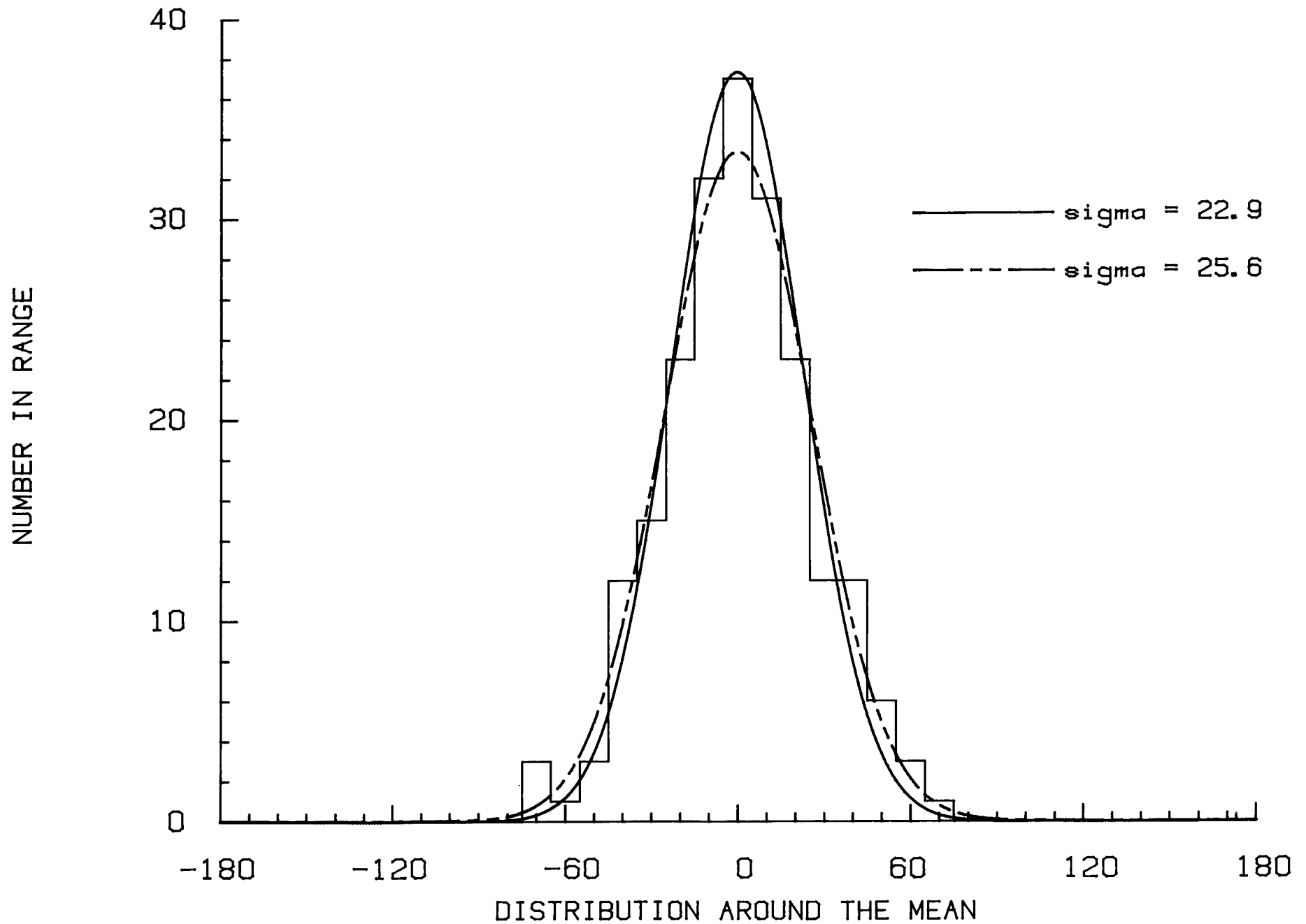


Fig 3. Differences in  $^{14}\text{C}$  ages of contemporaneously formed wood samples measured in Belfast and Seattle. Belfast and Seattle laboratory errors predict a standard deviation of 22.9 yr in the differences. Observed distribution has a 25.6 yr standard deviation.

TABLE 1-A

The radiocarbon ages are the weighted averages of age determinations made at the University of Washington (Seattle) and the University of Belfast. The cal AD/BC (or cal BP) ages represent the mid-points of bi-decadal wood sections, except in a few instances, where Belfast skipped a decade (†). Here 3 10-year blocks of Seattle data were averaged to fill the gaps. Seattle bi-decadal results were also solely used for the AD 1940 to 1860 radiocarbon ages.

The cal AD/BC ages follow the mid-points of the Belfast bi-decadal series whenever possible, starting at AD 1840. The actual mid-points of the averages were occasionally slightly different. The differences have been neglected because the mid-points of the Seattle sample were always within 1.5 years of the mid-point of the corresponding Belfast sample, except for 3 samples denoted by \*, where the Seattle/Belfast mid-points were 5 years apart. The standard deviation in the ages and Δ values include lab error multipliers of 1.23 for Belfast and 1.6 for Seattle. The trees used and sample treatments are listed in Table 2.

cal AD/BC cal BP	Δ <sup>14</sup> C	Radiocarbon age BP	cal AD/BC cal BP	Δ <sup>14</sup> C	Radiocarbon age BP
AD 1940 BP 10	-19.0 ± .6	164 ± 5	AD 1610 BP 340	-2.3 ± .5	349 ± 4
AD 1920 BP 30	-10.9 ± .7	117 ± 5	AD 1590 BP 360	2.4 ± .5	331 ± 4
AD 1900 BP 50	-3.4 ± .8	76 ± 6	AD 1570 BP 380	5.6 ± .6	324 ± 5
AD 1880 BP 70	-5.1 ± .5	109 ± 4	AD 1550 BP 400	10.3 ± .5	306 ± 4
AD 1860 BP 90	-4.1 ± .6	120 ± 5	AD 1530 BP 420	12.9 ± .5	306 ± 4
AD 1840 BP 110	-.5 ± .6	111 ± 4	AD 1510 BP 440	9.8 ± .7	349 ± 6
†AD 1825 BP 125	1.6 ± .4	109 ± 4	AD 1490 BP 460	11.7 ± 1.3	354 ± 11
AD 1810 BP 140	.5 ± .5	132 ± 4	AD 1470 BP 480	10.0 ± 1.6	387 ± 13
AD 1790 BP 160	-5.5 ± 1.2	200 ± 10	AD 1450 BP 500	8.9 ± 1.3	414 ± 10
AD 1770 BP 180	-1.4 ± 1.6	186 ± 13	AD 1430 BP 520	2.8 ± 1.6	483 ± 12
AD 1750 BP 200	2.0 ± 1.4	179 ± 12	AD 1410 BP 540	-.4 ± 1.4	528 ± 11
AD 1730 BP 220	11.2 ± 1.6	124 ± 13	AD 1390 BP 560	-6.5 ± 1.5	597 ± 12
AD 1710 BP 240	16.6 ± .5	101 ± 4	AD 1370 BP 580	-9.4 ± 1.2	639 ± 10
AD 1690 BP 260	15.7 ± .5	128 ± 4	AD 1350 BP 600	-2.7 ± 1.3	605 ± 11
AD 1670 BP 280	10.6 ± .5	188 ± 4	AD 1330 BP 620	3.3 ± 1.2	576 ± 9
AD 1650 BP 300	4.8 ± .5	253 ± 4	AD 1310 BP 640	1.1 ± 1.1	613 ± 9
AD 1630 BP 320	-1.0 ± .5	319 ± 4	AD 1290 BP 660	-.9 ± 1.8	648 ± 14

TABLE 1-B

cal AD/BC cal BP	Δ <sup>14</sup> C	Radiocarbon age BP	cal AD/BC cal BP	Δ <sup>14</sup> C	Radiocarbon age BP
†AD 1275 BP 675	-7.8 ± .4	719 ± 4	AD 810 BP 1140	-11.5 ± 1.6	1201 ± 13
AD 1260 BP 690	-13.4 ± 1.2	779 ± 10	AD 790 BP 1160	-10.2 ± 1.3	1209 ± 10
†AD 1245 BP 705	-14.2 ± .4	800 ± 4	AD 770 BP 1180	-13.3 ± 1.2	1255 ± 9
AD 1230 BP 720	-13.6 ± 1.2	809 ± 9	AD 750 BP 1200	-13.8 ± 1.0	1278 ± 8
*AD 1212.5 BP 737.5	-16.4 ± 1.5	849 ± 12	AD 730 BP 1220	-8.5 ± .9	1254 ± 8
*AD 1192.5 BP 757.5	-14.5 ± 1.5	854 ± 12	AD 710 BP 1240	-8.9 ± 1.3	1277 ± 10
AD 1170 BP 780	-13.4 ± 1.1	867 ± 9	AD 690 BP 1260	-6.6 ± 1.7	1278 ± 13
AD 1150 BP 800	-18.8 ± 1.0	930 ± 8	AD 670 BP 1280	-10.3 ± 1.7	1327 ± 14
AD 1130 BP 820	-12.9 ± 1.3	901 ± 10	AD 650 BP 1300	-16.2 ± 1.4	1395 ± 11
AD 1110 BP 840	-14.5 ± 1.1	934 ± 9	AD 630 BP 1320	-18.5 ± 1.5	1433 ± 12
AD 1090 BP 860	-10.3 ± 1.0	919 ± 8	AD 610 BP 1340	-17.9 ± 1.7	1448 ± 14
AD 1070 BP 880	-6.0 ± .9	904 ± 7	AD 590 BP 1360	-21.1 ± 1.7	1493 ± 14
AD 1050 BP 900	-4.8 ± 1.1	914 ± 9	AD 570 BP 1380	-18.0 ± 1.7	1487 ± 14
AD 1030 BP 920	-8.3 ± 1.2	961 ± 10	AD 550 BP 1400	-19.2 ± 1.7	1516 ± 14
AD 1010 BP 940	-14.1 ± 1.3	1027 ± 10	AD 530 BP 1420	-22.1 ± 1.5	1560 ± 12
AD 990 BP 960	-14.6 ± 1.2	1051 ± 9	AD 510 BP 1440	-20.0 ± 1.6	1562 ± 13
AD 970 BP 980	-16.7 ± 1.2	1088 ± 10	AD 490 BP 1460	-18.1 ± 1.6	1565 ± 13
*AD 952.5 BP 997.5	-17.4 ± .4	1110 ± 3	AD 470 BP 1480	-14.6 ± 1.6	1557 ± 13
AD 940 BP 1010	-17.0 ± 1.6	1119 ± 13	AD 450 BP 1500	-13.2 ± 1.7	1565 ± 14
AD 920 BP 1030	-14.5 ± 1.5	1118 ± 12	AD 430 BP 1520	-15.0 ± 1.6	1598 ± 13
AD 900 BP 1050	-11.0 ± 1.5	1109 ± 12	AD 410 BP 1540	-18.1 ± 1.6	1643 ± 13
AD 880 BP 1070	-17.5 ± 1.5	1181 ± 12	AD 390 BP 1560	-19.1 ± 1.3	1671 ± 11
AD 860 BP 1090	-16.1 ± 1.5	1189 ± 12	AD 370 BP 1580	-19.2 ± 1.4	1691 ± 11
AD 850 BP 1100	-16.4 ± .4	1202 ± 3	AD 350 BP 1600	-16.1 ± 1.7	1685 ± 13
AD 830 BP 1120	-12.6 ± 1.6	1190 ± 13	AD 330 BP 1620	-18.7 ± 1.7	1726 ± 14



TABLE 1-C

cal AD/BC cal BP	$\Delta^{14}\text{C}$	Radiocarbon age BP	cal AD/BC cal BP	$\Delta^{14}\text{C}$	Radiocarbon age BP
AD 310	-20.1 ± 1.6	1757 ± 13	BC 190	-8.1 ± 1.3	2144 ± 11
BP 1640			BP 2139		
AD 290	-14.7 ± 1.6	1732 ± 13	BC 210	-12.3 ± 1.3	2198 ± 10
BP 1660			BP 2159		
AD 270	-9.1 ± 1.5	1706 ± 12	BC 230	-9.8 ± 1.3	2197 ± 10
BP 1680			BP 2179		
AD 250	-13.2 ± 1.1	1759 ± 9	BC 250	-8.7 ± 1.5	2207 ± 12
BP 1700			BP 2199		
AD 230	-15.3 ± 1.6	1796 ± 13	BC 270	-10.2 ± 1.5	2239 ± 12
BP 1720			BP 2219		
AD 210	-16.7 ± 1.6	1826 ± 13	BC 290	-4.0 ± 1.5	2208 ± 12
BP 1740			BP 2239		
AD 190	-14.7 ± 1.7	1830 ± 13	BC 310	-3 ± 1.4	2198 ± 11
BP 1760			BP 2259		
AD 170	-12.7 ± 1.8	1833 ± 14	BC 330	5.7 ± 1.5	2169 ± 12
BP 1780			BP 2279		
AD 150	-9.1 ± 1.7	1823 ± 13	BC 350	5.2 ± 1.3	2192 ± 10
BP 1800			BP 2299		
AD 130	-11.0 ± 1.2	1857 ± 9	BC 370	1.8 ± 1.2	2240 ± 10
BP 1820			BP 2319		
AD 110	-13.4 ± 1.8	1896 ± 14	BC 390	-1.6 ± 1.5	2286 ± 12
BP 1840			BP 2339		
AD 90	-10.8 ± 1.6	1895 ± 13	BC 410	-14.7 ± 1.5	2411 ± 12
BP 1860			BP 2359		
AD 70	-13.3 ± 1.3	1934 ± 10	BC 430	-13.9 ± 1.3	2424 ± 11
BP 1880			BP 2379		
AD 50	-14.2 ± 1.1	1961 ± 9	BC 450	-10.2 ± 1.6	2413 ± 13
BP 1900			BP 2399		
AD 30	-11.2 ± 1.3	1957 ± 11	BC 470	-8.0 ± 1.3	2415 ± 11
BP 1920			BP 2419		
AD 10	-12.7 ± 1.1	1988 ± 9	BC 490	-6.4 ± 1.4	2422 ± 11
BP 1940			BP 2439		
BC 10	-13.1 ± 1.1	2010 ± 9	BC 510	-4.1 ± 1.2	2422 ± 10
BP 1959			BP 2459		
BC 30	-10.9 ± 1.1	2012 ± 9	BC 530	-5.0 ± 1.1	2450 ± 9
BP 1979			BP 2479		
BC 50	-12.0 ± 1.1	2040 ± 9	BC 550	-6.3 ± 1.0	2480 ± 8
BP 1999			BP 2499		
BC 70	-10.0 ± 1.2	2043 ± 10	BC 570	-5.1 ± 1.3	2489 ± 10
BP 2019			BP 2519		
BC 90	-8.0 ± 1.2	2046 ± 10	BC 590	-1.4 ± 1.3	2478 ± 11
BP 2039			BP 2539		
BC 110	-11.1 ± 1.1	2091 ± 9	BC 610	-1.9 ± 1.2	2502 ± 10
BP 2059			BP 2559		
BC 130	-12.1 ± 1.3	2118 ± 10	BC 630	2.3 ± 1.2	2488 ± 10
BP 2079			BP 2579		
BC 150	-7.4 ± 1.5	2099 ± 12	BC 650	7.3 ± 1.2	2468 ± 10
BP 2099			BP 2599		
BC 170	-7.8 ± 1.3	2122 ± 11	BC 670	5.0 ± 1.8	2505 ± 15
BP 2119			BP 2619		

TABLE 2

Lab code	Species	Dendro-ages used	Wood treatment*	Location	Dendro-chronology
C	Douglas fir	AD 1915-1954 (single year)	CL	Olympic Peninsula, WA (47°46'N, 124°06'W)	Ring counted only
A	Douglas fir	AD 1820-1913 (single year)	DV**	Olympic Peninsula, WA (47°46'N, 124°06'W)	Ring counted only
B	Douglas fir	AD 1690-1719 (single year)	DV	Mt Rainier Natl Park, Washington (46°45'N, 121°45'W)	Ring counted only
F	Douglas fir	AD 1790-1819 (single year)	DV	Coos Bay, OR (43°07'N, 123°40'W)	Ring counted only
		AD 1510-1699 (single year)	DV†		
		AD 1505-1935 (decadal)			
R	Douglas fir	AD 1305-1505 (single year)	DV	Pierce County, WA (47°N, 122°W)	Ring counted only
		AD 1505-1935 (decadal)			
S	Douglas fir	AD 945-1315 (decadal)	DV	Shawnigan Lake, Vancouver Island, BC Canada (48°40'N, 123°40'W)	Cross-dated by M Parker <i>et al</i> , Western Products Forestry, Vancouver, BC
RC	Sequoia	AD 265-935 (decadal)	DV	Sequoia Natl Park, CA (36.5°N, 118.5°W)	Cross-dated by H Garfinkel, University of Washington, Seattle
ECK	Oak	AD 705-765 (decadal)	DV	Northern Germany	Cross-dated by D Eckstein, University of Hamburg
SR	Sequoia	145 BC-AD 265 (decadal)	DV	Sequoia Natl Park, CA (36.5°N, 118.5°W)	Cross-dated by H Garfinkel
BK	Oak	495 BC-AD 45	CL	Southern Germany	Cross-dated by B Becker, University of Hohenheim, Stuttgart, W Germany
BK‡	Oak	505-2495 BC (decadal)	CL	Southern Germany	Cross-dated by B Becker
PQ‡	Oak	515-625 BC (decadal)	CL	Ireland	Cross-dated by J R Pilcher, M G L Bailie, and G W Pearson, University of Belfast, Northern Ireland

\* CL = cellulose method; DV = De Vries method

\*\* Cellulose duplicates run for AD 1836, 1837, and 1853

† Cellulose treatment AD 1505 and 1515

‡ These trees were used for Pearson and Stuiver (1986)

TABLE 3

The conversion of the radiocarbon ages to a series of ranges of cal AD/BC (and BP) dates is determined by the AD/BC intercepts of the sample radiocarbon age  $\pm \sqrt{(\text{sample } \sigma)^2 + (\text{curve } \sigma)^2}$  and the calibration curve. Intercepts of the radiocarbon age with the calibration curve are listed to the right. Sample  $\sigma$  is the standard error in the radiocarbon age.

The youngest point of the 20-year calibration curve is AD 1940 with a conventional radiocarbon age of 164 years BP. The curve has been extended to 1954 using data from Stuiver and Quay (1981). Nuclear bomb testing increased atmospheric <sup>14</sup>C substantially in 1955, resulting in the “vertical” portion of the Fig 1A calibration curve. Intercepts with this vertical portion yield the 1955\*s of the table. In those instances where cal AD/BC ages, indicate “negative” BP ages, the BP age is given as 0\* BP.

For sample sigmas and ranges larger or equal to 100 years the data were rounded to the nearest decade. When the gap between two successive ranges was less than 10 years, the two ranges were combined to a single one.

Illustrations of the above are given below.

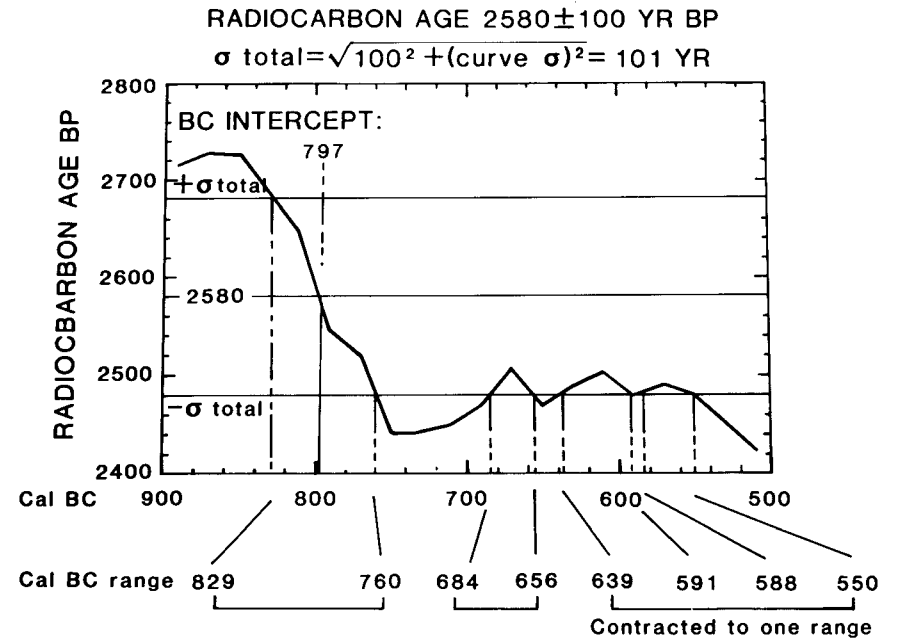
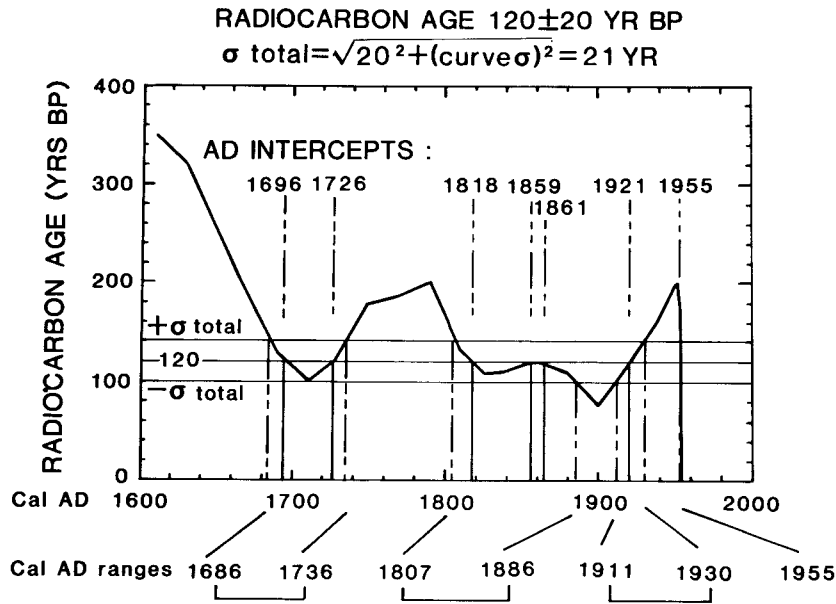


TABLE 3-A

RADIOCARBON AGE BP 80 CALIBRATED AGES: cal AD 1898, 1902, 1955\*  
cal BP 52, 48, 0\*

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1709-1711(241-239)	1884-1913(66-37)	1955*
$\sigma = 40$	1695-1727(255-223)	1817-1922(133-28)	1955*
$\sigma = 60$	1686-1736(264-214)	1807-1930(143-20)	1955*
$\sigma = 80$	1679-1743(271-207)	1802-1939(148-11)	1955*
$\sigma = 100$	1672-1755(278-195)	1800-1955*(150-0*)	
$\sigma = 120$	1670-1955*(280-0*)		
$\sigma = 160$	1650-1955*(300-0*)		
$\sigma = 200$	1640-1955*(310-0*)		

RADIOCARBON AGE BP 100 CALIBRATED AGES: cal AD 1885, 1912, 1955\*  
cal BP 65, 38, 0\*

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1694-1728(256-222)	1817-1922(133-28)	1955*
$\sigma = 40$	1686-1736(264-214)	1807-1930(143-20)	1955*
$\sigma = 60$	1679-1743(271-207)	1802-1939(148-11)	1955*
$\sigma = 80$	1672-1755(278-195)	1796-1955*(154-0*)	
$\sigma = 100$	1670-1955*(280-0*)		
$\sigma = 120$	1660-1955*(290-0*)		
$\sigma = 160$	1650-1955*(300-0*)		
$\sigma = 200$	1640-1955*(310-0*)		

RADIOCARBON AGE BP 120 CALIBRATED AGES: cal AD 1696, 1726, 1818, 1859, 1861,  
1921, 1955\*  
cal BP 254, 224, 132, 91, 89,  
29, 0\*

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1686-1736(264-214)	1807-1886(143-64)	1911-1930(39-20)
	1955*		
$\sigma = 40$	1679-1743(271-207)	1802-1939(148-11)	1955*
$\sigma = 60$	1672-1755(278-195)	1796-1955*(154-0*)	
$\sigma = 80$	1666-1955*(284-0*)		
$\sigma = 100$	1660-1955*(290-0*)		
$\sigma = 120$	1650-1955*(300-0*)		
$\sigma = 160$	1640-1955*(310-0*)		
$\sigma = 200$	1523-1565(427-385)	1630-1955*(320-0*)	

RADIOCARBON AGE BP 140 CALIBRATED AGES: cal AD 1686, 1736, 1808, 1930, 1955\*  
cal BP 264, 214, 142, 20, 0\*

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1679-1697(271-253)	1725-1744(225-206)	1801-1819(149-131)
	1855-1864(95-86)	1920-1939(30-11)	1955*
$\sigma = 40$	1672-1756(278-194)	1796-1886(154-64)	1911-1955*(39-0*)
$\sigma = 60$	1666-1955*(284-0*)		
$\sigma = 80$	1660-1955*(290-0*)		
$\sigma = 100$	1650-1955*(300-0*)		
$\sigma = 120$	1650-1955*(300-0*)		
$\sigma = 160$	1640-1955*(310-0*)		
$\sigma = 200$	1514-1600(436-350)	1620-1955*(330-0*)	

TABLE 3-B

RADIOCARBON AGE BP 160 CALIBRATED AGES: cal AD 1679, 1743, 1802, 1938, 1955\*  
cal BP 271, 207, 148, 12, 0\*

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1672-1687(278-263)	1735-1759(215-191)	1795-1808(155-142)
	1929-1955*(21-0*)		
$\sigma = 40$	1666-1696(284-254)	1726-1818(224-132)	1857-1862(93-88)
	1921-1955*(29-0*)		
$\sigma = 60$	1660-1886(290-64)	1911-1955*(39-0*)	
$\sigma = 80$	1654-1955*(296-0*)		
$\sigma = 100$	1650-1955*(300-0*)		
$\sigma = 120$	1640-1955*(310-0*)		
$\sigma = 160$	1523-1565(427-385)	1630-1955*(320-0*)	
$\sigma = 200$	1490-1955*(460-0*)		

RADIOCARBON AGE BP 180 CALIBRATED AGES: cal AD 1673, 1754, 1796, 1945, 1954  
cal BP 277, 196, 154, 5, 0\*

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1665-1680(285-270)	1742-1803(208-147)	1937-1955*(13-0*)
$\sigma = 40$	1659-1687(291-263)	1735-1808(215-142)	1929-1955*(21-0*)
$\sigma = 60$	1654-1697(296-253)	1725-1819(225-131)	1856-1863(94-87)
	1921-1955*(29-0*)		
$\sigma = 80$	1648-1886(302-64)	1911-1955*(39-0*)	
$\sigma = 100$	1640-1955*(310-0*)		
$\sigma = 120$	1640-1955*(310-0*)		
$\sigma = 160$	1514-1601(436-349)	1620-1955*(330-0*)	
$\sigma = 200$	1470-1955*(480-0*)		

RADIOCARBON AGE BP 200 CALIBRATED AGES: cal AD 1666, 1790, 1951, 1952  
cal BP 284, 160, 0\*, 0\*

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1659-1674(291-276)	1749-1797(201-153)	1944-1955*(6-0*)
$\sigma = 40$	1653-1680(297-270)	1742-1802(208-148)	1937-1955*(13-0*)
$\sigma = 60$	1647-1686(303-264)	1735-1808(215-142)	1929-1955*(21-0*)
$\sigma = 80$	1641-1697(309-253)	1726-1818(224-132)	1857-1863(93-87)
	1921-1955*(29-0*)		
$\sigma = 100$	1640-1890(310-60)	1911-1955*(39-0*)	
$\sigma = 120$	1523-1566(427-384)	1630-1955*(320-0*)	
$\sigma = 160$	1490-1955*(460-0*)		
$\sigma = 200$	1460-1955*(490-0*)		

RADIOCARBON AGE BP 220 CALIBRATED AGE: cal AD 1660  
cal BP 290

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1654-1666(296-284)	1789-1790(161-160)	1951-1952(0*)
$\sigma = 40$	1648-1673(302-277)	1753-1796(197-154)	1945-1954(5-0*)
$\sigma = 60$	1642-1679(308-271)	1743-1802(207-148)	1938-1955*(12-0*)
$\sigma = 80$	1636-1686(314-264)	1736-1808(214-142)	1930-1955*(20-0*)
$\sigma = 100$	1523-1565(427-385)	1629-1696(321-254)	1726-1818(224-132)
	1859-1861(91-89)	1921-1955*(29-0*)	
$\sigma = 120$	1514-1600(436-350)	1620-1890(330-60)	1912-1955*(38-0*)
$\sigma = 160$	1470-1955*(480-0*)		
$\sigma = 200$	1450-1955*(500-0*)		

TABLE 3-C

RADIOCARBON AGE BP	240	CALIBRATED AGE:	cal AD 1654
			cal BP 296
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1648-1660(302-290)		
$\sigma = 40$	1642-1666(308-284)	1951-1952(0*)	
$\sigma = 60$	1636-1673(314-277)	1753-1796(197-154)	1945-1954(5-0*)
$\sigma = 80$	1523-1565(427-385)	1629-1679(321-271)	1743-1802(207-148)
	1938-1955*(12-0*)		
$\sigma = 100$	1514-1600(436-350)	1616-1686(334-264)	1736-1808(214-142)
	1930-1955*(20-0*)		
$\sigma = 120$	1490-1700(460-250)	1726-1818(224-132)	1859-1861(91-89)
	1921-1955*(29-0*)		
$\sigma = 160$	1460-1955*(490-0*)		
$\sigma = 200$	1440-1955*(510-0*)		

RADIOCARBON AGE BP	260	CALIBRATED AGE:	cal AD 1648
			cal BP 302
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1642-1654(308-296)		
$\sigma = 40$	1636-1660(314-290)		
$\sigma = 60$	1523-1565(427-385)	1629-1666(321-284)	1951-1952(0*)
$\sigma = 80$	1514-1600(436-350)	1616-1673(334-277)	1753-1796(197-154)
	1945-1954(5-0*)		
$\sigma = 100$	1490-1680(460-270)	1743-1802(207-148)	1938-1955*(12-0*)
$\sigma = 120$	1470-1690(480-260)	1736-1808(214-142)	1930-1955*(20-0*)
$\sigma = 160$	1450-1890(500-60)	1912-1955*(38-0*)	
$\sigma = 200$	1440-1955*(510-0*)		

RADIOCARBON AGE BP	280	CALIBRATED AGE:	cal AD 1642
			cal BP 308
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1636-1648(314-302)		
$\sigma = 40$	1523-1565(427-385)	1629-1654(321-296)	
$\sigma = 60$	1514-1600(436-350)	1616-1660(334-290)	
$\sigma = 80$	1486-1666(464-284)	1951-1952(0*)	
$\sigma = 100$	1470-1670(480-280)	1753-1796(197-154)	1945-1954(5-0*)
$\sigma = 120$	1460-1680(490-270)	1743-1802(207-148)	1938-1955*(12-0*)
$\sigma = 160$	1440-1700(510-250)	1726-1818(224-132)	1859-1861(91-89)
	1921-1955*(29-0*)		
$\sigma = 200$	1430-1955*(520-0*)		

TABLE 3-D

RADIOCARBON AGE BP	300	CALIBRATED AGE:	cal AD 1636
			cal BP 314
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1523-1566(427-384)	1629-1642(321-308)	
$\sigma = 40$	1514-1601(436-349)	1616-1648(334-302)	
$\sigma = 60$	1486-1654(464-296)		
$\sigma = 80$	1474-1660(476-290)		
$\sigma = 100$	1460-1670(490-280)	1951-1952(0*)	
$\sigma = 120$	1450-1670(500-280)	1753-1796(197-154)	1945-1954(5-0*)
$\sigma = 160$	1440-1690(510-260)	1736-1808(214-142)	1930-1955*(20-0*)
$\sigma = 200$	1420-1890(530-60)	1912-1955*(38-0*)	

RADIOCARBON AGE BP	320	CALIBRATED AGES:	cal AD 1523, 1565, 1629
			cal BP 427, 385, 321

Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1514-1601(436-349)	1616-1636(334-314)	
$\sigma = 40$	1486-1642(464-308)		
$\sigma = 60$	1474-1648(476-302)		
$\sigma = 80$	1460-1654(490-296)		
$\sigma = 100$	1450-1660(500-290)		
$\sigma = 120$	1440-1670(510-280)	1951-1952(0*)	
$\sigma = 160$	1430-1680(520-270)	1743-1802(207-148)	1938-1955*(12-0*)
$\sigma = 200$	1410-1700(540-250)	1726-1818(224-132)	1859-1861(91-89)
	1921-1955*(29-0*)		

RADIOCARBON AGE BP	340	CALIBRATED AGES:	cal AD 1514, 1600, 1616
			cal BP 436, 350, 334

Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1486-1524(464-426)	1565-1630(385-320)	
$\sigma = 40$	1474-1636(476-314)		
$\sigma = 60$	1460-1642(490-308)		
$\sigma = 80$	1448-1648(502-302)		
$\sigma = 100$	1440-1650(510-300)		
$\sigma = 120$	1440-1660(510-290)		
$\sigma = 160$	1420-1670(530-280)	1754-1796(196-154)	1945-1954(5-0*)
$\sigma = 200$	1410-1690(540-260)	1736-1808(214-142)	1930-1955*(20-0*)

RADIOCARBON AGE BP	360	CALIBRATED AGE:	cal AD 1486
			cal BP 464

Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1472-1516(478-434)	1597-1618(353-332)	
$\sigma = 40$	1459-1524(491-426)	1563-1630(387-320)	
$\sigma = 60$	1448-1636(502-314)		
$\sigma = 80$	1442-1642(508-308)		
$\sigma = 100$	1440-1650(510-300)		
$\sigma = 120$	1430-1650(520-300)		
$\sigma = 160$	1410-1670(540-280)	1789-1790(161-160)	1951-1952(0*)
$\sigma = 200$	1400-1680(550-270)	1743-1802(207-148)	1938-1955*(12-0*)

TABLE 3-E

RADIOCARBON AGE BP	380	CALIBRATED AGE:	cal AD 1474
			cal BP 476
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1458-1488(492-462)		
$\sigma = 40$	1448-1515(502-435)	1598-1617(352-333)	
$\sigma = 60$	1442-1524(508-426)	1564-1630(386-320)	
$\sigma = 80$	1436-1636(514-314)		
$\sigma = 100$	1430-1640(520-310)		
$\sigma = 120$	1420-1650(530-300)		
$\sigma = 160$	1410-1660(540-290)		
$\sigma = 200$	1328-1333(622-617)	1390-1670(560-280)	1753-1796(197-154)
	1945-1954(5-0*)		

RADIOCARBON AGE BP	400	CALIBRATED AGE:	cal AD 1460
			cal BP 490
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1447-1476(503-474)		
$\sigma = 40$	1442-1487(508-463)		
$\sigma = 60$	1436-1515(514-435)	1599-1617(351-333)	
$\sigma = 80$	1431-1524(519-426)	1564-1630(386-320)	
$\sigma = 100$	1420-1640(530-310)		
$\sigma = 120$	1410-1640(540-310)		
$\sigma = 160$	1400-1650(550-300)		
$\sigma = 200$	1317-1347(633-603)	1390-1670(560-280)	1789-1790(161-160)
	1951-1952(0*)		

RADIOCARBON AGE BP	420	CALIBRATED AGE:	cal AD 1448
			cal BP 502
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1442-1463(508-487)		
$\sigma = 40$	1436-1475(514-475)		
$\sigma = 60$	1431-1487(519-463)		
$\sigma = 80$	1422-1514(528-436)	1599-1616(351-334)	
$\sigma = 100$	1410-1520(540-430)	1564-1630(386-320)	
$\sigma = 120$	1410-1640(540-310)		
$\sigma = 160$	1328-1333(622-617)	1390-1650(560-300)	
$\sigma = 200$	1306-1359(644-591)	1380-1660(570-290)	

RADIOCARBON AGE BP	440	CALIBRATED AGE:	cal AD 1443
			cal BP 507
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1436-1449(514-501)		
$\sigma = 40$	1430-1462(520-488)		
$\sigma = 60$	1422-1475(528-475)		
$\sigma = 80$	1413-1487(537-463)		
$\sigma = 100$	1410-1510(540-440)	1600-1616(350-334)	
$\sigma = 120$	1400-1520(550-430)	1565-1630(385-320)	
$\sigma = 160$	1317-1347(633-603)	1390-1640(560-310)	
$\sigma = 200$	1290-1650(660-300)		

TABLE 3-F

RADIOCARBON AGE BP	460	CALIBRATED AGE:	cal AD 1437
			cal BP 513
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1430-1443(520-507)		
$\sigma = 40$	1422-1449(528-501)		
$\sigma = 60$	1413-1461(537-489)		
$\sigma = 80$	1406-1475(544-475)		
$\sigma = 100$	1401-1487(549-463)		
$\sigma = 120$	1328-1333(622-617)	1390-1510(560-440)	1600-1616(350-334)
$\sigma = 160$	1306-1359(644-591)	1380-1640(570-310)	
$\sigma = 200$	1290-1650(660-300)		

RADIOCARBON AGE BP	480	CALIBRATED AGE:	cal AD 1431
			cal BP 519
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1421-1438(529-512)		
$\sigma = 40$	1413-1443(537-507)		
$\sigma = 60$	1406-1449(544-501)		
$\sigma = 80$	1400-1461(550-489)		
$\sigma = 100$	1327-1333(623-617)	1395-1474(555-476)	
$\sigma = 120$	1317-1347(633-603)	1388-1486(562-464)	
$\sigma = 160$	1290-1520(660-430)	1565-1630(385-320)	
$\sigma = 200$	1280-1640(670-310)		

RADIOCARBON AGE BP	500	CALIBRATED AGE:	cal AD 1422
			cal BP 528
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1412-1432(538-518)		
$\sigma = 40$	1406-1437(544-513)		
$\sigma = 60$	1400-1443(550-507)		
$\sigma = 80$	1327-1333(623-617)	1395-1449(555-501)	
$\sigma = 100$	1317-1347(633-603)	1388-1461(562-489)	
$\sigma = 120$	1306-1359(644-591)	1379-1474(571-476)	
$\sigma = 160$	1290-1510(660-440)	1600-1616(350-334)	
$\sigma = 200$	1280-1640(670-310)		

RADIOCARBON AGE BP	520	CALIBRATED AGE:	cal AD 1414
			cal BP 536
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	1406-1424(544-526)		
$\sigma = 40$	1400-1431(550-519)		
$\sigma = 60$	1327-1334(623-616)	1395-1437(555-513)	
$\sigma = 80$	1317-1347(633-603)	1388-1443(562-507)	
$\sigma = 100$	1306-1359(644-591)	1379-1449(571-501)	
$\sigma = 120$	1290-1460(660-490)		
$\sigma = 160$	1280-1490(670-460)		
$\sigma = 200$	1270-1520(680-430)	1565-1629(385-321)	

TABLE 3-G

RADIOCARBON AGE BP 540 CALIBRATED AGE: cal AD 1407  
cal BP 543

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1400-1415(550-535)	
$\sigma = 40$	1327-1334(623-616)	1394-1423(556-527)
$\sigma = 60$	1317-1348(633-602)	1388-1431(562-519)
$\sigma = 80$	1306-1359(644-591)	1379-1437(571-513)
$\sigma = 100$	1290-1440(660-510)	
$\sigma = 120$	1290-1450(660-500)	
$\sigma = 160$	1280-1470(670-480)	
$\sigma = 200$	1270-1510(680-440)	1600-1616(350-334)

RADIOCARBON AGE BP 560 CALIBRATED AGE: cal AD 1401  
cal BP 549

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1326-1335(624-615)	1394-1407(556-543)
$\sigma = 40$	1316-1348(634-602)	1388-1414(562-536)
$\sigma = 60$	1306-1359(644-591)	1379-1423(571-527)
$\sigma = 80$	1294-1431(656-519)	
$\sigma = 100$	1290-1440(660-510)	
$\sigma = 120$	1280-1440(670-510)	
$\sigma = 160$	1270-1460(680-490)	
$\sigma = 200$	1260-1490(690-460)	

RADIOCARBON AGE BP 580 CALIBRATED AGES: cal AD 1328, 1333, 1395  
cal BP 622, 617, 555

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1316-1348(634-602)	1387-1401(563-549)
$\sigma = 40$	1306-1360(644-590)	1378-1407(572-543)
$\sigma = 60$	1294-1414(656-536)	
$\sigma = 80$	1287-1423(663-527)	
$\sigma = 100$	1280-1430(670-520)	
$\sigma = 120$	1280-1440(670-510)	
$\sigma = 160$	1270-1450(680-500)	
$\sigma = 200$	1260-1470(690-480)	

RADIOCARBON AGE BP 600 CALIBRATED AGES: cal AD 1317, 1347, 1388  
cal BP 633, 603, 562

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1305-1360(645-590)	1378-1396(572-554)
$\sigma = 40$	1294-1401(656-549)	
$\sigma = 60$	1287-1407(663-543)	
$\sigma = 80$	1283-1414(667-536)	
$\sigma = 100$	1280-1420(670-530)	
$\sigma = 120$	1270-1430(680-520)	
$\sigma = 160$	1260-1440(690-510)	
$\sigma = 200$	1240-1460(710-490)	

TABLE 3-H

RADIOCARBON AGE BP 620 CALIBRATED AGES: cal AD 1306, 1359, 1379  
cal BP 644, 591, 571

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1293-1319(657-631)	1345-1390(605-560)
$\sigma = 40$	1287-1395(663-555)	
$\sigma = 60$	1283-1401(667-549)	
$\sigma = 80$	1279-1407(671-543)	
$\sigma = 100$	1270-1410(680-540)	
$\sigma = 120$	1270-1420(680-530)	
$\sigma = 160$	1260-1440(690-510)	
$\sigma = 200$	1230-1450(720-500)	

RADIOCARBON AGE BP 640 CALIBRATED AGE: cal AD 1295  
cal BP 655

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1287-1308(663-642)	1357-1381(593-569)
$\sigma = 40$	1283-1318(667-632)	1346-1389(604-561)
$\sigma = 60$	1279-1395(671-555)	
$\sigma = 80$	1274-1401(676-549)	
$\sigma = 100$	1270-1410(680-540)	
$\sigma = 120$	1260-1410(690-540)	
$\sigma = 160$	1240-1430(710-520)	
$\sigma = 200$	1220-1440(730-510)	

RADIOCARBON AGE BP 660 CALIBRATED AGE: cal AD 1288  
cal BP 662

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1283-1296(667-654)	1369-1371(581-579)
$\sigma = 40$	1279-1307(671-643)	1358-1380(592-570)
$\sigma = 60$	1275-1318(675-632)	1346-1389(604-561)
$\sigma = 80$	1270-1395(680-555)	
$\sigma = 100$	1260-1400(690-550)	
$\sigma = 120$	1260-1410(690-540)	
$\sigma = 160$	1230-1420(720-530)	
$\sigma = 200$	1180-1440(770-510)	

RADIOCARBON AGE BP 680 CALIBRATED AGE: cal AD 1283  
cal BP 667

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	1279-1288(671-662)	
$\sigma = 40$	1274-1295(676-655)	
$\sigma = 60$	1270-1307(680-643)	1358-1379(592-571)
$\sigma = 80$	1265-1317(685-633)	1346-1389(604-561)
$\sigma = 100$	1260-1390(690-560)	
$\sigma = 120$	1240-1400(710-550)	
$\sigma = 160$	1220-1410(730-540)	
$\sigma = 200$	1170-1430(780-520)	

TABLE 3-I

RADIOCARBON AGE BP 700 CALIBRATED AGE: cal AD 1279  
cal BP 671

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	1274-1284(676-666)	
$\sigma$ = 40	1269-1288(681-662)	
$\sigma$ = 60	1265-1295(685-655)	
$\sigma$ = 80	1259-1307(691-643)	1359-1379(591-571)
$\sigma$ = 100	1244-1317(706-633)	1346-1389(604-561)
$\sigma$ = 120	1230-1390(720-560)	
$\sigma$ = 160	1180-1410(770-540)	
$\sigma$ = 200	1160-1420(790-530)	

RADIOCARBON AGE BP 720 CALIBRATED AGE: cal AD 1275  
cal BP 675

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	1269-1279(681-671)	
$\sigma$ = 40	1265-1283(685-667)	
$\sigma$ = 60	1259-1288(691-662)	
$\sigma$ = 80	1245-1295(705-655)	
$\sigma$ = 100	1225-1306(725-644)	1359-1379(591-571)
$\sigma$ = 120	1220-1320(730-630)	1347-1389(603-561)
$\sigma$ = 160	1170-1400(780-550)	
$\sigma$ = 200	1047-1092(903-858)	1118-1143(832-807) 1150-1410(800-540)

RADIOCARBON AGE BP 740 CALIBRATED AGE: cal AD 1270  
cal BP 680

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	1264-1275(686-675)	
$\sigma$ = 40	1259-1279(691-671)	
$\sigma$ = 60	1244-1283(706-667)	
$\sigma$ = 80	1225-1288(725-662)	
$\sigma$ = 100	1217-1295(733-655)	
$\sigma$ = 120	1180-1310(770-640)	1359-1379(591-571)
$\sigma$ = 160	1160-1390(790-560)	
$\sigma$ = 200	1040-1410(910-540)	

RADIOCARBON AGE BP 760 CALIBRATED AGE: cal AD 1265  
cal BP 685

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	1258-1270(692-680)	
$\sigma$ = 40	1244-1275(706-675)	
$\sigma$ = 60	1225-1279(725-671)	
$\sigma$ = 80	1216-1283(734-667)	
$\sigma$ = 100	1180-1290(770-660)	
$\sigma$ = 120	1170-1290(780-660)	
$\sigma$ = 160	1047-1092(903-858)	1118-1143(832-807) 1150-1320(800-630)
	1347-1388(603-562)	
$\sigma$ = 200	1030-1400(920-550)	

TABLE 3-J

RADIOCARBON AGE BP 780 CALIBRATED AGE: cal AD 1259  
cal BP 691

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	1243-1265(707-685)	
$\sigma$ = 40	1225-1270(725-680)	
$\sigma$ = 60	1216-1275(734-675)	
$\sigma$ = 80	1181-1279(769-671)	
$\sigma$ = 100	1170-1280(780-670)	
$\sigma$ = 120	1160-1290(790-660)	
$\sigma$ = 160	1040-1310(910-640)	1359-1379(591-571)
$\sigma$ = 200	1020-1390(930-560)	

RADIOCARBON AGE BP 800 CALIBRATED AGE: cal AD 1245  
cal BP 705

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	1225-1260(725-690)	
$\sigma$ = 40	1216-1265(734-685)	
$\sigma$ = 60	1181-1270(769-680)	
$\sigma$ = 80	1166-1275(784-675)	
$\sigma$ = 100	1160-1280(790-670)	
$\sigma$ = 120	1047-1092(903-858)	1120-1280(830-670)
$\sigma$ = 160	1030-1290(920-660)	
$\sigma$ = 200	1020-1320(930-630)	1347-1388(603-562)

RADIOCARBON AGE BP 820 CALIBRATED AGE: cal AD 1225  
cal BP 725

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	1215-1247(735-703)	
$\sigma$ = 40	1179-1260(771-690)	
$\sigma$ = 60	1165-1265(785-685)	
$\sigma$ = 80	1159-1270(791-680)	
$\sigma$ = 100	1047-1092(903-858)	1120-1270(830-680)
$\sigma$ = 120	1040-1280(910-670)	
$\sigma$ = 160	1020-1290(930-660)	
$\sigma$ = 200	1010-1310(940-640)	1359-1379(591-571)

RADIOCARBON AGE BP 840 CALIBRATED AGE: cal AD 1217  
cal BP 733

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	1177-1227(773-723)	
$\sigma$ = 40	1165-1246(785-704)	
$\sigma$ = 60	1159-1260(791-690)	
$\sigma$ = 80	1047-1093(903-857)	1118-1265(832-685)
$\sigma$ = 100	1040-1270(910-680)	
$\sigma$ = 120	1030-1270(920-680)	
$\sigma$ = 160	1020-1280(930-670)	
$\sigma$ = 200	1000-1290(950-660)	

TABLE 3-K

RADIOCARBON AGE BP 860 CALIBRATED AGE: cal AD 1181  
cal BP 769

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 1165–1218(785–732)  
 $\sigma$  = 40 1159–1226(791–724)  
 $\sigma$  = 60 1047–1093(903–857) 1118–1246(832–704)  
 $\sigma$  = 80 1039–1260(911–690)  
 $\sigma$  = 100 1030–1260(920–690)  
 $\sigma$  = 120 1020–1270(930–680)  
 $\sigma$  = 160 1010–1280(940–670)  
 $\sigma$  = 200 980–1290(970–660)

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RADIOCARBON AGE BP 880 CALIBRATED AGE: cal AD 1166  
cal BP 784

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 1159–1185(791–765)  
 $\sigma$  = 40 1047–1093(903–857) 1118–1217(832–733)  
 $\sigma$  = 60 1039–1226(911–724)  
 $\sigma$  = 80 1030–1245(920–705)  
 $\sigma$  = 100 1020–1260(930–690)  
 $\sigma$  = 120 1020–1260(930–690)  
 $\sigma$  = 160 1000–1270(950–680)  
 $\sigma$  = 200 970–1280(980–670)

—————○—————

RADIOCARBON AGE BP 900 CALIBRATED AGE: cal AD 1159  
cal BP 791

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 1047–1094(903–856) 1117–1166(833–784)  
 $\sigma$  = 40 1038–1183(912–767)  
 $\sigma$  = 60 1030–1217(920–733)  
 $\sigma$  = 80 1024–1226(926–724)  
 $\sigma$  = 100 1020–1250(930–700)  
 $\sigma$  = 120 1010–1260(940–690)  
 $\sigma$  = 160 980–1270(970–680)  
 $\sigma$  = 200 960–1280(990–670)

—————○—————

RADIOCARBON AGE BP 920 CALIBRATED AGES: cal AD 1047, 1092, 1119, 1143, 1153  
cal BP 903, 858, 831, 807, 797

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 1038–1160(912–790)  
 $\sigma$  = 40 1030–1166(920–784)  
 $\sigma$  = 60 1024–1183(926–767)  
 $\sigma$  = 80 1018–1217(932–733)  
 $\sigma$  = 100 1010–1230(940–720)  
 $\sigma$  = 120 1000–1250(950–700)  
 $\sigma$  = 160 970–1260(980–690)  
 $\sigma$  = 200 900–1270(1050–680)

TABLE 3-L

RADIOCARBON AGE BP 940 CALIBRATED AGE: cal AD 1039  
cal BP 911

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 1030–1048(920–902) 1089–1120(861–830) 1142–1154(808–796)  
 $\sigma$  = 40 1024–1160(926–790)  
 $\sigma$  = 60 1018–1166(932–784)  
 $\sigma$  = 80 1012–1182(938–768)  
 $\sigma$  = 100 1000–1220(950–730)  
 $\sigma$  = 120 980–1230(970–720)  
 $\sigma$  = 160 960–1260(990–690)  
 $\sigma$  = 200 890–1270(1060–680)

—————○—————

RADIOCARBON AGE BP 960 CALIBRATED AGE: cal AD 1030  
cal BP 920

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 1024–1040(926–910)  
 $\sigma$  = 40 1018–1048(932–902) 1090–1119(860–831) 1142–1153(808–797)  
 $\sigma$  = 60 1012–1160(938–790)  
 $\sigma$  = 80 999–1166(951–784)  
 $\sigma$  = 100 980–1180(970–770)  
 $\sigma$  = 120 970–1220(980–730)  
 $\sigma$  = 160 900–1250(1050–700)  
 $\sigma$  = 200 890–1260(1060–690)

—————○—————

RADIOCARBON AGE BP 980 CALIBRATED AGE: cal AD 1024  
cal BP 926

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 1018–1031(932–919)  
 $\sigma$  = 40 1012–1039(938–911)  
 $\sigma$  = 60 999–1048(951–902) 1091–1119(859–831) 1142–1153(808–797)  
 $\sigma$  = 80 985–1160(965–790)  
 $\sigma$  = 100 970–1170(980–780)  
 $\sigma$  = 120 960–1180(990–770)  
 $\sigma$  = 160 890–1230(1060–720)  
 $\sigma$  = 200 880–1260(1070–690)

—————○—————

RADIOCARBON AGE BP 1000 CALIBRATED AGE: cal AD 1018  
cal BP 932

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 1012–1025(938–925)  
 $\sigma$  = 40 998–1031(952–919)  
 $\sigma$  = 60 985–1039(965–911)  
 $\sigma$  = 80 974–1048(976–902) 1091–1119(859–831) 1143–1153(807–797)  
 $\sigma$  = 100 960–1160(990–790)  
 $\sigma$  = 120 900–1170(1050–780)  
 $\sigma$  = 160 890–1220(1060–730)  
 $\sigma$  = 200 810–1250(1140–700)



TABLE 3-M

RADIOCARBON AGE BP 1020	CALIBRATED AGE:	cal AD 1012	
		cal BP 938	
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	997-1019(953-931)		
$\sigma = 40$	984-1025(966-925)		
$\sigma = 60$	974-1031(976-919)		
$\sigma = 80$	960-1039(990-911)		
$\sigma = 100$	900-1050(1050-900)	1091-1119(859-831)	1143-1153(807-797)
$\sigma = 120$	890-1160(1060-790)		
$\sigma = 160$	880-1180(1070-770)		
$\sigma = 200$	790-1230(1160-720)		

RADIOCARBON AGE BP 1040	CALIBRATED AGE:	cal AD 999	
		cal BP 951	
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	984-1013(966-937)		
$\sigma = 40$	974-1019(976-931)		
$\sigma = 60$	960-1025(990-925)		
$\sigma = 80$	897-1031(1053-919)		
$\sigma = 100$	890-1040(1060-910)		
$\sigma = 120$	890-1050(1060-900)	1091-1119(859-831)	1143-1153(807-797)
$\sigma = 160$	810-1170(1140-780)		
$\sigma = 200$	780-1220(1170-730)		

RADIOCARBON AGE BP 1060	CALIBRATED AGE:	cal AD 985	
		cal BP 965	
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	973-1001(977-949)		
$\sigma = 40$	960-1013(990-937)		
$\sigma = 60$	897-1018(1053-932)		
$\sigma = 80$	891-1024(1059-926)		
$\sigma = 100$	890-1030(1060-920)		
$\sigma = 120$	880-1040(1070-910)		
$\sigma = 160$	790-1160(1160-790)		
$\sigma = 200$	725-735(1225-1215)	770-1180(1180-770)	

RADIOCARBON AGE BP 1080	CALIBRATED AGE:	cal AD 974	
		cal BP 976	
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	959-986(991-964)		
$\sigma = 40$	897-1000(1053-950)		
$\sigma = 60$	891-1012(1059-938)		
$\sigma = 80$	886-1018(1064-932)		
$\sigma = 100$	880-1020(1070-930)		
$\sigma = 120$	810-1030(1140-920)		
$\sigma = 160$	780-1050(1170-900)	1091-1119(859-831)	1143-1153(807-797)
$\sigma = 200$	690-1170(1260-780)		

TABLE 3-N

RADIOCARBON AGE BP 1100	CALIBRATED AGE:	cal AD 961	
		cal BP 989	
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	897-975(1053-975)		
$\sigma = 40$	891-985(1059-965)		
$\sigma = 60$	886-1000(1064-950)		
$\sigma = 80$	880-1012(1070-938)		
$\sigma = 100$	810-1020(1140-930)		
$\sigma = 120$	790-1020(1160-930)		
$\sigma = 160$	725-735(1225-1215)	770-1040(1180-910)	
$\sigma = 200$	680-1160(1270-790)		

RADIOCARBON AGE BP 1120	CALIBRATED AGE:	cal AD 897	
		cal BP 1053	
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	891-963(1059-987)		
$\sigma = 40$	885-975(1065-975)		
$\sigma = 60$	880-986(1070-964)		
$\sigma = 80$	809-1000(1141-950)		
$\sigma = 100$	780-1010(1170-940)		
$\sigma = 120$	780-1020(1170-930)		
$\sigma = 160$	690-1030(1260-920)		
$\sigma = 200$	670-1050(1280-900)	1091-1119(859-831)	1143-1153(807-797)

RADIOCARBON AGE BP 1140	CALIBRATED AGE:	cal AD 891	
		cal BP 1059	
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	885-898(1065-1052)	916-944(1034-1006)	
$\sigma = 40$	879-962(1071-988)		
$\sigma = 60$	809-975(1141-975)		
$\sigma = 80$	785-986(1165-964)		
$\sigma = 100$	780-1000(1170-950)		
$\sigma = 120$	724-735(1226-1215)	760-1010(1190-940)	
$\sigma = 160$	680-1020(1270-930)		
$\sigma = 200$	670-1040(1280-910)		

RADIOCARBON AGE BP 1160	CALIBRATED AGE:	cal AD 886	
		cal BP 1064	
Sample $\sigma$ and cal AD(cal BP) ranges:			
$\sigma = 20$	875-892(1075-1058)		
$\sigma = 40$	807-898(1143-1052)	920-941(1030-1009)	
$\sigma = 60$	785-962(1165-988)		
$\sigma = 80$	776-975(1174-975)		
$\sigma = 100$	724-736(1226-1214)	760-990(1190-960)	
$\sigma = 120$	690-1000(1260-950)		
$\sigma = 160$	670-1020(1280-930)		
$\sigma = 200$	660-1030(1290-920)		

TABLE 3-O

RADIOCARBON AGE BP 1180 CALIBRATED AGE: cal AD 880  
cal BP 1070

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	804-887(1146-1063)	
$\sigma$ = 40	784-892(1166-1058)	
$\sigma$ = 60	776-897(1174-1053)	933-940(1017-1010)
$\sigma$ = 80	724-736(1226-1214)	764-961(1186-989)
$\sigma$ = 100	690-970(1260-980)	
$\sigma$ = 120	680-990(1270-960)	
$\sigma$ = 160	670-1010(1280-940)	
$\sigma$ = 200	650-1020(1300-930)	

RADIOCARBON AGE BP 1200 CALIBRATED AGES: cal AD 811, 847, 851  
cal BP 1139, 1103, 1099

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	784-881(1166-1069)	
$\sigma$ = 40	776-886(1174-1064)	
$\sigma$ = 60	724-736(1226-1214)	765-892(1185-1058)
$\sigma$ = 80	689-897(1261-1053)	
$\sigma$ = 100	680-960(1270-990)	
$\sigma$ = 120	670-970(1280-980)	
$\sigma$ = 160	660-1000(1290-950)	
$\sigma$ = 200	650-1020(1300-930)	

RADIOCARBON AGE BP 1220 CALIBRATED AGE: cal AD 785  
cal BP 1165

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	775-816(1175-1134)	843-853(1107-1097)
$\sigma$ = 40	724-736(1226-1214)	764-881(1186-1069)
$\sigma$ = 60	689-886(1261-1064)	
$\sigma$ = 80	681-892(1269-1058)	
$\sigma$ = 100	670-900(1280-1050)	
$\sigma$ = 120	670-960(1280-990)	
$\sigma$ = 160	650-990(1300-960)	
$\sigma$ = 200	640-1010(1310-940)	

RADIOCARBON AGE BP 1240 CALIBRATED AGE: cal AD 776  
cal BP 1174

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	723-737(1227-1213)	763-786(1187-1164)
$\sigma$ = 40	689-814(1261-1136)	845-852(1105-1098)
$\sigma$ = 60	681-881(1269-1069)	
$\sigma$ = 80	673-886(1277-1064)	
$\sigma$ = 100	670-890(1280-1060)	
$\sigma$ = 120	660-900(1290-1050)	
$\sigma$ = 160	650-970(1300-980)	
$\sigma$ = 200	620-1000(1330-950)	

TABLE 3-P

RADIOCARBON AGE BP 1260 CALIBRATED AGES: cal AD 725, 735, 765  
cal BP 1225, 1215, 1185

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	688-777(1262-1173)	
$\sigma$ = 40	681-786(1269-1164)	
$\sigma$ = 60	673-812(1277-1138)	846-852(1104-1098)
$\sigma$ = 80	666-881(1284-1069)	
$\sigma$ = 100	660-890(1290-1060)	
$\sigma$ = 120	650-890(1300-1060)	
$\sigma$ = 160	640-960(1310-990)	
$\sigma$ = 200	600-990(1350-960)	

RADIOCARBON AGE BP 1280 CALIBRATED AGE: cal AD 689  
cal BP 1261

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	679-769(1271-1181)	
$\sigma$ = 40	672-777(1278-1173)	
$\sigma$ = 60	666-786(1284-1164)	
$\sigma$ = 80	660-814(1290-1136)	845-852(1105-1098)
$\sigma$ = 100	650-880(1300-1070)	
$\sigma$ = 120	650-890(1300-1060)	
$\sigma$ = 160	620-900(1330-1050)	
$\sigma$ = 200	600-970(1350-980)	

RADIOCARBON AGE BP 1300 CALIBRATED AGE: cal AD 681  
cal BP 1269

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	671-711(1279-1239)	748-752(1202-1198)
$\sigma$ = 40	666-767(1284-1183)	
$\sigma$ = 60	660-777(1290-1173)	
$\sigma$ = 80	654-786(1296-1164)	
$\sigma$ = 100	650-810(1300-1140)	845-852(1105-1098)
$\sigma$ = 120	640-880(1310-1070)	
$\sigma$ = 160	600-890(1350-1060)	
$\sigma$ = 200	560-960(1390-990)	

RADIOCARBON AGE BP 1320 CALIBRATED AGE: cal AD 673  
cal BP 1277

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$ = 20	665-683(1285-1267)	
$\sigma$ = 40	660-696(1290-1254)	
$\sigma$ = 60	654-767(1296-1183)	
$\sigma$ = 80	647-777(1303-1173)	
$\sigma$ = 100	640-790(1310-1160)	
$\sigma$ = 120	620-810(1330-1140)	846-852(1104-1098)
$\sigma$ = 160	600-890(1350-1060)	
$\sigma$ = 200	550-900(1400-1050)	

TABLE 3-Q

RADIOCARBON AGE BP 1340 CALIBRATED AGE: cal AD 666  
cal BP 1284

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 659-674(1291-1276)  
 $\sigma$  = 40 654-682(1296-1268)  
 $\sigma$  = 60 647-690(1303-1260)  
 $\sigma$  = 80 636-766(1314-1184)  
 $\sigma$  = 100 620-780(1330-1170)  
 $\sigma$  = 120 600-790(1350-1160)  
 $\sigma$  = 160 560-880(1390-1070)  
 $\sigma$  = 200 540-890(1410-1060)

RADIOCARBON AGE BP 1360 CALIBRATED AGE: cal AD 660  
cal BP 1290

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 653-667(1297-1283)  
 $\sigma$  = 40 646-674(1304-1276)  
 $\sigma$  = 60 636-682(1314-1268)  
 $\sigma$  = 80 619-690(1331-1260)  
 $\sigma$  = 100 600-770(1350-1180)  
 $\sigma$  = 120 600-780(1350-1170)  
 $\sigma$  = 160 550-810(1400-1140) 846-852(1104-1098)  
 $\sigma$  = 200 461-478(1489-1472) 520-890(1430-1060)

RADIOCARBON AGE BP 1380 CALIBRATED AGE: cal AD 654  
cal BP 1296

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 645-661(1305-1289)  
 $\sigma$  = 40 636-667(1314-1283)  
 $\sigma$  = 60 619-674(1331-1276)  
 $\sigma$  = 80 604-681(1346-1269)  
 $\sigma$  = 100 595-689(1355-1261)  
 $\sigma$  = 120 560-770(1390-1180)  
 $\sigma$  = 160 540-790(1410-1160)  
 $\sigma$  = 200 440-880(1510-1070)

RADIOCARBON AGE BP 1400 CALIBRATED AGE: cal AD 647  
cal BP 1303

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 635-655(1315-1295)  
 $\sigma$  = 40 618-661(1332-1289)  
 $\sigma$  = 60 604-667(1346-1283)  
 $\sigma$  = 80 595-673(1355-1277)  
 $\sigma$  = 100 560-680(1390-1270)  
 $\sigma$  = 120 550-690(1400-1260)  
 $\sigma$  = 160 461-479(1489-1471) 520-780(1430-1170)  
 $\sigma$  = 200 430-810(1520-1140) 846-852(1104-1098)

TABLE 3-R

RADIOCARBON AGE BP 1420 CALIBRATED AGE: cal AD 637  
cal BP 1313

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 616-649(1334-1301)  
 $\sigma$  = 40 604-655(1346-1295)  
 $\sigma$  = 60 595-661(1355-1289)  
 $\sigma$  = 80 560-667(1390-1283)  
 $\sigma$  = 100 550-670(1400-1280)  
 $\sigma$  = 120 540-680(1410-1270)  
 $\sigma$  = 160 440-770(1510-1180)  
 $\sigma$  = 200 420-790(1530-1160)

RADIOCARBON AGE BP 1440 CALIBRATED AGE: cal AD 620  
cal BP 1330

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 603-639(1347-1311)  
 $\sigma$  = 40 595-648(1355-1302)  
 $\sigma$  = 60 560-655(1390-1295)  
 $\sigma$  = 80 548-661(1402-1289)  
 $\sigma$  = 100 540-670(1410-1280)  
 $\sigma$  = 120 460-479(1490-1471) 520-670(1430-1280)  
 $\sigma$  = 160 430-690(1520-1260)  
 $\sigma$  = 200 410-780(1540-1170)

RADIOCARBON AGE BP 1460 CALIBRATED AGE: cal AD 605  
cal BP 1345

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 594-626(1356-1324)  
 $\sigma$  = 40 559-638(1391-1312)  
 $\sigma$  = 60 547-648(1403-1302)  
 $\sigma$  = 80 538-655(1412-1295)  
 $\sigma$  = 100 460-480(1490-1470) 520-660(1430-1290)  
 $\sigma$  = 120 440-670(1510-1280)  
 $\sigma$  = 160 420-680(1530-1270)  
 $\sigma$  = 200 400-770(1550-1180)

RADIOCARBON AGE BP 1480 CALIBRATED AGE: cal AD 596  
cal BP 1354

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma$  = 20 558-606(1392-1344)  
 $\sigma$  = 40 547-623(1403-1327)  
 $\sigma$  = 60 538-638(1412-1312)  
 $\sigma$  = 80 459-480(1491-1470) 514-648(1436-1302)  
 $\sigma$  = 100 440-650(1510-1300)  
 $\sigma$  = 120 430-660(1520-1290)  
 $\sigma$  = 160 410-670(1540-1280)  
 $\sigma$  = 200 380-690(1570-1260)

TABLE 3-S

RADIOCARBON AGE BP 1500 CALIBRATED AGE: cal AD 561  
cal BP 1389

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	546-598(1404-1352)	
$\sigma = 40$	538-606(1412-1344)	
$\sigma = 60$	458-481(1492-1469)	510-622(1440-1328)
$\sigma = 80$	440-637(1510-1313)	
$\sigma = 100$	430-650(1520-1300)	
$\sigma = 120$	420-650(1530-1300)	
$\sigma = 160$	400-670(1550-1280)	
$\sigma = 200$	340-680(1610-1270)	

RADIOCARBON AGE BP 1520 CALIBRATED AGE: cal AD 548  
cal BP 1402

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	537-564(1413-1386)	
$\sigma = 40$	457-482(1493-1468)	507-597(1443-1353)
$\sigma = 60$	440-605(1510-1345)	
$\sigma = 80$	429-622(1521-1328)	
$\sigma = 100$	420-640(1530-1310)	
$\sigma = 120$	410-650(1540-1300)	
$\sigma = 160$	380-660(1570-1290)	
$\sigma = 200$	265-281(1685-1669)	330-670(1620-1280)

RADIOCARBON AGE BP 1540 CALIBRATED AGE: cal AD 539  
cal BP 1411

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	452-487(1498-1463)	498-550(1452-1400)
$\sigma = 40$	440-562(1510-1388)	
$\sigma = 60$	429-596(1521-1354)	
$\sigma = 80$	420-605(1530-1345)	
$\sigma = 100$	410-620(1540-1330)	
$\sigma = 120$	400-640(1550-1310)	
$\sigma = 160$	340-650(1610-1300)	
$\sigma = 200$	257-297(1693-1653)	320-670(1630-1280)

RADIOCARBON AGE BP 1560 CALIBRATED AGES: cal AD 462, 477, 526  
cal BP 1488, 1473, 1424

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	439-541(1511-1409)	
$\sigma = 40$	428-549(1522-1401)	
$\sigma = 60$	420-562(1530-1388)	
$\sigma = 80$	411-596(1539-1354)	
$\sigma = 100$	400-600(1550-1350)	
$\sigma = 120$	380-620(1570-1330)	
$\sigma = 160$	265-281(1685-1669)	330-650(1620-1300)
$\sigma = 200$	250-660(1700-1290)	

TABLE 3-T

RADIOCARBON AGE BP 1580 CALIBRATED AGE: cal AD 441  
cal BP 1509

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	428-532(1522-1418)	
$\sigma = 40$	419-540(1531-1410)	
$\sigma = 60$	411-549(1539-1401)	
$\sigma = 80$	397-562(1553-1388)	
$\sigma = 100$	380-600(1570-1350)	
$\sigma = 120$	340-600(1610-1350)	
$\sigma = 160$	257-297(1693-1653)	320-640(1630-1310)
$\sigma = 200$	240-650(1710-1300)	

RADIOCARBON AGE BP 1600 CALIBRATED AGE: cal AD 429  
cal BP 1521

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	419-443(1531-1507)	
$\sigma = 40$	411-531(1539-1419)	
$\sigma = 60$	397-540(1553-1410)	
$\sigma = 80$	380-549(1570-1401)	
$\sigma = 100$	340-560(1610-1390)	
$\sigma = 120$	265-281(1685-1669)	330-600(1620-1350)
$\sigma = 160$	250-620(1700-1330)	
$\sigma = 200$	230-650(1720-1300)	

RADIOCARBON AGE BP 1620 CALIBRATED AGE: cal AD 420  
cal BP 1530

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	410-431(1540-1519)	
$\sigma = 40$	396-442(1554-1508)	
$\sigma = 60$	379-530(1571-1420)	
$\sigma = 80$	342-539(1608-1411)	
$\sigma = 100$	264-281(1686-1669)	330-550(1620-1400)
$\sigma = 120$	257-297(1693-1653)	320-560(1630-1390)
$\sigma = 160$	240-600(1710-1350)	
$\sigma = 200$	210-640(1740-1310)	

RADIOCARBON AGE BP 1640 CALIBRATED AGE: cal AD 412  
cal BP 1538

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	395-422(1555-1528)	
$\sigma = 40$	379-430(1571-1520)	
$\sigma = 60$	342-442(1608-1508)	
$\sigma = 80$	264-281(1686-1669)	333-464(1617-1486) 475-530(1475-1420)
$\sigma = 100$	257-297(1693-1653)	320-540(1630-1410)
$\sigma = 120$	250-550(1700-1400)	
$\sigma = 160$	230-600(1720-1350)	
$\sigma = 200$	140-620(1810-1330)	

TABLE 3-U

RADIOCARBON AGE BP 1660 CALIBRATED AGE: cal AD 398  
cal BP 1552

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	377-413(1573-1537)	
$\sigma = 40$	342-421(1608-1529)	
$\sigma = 60$	264-281(1686-1669)	332-430(1618-1520)
$\sigma = 80$	257-297(1693-1653)	320-441(1630-1509)
$\sigma = 100$	250-460(1700-1490)	476-530(1474-1420)
$\sigma = 120$	240-540(1710-1410)	
$\sigma = 160$	210-560(1740-1390)	
$\sigma = 200$	130-600(1820-1350)	

RADIOCARBON AGE BP 1680 CALIBRATED AGE: cal AD 381  
cal BP 1569

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	341-400(1609-1550)	
$\sigma = 40$	264-282(1686-1668)	332-412(1618-1538)
$\sigma = 60$	257-297(1693-1653)	320-421(1630-1529)
$\sigma = 80$	249-430(1701-1520)	
$\sigma = 100$	240-440(1710-1510)	
$\sigma = 120$	230-460(1720-1490)	476-530(1474-1420)
$\sigma = 160$	140-550(1810-1400)	
$\sigma = 200$	120-600(1830-1350)	

RADIOCARBON AGE BP 1700 CALIBRATED AGE: cal AD 343  
cal BP 1607

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	263-284(1687-1666)	331-385(1619-1565)
$\sigma = 40$	256-298(1694-1652)	319-399(1631-1551)
$\sigma = 60$	248-412(1702-1538)	
$\sigma = 80$	238-421(1712-1529)	
$\sigma = 100$	230-430(1720-1520)	
$\sigma = 120$	210-440(1740-1510)	
$\sigma = 160$	130-540(1820-1410)	
$\sigma = 200$	90-560(1860-1390)	

RADIOCARBON AGE BP 1720 CALIBRATED AGES: cal AD 265, 281, 333  
cal BP 1685, 1669, 1617

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	256-299(1694-1651)	319-344(1631-1606)
$\sigma = 40$	248-382(1702-1568)	
$\sigma = 60$	238-399(1712-1551)	
$\sigma = 80$	227-412(1723-1538)	
$\sigma = 100$	210-420(1740-1530)	
$\sigma = 120$	140-430(1810-1520)	
$\sigma = 160$	120-460(1830-1490)	476-530(1474-1420)
$\sigma = 200$	80-550(1870-1400)	

TABLE 3-V

RADIOCARBON AGE BP 1740 CALIBRATED AGES: cal AD 257, 296, 321  
cal BP 1693, 1654, 1629

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	247-266(1703-1684)	278-335(1672-1615)
$\sigma = 40$	237-344(1713-1606)	
$\sigma = 60$	226-382(1724-1568)	
$\sigma = 80$	213-398(1737-1552)	
$\sigma = 100$	140-410(1810-1540)	
$\sigma = 120$	130-420(1820-1530)	
$\sigma = 160$	90-440(1860-1510)	
$\sigma = 200$	70-540(1880-1410)	

RADIOCARBON AGE BP 1760 CALIBRATED AGE: cal AD 249  
cal BP 1701

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	237-258(1713-1692)	294-323(1656-1627)
$\sigma = 40$	226-265(1724-1685)	280-334(1670-1616)
$\sigma = 60$	213-343(1737-1607)	
$\sigma = 80$	140-381(1810-1569)	
$\sigma = 100$	130-400(1820-1550)	
$\sigma = 120$	120-410(1830-1540)	
$\sigma = 160$	80-430(1870-1520)	
$\sigma = 200$	30-460(1920-1490)	477-529(1473-1421)

RADIOCARBON AGE BP 1780 CALIBRATED AGE: cal AD 238  
cal BP 1712

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	225-251(1725-1699)	
$\sigma = 40$	213-258(1737-1692)	295-322(1655-1628)
$\sigma = 60$	140-265(1810-1685)	280-334(1670-1616)
$\sigma = 80$	128-343(1822-1607)	
$\sigma = 100$	120-380(1830-1570)	
$\sigma = 120$	90-400(1860-1550)	
$\sigma = 160$	70-420(1880-1530)	
$\sigma = 200$	20-440(1930-1510)	

RADIOCARBON AGE BP 1800 CALIBRATED AGE: cal AD 227  
cal BP 1723

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$	150-152(1800-1798)	212-240(1738-1710)
$\sigma = 40$	139-250(1811-1700)	
$\sigma = 60$	128-258(1822-1692)	295-322(1655-1628)
$\sigma = 80$	118-265(1832-1685)	280-334(1670-1616)
$\sigma = 100$	90-340(1860-1610)	
$\sigma = 120$	80-380(1870-1570)	
$\sigma = 160$	30-410(1920-1540)	
$\sigma = 200$	cal BC 1-cal AD 430(1950-1520)	

TABLE 3-W

RADIOCARBON AGE BP 1820 CALIBRATED AGE: cal AD 214  
cal BP 1736

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$  138-230(1812-1720)  
 $\sigma = 40$  128-240(1822-1710)  
 $\sigma = 60$  118-250(1832-1700)  
 $\sigma = 80$  87-258(1863-1692) 296-322(1654-1628)  
 $\sigma = 100$  80-270(1870-1680) 280-333(1670-1617)  
 $\sigma = 120$  70-340(1880-1610)  
 $\sigma = 160$  10-400(1940-1550)  
 $\sigma = 200$  cal BC 40-cal AD 420(1990-1530)

RADIOCARBON AGE BP 1840 CALIBRATED AGE: cal AD 140  
cal BP 1810

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$  127-216(1823-1734)  
 $\sigma = 40$  118-228(1832-1722)  
 $\sigma = 60$  87-239(1863-1711)  
 $\sigma = 80$  77-250(1873-1700)  
 $\sigma = 100$  70-260(1880-1690) 296-321(1654-1629)  
 $\sigma = 120$  30-260(1920-1690) 280-333(1670-1617)  
 $\sigma = 160$  cal BC 1-cal AD 380(1950-1570)  
 $\sigma = 200$  cal BC 50-cal AD 410(2000-1540)

RADIOCARBON AGE BP 1860 CALIBRATED AGE: cal AD 129  
cal BP 1821

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$  117-142(1833-1808)  
 $\sigma = 40$  86-215(1864-1735)  
 $\sigma = 60$  77-228(1873-1722)  
 $\sigma = 80$  65-239(1885-1711)  
 $\sigma = 100$  30-250(1920-1700)  
 $\sigma = 120$  10-260(1940-1690) 296-321(1654-1629)  
 $\sigma = 160$  cal BC 40-cal AD 340(1990-1610)  
 $\sigma = 200$  cal BC 100-cal AD 400(2050-1550)

RADIOCARBON AGE BP 1880 CALIBRATED AGE: cal AD 118  
cal BP 1832

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$  86-130(1864-1820)  
 $\sigma = 40$  76-141(1874-1809)  
 $\sigma = 60$  65-215(1885-1735)  
 $\sigma = 80$  27-228(1923-1722)  
 $\sigma = 100$  10-240(1940-1710)  
 $\sigma = 120$  cal BC 1-cal AD 250(1950-1700)  
 $\sigma = 160$  cal BC 50-cal AD 260(2000-1690) 280-333(1670-1617)  
 $\sigma = 200$  cal BC 110-cal AD 380(2060-1570)

TABLE 3-X

RADIOCARBON AGE BP 1900 CALIBRATED AGE: cal AD 87  
cal BP 1863

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$  76-120(1874-1830)  
 $\sigma = 40$  65-129(1885-1821)  
 $\sigma = 60$  27-141(1923-1809)  
 $\sigma = 80$  15-215(1935-1735)  
 $\sigma = 100$  cal BC 1-cal AD 230(1950-1720)  
 $\sigma = 120$  cal BC 40-cal AD 240(1990-1710)  
 $\sigma = 160$  cal BC 100-cal AD 260(2050-1690) 296-321(1654-1629)  
 $\sigma = 200$  cal BC 151-149(2100-2098) cal BC 120-cal AD 340(2070-1610)

RADIOCARBON AGE BP 1920 CALIBRATED AGE: cal AD 77  
cal BP 1873

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$  64-89(1886-1861)  
 $\sigma = 40$  27-119(1923-1831)  
 $\sigma = 60$  14-129(1936-1821)  
 $\sigma = 80$  cal BC 2-cal AD 141(1951-1809)  
 $\sigma = 100$  cal BC 40-cal AD 210(1990-1740)  
 $\sigma = 120$  cal BC 50-cal AD 230(2000-1720)  
 $\sigma = 160$  cal BC 110-cal AD 250(2060-1700)  
 $\sigma = 200$  cal BC 170-cal AD 260(2120-1690) 280-333(1670-1617)

RADIOCARBON AGE BP 1940 CALIBRATED AGE: cal AD 66  
cal BP 1884

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$  26-78(1924-1872)  
 $\sigma = 40$  14-88(1936-1862)  
 $\sigma = 60$  cal BC 2-cal AD 119(1951-1831)  
 $\sigma = 80$  cal BC 36-cal AD 129(1985-1821)  
 $\sigma = 100$  cal BC 50-cal AD 140(2000-1810)  
 $\sigma = 120$  cal BC 100-cal AD 210(2050-1740)  
 $\sigma = 160$  cal BC 151-149(2100-2098) cal BC 120-cal AD 240(2070-1710)  
 $\sigma = 200$  cal BC 190-cal AD 260(2140-1690) 296-321(1654-1629)

RADIOCARBON AGE BP 1960 CALIBRATED AGES: cal AD 28, 44, 51  
cal BP 1922, 1906, 1899

Sample  $\sigma$  and cal AD(cal BP) ranges:

$\sigma = 20$  14-68(1936-1882)  
 $\sigma = 40$  cal BC 2-cal AD 78(1951-1872)  
 $\sigma = 60$  cal BC 37-cal AD 88(1986-1862)  
 $\sigma = 80$  cal BC 55-cal AD 119(2004-1831)  
 $\sigma = 100$  cal BC 100-cal AD 130(2050-1820)  
 $\sigma = 120$  cal BC 110-cal AD 140(2060-1810)  
 $\sigma = 160$  cal BC 170-cal AD 230(2120-1720)  
 $\sigma = 200$  cal BC 200-cal AD 250(2150-1700)

TABLE 3-Y

RADIOCARBON AGE BP 1980	CALIBRATED AGE:	cal AD 15
		cal BP 1935
Sample $\sigma$ and cal AD(cal BP) ranges:		
$\sigma = 20$	cal BC 3-cal AD 53(1952-1897)	
$\sigma = 40$	cal BC 37-cal AD 67(1986-1883)	
$\sigma = 60$	cal BC 56-cal AD 78(2005-1872)	
$\sigma = 80$	cal BC 97-cal AD 88(2046-1862)	
$\sigma = 100$	cal BC 110-cal AD 120(2060-1830)	
$\sigma = 120$	cal BC 151-149(2100-2098)	cal BC 120-cal AD 130(2070-1820)
$\sigma = 160$	cal BC 190-cal AD 210(2140-1740)	
$\sigma = 200$	cal BC 340-322(2289-2271)	cal BC 200-cal AD 240(2150-1710)

RADIOCARBON AGE BP 2000	CALIBRATED AGE:	cal BC 1
		cal BP 1950
Sample $\sigma$ and cal BC(cal BP) ranges:		
$\sigma = 20$	cal BC 37-cal AD 16(1986-1934)	
$\sigma = 40$	cal BC 58-cal AD 28(2007-1922)	cal AD 40-52(1910-1898)
$\sigma = 60$	cal BC 97-cal AD 66(2046-1884)	
$\sigma = 80$	cal BC 105-cal AD 78(2054-1872)	
$\sigma = 100$	151-149(2100-2098)	cal BC 120-cal AD 90(2070-1860)
$\sigma = 120$	cal BC 170-cal AD 120(2120-1830)	
$\sigma = 160$	cal BC 200-cal AD 140(2150-1810)	
$\sigma = 200$	353-306(2302-2255)	cal BC 240-cal AD 230(2190-1720)

RADIOCARBON AGE BP 2020	CALIBRATED AGE:	cal BC 36
		cal BP 1985
Sample $\sigma$ and cal BC(cal BP) ranges:		
$\sigma = 20$	cal BC 65-cal AD 1(2014-1949)	
$\sigma = 40$	cal BC 97-cal AD 16(2046-1934)	
$\sigma = 60$	cal BC 105-cal AD 28(2054-1922)	cal AD 42-52(1908-1898)
$\sigma = 80$	151-149(2100-2098)	cal BC 117-cal AD 66(2066-1884)
$\sigma = 100$	cal BC 170-cal AD 80(2120-1870)	
$\sigma = 120$	cal BC 190-cal AD 90(2140-1860)	
$\sigma = 160$	340-322(2289-2271)	cal BC 200-cal AD 130(2150-1820)
$\sigma = 200$	362-282(2311-2231)	cal BC 260-cal AD 210(2210-1740)

RADIOCARBON AGE BP 2040	CALIBRATED AGE:	cal BC 50
		cal BP 1999
Sample $\sigma$ and cal BC(cal BP) ranges:		
$\sigma = 20$	97-34(2046-1983)	
$\sigma = 40$	cal BC 106-cal AD 1(2055-1949)	
$\sigma = 60$	151-148(2100-2097)	cal BC 117-cal AD 16(2066-1934)
$\sigma = 80$	cal BC 169-cal AD 28(2118-1922)	cal AD 42-51(1908-1899)
$\sigma = 100$	cal BC 190-cal AD 70(2140-1880)	
$\sigma = 120$	cal BC 200-cal AD 80(2150-1870)	
$\sigma = 160$	353-306(2302-2255)	cal BC 240-cal AD 120(2190-1830)
$\sigma = 200$	cal BC 370-cal AD 140(2320-1810)	

TABLE 3-Z

RADIOCARBON AGE BP 2060	CALIBRATED AGE:	cal BC 96
		cal BP 2045
Sample $\sigma$ and cal BC(cal BP) ranges:		
$\sigma = 20$	106-49(2055-1998)	
$\sigma = 40$	152-148(2101-2097)	117-35(2066-1984)
$\sigma = 60$	169-1(2118-1950)	
$\sigma = 80$	cal BC 187-cal AD 16(2136-1934)	
$\sigma = 100$	cal BC 200-cal AD 30(2150-1920)	cal AD 42-51(1908-1899)
$\sigma = 120$	340-322(2289-2271)	cal BC 200-cal AD 70(2150-1880)
$\sigma = 160$	362-282(2311-2231)	cal BC 260-cal AD 90(2210-1860)
$\sigma = 200$	cal BC 380-cal AD 130(2330-1820)	

RADIOCARBON AGE BP 2080	CALIBRATED AGE:	cal BC 105
		cal BP 2054
Sample $\sigma$ and cal BC(cal BP) ranges:		
$\sigma = 20$	153-147(2102-2096)	118-95(2067-2044)
$\sigma = 40$	169-49(2118-1998)	
$\sigma = 60$	187-35(2136-1984)	
$\sigma = 80$	196-1(2145-1950)	
$\sigma = 100$	340-322(2289-2271)	cal BC 200-cal AD 20(2150-1930)
$\sigma = 120$	353-305(2302-2254)	cal BC 240-cal AD 30(2190-1920)
	cal AD 43-51(1907-1899)	
$\sigma = 160$	cal BC 370-cal AD 80(2320-1870)	
$\sigma = 200$	cal BC 390-cal AD 120(2340-1830)	

RADIOCARBON AGE BP 2100	CALIBRATED AGES:	cal BC 151, 149, 117
		cal BP 2100, 2098, 2066
Sample $\sigma$ and cal BC(cal BP) ranges:		
$\sigma = 20$	171-104(2120-2053)	
$\sigma = 40$	188-96(2137-2045)	
$\sigma = 60$	196-49(2145-1998)	
$\sigma = 80$	340-322(2289-2271)	204-35(2153-1984)
$\sigma = 100$	354-305(2303-2254)	240-1(2190-1950)
$\sigma = 120$	362-282(2311-2231)	cal BC 260-cal AD 20(2210-1930)
$\sigma = 160$	cal BC 380-cal AD 70(2330-1880)	
$\sigma = 200$	cal BC 390-cal AD 90(2340-1860)	

RADIOCARBON AGE BP 2120	CALIBRATED AGE:	cal BC 168
		cal BP 2117
Sample $\sigma$ and cal BC(cal BP) ranges:		
$\sigma = 20$	189-114(2138-2063)	
$\sigma = 40$	197-104(2146-2053)	
$\sigma = 60$	340-322(2289-2271)	204-96(2153-2045)
$\sigma = 80$	354-305(2303-2254)	238-49(2187-1998)
$\sigma = 100$	362-282(2311-2231)	260-40(2210-1990)
$\sigma = 120$	370-1(2320-1950)	
$\sigma = 160$	cal BC 390-cal AD 30(2340-1920)	cal AD 43-51(1907-1899)
$\sigma = 200$	cal BC 400-cal AD 80(2350-1870)	

TABLE 3-AA

RADIOCARBON AGE BP 2140 CALIBRATED AGE: cal BC 187  
cal BP 2136

Sample  $\sigma$  and cal BC(cal BP) ranges:

$\sigma = 20$	197-166(2146-2115)	131-129(2080-2078)
$\sigma = 40$	341-322(2290-2271)	204-116(2153-2065)
$\sigma = 60$	354-304(2303-2253)	238-105(2187-2054)
$\sigma = 80$	362-282(2311-2231)	258-96(2207-2045)
$\sigma = 100$	370-50(2320-2000)	
$\sigma = 120$	380-40(2330-1990)	
$\sigma = 160$	cal BC 390-cal AD 20(2340-1930)	
$\sigma = 200$	cal BC 400-cal AD 70(2350-1880)	

RADIOCARBON AGE BP 2160 CALIBRATED AGE: cal BC 196  
cal BP 2145

Sample  $\sigma$  and cal BC(cal BP) ranges:

$\sigma = 20$	342-321(2291-2270)	204-184(2153-2133)
$\sigma = 40$	354-303(2303-2252)	239-167(2188-2116)
$\sigma = 60$	362-282(2311-2231)	259-116(2208-2065)
$\sigma = 80$	370-105(2319-2054)	
$\sigma = 100$	380-100(2330-2050)	
$\sigma = 120$	390-50(2340-2000)	
$\sigma = 160$	400-1(2350-1950)	
$\sigma = 200$	cal BC 400-cal AD 30(2350-1920) cal AD 43-51(1907-1899)	

RADIOCARBON AGE BP 2180 CALIBRATED AGES: cal BC 339, 323, 203  
cal BP 2288, 2272, 2152

Sample  $\sigma$  and cal BC(cal BP) ranges:

$\sigma = 20$	355-300(2304-2249)	242-195(2191-2144)
$\sigma = 40$	362-281(2311-2230)	259-185(2208-2134)
$\sigma = 60$	371-167(2320-2116)	
$\sigma = 80$	379-116(2328-2065)	
$\sigma = 100$	390-100(2340-2050)	
$\sigma = 120$	390-100(2340-2050)	
$\sigma = 160$	400-40(2350-1990)	
$\sigma = 200$	cal BC 410-cal AD 20(2360-1930)	

RADIOCARBON AGE BP 2200 CALIBRATED AGES: cal BC 353, 306, 236  
cal BP 2302, 2255, 2185

Sample  $\sigma$  and cal BC(cal BP) ranges:

$\sigma = 20$	363-337(2312-2286)	325-280(2274-2229)	260-202(2209-2151)
$\sigma = 40$	371-195(2320-2144)		
$\sigma = 60$	379-186(2328-2135)		
$\sigma = 80$	388-168(2337-2117)		
$\sigma = 100$	390-120(2340-2070)		
$\sigma = 120$	400-100(2350-2050)		
$\sigma = 160$	400-50(2350-2000)		
$\sigma = 200$	410-1(2360-1950)		

TABLE 3-BB

RADIOCARBON AGE BP 2220 CALIBRATED AGES: cal BC 362, 282, 258  
cal BP 2311, 2231, 2207

Sample  $\sigma$  and cal BC(cal BP) ranges:

$\sigma = 20$	371-352(2320-2301)	311-210(2260-2159)
$\sigma = 40$	380-338(2329-2287)	324-203(2273-2152)
$\sigma = 60$	388-196(2337-2145)	
$\sigma = 80$	392-186(2341-2135)	
$\sigma = 100$	400-170(2350-2120)	
$\sigma = 120$	400-120(2350-2070)	
$\sigma = 160$	410-100(2360-2050)	
$\sigma = 200$	485-437(2434-2386)	420-40(2370-1990)

RADIOCARBON AGE BP 2240 CALIBRATED AGE: cal BC 370  
cal BP 2319

Sample  $\sigma$  and cal BC(cal BP) ranges:

$\sigma = 20$	380-361(2329-2310)	284-256(2233-2205)
$\sigma = 40$	388-353(2337-2302)	309-233(2258-2182)
$\sigma = 60$	392-338(2341-2287)	323-203(2272-2152)
$\sigma = 80$	396-196(2345-2145)	
$\sigma = 100$	400-190(2350-2140)	
$\sigma = 120$	400-170(2350-2120)	
$\sigma = 160$	410-110(2360-2060)	
$\sigma = 200$	520-50(2470-2000)	

RADIOCARBON AGE BP 2260 CALIBRATED AGE: cal BC 379  
cal BP 2328

Sample  $\sigma$  and cal BC(cal BP) ranges:

$\sigma = 20$	389-369(2338-2318)	271-269(2220-2218)
$\sigma = 40$	393-361(2342-2310)	283-257(2232-2206)
$\sigma = 60$	396-353(2345-2302)	308-234(2257-2183)
$\sigma = 80$	399-339(2348-2288)	323-203(2272-2152)
$\sigma = 100$	400-200(2350-2150)	
$\sigma = 120$	410-190(2360-2140)	
$\sigma = 160$	485-437(2434-2386)	420-120(2370-2070)
$\sigma = 200$	755-698(2704-2647)	540-100(2490-2050)

RADIOCARBON AGE BP 2280 CALIBRATED AGE: cal BC 388  
cal BP 2337

Sample  $\sigma$  and cal BC(cal BP) ranges:

$\sigma = 20$	393-378(2342-2327)		
$\sigma = 40$	396-370(2345-2319)		
$\sigma = 60$	399-361(2348-2310)	283-257(2232-2206)	
$\sigma = 80$	402-353(2351-2302)	308-235(2257-2184)	
$\sigma = 100$	405-339(2354-2288)	320-200(2270-2150)	
$\sigma = 120$	410-200(2360-2150)		
$\sigma = 160$	520-170(2470-2120)		
$\sigma = 200$	760-683(2709-2632)	657-638(2606-2587)	592-586(2541-2535)
	550-110(2500-2060)		



TABLE 3-CC

RADIOCARBON AGE BP 2300	CALIBRATED AGE:	cal BC 392	
		cal BP 2341	
Sample $\sigma$ and cal BC(cal BP) ranges:			
$\sigma = 20$	396-386(2345-2335)		
$\sigma = 40$	399-378(2348-2327)		
$\sigma = 60$	402-370(2351-2319)		
$\sigma = 80$	405-361(2354-2310)	283-257(2232-2206)	
$\sigma = 100$	408-353(2357-2302)	308-235(2257-2184)	
$\sigma = 120$	486-437(2435-2386)	424-339(2373-2288)	320-200(2270-2150)
$\sigma = 160$	755-698(2704-2647)	540-190(2490-2140)	
$\sigma = 200$	760-120(2710-2070)		

RADIOCARBON AGE BP 2320	CALIBRATED AGE:	cal BC 395	
		cal BP 2344	
Sample $\sigma$ and cal BC(cal BP) ranges:			
$\sigma = 20$	399-392(2348-2341)		
$\sigma = 40$	402-387(2351-2336)		
$\sigma = 60$	405-378(2354-2327)		
$\sigma = 80$	408-370(2357-2319)		
$\sigma = 100$	486-437(2435-2386)	424-361(2373-2310)	283-258(2232-2207)
$\sigma = 120$	520-350(2470-2300)	307-235(2256-2184)	
$\sigma = 160$	760-683(2709-2632)	657-637(2606-2586)	592-586(2541-2535)
	550-200(2500-2150)		
$\sigma = 200$	770-170(2720-2120)		

RADIOCARBON AGE BP 2340	CALIBRATED AGE:	cal BC 399	
		cal BP 2348	
Sample $\sigma$ and cal BC(cal BP) ranges:			
$\sigma = 20$	402-395(2351-2344)		
$\sigma = 40$	405-392(2354-2341)		
$\sigma = 60$	408-387(2357-2336)		
$\sigma = 80$	487-436(2436-2385)	425-378(2374-2327)	
$\sigma = 100$	520-370(2470-2320)		
$\sigma = 120$	755-698(2704-2647)	540-360(2490-2310)	283-258(2232-2207)
$\sigma = 160$	760-340(2710-2290)	320-200(2270-2150)	
$\sigma = 200$	790-190(2740-2140)		

RADIOCARBON AGE BP 2360	CALIBRATED AGE:	cal BC 402	
		cal BP 2351	
Sample $\sigma$ and cal BC(cal BP) ranges:			
$\sigma = 20$	406-398(2355-2347)		
$\sigma = 40$	408-395(2357-2344)		
$\sigma = 60$	488-436(2437-2385)	425-392(2374-2341)	
$\sigma = 80$	524-387(2473-2336)		
$\sigma = 100$	755-698(2704-2647)	540-380(2490-2330)	
$\sigma = 120$	760-683(2709-2632)	657-637(2606-2586)	592-586(2541-2535)
	550-370(2500-2320)		
$\sigma = 160$	770-350(2720-2300)	307-235(2256-2184)	
$\sigma = 200$	790-200(2740-2150)		

TABLE 3-DD

RADIOCARBON AGE BP 2380	CALIBRATED AGE:	cal BC 405	
		cal BP 2354	
Sample $\sigma$ and cal BC(cal BP) ranges:			
$\sigma = 20$	409-401(2358-2350)		
$\sigma = 40$	489-398(2438-2347)		
$\sigma = 60$	524-395(2473-2344)		
$\sigma = 80$	755-698(2704-2647)	537-392(2486-2341)	
$\sigma = 100$	760-683(2709-2632)	657-637(2606-2586)	592-586(2541-2535)
	550-390(2500-2340)		
$\sigma = 120$	760-380(2710-2330)		
$\sigma = 160$	790-360(2740-2310)	283-258(2232-2207)	
$\sigma = 200$	800-340(2750-2290)	320-200(2270-2150)	

RADIOCARBON AGE BP 2400	CALIBRATED AGE:	cal BC 408	
		cal BP 2357	
Sample $\sigma$ and cal BC(cal BP) ranges:			
$\sigma = 20$	511-405(2460-2354)		
$\sigma = 40$	750-730(2699-2679)	524-402(2473-2351)	
$\sigma = 60$	755-697(2704-2646)	538-398(2487-2347)	
$\sigma = 80$	760-683(2709-2632)	657-637(2606-2586)	592-585(2541-2534)
	553-395(2502-2344)		
$\sigma = 100$	760-390(2710-2340)		
$\sigma = 120$	770-390(2720-2340)		
$\sigma = 160$	790-370(2740-2320)		
$\sigma = 200$	800-350(2750-2300)	307-235(2256-2184)	

RADIOCARBON AGE BP 2420	CALIBRATED AGES:	cal BC 484, 438, 423	
		cal BP 2433, 2387, 2372	
Sample $\sigma$ and cal BC(cal BP) ranges:			
$\sigma = 20$	750-726(2699-2675)	525-408(2474-2357)	
$\sigma = 40$	755-697(2704-2646)	538-405(2487-2354)	
$\sigma = 60$	760-683(2709-2632)	657-637(2606-2586)	592-585(2541-2534)
	553-402(2502-2351)		
$\sigma = 80$	765-399(2714-2348)		
$\sigma = 100$	770-400(2720-2350)		
$\sigma = 120$	790-390(2740-2340)		
$\sigma = 160$	800-380(2750-2330)		
$\sigma = 200$	810-360(2760-2310)	283-258(2232-2207)	

RADIOCARBON AGE BP 2440	CALIBRATED AGE:	cal BC 523	
		cal BP 2472	
Sample $\sigma$ and cal BC(cal BP) ranges:			
$\sigma = 20$	755-696(2704-2645)	538-478(2487-2427)	442-420(2391-2369)
$\sigma = 40$	760-683(2709-2632)	657-637(2606-2586)	592-585(2541-2534)
	553-408(2502-2357)		
$\sigma = 60$	765-405(2714-2354)		
$\sigma = 80$	770-402(2719-2351)		
$\sigma = 100$	790-400(2740-2350)		
$\sigma = 120$	790-400(2740-2350)		
$\sigma = 160$	800-390(2750-2340)		
$\sigma = 200$	810-370(2760-2320)		