NOTICE TO READERS AND CONTRIBUTORS

Since its inception, the basic purpose of Radiocarbon has been the publication of compilations of 14C dates produced by various laboratories. These lists are extremely useful for the dissemination of basic 14C information.

In recent years, Radiocarbon has also been publishing technical and interpretative articles on all aspects of 14C. We would like to encourage this type of publication on a regular basis. In addition, we will be publishing compilations of published and unpublished dates along with interpretative text for these dates on a regional basis. Authors who would like to compose such an article for his/her area of interest should contact the Managing Editor for information.

Another section is added to our regular issues, “Notes and Comments”. Authors are invited to extend discussions or raise pertinent questions to the results of scientific investigations that have appeared on our pages. The section includes short, technical notes to relay information concerning innovative sample preparation procedures. Laboratories may also seek assistance in technical aspects of radiocarbon dating. Book reviews will also be included for special editions.

Manuscripts of radiocarbon papers should follow the recommendations in Suggestions to Authors* and RADIOCARBON Style Guide (R, 1984, v 26, p 152-158). Our deadline schedule is:

<table>
<thead>
<tr>
<th>For</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vol 27, No. 1, 1985</td>
<td>Sept 1, 1984</td>
</tr>
<tr>
<td>Vol 27, No. 2, 1985</td>
<td>Jan 1, 1985</td>
</tr>
<tr>
<td>Vol 27, No. 3, 1985</td>
<td>May 1, 1985</td>
</tr>
</tbody>
</table>

Half life of 14C. In accordance with the decision of the Fifth Radiocarbon Dating Conference, Cambridge, 1962, all dates published in this volume (as in previous volumes) are based on the Libby value, 5570 ± 30 yr, for the half life. This decision was reaffirmed at the 11th International Radiocarbon Conference in Seattle, Washington, 1982. Because of various uncertainties, when 14C measurements are expressed as dates in years BP the accuracy of the dates is limited, and refinements that take some but not all uncertainties into account may be misleading. The mean of three recent determinations of the half life, 5730 ± 40 yr, (Nature, v 195, no. 4845, p 984, 1962), is regarded as the best value presently available. Published dates in years BP, can be converted to this basis by multiplying them by 1.03.

AD/BC Dates. In accordance with the decision of the Ninth International Radiocarbon Conference, Los Angeles and San Diego, 1976, the designation of AD/BC, obtained by subtracting AD 1950 from conventional BP determinations is discontinued in Radiocarbon. Authors or submitters may include calendar estimates as a comment, and report these estimates as AD/BC, citing the specific calibration curve used to obtain the estimate.

Meaning of δ14C. In Volume 3, 1961, we endorsed the notation Δ (Lamont VIII, 1961) for geochemical measurements of 14C activity, corrected for isotopic fractionation in samples and in the NBS oxalic-acid standard. The value of δ14C that entered the calculation of Δ was defined by reference to Lamont VI, 1959, and was corrected for age. This fact has been lost sight of, by editors as well as by authors, and recent papers have used δ14C as the observed deviation from the standard. At the New Zealand Radiocarbon Dating Conference it was recommended to use δ14C only for age-corrected samples. Without an age correction, the value should then be reported as percent of modern relative to 0.95 NBS oxalic acid (Proceedings 8th Conference on Radiocarbon Dating, Wellington, New Zealand, 1972). The Ninth International Radiocarbon Conference, Los Angeles and San Diego, 1976, recommended that the reference standard, 0.95 times NBS oxalic acid activity, be normalized to δ14C = −19‰.

In several fields, however, age corrections are not possible. δ14C and Δ, uncorrected for age, have been used extensively in oceanography, and are an integral part of models and theories. For the present, therefore, we continue the editorial policy of using Δ notations for samples not corrected for age.

RADIOCARBON  
Editor: Minze Stuiver  
Managing Editor: Renee J Kra  
Published by:  
THE AMERICAN JOURNAL OF SCIENCE  
Editors: John Rodgers, John H Ostrom, Robert A Berner  
Managing Editor: Marie C Casey  

Published three times a year, in Winter, Spring, and Summer, at Yale University, New Haven, Connecticut 06511.

Subscription rate $75.00 (for institutions), $50.00 (for individuals), available only in whole volumes. The price of the full volume 22, nos. 1-4, is $60.00 for individuals and $80.00 for institutions. The Proceedings of the Eleventh International Radiocarbon Conference, Vol 22, nos. 2 and 3, are available for $60.00. The Proceedings of the Eleventh International Radiocarbon Conference, Vol 25, No. 2, 1988, is $50.00.

All correspondence and manuscripts should be addressed to the Managing Editor, RADIOCARBON, Kline Geology Laboratory, Yale University, 210 Whitney Ave, PO Box 6666, New Haven, Connecticut 06511.

Reprints. The minimum reprint order for each article will be 50 copies without cover. No reprints will be furnished free of charge unless page charges are paid. The cost of additional copies will, of course, be greater if the article is accompanied by plates involving unusual expense. Copies will be furnished with a printed cover giving the title, author, volume, page, and year, when specially ordered.

Page charges. Each institution sponsoring research reported in a technical paper or a date list, will be asked to pay a charge of $80.00 per printed page. Institutions or authors paying such charges will be entitled to 100 free reprints without covers. No charge will be made if the author indicates that his institution is unable to pay them, and payment of page charges on an article will not in any case be a condition for its acceptance.

Back issues and price lists may be obtained from the office of RADIOCARBON.

Missing issues will be replaced without charge only if claim is made within three months (six months for India and Australia) after the publication date. Claim for missing issues will not be honored if absence results from failure by the subscriber to notify the Journal of an address change.

Illustrations should include explanation of symbols used. Copy that cannot be reproduced cannot be accepted; it should be capable of reduction to not more than 10 by 17.5, all lettering being at least 1/6 inch high after reduction. When necessary, one large map or table can be accepted, if it will not exceed 17.5 inches in width after reduction. Line drawings should be in black India ink on white drawing board, tracing cloth, or coordinate paper printed in blue and should be accompanied by clear ozalids or reduced photographs for use by the reviewers. Photographs should be positive prints. Photostatic and typewritten material cannot be accepted as copy for illustrations. Plates (photographs) and figures (line drawings) should each be numbered consecutively through each article, using arabic numerals. If two photographs form one plate, they are figures A and B of that plate. All measurements should be given in SI (metric units).

Citations. A number of radiocarbon dates appear in publications without laboratory citation or reference to published date lists. We ask that laboratories remind submitters and users of radiocarbon dates to include proper citation (laboratory number and date-list citation) in all publications in which radiocarbon dates appear.

Radiocarbon Measurements: Comprehensive Index, 1950-1965. This index covers all published ¹⁴C measurements through Volume 7 of RADIOCARBON, and incorporates revisions made by all laboratories. It is available to all subscribers to RADIOCARBON at $20.00 US per copy.

List of laboratories. The comprehensive list of laboratories at the end of each volume appears in the third number of each volume. Changes in names or addresses should be reported to the Managing Editor by May 1.

Annual Index. All dates appear in index form at the end of the third number of each volume. Authors of date lists are asked to supply indexed material of archaeologic samples only with their date lists.
## CONTENTS

Time Series Analysis of Low Level Gas Counting Data  
*Laurie Kaihola, Henry Polach, and Hannu Kojola* ........................................ 159

### DATE LISTS

<table>
<thead>
<tr>
<th>Code</th>
<th>Date List Title</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td><em>In Che Yang</em></td>
<td>US Geological Survey, Denver, Colorado Radiocarbon Dates IV</td>
</tr>
<tr>
<td>Fra</td>
<td><em>Reiner Protsch and Bernhard Weninger</em></td>
<td>Frankfurt Radiocarbon Dates I</td>
</tr>
<tr>
<td>HAM</td>
<td><em>H W Scharpenseel, Heinrich Schiffmann, and Bernd Hintze</em></td>
<td>Hamburg University Radiocarbon Dates III</td>
</tr>
<tr>
<td>JGS</td>
<td><em>Shigeko Togashi and Eiji Matsumoto</em></td>
<td>Geological Survey of Japan Radiocarbon Dates I</td>
</tr>
<tr>
<td>P</td>
<td><em>Barbara J Hurst and Barbara Lawn</em></td>
<td>University of Pennsylvania Radiocarbon Dates XXII</td>
</tr>
<tr>
<td>S</td>
<td><em>A A Rutherford, Jurgen Wittenberg, and B C Gordon</em></td>
<td>University of Saskatchewan Radiocarbon Dates X</td>
</tr>
<tr>
<td>UD</td>
<td><em>Valerio Barbina, Franco Calligaris, Adriano Del Fabbro, and Alessandro Turello</em></td>
<td>Udine Radiocarbon Laboratory Date List II</td>
</tr>
</tbody>
</table>
TIME SERIES ANALYSIS OF LOW LEVEL GAS COUNTING DATA

LAURI KAIHOLA*, HENRY POLACH**, and HANNU KOJOLA†

ABSTRACT. We demonstrate the feasibility of pulse time of arrival information for early detection of periodic events in low level counting. Time of arrival data allows us to apply time series analysis and serial correlation tests which, in graphic form, give the user an illustrative view of the parameters affecting the validity of counting statistics. The decision to discontinue counting can already be made on the basis of less than 100 counts from the time information alone if more than 10 of these are non-Poisson periodic counts. The analyses also serve as a means of quality control for low level counting, being directly based upon the interval distribution of the Poisson process.

INTRODUCTION

We are developing an ultra low level gas counter that is capable of counting simultaneously 14 different CH₄ samples contained in 10ml proportional detectors at 1 to 10 atm pressures (Polach et al, 1982; Kaihola et al, 1983). Like Currie et al (1983) we have found it useful to provide each pulse with time of arrival (TA) information in addition to pulse height (PH) and rise-time (RT) data. Time of arrival analyses are powerful in detecting very low count rate, periodic noise. Thus, we have included pulse time series programs in the counting software in order to enhance detection of spurious events that do not fit Poisson statistics. TA, PH, and RT data are stored on disk for the analyses to be carried out after the runs. In low-level counting the required storage capacity remains reasonable even during prolonged (several days') counting.

To suppress HV capacitor induced spurious events by electronic means we have encapsulated these components in resin enabling up to 7kV to be applied without noise. Thus rigidly held, the HV components settle very fast, producing only 10 to 20 spurious pulses when first turned on in contrast to thousands of counts when they remain exposed to the atmosphere. To suppress radio frequency and line noise, the pulses detected by an aerial are amplified and channeled into the anticoincidence (pulse inhibit) module.

TIME INTERVAL PROBABILITY DISTRIBUTION

Radioactive decay is a Poisson process when the source half-life is much longer than the observation time, ie, the decay probability is time-invariant. When the recording system dead time is small compared with the mean time interval between decays then also the counting process can

---

* Department of Physical Sciences, University of Turku, SF-20500 Turku 50, Finland
** Radiocarbon Dating Research, Australian National University, POB 4, Canberra 2600, Australia
† Wallac Oy, Research Department, POB 10, SF-20101 Turku 10, Finland
be considered to be a Poisson one. Both the conditions are very well met in $^{14}$C and $^3$H counting. The mean modern count rate is only 0.5cpm in our sample detector, for example.

Let $\lambda$ be the mean rate of occurrence for the detector pulses. Then the probability of the number of events $N_t$ observed in time interval of length $t$ has a Poisson distribution of mean $\lambda t$ (fig 1),

$$\text{prob} \{ N_t = n \} = \frac{(\lambda t)^n e^{-\lambda t}}{n!}, \quad (n = 0, 1, \ldots).$$  \hfill (1)

The probability for the time interval $X$ from time origin to the next pulse to be $X > t$ is equivalent to the fact that no pulse is observed in time interval $(0, t)$ and

$$\text{prob} \{ X > t \} = \text{prob} \{ N_t = 0 \} = e^{-\lambda t}.$$  \hfill (2)

Further, $\text{prob} \{ \text{there will be a pulse in the time interval } (t, t+dt) \} = \lambda dt$. Therefore, the joint probability for no event in the interval $(0, t)$ and one event in $(t, t+dt)$ is the pulse time interval probability density function

$$f_X(t) = \lambda e^{-\lambda t}, \quad (t \geq 0).$$  \hfill (3)

The origin of the counting process can be freely selected (Cox & Lewis, 1966).

The pulse time interval distribution function $F_X(t)$ is prob {at least one event between $(0, t)$} or

$$F_X(t) = 1 - e^{-\lambda t}$$  \hfill (4)

(see fig 2). Of the number $N_o$ of pulse intervals there are $N = N_o(1 - e^{-1}) = 0.63N_o$ intervals smaller than the mean interval length $1/\lambda$ and half of the intervals are shorter than 0.69$\lambda$. The density of decay intervals increases towards the shorter lengths according to the negative exponential gap distribution Eq (3).

The so-called survivor function $R(t) = 1 - F_X(t)$ contains the same information as Eqs (3) and (4). On a logarithmic scale deviation of $R(t)$ from linearity indicates non-Poisson component in the counting process, seen as a mismatch of the predicted and actual data.

---

**Fig 1.** Distribution of counts in 200 s counting intervals. Total number of counts was 194 in 22.1 hr (397 intervals). The theoretical Poisson probability histogram is calculated using the observed mean $= 0.49$ c per interval. Bar length indicates number of intervals containing given number of counts.
PULSE TIME INTERVAL SPECTRUM

Non-random events can be tested by calculating the time intervals $\Delta t_i$ from the pulse $i$ to a later pulse $i+j$, $\Delta t_i = t_{i+j} - t_i < \tau$, $j = 1, 2, \ldots$ with a reasonable upper limit for the time interval span. A histogram is constructed to visualize the frequency of time intervals between pulses in constant segment categories over $\tau$ (fig 3). Periodic events will be disclosed as non-randomly distributed peaks in the spectrum (cf fig 3, normal case, with fig 6, non-random).

SCATTER DIAGRAM

As a test of serial correlation between successive time intervals between pulses a scatter dot diagram is useful (Cox & Lewis, 1966) i.e, we plot time interval $\Delta t_{i+1} = t_{i+1} - t_i$ as a function of $\Delta t_i = t_i - t_{i-1}$. A higher number of short intervals leads in a normal case to concentration of dots along to the axes, their equidensity curves being hyperbolic (fig 4).
CUMULATIVE PLOT OF COUNTING DATA

The accumulated number of pulses as a function of counting time is a rising line at a slope $\lambda$ with some scatter around it (Cox & Lewis, 1966). It is convenient to turn the plot horizontal, ie, we plot

$$N = N_t - \dot{N}t.$$

(5)

This plot is produced after the data has been collected on the basis of a posteriori Poisson mean count rate $\dot{N}$. Deviations from horizontal indicate fluctuations in the count rate, ie, due to cosmic flux or anticoincidence shield efficiency variations (fig 5).

RESULTS

A background run of 167 counts in 7.6 hr was divided into 200-second periods. We observed 62 periods containing one pulse while the theoretical Poisson distribution based on the observed mean count rate predicted only 48.9 such periods. $\chi^2$ test and index of dispersion showed excessive variance (table 1). The time interval spectrum showed a 400 s period with $\pm$ 100 s scatter in its length (fig 6). The same fact is dramatically illus-
Table 1
A background run containing non-random counts

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of counts</td>
<td>167</td>
</tr>
<tr>
<td>Counting time</td>
<td>7.57 hr</td>
</tr>
<tr>
<td>Mean count rate ± ( \sigma )</td>
<td>0.37 ± 0.10 cpm</td>
</tr>
<tr>
<td>Segmented in 200 s intervals:</td>
<td></td>
</tr>
<tr>
<td>Number of intervals</td>
<td>136</td>
</tr>
<tr>
<td>Mean number of counts/interval</td>
<td>1.23 ± 1.36 c</td>
</tr>
<tr>
<td>Expected Poisson error/interval</td>
<td>1.11 c</td>
</tr>
<tr>
<td>( \chi^2 )</td>
<td>203.5</td>
</tr>
<tr>
<td>Index of dispersion =</td>
<td></td>
</tr>
<tr>
<td>( \chi^2 / \text{degrees of freedom} )</td>
<td>1.51</td>
</tr>
</tbody>
</table>

Illustrated in the time interval distribution function (fig 7). Because this is a background run, as a gross deviation from the predicted curve we can estimate the fraction of the extra counts to be some 30% of the total number.

Another run of 606 counts in 20.5 hr contained 60% of extra pulses. The horizontal cumulative plot is not time-dependent. The scatter diagram showed a clear correlation between successive time intervals (fig 8). The time interval spectrum and distribution function both show a periodicity of 270 seconds.

Time resolution of the above run was rounded from 10 ms to 1 s and 10 s without loss of the interval spectrum structure. The data file was also examined in sections of 100 seconds. No great change was observed beyond the first 100 s while the first section of data showed less prominent periodicity.

To test the detection level of the time series analysis in low-level counting, cyclic spurious counts were added into pure random data files. Fifty counts were added into 373 counts collected in 33.8 hr with 20 s and 40 s scatter around the mean 400 s interval length (see figs 9a, 9b). If <10% of spurious counts or >10% scatter in interval length are introduced, it is difficult to resolve any periodic structure in the interval spectrum.

The addition of artificial spurious periodic counts is a "rigorous" test of the method because we assume that the pulse height spectrum of the added counts does not differ from that of the true counts.

Fig 6. Periodic pulses in the data of table 1 indicating 400 s period and its harmonic at ca 800 s. Time window is 10 s.
Fig 7. Time interval distribution function for the data of figure 6 indicating too many intervals of length 400 s. Theoretical curve is drawn on the basis of the experimental mean count rate.

CONCLUSIONS

The use of pulse time arrival information in statistical analyses of low-level counting data offers a possibility of identifying the existence of

Fig 8. Scatter diagram for 200 intervals out of a run of 606 counts in 20.5 hr. Extra counts appear in encircled areas around the lines $\Delta t_{i+1} = 270$ s and $\Delta t_i = 270$ s. Grouping of dots around the descending line $\Delta t_{i+1} + \Delta t_i = 270$ s indicates cases where the 270 s periods are intercepted by single real events.
periodic events at an early stage of counting. If the level of spurious
counts reaches 10 out of 100 total counts, the spurious events can be
detected. We have not used or planned to use time series analyses for trac-
ing outliers, but only for establishing the possible existence of periodicity.
The method is of particular advantage in examining very low frequency
periodic phenomena, as higher frequency non-random events are detected
by other means.

Time series analyses displayed in suitable graphic form permits the
user to visually assess the validity of low count-rate data. Time-dependent
effects, radon decay, anticoincidence shield efficiency fluctuations, and nat-
ural fluctuations in environmental radiation show up in cumulative plots
that can be displayed while counting is in progress.

References
York, John Wiley & Sons, p 1.
Currie, L A, Gerlach, R W, Klooda, G A, Ruegg, F C, and Tompkins, G B, 1983, Mini-
ture signals and miniature counters: Accuracy assurance via microprocessors and
multiparameter control techniques, in Stuiver, M and Kra, R S, eds, Internatl radi-
Kaihola, L, Kojola, H, Polach, H, Soini, E, and Otlet, R, 1983, An evaluation of shield-
ing characteristics applicable to mini-gas proportional counter-based \(^{14}C\) dating sys-
of milligram-size samples using gas proportional counters: an evaluation of preci-
sion and of design parameters, in Ambrose, W and Duerden, P, eds, Archaeometry:
INTRODUCTION

This list contains the results of measurements of 167 groundwater samples made between September 1979 and December 1982. An additional 175 samples were measured, but these were submitted without detailed information, such as sampling depth, well location, etc; therefore, they were excluded from the following list.

$^{14}$C age calculations were based on the assumption that initial activity of the total dissolved inorganic carbon was 100% of modern $^{14}$C activity. Although, this assumption generally is true for material of organic origin, it is not true for dissolved carbon in ground water. Estimation of initial activity of total dissolved carbon can be made from models. A review of the existing models and a new approach was made by Fontes and Garnier (1979). Interested readers may refer to these models for corrections of groundwater ages. $^{14}$C half-life of 5568 ± 30 years was used in age calculations. Statistical errors quoted are $1\sigma$ counting errors, including sample, background, and standard error estimates. The age limit reported is calculated on the basis of $3\sigma$ activity. The $\delta^{13}$C values in table 1 were measured in an isotope laboratory of the US Geological Survey in Reston, Virginia, and calculated relative to Craig’s Peedee Belemnite (PDB) limestone standard (Craig, 1957). Total alkalinity as bicarbonate values reported in table 1 was determined using techniques described by Brown, Skougstad, and Fishman (1970). Unless otherwise stated, all samples were collected and submitted by personnel of the US Geological Survey. Sample preparation and counting technique remain as previously reported (Yang & Emerson, 1980; Yang, McAvoy, & Emerson, 1981).

GROUNDWATER SAMPLES

*Alabama*

**DE-69. Well Burkville A-2**

11,300 ± 450

Sample coll Jan 14, 1981, from Montgomery Co (32° 18’ 30” N, 86° 31’ 25” W) from depth 225.55m. Alt of well head, 70.1m above msl.

**DE-70. Well A-5 W F Junkin**

6300 ± 130

Sample coll Jan 15, 1981, from Pickens Co (33° 26’ 49” N, 87° 56’ 29” W) from depth 67.67m. Hole drilled to 67.67m. Alt of well head, 109.42m above msl.

**DE-71. Well D-17 Bobby Bain**

2900 ± 110

Sample coll Jan 16, 1981, from Pickens Co (33° 28’ 47” N, 88° 12’ 37” W) from depth 48.77m. Hole drilled to 48.77m. Alt of well head, 88.39m above msl.
DE-72. Well 0-15 Hickman Farms 18,900 ± 1010
Sample coll Jan 16, 1981, from Pickens Co (33° 16' 37" N, 88° 15' 44" W) from depth <60.96m. Hole drilled to 60.96m. Alt of well head, 82.3m above msl.

DE-73. Well Burkville D-1 21,900 ± 1800
Sample coll Apr 14, 1981, from Lowndes Co (32° 19' 51" N, 86° 31' 41" W) from depth 335.28m. Hole drilled to 408.43m. Alt of well head, 46.94m above msl.

DE-74. Well Burkville B-2 30,200 ± 600
Sample coll Apr 14, 1981, from Lowndes Co (32° 16' 12" N, 86° 31' 13" W) from depth 158.5m. Hole drilled to 158.5m. Alt of well head, 65.53m above msl.

DE-75. Well CHO 1,Z 2 NR Melvin 31,700 ± 1330
Sample coll Jan 27, 1981, from Choctaw Co (31° 55' 53" N, 88° 27' 30" W) from depth 542.54m. Hole drilled to 542.54m. Alt of well head, 106.68m above msl.

DE-76. Well H 14A Jerome McArthur 4300 ± 680
Sample coll July 28, 1982, from Russell Co (32° 19' 45" N, 85° 10' 05" W) from depth 25.91m. Hole drilled to 25.91m. Alt of well head, 140.21m above msl.

DE-77. Well L 12 City of Haneyville >40,000
Sample coll July 8, 1982, from Lowndes Co (32° 10' 58" N, 86° 34' 32" W) from depth 323.09m. Hole drilled to 323.39m. Alt of well head, 75.54m above msl.

DE-78. Newtontown Well No. 2 32,100 ± 2120
Sample coll July 13, 1982, from Dale Co (31° 19' 21" N, 85° 35' 33" W) from depth 189.89m. Hole drilled to 219.46m. Alt of well head, 106.68m above msl.

DE-79. Well P-2 19,400 ± 520
Sample coll July 28, 1982, from Barbour Co (31° 53' 08" N, 85° 35' 57" W) from depth 32m. Hole drilled to 55.17m. Alt of well head, 144.78m above msl.

DE-80. Well Q Olympia Spa Golf Course 15,400 ± 460
Sample coll July 12, 1982 from Houston Co (31° 07' 12" N, 85° 24' 24" W) from depth 85.34m. Hole drilled to 85.34m. Alt of well head, 82.3m above msl.

DE-81. Well M Wyecott Plantation >36,800
Sample coll July 14, 1982, from Barbour Co (31° 58' 14" N, 85° 19' 22" W) from depth 91.44m. Hole drilled to 91.44m. Alt of well head, 112.78m above msl.
DE-82. **S-1 City Well 3 at Clayton** 1300 ± 80
   Sample coll July 14, 1982, from Barbour Co (31° 52’ 08” N, 85° 24’ 48” W) from depth 61.26m. Hole drilled to 59.44m. Alt of well head, 168.86m above msl.

DE-83. **Well A-1 Ben Bowden** 21,300 ± 1340
   Sample coll July 15, 1982, from Barbour Co (32° 05’ 19” N, 85° 12’ 54” W) from depth 160.68m. Hole drilled to 60.96m. Alt of well head, 71.32m above msl.

DE-84. **Well B-3 Barbour County Board of Education** >30,700
   Sample coll July 14, 1982, from Barbour Co (32° 04’ 31” N, 85° 19’ 32” W) from depth 367.76m. Hole drilled to 367.76m. Alt of well head, 110.34m above msl.

DE-85. **Well B-11 Tom Smith** 4100 ± 100
   Sample coll July 29, 1982, from Russell Co (32° 27’ 41” N, 85° 07’ 41” W) from depth 42.67m. Hole drilled to 42.67m.

DE-86. **Well E-9 SH Robinson** 10,900 ± 180
   Sample coll July 13, 1982, from Henry Co (31° 37’ 38” N, 85° 16’ 30” W) from depth 103.94m.

DE-87. **Well H-16 Lardonier-Crawford** 18,700 ± 660
   Sample coll July 27, 1982, from Russell Co (32° 22’ 41” N, 85° 07’ 41” W) from depth 114.91m. Hole drilled to 114.91m. Alt of well head, 80.77m above msl.

DE-88. **Ozark City Well No. 2** 38,600 ± 4150
   Sample coll July 13, 1982, from Dale Co (31° 27’ 23” N, 85° 38’ 42” W) from depth 213.36m.

DE-89. **H-12 Greenville City Well** >37,800
   Sample coll July 8, 1982, from Butler Co (31° 49’ 47” N, 86° 36’ 40” W) from depth 133.81m. Hole drilled to 175.87m. Alt of well head, 115.52m above msl.

DE-90. **Well P-1 JB Neighbors** <50
   Sample coll July 7, 1982, from Macon Co (32° 28’ 33” N, 86° 41’ 08” W) from depth 54.86m. Alt of well head, 56.69m above msl.

DE-91. **Well F-4 LB Bormeister** 14,000 ± 380
   Sample coll July 8, 1982, from Autauga Co (32° 36’ 48” N, 86° 40’ 16” W) from depth 36.58m. Hole drilled to 36.58m. Alt of well head, 89.92m above msl.

*Colorado*

DE-92. **Well TH 75-15A (C3-97-30 ACCI)** 21,500 ± 230
   Sample coll Oct 5, 1982, Rio Blanco Co (39° 45’ 40” N, 108° 19’ 12” W) from depth 199.64m.
**DE-93. Well TH-75-13B (C2-98-24 CBB3)**  
Sample coll Oct 6, 1982, from Rio Blanco Co (39° 51' 36" N, 108° 21' 00" W) from depth 329.18m.

**DE-94. Well TH 75-1A (B1-97-CAD1)**  
Sample coll Oct 13, 1982, from Rio Blanco Co (40° 02' 18" N, 108° 17' 06" W) from depth 329.08m.

**DE-95. Spring Yellow Creek No. 1**  
Sample coll Oct 14, 1982, from Rio Blanco Co (40° 00' 19" N, 108° 21' 10" W) from depth 218.36m.

### Florida

**DE-96. Well Fla For Srv Cmp Hndrsn**  
Sample coll Feb 20, 1980, from Santa Rosa Co (30° 59' 40" N, 86° 58' 06" W) from depth 248.41m. Alt of well head, 85.34m above msl.

**DE-97. USGS Test Well No. 1**  
Sample coll Jan 23, 1980, from Santa Rosa Co (30° 35' 14" N, 87° 05' 48" W) from depth 509.02m. Alt of well head, 37.17m above msl.

**DE-98. USGS Test Well No. 2**  
Sample coll Jan 8, 1980, from Santa Rosa Co (30° 42' 52" N, 87° 00' 22" W) from depth 393.19m. Alt of well head, 38.12m above msl.

**DE-99. Well North Monitor**  
Sample coll Jan 22, 1980, from Escambia Co (30° 36' 57" N, 87° 15' 43" W) from depth 464.21m. Alt of well head, 2.39m above msl.

**DE-100. Well Deep Monitor North Am Cy**  
Sample coll Jan 7, 1980, from Santa Rosa Co (30° 35' 14" N, 87° 05' 48" W) from depth 509.02m. Alt of well head, 37.17m above msl.

**DE-101. Well D-0349 J-0414**  
Sample coll June 19, 1981, from Duval Co (30° 24' 16" N, 81° 52' 26" W) from depth 211.83m. Hole drilled to 679.7m. Alt of well head, 24.38m above msl.

**DE-102. Well D-0349 J-0414**  
Sample coll June 25, 1980, from Duval Co (30° 24' 16" N, 81° 52' 26" W) from depth 679.7m. Alt of well head, 24.38m above msl.

**DE-103. Well 29S/38E-10**  
Sample coll July 28, 1980, from Brevard Co (27° 58' 58" N, 80° 31' 18" W) from depth 100.28m. Alt of well head, 0.3m above msl.

**DE-104. Well 30S/31E-1**  
Sample coll July 29, 1980, from Brevard Co (27° 52' 08" N, 80° 27' 17" W) from depth 74.68m.

**DE-118. Well 50S/35E-03g**  
Sample coll Oct 19, 1981, from Broward Co (26° 10' 16" N, 80° 49' 26" W) from depth 274.32m. Hole drilled to 856.79m. Alt of well head, 4.71m above msl.

**DE-119. Well 50S/42E-14bi**  
Sample coll Oct 21, 1981, from Broward Co (26° 05' 55" N, 80° 00' 73" W) from depth 782.73m.
DE-105. Yates Well 25,500 ± 950
Sample coll July 31, 1980, from Indian River Co (27° 48' 57" N, 80° 49' 34" W) from depth 71.02m. Alt of well head, 8.53m above msl.

DE-106. Well OS-273 NR Kenansville 30,000 ± 2000
Sample coll July 31, 1980, from Hillsborough Co (27° 59' 57" N, 80° 52' 31" W) from depth 83.52m. Hole drilled to 10.97m.

DE-107. Well 30S/37E-35 28,800 ± 2900
Sample coll July 29, 1980 from Brevard Co (27° 49' 25" N, 80° 36' 17" W) from depth 71.02m. Alt of well head, 8.53m above msl.

DE-108. Well 50S/35E-03g 13,900 ± 680
Sample coll Oct 18, 1980, from Broward Co (26° 10' 16" N, 80° 49' 26" W) from depth 284.68m. Hole drilled to 856.79m. Alt of well head, 4.71m above msl.

DE-109. Well 50S/35E-03g >24,500
Sample coll Mar 9, 1981, from Broward Co (26° 10' 16" N, 80° 49' 26" W) from depth 284.68m. Hole drilled to 856.79m. Alt of well head, 4.71m above msl.

DE-110. Well 50S/35E-03g 22,900 ± 1060
Sample coll Mar 8, 1981, from Broward Co (26° 10' 16" N, 80° 49' 26" W) from depth 284.68m. Hole drilled to 856.79m. Alt of well head, 4.71m above msl.

DE-111. Well 50S/35E-03g 24,500 ± 1150
Sample coll Mar 7, 1981, from Broward Co (26° 10' 16" N, 80° 49' 26" W) from depth 466.34m.

DE-112. Well 50S/35E-03g 9600 ± 480
Sample coll Mar 3, 1981, from Broward Co (26° 10' 16" N, 80° 49' 26" W) from depth 746.76m.

DE-113. Tide Water Well 1 6300 ± 130
Sample coll Sept 7, 1981, from Marion Co (29° 07' 43" N, 82° 34' 15" W) from depth 238.86m. Alt of well head, 22.51m above msl.

DE-114. Well 50S/35E-03g >37,800
Sample coll Oct 19, 1981, from Broward Co (26° 10' 16" N, 80° 49' 26" W) from depth 284.68m. Hole drilled to 856.79m. Alt of well head, 4.71m above msl.

DE-115. Well 50S/35E-03g >20,700
Sample coll Oct 19, 1981, from Broward Co (26° 10' 16" N, 80° 49' 26" W) from depth 762m. Hole drilled to 856.79m. Alt of well head, 4.71m above msl.

DE-116. Well 56S/40E-21 7100 ± 190
Sample coll Oct 22, 1981, from Hendry Co (26° 32' 55" N, 80° 19' 28" W) from depth 242.78m. Alt of well head, 9.73m above msl.

DE-129. Palm Coast Well SW-91 13,400 ± 280
Sample coll Mar 1, 1982, from Flagler Co (29° 07' 06" N, 81° 17' 46" W) from depth 24.99m. Alt of well head, 9.73m above msl.

DE-130. Well USGS TW 1 25,200 ± 1200
Sample coll June 9, 1981, from Ware Co (31° 07' 06" N, 82° 15' 51" W) from depth 565.71m. Alt of well head, 45.7m above msl.

DE-131. Well J P Stevens 4 8800 ± 140
Sample coll Aug 22, 1981, from Jefferson Co (33° 00' 14" N, 82° 27' 39" W) from depth 129.24m. Alt of well head, 85.34m above msl.

DE-132. Well Wrens, GA 2000 ± 130
DE-117. Well 50S/42E-14bi
Sample coll Oct 21, 1981, from Broward Co (26° 05’ 55” N, 80° 00’ 73” W) from depth 782.73m.

DE-118. Well 50S/35E-03g
Sample coll Oct 19, 1981, from Broward Co (26° 10’ 16” N, 80° 49’ 26” W) from depth 274.32m. Hole drilled to 856.79m. Alt of well head, 4.71m above msl.

DE-119. Well 50S/42E-14bi
Sample coll Oct 21, 1981, from Broward Co (26° 05’ 55” N, 80° 00’ 73” W) from depth 311.2m.

DE-120. Well 56S/40E-21
Sample coll Oct 22, 1981, from Palm Beach Co (26° 32’ 55” N, 80° 19’ 57” W) from depth 307.85m. Hole drilled to 825.09m. Alt of well head, 3.05m above msl.

DE-121. Firetower Well nr Codys Corner
Sample coll Feb 17, 1982, from Flagler Co (29° 18’ 18” N, 81° 19’ 05” W) from depth 42.67m. Alt of well head, 7.62m above msl.

DE-122. 12S/29E-33 Harper Well
Sample coll Feb 18, 1982, from Flagler Co (29° 25’ 21” N, 81° 22’ 23” W) from depth 91.44m. Alt of well head, 2.13m above msl.

DE-123. Newbold Irrigation Well at Crescent City
Sample coll Feb 16, 1982, from Putnam Co (29° 27’ 41” N, 81° 30’ 58” W) from depth 24.38m. Alt of well head, 1.52m above msl.

DE-124. Well Yarborough Home
Sample coll Mar 3, 1982, from Seminole Co (28° 44’ 11” N, 81° 26’ 58” W) from depth 45.72m. Alt of well head, 10.73m above msl.

DE-125. Well 13S/30E-06
Sample coll Feb 18, 1982, from Flagler Co (29° 23’ 42” N, 81° 18’ 37” W) from depth 86.86m. Alt of well head, 4.32m above msl.

DE-126. Well Seminole Pkwy at Sesame Blvd
Sample coll Feb 22, 1982, from Flagler Co (29° 25’ 59” N, 81° 11’ 11” W) from depth 89.92m. Alt of well head, 8.53m above msl.

DE-127. Stock Well at St. Johns Park
Sample coll Feb 22, 1982, from Flagler Co (29° 25’ 28” N, 81° 25’ 53” W) from depth 91.44m. Alt of well head, 2.13m above msl.

DE-128. Palm Coast Well SW-92
Sample coll Mar 1, 1982, from Flagler Co (29° 36’ 36” N, 81° 18’ 09” W) from depth 26.82m. Alt of well head, 9.14m above msl.
DE-129. Palm Coast Well SW-91 13,400 ± 280
Sample coll Mar 1, 1982, from Flagler Co (29° 34’ 06” N, 81° 17’ 46” W) from depth 24.99m. Alt of well head, 9.73m above msl.

Georgia

DE-130. Well USGS TW 1 25,200 ± 1200
Sample coll June 9, 1981, from Ware Co (31° 07’ 06” N, 82° 15’ 51” W) from depth 565.71m. Alt of well head, 45.7m above msl.

DE-131. Well J P Stevens 4 8800 ± 140
Sample coll Aug 22, 1981, from Jefferson Co (33° 00’ 14” N, 82° 27’ 39” W) from depth 129.24m. Alt of well head, 85.34m above msl.

DE-132. Well Wrens, GA;3 2000 ± 130
Sample coll Sept 3, 1981, from Jefferson Co (33° 11’ 57” N, 82° 23’ 25” W) from depth 42.98m. Alt of well head, 128.93m above msl.

DE-133. Well Thiele Co, Reedy CR 1 1500 ± 270
Sample coll Sept 4, 1981, from Jefferson Co (33° 10’ 49” N, 82° 27’ 11” W) from depth 45.79m. Alt of well head, 138.44m above msl.

DE-134. Well J M Huber Co., 2 3700 ± 240
Sample coll Aug 3, 1982, from Jefferson Co (33° 16’ 52” N, 82° 24’ 34” W) from depth 95.1m. Alt of well head, 131.06m above msl.

DE-135. Well Gibson, GA 3 <50
Sample coll Sept 4, 1981, from Glascock Co (33° 13’ 59” N, 82° 35’ 56” W) from depth 61.87m. Alt of well head, 132.56m above msl.

DE-136. Well King Finishing No. 1 32,900 ± 2700
Sample coll Aug 19, 1981, from Screven Co (32° 36’ 14” N, 81° 44’ 21” W) from depth 404.17m. Alt of well head, 48.77m above msl.

DE-137. Chalker Well <50
Sample coll Aug 21, 1981, from Warren Co (33° 20’ 00” N, 82° 38’ 08” W) from depth 6.09m.

DE-138. Well Pincushion TW-3 19,700 ± 370
Sample coll Jan 28, 1982, from Laurens Co (32° 30’ 30” N, 83° 03’ 00” W) from depth 377.92m. Hole drilled to 513.59m. Alt of well head, 85.95m above msl.

DE-139. Well Ellaville GA 5 8300 ± 290
Sample coll Aug 3, 1982, from Schley Co (32° 14’ 08” N, 84° 18’ 20” W) from depth 195.07m. Hole drilled to 198.12m. Alt of well head, 173.13m above msl.

DE-140. Well Breeland, Lee 600 ± 570
Sample coll Aug 5, 1982, from Schley Co (32° 17’ 47” N, 84° 17’ 24” W) from depth 39.01m. Hole drilled to 39.01m. Alt of well head, 146.91m above msl.
DE-141. Well Albany TW-10  
Sample coll July 20, 1982, from Dougherty Co (31° 35’ 30” N, 84° 10’ 30” W) from depth 256.03m. 

DE-142. Crouch Well H-5  
Sample coll July 28, 1982, from Chattahoochee Co (32° 23’ 22” N, 85° 07’ 13” W) from depth 32m. 

DE-143. Well Kolomoki State Park No. 2  
Sample coll July 20, 1982, from Early Co (31° 28’ 05” N, 84° 55’ 40” W) from depth 44.2m. 

DE-144. Well Albany TW-1  
Sample coll July 19, 1982, from Dougherty Co (31° 31’ 05” N, 84° 06’ 43” W) from depth 449.28m. 

DE-145. Well Fort Gains, GA-3  
Sample coll July 21, 1982, from Clay Co (31° 36’ 38” N, 85° 03’ 21” W) from depth 109.73m. Hole drilled to 112.78m. Alt of well head, 45.42m above msl. 

DE-146. Well Wainwright-House  
Sample coll July 22, 1982, from Taylor Co (32° 40’ 12” N, 84° 11’ 04” W) from depth 21.34m. Hole drilled to 21.34m. Alt of well head, 165.51m above msl. 

DE-147. Well Georgetown No. 1  
Sample coll July 21, 1982, from Quitman Co (31° 53’ 05” N, 85° 05’ 57” W) from depth 416.05m. 

DE-148. Well Georgetown No. 2  
Sample coll July 21, 1982, from Quitman Co (31° 52’ 21” N, 85° 04’ 51” W) from depth 536.45m. 

DE-149. Omaha School Well  
Sample coll Aug 4, 1982, from Stewart Co (32° 08’ 32” N, 85° 00’ 04” W) from depth 96.32m. 

DE-150. Well Omaha, GA-1  
Sample coll Aug 4, 1982, from Stewart Co (32° 08’ 59” N, 85° 00’ 37” W) from depth 295.05m. Hole drilled to 312.42m. Alt of well head, 91.74m above msl. 

DE-151. Well BIBB Plant Laurel 2  
Sample coll July 22, 1982, from Taylor Co (32° 30’ 58” N, 84° 07’ 19” W) from depth 58.83m. Hole drilled to 58.83m. Alt of well head, 129.54m above msl. 

DE-152. Well Singletary Bancerof  
Sample coll July 20, 1982, from Early Co (31° 24’ 45” N, 84° 49’ 41” W) from depth 234.7m. Alt of well head, 233.78m above msl.
DE-153. Well Wainwright 2 6200 ± 780
Sample collected July 22, 1982, from Taylor Co (32° 33' 04" N, 84° 10' 11" W) from depth 185.01m. Hole drilled to 185.01m. Alt of well head, 192.63m above msl.

DE-154. Well Weston GA (Old 1) 10,500 ± 170
Sample collected Aug 4, 1982, from Webster Co (31° 58' 41" N, 84° 36' 55" W) from depth 81.69m. Hole drilled to 81.69m. Alt of well head, 159.11m above msl.

Idaho

DE-155. Well 04S/01E-34bad1 21,500 ± 600
Sample collected Jan 27, 1982, from Owyhee Co (43° 02' 36" N, 116° 19' 26" W) from depth 408.30m. Alt of well head, 783.34m above msl.

DE-156. Well 05S/03E-26bcb1 24,600 ± 1850
Sample collected Jan 26, 1982 from Owyhee Co (42° 57' 50" N, 116° 04' 32" W) from depth 905.26m. Alt of well head, 757.43m above msl.

DE-157. Well 08S/14E-30acd2 25,800 ± 1570
Sample collected Jan 18, 1982, from Jerome Co (42° 42' 14" N, 114° 51' 21" W) from depth 128.02m. Alt of well head, 882.09m above msl.

Iowa

DE-158. Well Webster 6 >37,400
Sample collected Feb 24, 1982, from Hamilton Co (42° 28' 55" N, 93° 48' 15" W) from depth 609.6m.

DE-159. Ode Bolt 2 Town Well 33,800 ± 1700
Sample collected Feb 23, 1982, from Carroll Co (42° 18' 31" N, 95° 15' 21" W) from depth 650.75m.

DE-160. Well 07-227W-10cdea 29,400 ± 930
Sample collected Feb 23, 1982, from Monroe Co (41° 02' 35" N, 93° 56' 49" W) from depth 949.15m. Alt of well head, 371.86m above msl.

DE-161. Well 08-007W-25bdcb 24,600 ± 510
Sample collected Feb 24, 1982, from Linn Co (41° 42' 35" N, 91° 36' 41" W) from depth 524.25m. Alt of well head, 247.5m above msl.

DE-162. Well 08-307W-01bade 26,400 ± 920
Sample collected Feb 24, 1982, from Monroe Co (42° 02' 00" N, 91° 36' 30" W) from depth 477.01m. Alt of well head, 243.84m above msl.

DE-163. Well 07-623W-31dadd 25,500 ± 290
Sample collected Feb 22, 1982, from Warren Co (41° 20' 25" N, 93° 32' 22" W) from depth 742.18m. Alt of well head, 258.78m above msl.
DE-164. Well C040 H Miller 19,700 ± 1110
Sample coll Jan 19, 1981, from Noxubee Co (33° 13’ 08” N, 88° 36’ 51” W) from depth 493.78m. Alt of well head, 78.64m above msl.

DE-165. Well B013 Hoffman 22,100 ± 300
Sample coll Jan 10, 1981, from Noxubee Co (33° 15’ 28” N, 88° 37’ 07” W) from depth 231.65m. Alt of well head, 88.39m above msl.

DE-166. Brooksville Town Well 21,600 ± 450
Sample coll Jan 12, 1981, from Noxubee Co (33° 13’ 57” N, 88° 34’ 52” W) from depth 287.12m.

DE-167. Well D018 Holeut Cairo WA 4200 ± 110
Sample coll Jan 9, 1981, from Jackson Co (34° 44’ 55” N, 88° 21’ 40” W) from depth 92.96m. Alt of well head, 179.83m above msl.

DE-168. Well H010 Ashland 14,400 ± 420
Sample coll Jan 7, 1981, from Amite Co (34° 51’ 00” N, 89° 10’ 48” W) from depth 280.42m. Alt of well head, 186.84m above msl.

DE-169. Well B011 Walnut 28,800 ± 2900
Sample coll Jan 6, 1981, from Alcorn Co (34° 57’ 24” N, 88° 54’ 00” W) from depth 292.91m. Alt of well head, 161.54m above msl.

DE-170. Well C018 Black Belt Exp Sta 7700 ± 900
Sample coll Jan 12, 1981, from Noxubee Co (33° 15’ 31” N, 88° 33’ 41” W) from depth 393.19m. Alt of well head, 85.95m above msl.

DE-171. Well B007 Walnut 10,900 ± 170
Sample coll Jan 8, 1981, from Tippah Co (34° 56’ 57” N, 88° 53’ 49” W) from depth 44.81m. Alt of well head, 143.26m above msl.

DE-172. Well B002 Abrams 13,300 ± 200
Sample coll Jan 10, 1981, from Noxubee Co (33° 11’ 45” N, 88° 37’ 04” W) from depth 264.57m. Alt of well head, 85.65m above msl.

DE-173. Well E003 Mathis 1200 ± 370
Sample coll Jan 8, 1981, from Alcorn Co (34° 56’ 00” N, 88° 48’ 26” W) from depth 38.1m. Alt of well head, 155.45m above msl.

DE-174. Well L006 Mashulaville 33,500 ± 1550
Sample coll Jan 11, 1981, from Noxubee Co (33° 05’ 28” N, 88° 44’ 30” W) from depth 557.78m. Alt of well head, 80.77m above msl.

DE-175. Well D005 Byhalia 29,800 ± 900
Sample coll Jan 7, 1981, from Harrison Co (34° 52’ 20” N, 89° 46’ 23” W) from depth 499.87m. Alt of well head, 109.73m above msl.
DE-176. Well A010 Columbus AFB No. 2 16,200 ± 500
Sample coll Jan 9, 1981, from Lowndes Co (33° 37' 32" N, 88° 26' 36" W) from depth 134.72m. Alt of well head, 61.87m above msl.

DE-177. Well C020 Butler 31,300 ± 900
Sample coll Jan 11, 1981, from Noxubee Co (33° 13' 57" N, 88° 34' 08" W) from depth 215.8m. Alt of well head, 79.25m above msl.

Nevada
DE-178. Well 210/S13/E63-23dd 20,700 ± 230
Sample coll Dec 23, 1980, from Clark Co (36° 47' 44" N, 114° 53' 32" W) from depth 203.91m. Alt of well head, 664.46m above msl.

DE-179. Well 179/N12/E63-12bdab1 9600 ± 110
Sample coll Jan 19, 1981, from White Pine Co (38° 55' 16" N, 114° 50' 21" W) from depth 288.95m.

DE-180. Well 210/S13/E63-23dd 20,800 ± 240
Sample coll July 22, 1981, from Clark Co (36° 47' 44" N, 114° 53' 32" W) from depth 203.91m. Alt of well head, 664.46m above msl.

DE-181. Well VE 29A-2-H 3800 ± 120
Sample coll Jan 8, 1982, from Nye Co (36° 56' 29" N, 116° 22' 26" W) from depth 335.7m.

DE-182. Well VE 29A-2-H 4100 ± 120
Sample coll Jan 15, 1982, from Nye Co (36° 56' 29" N, 116° 22' 26" W) from depth 150.12m.

DE-183. USW-H 6 14,600 ± 100
Sample coll Oct 16, 1982, from Nye Co (36° 50' 49" N, 116° 28' 55" W) from depth 557.75m.

New Mexico
DE-184. Oscura Range Camp Well 15,700 ± 330
Sample coll July 29, 1982, from Lincoln Co (33° 29' 54" N, 106° 10' 22" W) from depth 41.76m.

North Carolina
DE-185. Carolina Welding Well 300 ± 140
Sample coll Aug 12, 1981, from Scotland Co (34° 44' 18" N, 79° 27' 13" W) from depth 7.62m.

DE-186. Rowland, RB-39 9000 ± 220
Sample coll Aug 12, 1981, from Robeson Co (34° 32' 21" N, 79° 17' 02" W) from depth 128.32m.

DE-187. Rowland, RB-41 6500 ± 250
Sample coll Aug 12, 1981 from Robeson Co (34° 32' 38" N, 79° 17' 43" W) from depth 76.2m.
DE-188. Laurinburg, SC-18  2700 ± 280
Sample coil Aug 12, 1981, from Scotland Co (34° 47' 02" N, 79° 26' 30" W) from depth 42.67m.

Oregon

DE-189. Wood  28,300 ± 880
Wood sample coil Oct 1979, from Douglas Co (43° 27' 16" N, 124° 16' 24" W) from depth 49.07m.

DE-190. Shell  7500 ± 190
Shell sample coil Oct 1979, from Douglas Co (43° 27' 16" N, 124° 16' 24" W) from depth 33.53m.

South Carolina

DE-191. Well BFT-457  28,600 ± 520
Sample coll Sept 10, 1981, from Beaufort Co (32° 19' 39" N, 80° 27' 42" W) from depth 832.1m. Hole drilled to 953.11m. Alt of well head, 2.13m above msl.

DE-192. Well Isle of Palms  28,400 ± 510
Sample coil Aug 7, 1981, from Charleston Co (32° 47' 15" N, 79° 49' 17" W) from depth 609.6m.

DE-193. Well BFT-454  30,100 ± 620
Sample coll Sept 10, 1981, from Beaufort Co (32° 14' 46" N, 80° 44' 40" W) from depth 923.54m. Hole drilled to 924.76m. Alt of well head, 2.05m above msl.

DE-194. Well MRN-42 Marion TWN No. 3  10,600 ± 150
Sample coll Aug 13, 1981, from Marion Co (34° 10' 26" N, 79° 23' 47" W) from depth 173.74m. Alt of well head, 21.34m above msl.

DE-195. Well MRN-38 Marion TWN No. 2  28,600 ± 1290
Sample coll Aug 13, 1981, from Marion Co (34° 11' 01" N, 79° 23' 47" W) from depth 60.96m. Hole drilled to 60.96m. Alt of well head, 21.95m above msl.

DE-196. Well Brookgreen No. 1  5100 ± 120
Sample coll Aug 5, 1981, from Horry Co (33° 31' 13" N, 79° 05' 35" W) from depth 33.52m.

DE-197. Well Brookgreen No. 2  26,700 ± 420
Sample coll Aug 5, 1981, from Horry Co (33° 30' 59" N, 79° 05' 32" W) from depth 205.74m.

DE-198. Well HO-299  >41,600
Sample coll Aug 5, 1981, from Horry Co (33° 53' 33" N, 78° 35' 20" W) from depth 381m.
DE-199.  Well CHN-64-CHN  
33,100 ± 930
Sample coll Aug 7, 1981, from Charleston Co (32° 47' 08" N, 79° 55' 55" W) from depth 408.43m. Hole drilled to 406.91m. Alt of well head, 4.88m above msl.

DE-200. Well Conway W-2  
32,600 ± 870
Sample coll Aug 6, 1981, from Horry Co (33° 51' 01" N, 79° 04' 08" W) from depth 204.06m.

DE-201. Well BFT-11  
36,200 ± 2920
Sample coll Sept 11, 1981, from Beaufort Co (32° 21' 10" N, 80° 41' 22" W) from depth 850.39m. Hole drilled 849.17m. Alt of well head, 3.66m above msl.

DE-202. Well BFT-10  
32,800 ± 890
Sample coll Sept 11, 1981, from Beaufort Co (32° 19' 46" N, 80° 42' 26" W) from depth 905.26m. Hole drilled to 1045.46m. Alt of well head, 3.66m above msl.

DE-203. Well GEO-88  
>41,800
Sample coll Aug 25, 1981, from Georgetown Co (33° 15' 08" N, 79° 16' 24" W) from depth 563.88m. Hole drilled to 594.72m. Alt of well head, 1.83m above msl.

DE-204. Hodge Well  
31,300 ± 800
Sample coll Aug 24, 1981, from Charleston Co (32° 55' 35" N, 79° 44' 16" W) from depth 129.54m.

DE-205. Well BRK-9  
26,800 ± 470
Sample coll Aug 24, 1981, from Charleston Co (33° 11' 50" N, 80° 00' 40" W) from depth 45.72m. Hole drilled to 45.72m. Alt of well head, 15.24m above msl.

DE-206. Well N Myrtle Beach-3  
6700 ± 130
Sample coll Aug 6, 1981, from Horry Co (33° 49' 19" N, 78° 40' 27" W) from depth 32m.

DE-207. MRN-78, Test Well No. 2  
24,500 ± 340
Sample coll Apr 1, 1982, from Horry Co (33° 51' 43" N, 79° 19' 50" W) from depth 347.47m.

DE-208. MRN-78, Test Well No. 2  
22,600 ± 250
Sample coll Apr 9, 1982, from Horry Co (33° 51' 43" N, 79° 19' 50" W) from depth 313.94m.

DE-209. MRN-78, Test Well No. 2  
29,900 ± 580
Sample coll Apr 19, 1982, from Horry Co (33° 51' 43" N, 79° 19' 50" W) from depth 253.29m.
DE-210. MRN-78, Test Well No. 2 29,600 ± 970
Sample coll Apr 24, 1982, from Horry Co (33° 51’ 43” N, 79° 19’ 50” W) from depth 234.09m.

DE-211. MRN-78, Test Well No. 2 28,400 ± 500
Sample coll Apr 30, 1982, from Horry Co (33° 51’ 43” N, 79° 19’ 50” W) from depth 163.68m.

DE-212. MRN-78, Test Well No. 2 >38,100
Sample coll May 2, 1982, from Horry Co (33° 51’ 43” N, 79° 19’ 50” W) from depth 108.2m.

South Dakota

DE-213. Well 93N/55W-04bbce 28,300 ± 580
Sample coll May 7, 1980, from Yankton Co (42° 54’ 40” N, 97° 21’ 25” W) from depth 117.65m. Hole drilled to 124.05m. Alt of well head, 365.76m above msl.

DE-214. Well 96N/63W-68cda 33,200 ± 1570
Sample coll May 8, 1980, from Charles Mix Co (43° 08’ 26” N, 98° 19’ 06” W) from depth 201.63m. Hole drilled to 204.83m. Alt of well head, 433.73m above msl.

DE-215. Well 91N/49W-19bcca 22,000 ± 320
Sample coll May 6, 1980, from Union Co (42° 41’ 13” N, 96° 41’ 13” W) from depth 99.06m. Hole drilled to 99.06m.

DE-216. Well 116N/70W-07ada 31,600 ± 780
Sample coll May 13, 1980, from Hand Co (44° 52’ 36” N, 99° 17’ 38” W) from depth 581.66m. Hole drilled to 587.96m. Alt of well head, 582.17m above msl.

DE-217. Well 109N/70W-04babd 33,700 ± 1140
Sample coll May 14, 1980, from Hand Co (44° 16’ 53” N, 99° 15’ 33” W) from depth 573.94m. Hole drilled to 592.84m. Alt of well head, 570.59m above msl.

DE-218. Well 113N/66W-25dada2 29,400 ± 1110
Sample coll May 12, 1980, from Hand Co (44° 34’ 01” N, 98° 42’ 26” W) from depth 352.04m.

DE-219. Well 107N/65W-5bbba 23,500 ± 540
Sample coll May 15, 1980, from Jerauld Co (44° 06’ 34” N, 98° 40’ 03” W) from depth 429.16m. Hole drilled to 432.82m. Alt of well head, 576.07m above msl.

DE-220. Well 104N/61W-36ddaa 30,268 ± 793
Sample coll May 19, 1980, from Davison Co (43° 45’ 55” N, 98° 05’ 12” W) from depth 103.63m. Hole drilled to 103.63m. Alt of well head, 394.72m above msl.
DE-221. Well 105N/58W-31bace 26,400 ± 520
Sample coll May 20, 1980, from Miner Co (43° 51’ 42” N, 97° 50’ 39” W) from depth 192.02m. Hole drilled to 192.02m. Alt of well head, 398.68m above msl.

DE-222. Well 128N/66W-08abbc 32,000 ± 1330
Sample coll May 22, 1980, from McPherson Co (45° 55’ 27” N, 98° 49’ 03” W) from depth 547.73m. Hole drilled to 581.25m.

DE-223. Well 2N/8E-17cdd 5000 ± 130
Sample coll June 19, 1980, from Pennington Co (44° 07’ 35” N, 103° 10’ 56” W) from depth 528.82m. Hole drilled to 528.82m.

DE-224. Well 106N/76W-3b >25,300
Sample coll June 26, 1980, from Buffalo Co (44° 00’ 50” N, 99° 56’ 06” W) from depth 431.6m. Hole drilled to 437.99m.

DE-225. Well 9N/26E-12add >35,300
Sample coll June 30, 1980, from Potter Co (44° 45’ 16” N, 100° 53’ 37” W) from depth 514.05m. Hole drilled to 548.6m.

DE-226. Well 02S/31E-35cace >42,200
Sample coll July 1, 1980, from Jones Co (43° 49’ 31” N, 100° 22’ 53” W) from depth 503.38m. Hole drilled to 539.5m.

DE-227. Well 112N/74W-4de >42,200
Sample coll July 2, 1980, from Hughes Co (44° 31’ 42” N, 99° 43’ 54” W) from depth 429.01m. Hole drilled to 445.01m.

Tennessee

DE-228. Well SH:Q-40 3800 ± 70
Sample coll Mar 31, 1982, from Shelby Co (35° 11’ 09” N, 89° 51’ 29” W) from depth 134.42m.

DE-229. Well SH:0-231 Mallory ML6N 3500 ± 60
Sample coll Mar 31, 1982, from Shelby Co (35° 09’ 17” N, 90° 01’ 20” W) from depth 157.89m. Hole drilled to 157.89m.

DE-230. Well SH:T-16 Shelby Forest Campground 7300 ± 70
Sample coll June 3, 1982, from Shelby Co (35° 20’ 45” N, 90° 02’ 49” W) from depth 178m. Hole drilled to 178m.

Utah

DE-231. Well DOE No. 6 >37,600
Sample coll Jan 8, 1980, from Grand Co (38° 50’ 33” N, 109° 44’ 21” W) from depth 148.13m.

DE-232. Well DOE No. 4 41,400 ± 2700
Sample coll Jan 31, 1980, from Grand Co (38° 50’ 24” N, 109° 44’ 08” W) from depth 149.68m.
DE-233. Well DOE No. 8  
Sample coll Feb 20, 1980, from Grand Co (38° 50' 34" N, 109° 44' 18" W) from depth 159.72m.

DE-234. Well DOE No. 9  
Sample coll Feb 26, 1980, from Grand Co (38° 50' 34" N, 109° 44' 18" W) from depth 136.25m.

DE-235. Well DOE No. 5  
Sample coll Mar 12, 1980, from Grand Co (38° 50' 31" N, 109° 44' 05" W) from depth 125.27m.

REFERENCES
<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Colln date</th>
<th>( ^{13}C ) (‰ PDB)</th>
<th>Total alkalinity as bicarbonate (mg/L)</th>
<th>Water source by state</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE-69</td>
<td>1/14/81</td>
<td>-16.7</td>
<td>45</td>
<td>Alabama</td>
</tr>
<tr>
<td>-70</td>
<td>1/15/81</td>
<td>-18.6</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>-71</td>
<td>1/16/81</td>
<td>-18.9</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>-72</td>
<td>1/16/81</td>
<td>-19.1</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>-73</td>
<td>4/14/81</td>
<td>-19.1</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>-74</td>
<td>4/14/81</td>
<td>-10.3</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>-75</td>
<td>1/27/81</td>
<td>-12.6</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>-76</td>
<td>7/28/82</td>
<td>-21.0</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>-77</td>
<td>7/8/82</td>
<td>-15.6</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>-78</td>
<td>7/13/82</td>
<td>-9.5</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>-79</td>
<td>7/25/82</td>
<td>-13.2</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>-80</td>
<td>7/12/82</td>
<td>-14.6</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>-81</td>
<td>7/14/82</td>
<td>-10.7</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>-82</td>
<td>7/15/82</td>
<td>-8.5</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>-83</td>
<td>7/14/82</td>
<td>-17.8</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>-84</td>
<td>7/20/82</td>
<td>-22.5</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>-85</td>
<td>7/13/82</td>
<td>-11.8</td>
<td>230</td>
<td></td>
</tr>
<tr>
<td>-86</td>
<td>7/27/82</td>
<td>-19.3</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>-87</td>
<td>7/13/82</td>
<td>-6.5</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>-88</td>
<td>7/8/82</td>
<td>-8.8</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>-89</td>
<td>7/7/82</td>
<td>-23.2</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>-90</td>
<td>7/8/82</td>
<td>-24.2</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>-91</td>
<td>10/3/82</td>
<td>-4.6</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>-92</td>
<td>10/6/82</td>
<td>-9.5</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>-93</td>
<td>10/13/82</td>
<td>-8.7</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>-94</td>
<td>10/14/82</td>
<td>-8.2</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>-95</td>
<td>2/20/80</td>
<td>-3.8</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>-96</td>
<td>1/23/80</td>
<td>-3.5</td>
<td>391</td>
<td></td>
</tr>
<tr>
<td>-97</td>
<td>1/8/80</td>
<td>-2.9</td>
<td>378</td>
<td></td>
</tr>
<tr>
<td>-98</td>
<td>1/22/80</td>
<td>-4.9</td>
<td>320</td>
<td></td>
</tr>
<tr>
<td>-99</td>
<td>10/7/80</td>
<td>-3.2</td>
<td>435</td>
<td></td>
</tr>
<tr>
<td>-100</td>
<td>6/19/80</td>
<td>-9.8</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>-101</td>
<td>6/25/80</td>
<td>-6.6</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>-102</td>
<td>7/28/80</td>
<td>-5.7</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>-103</td>
<td>7/29/80</td>
<td>-4.4</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>-104</td>
<td>7/31/80</td>
<td>-7.7</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>-105</td>
<td>7/31/80</td>
<td>-7.4</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>-106</td>
<td>10/18/80</td>
<td>-3.1</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>-107</td>
<td>3/9/81</td>
<td>-2.4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>-108</td>
<td>3/8/81</td>
<td>-2.6</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-109</td>
<td>3/7/81</td>
<td>-1.6</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-110</td>
<td>3/5/81</td>
<td>-3.8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-111</td>
<td>9/7/81</td>
<td>-2.2</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-112</td>
<td>10/15/81</td>
<td>-1.8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-113</td>
<td>10/19/81</td>
<td>-7.3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-114</td>
<td>10/22/82</td>
<td>-5.3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-115</td>
<td>10/21/81</td>
<td>-1.2</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-116</td>
<td>10/21/81</td>
<td>-1.2</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-117</td>
<td>10/22/81</td>
<td>-3.9</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-118</td>
<td>2/17/82</td>
<td>-11.1</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-119</td>
<td>2/18/82</td>
<td>-9.0</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-120</td>
<td>2/16/82</td>
<td>-6.9</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-121</td>
<td>3/3/82</td>
<td>-9.3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>-122</td>
<td>2/18/82</td>
<td>-8.8</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
## Table 1 (continued)

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Colln date</th>
<th>$\delta^{13}C$ (‰ PDB)</th>
<th>Total alkalinity as bicarbonate (mg/L)</th>
<th>Water source by state</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE-126</td>
<td>2/22/82</td>
<td>-7.3</td>
<td>—</td>
<td>Florida</td>
</tr>
<tr>
<td>-127</td>
<td>2/22/82</td>
<td>-9.0</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-128</td>
<td>3/1/82</td>
<td>-11.5</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-129</td>
<td>3/1/82</td>
<td>-10.6</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-130</td>
<td>6/9/81</td>
<td>-12.1</td>
<td>140</td>
<td>Georgia</td>
</tr>
<tr>
<td>-131</td>
<td>8/22/81</td>
<td>-19.1</td>
<td>46</td>
<td>&quot;</td>
</tr>
<tr>
<td>-132</td>
<td>9/3/81</td>
<td>-22.9</td>
<td>7</td>
<td>&quot;</td>
</tr>
<tr>
<td>-133</td>
<td>9/4/81</td>
<td>-19.1</td>
<td>28</td>
<td>&quot;</td>
</tr>
<tr>
<td>-134</td>
<td>9/5/81</td>
<td>-25.7</td>
<td>2</td>
<td>&quot;</td>
</tr>
<tr>
<td>-135</td>
<td>9/4/81</td>
<td>-25.4</td>
<td>1</td>
<td>&quot;</td>
</tr>
<tr>
<td>-136</td>
<td>8/19/81</td>
<td>-16.4</td>
<td>110</td>
<td>&quot;</td>
</tr>
<tr>
<td>-137</td>
<td>8/21/81</td>
<td>-21.8</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-138</td>
<td>1/22/82</td>
<td>-20.6</td>
<td>46</td>
<td>&quot;</td>
</tr>
<tr>
<td>-139</td>
<td>8/5/82</td>
<td>-22.3</td>
<td>25</td>
<td>&quot;</td>
</tr>
<tr>
<td>-140</td>
<td>8/5/82</td>
<td>-20.4</td>
<td>2</td>
<td>&quot;</td>
</tr>
<tr>
<td>-141</td>
<td>7/20/82</td>
<td>-4.8</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-142</td>
<td>7/23/82</td>
<td>-21.4</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-143</td>
<td>7/20/82</td>
<td>-12.2</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-144</td>
<td>7/19/82</td>
<td>-2.0</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-145</td>
<td>7/21/82</td>
<td>-4.2</td>
<td>210</td>
<td>&quot;</td>
</tr>
<tr>
<td>-146</td>
<td>7/22/82</td>
<td>-22.4</td>
<td>1</td>
<td>&quot;</td>
</tr>
<tr>
<td>-147</td>
<td>7/21/82</td>
<td>-10.4</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-148</td>
<td>7/21/82</td>
<td>-17.2</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-149</td>
<td>8/4/82</td>
<td>-13.4</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-150</td>
<td>8/4/82</td>
<td>-16.2</td>
<td>88</td>
<td>&quot;</td>
</tr>
<tr>
<td>-151</td>
<td>7/22/82</td>
<td>-23.2</td>
<td>2</td>
<td>&quot;</td>
</tr>
<tr>
<td>-152</td>
<td>7/20/82</td>
<td>-6.3</td>
<td>160</td>
<td>&quot;</td>
</tr>
<tr>
<td>-153</td>
<td>7/22/82</td>
<td>-20.9</td>
<td>2</td>
<td>&quot;</td>
</tr>
<tr>
<td>-154</td>
<td>8/4/82</td>
<td>-9.1</td>
<td>180</td>
<td>&quot;</td>
</tr>
<tr>
<td>-155</td>
<td>1/27/82</td>
<td>-11.5</td>
<td>—</td>
<td>Idaho</td>
</tr>
<tr>
<td>-156</td>
<td>1/20/82</td>
<td>-14.0</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-157</td>
<td>1/18/82</td>
<td>-7.9</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-158</td>
<td>2/24/82</td>
<td>—</td>
<td>—</td>
<td>Iowa</td>
</tr>
<tr>
<td>-159</td>
<td>2/24/82</td>
<td>—</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-160</td>
<td>2/24/82</td>
<td>—</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-161</td>
<td>2/24/82</td>
<td>—</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-162</td>
<td>2/24/82</td>
<td>—</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-163</td>
<td>2/24/82</td>
<td>—</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-164</td>
<td>1/19/81</td>
<td>-16.3</td>
<td>90</td>
<td>Mississippi</td>
</tr>
<tr>
<td>-165</td>
<td>1/10/81</td>
<td>-5.2</td>
<td>400</td>
<td>&quot;</td>
</tr>
<tr>
<td>-166</td>
<td>1/12/81</td>
<td>-17.4</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-167</td>
<td>1/9/81</td>
<td>-18.7</td>
<td>71</td>
<td>&quot;</td>
</tr>
<tr>
<td>-168</td>
<td>1/7/81</td>
<td>-13.2</td>
<td>190</td>
<td>&quot;</td>
</tr>
<tr>
<td>-169</td>
<td>1/6/81</td>
<td>-16.3</td>
<td>150</td>
<td>&quot;</td>
</tr>
<tr>
<td>-170</td>
<td>1/12/81</td>
<td>-19.6</td>
<td>80</td>
<td>&quot;</td>
</tr>
<tr>
<td>-171</td>
<td>1/8/81</td>
<td>-12.4</td>
<td>210</td>
<td>&quot;</td>
</tr>
<tr>
<td>-172</td>
<td>1/10/81</td>
<td>-9.6</td>
<td>180</td>
<td>&quot;</td>
</tr>
<tr>
<td>-173</td>
<td>1/8/81</td>
<td>-19.3</td>
<td>6</td>
<td>&quot;</td>
</tr>
<tr>
<td>-174</td>
<td>1/11/81</td>
<td>-15.9</td>
<td>200</td>
<td>&quot;</td>
</tr>
<tr>
<td>-175</td>
<td>1/7/81</td>
<td>-12.1</td>
<td>480</td>
<td>&quot;</td>
</tr>
<tr>
<td>-176</td>
<td>1/9/81</td>
<td>-18.3</td>
<td>71</td>
<td>&quot;</td>
</tr>
<tr>
<td>-177</td>
<td>1/11/81</td>
<td>-8.2</td>
<td>470</td>
<td>&quot;</td>
</tr>
<tr>
<td>-178</td>
<td>12/23/80</td>
<td>-10.6</td>
<td>—</td>
<td>Nevada</td>
</tr>
<tr>
<td>-179</td>
<td>1/19/81</td>
<td>-14.6</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-180</td>
<td>7/22/81</td>
<td>-14.4</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-181</td>
<td>1/8/82</td>
<td>—</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-182</td>
<td>1/15/82</td>
<td>—</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-183</td>
<td>10/16/82</td>
<td>-7.5</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-184</td>
<td>7/29/82</td>
<td>-3.5</td>
<td>—</td>
<td>New Mexico</td>
</tr>
<tr>
<td>Sample no.</td>
<td>Coll date</td>
<td>$^{13}C_{(% e PDB)}$</td>
<td>Total alkalinity as bicarbonate (mg/L)</td>
<td>Water source by state</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td>------------------------</td>
<td>----------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>DE-185</td>
<td>8/12/81</td>
<td>-21.5</td>
<td>—</td>
<td>North Carolina</td>
</tr>
<tr>
<td>-186</td>
<td>8/12/81</td>
<td>-18.3</td>
<td>48</td>
<td>&quot;</td>
</tr>
<tr>
<td>-187</td>
<td>8/12/81</td>
<td>-13.4</td>
<td>69</td>
<td>&quot;</td>
</tr>
<tr>
<td>-188</td>
<td>8/12/81</td>
<td>-22.7</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-189</td>
<td>10/79</td>
<td>—</td>
<td>—</td>
<td>Oregon</td>
</tr>
<tr>
<td>-190</td>
<td>10/79</td>
<td>—</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-191</td>
<td>9/10/81</td>
<td>-6.8</td>
<td>1430</td>
<td>South Carolina</td>
</tr>
<tr>
<td>-192</td>
<td>8/7/81</td>
<td>-6.6</td>
<td>1050</td>
<td>&quot;</td>
</tr>
<tr>
<td>-193</td>
<td>9/10/81</td>
<td>-6.8</td>
<td>1100</td>
<td>&quot;</td>
</tr>
<tr>
<td>-194</td>
<td>8/13/81</td>
<td>-19.3</td>
<td>92</td>
<td>&quot;</td>
</tr>
<tr>
<td>-195</td>
<td>8/13/81</td>
<td>-16.8</td>
<td>110</td>
<td>&quot;</td>
</tr>
<tr>
<td>-196</td>
<td>8/5/81</td>
<td>-11.1</td>
<td>190</td>
<td>&quot;</td>
</tr>
<tr>
<td>-197</td>
<td>8/5/81</td>
<td>-5.2</td>
<td>600</td>
<td>&quot;</td>
</tr>
<tr>
<td>-198</td>
<td>8/5/81</td>
<td>-9.0</td>
<td>460</td>
<td>&quot;</td>
</tr>
<tr>
<td>-199</td>
<td>8/7/81</td>
<td>-6.6</td>
<td>860</td>
<td>&quot;</td>
</tr>
<tr>
<td>-200</td>
<td>8/6/81</td>
<td>-8.9</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-201</td>
<td>9/11/81</td>
<td>-5.6</td>
<td>1080</td>
<td>&quot;</td>
</tr>
<tr>
<td>-202</td>
<td>9/11/81</td>
<td>-6.0</td>
<td>1250</td>
<td>&quot;</td>
</tr>
<tr>
<td>-203</td>
<td>8/25/81</td>
<td>-6.8</td>
<td>1240</td>
<td>&quot;</td>
</tr>
<tr>
<td>-204</td>
<td>8/24/81</td>
<td>-4.6</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-205</td>
<td>8/24/81</td>
<td>-7.7</td>
<td>260</td>
<td>&quot;</td>
</tr>
<tr>
<td>-206</td>
<td>8/6/81</td>
<td>-9.6</td>
<td>590</td>
<td>&quot;</td>
</tr>
<tr>
<td>-207</td>
<td>4/1/82</td>
<td>-13.6</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-208</td>
<td>4/9/82</td>
<td>-12.9</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-209</td>
<td>4/19/82</td>
<td>-12.2</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-210</td>
<td>4/24/82</td>
<td>-10.3</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-211</td>
<td>4/30/82</td>
<td>—</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-212</td>
<td>5/2/82</td>
<td>—</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-213</td>
<td>5/7/80</td>
<td>-6.1</td>
<td>—</td>
<td>South Dakota</td>
</tr>
<tr>
<td>-214</td>
<td>5/8/80</td>
<td>-9.1</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-215</td>
<td>5/6/80</td>
<td>-7.5</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-216</td>
<td>5/13/80</td>
<td>-3.9</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-217</td>
<td>5/14/80</td>
<td>-3.4</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-218</td>
<td>5/12/80</td>
<td>-5.0</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-219</td>
<td>5/15/80</td>
<td>-5.1</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-220</td>
<td>5/19/80</td>
<td>-4.6</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-221</td>
<td>5/20/80</td>
<td>-5.5</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-222</td>
<td>5/22/80</td>
<td>-4.8</td>
<td>—</td>
<td>&quot;</td>
</tr>
<tr>
<td>-223</td>
<td>6/19/80</td>
<td>-10.0</td>
<td>254</td>
<td>&quot;</td>
</tr>
<tr>
<td>-224</td>
<td>6/26/80</td>
<td>-9.0</td>
<td>170</td>
<td>&quot;</td>
</tr>
<tr>
<td>-225</td>
<td>6/30/80</td>
<td>-5.4</td>
<td>234</td>
<td>&quot;</td>
</tr>
<tr>
<td>-226</td>
<td>7/1/80</td>
<td>-19.6</td>
<td>1320</td>
<td>&quot;</td>
</tr>
<tr>
<td>-227</td>
<td>7/2/80</td>
<td>-20.2</td>
<td>560</td>
<td>&quot;</td>
</tr>
<tr>
<td>-228</td>
<td>3/31/82</td>
<td>-21.5</td>
<td>—</td>
<td>Tennessee</td>
</tr>
<tr>
<td>-229</td>
<td>3/31/82</td>
<td>-20.5</td>
<td>84</td>
<td>&quot;</td>
</tr>
<tr>
<td>-230</td>
<td>6/3/82</td>
<td>-14.8</td>
<td>181</td>
<td>&quot;</td>
</tr>
<tr>
<td>-231</td>
<td>1/8/80</td>
<td>-19.2</td>
<td>—</td>
<td>Utah</td>
</tr>
<tr>
<td>-232</td>
<td>1/31/80</td>
<td>—</td>
<td>228</td>
<td>&quot;</td>
</tr>
<tr>
<td>-233</td>
<td>2/20/80</td>
<td>-8.6</td>
<td>351</td>
<td>&quot;</td>
</tr>
<tr>
<td>-234</td>
<td>2/26/80</td>
<td>-8.6</td>
<td>135</td>
<td>&quot;</td>
</tr>
<tr>
<td>-235</td>
<td>3/12/80</td>
<td>-9.4</td>
<td>220</td>
<td>&quot;</td>
</tr>
</tbody>
</table>
FRANKFURT RADIOCARBON DATES I
REINER PROTSCH and BERNHARD WENINGER
Johann Wolfgang Goethe-University, Frankfurt/Main
German Federal Republic

Facilities for radiocarbon dating were established at the University of Frankfurt/Main in the Institute of Anthropology. The Radiocarbon Laboratory provides assistance to the Amino-Acid-Dating Laboratory. This list reports on $^{14}$C dates measured up to September 1983.

The laboratory is installed in the basement of a three-story building and is equipped with a 2L copper proportional counter filled to 1013 mbar with purified CO$_2$. The counter is protected against cosmic and surrounding radiation by a 3.5 ton lead shield and a copper multewire anticoincidence ring-counter flushed with purified 90Ar/10CH$_4$. Electronics are of the commercial NIM type. Charcoal and wood samples are treated by standard acid-alkali-acid methods. Bone samples are treated according to the collagen methods described by Berger, Horney, and Libby (1964), Longin (1971), Protsch (1972; 1975), and Protsch and Berger (1973).

Conversion to CO$_2$ is by controlled combustion. Initial purification is achieved by passing the CO$_2$ over hot (600°C) CuO, through several KMnO$_4$ and AgNO$_3$ solutions and dry-ice/acetone water traps. The sample is stored for at least three weeks to ensure $^{222}$Rn-decay. Final purification is by thermal circulation over hot (600°C) copper and silver wool in a 6L sample container with external quartz convection tube. Prior to each counter filling the CO$_2$ is routinely passed over hot (450°C) Cu/Ag a few times in a separate system and is vacuum-distilled at $-78$°C. Gas quality after this procedure is excellent.

Counter plateaus are 500V long with slopes of 0.6%/100V for muons and < 1%/100V for $^{14}$C + background. The standard working point is 4300V. The absence of electronegative impurities is verified before and after each run by measuring the count rate at the steep part of the muon characteristic curve. An experimental linear correlation between guard gross and sample muon count rates, valid within counting statistics, gives a post-measurement check on working point and a long-term check on instrument stability. Background is nominally 7.9 ± 0.08cpm with slow seasonal variations in the maximum range ±0.2cpm (95% confidence level). No dependence on atmospheric pressure was found on the basis of 90 background measurements, each 2000 minutes. Four months of continuous monitoring of the laboratory aerosol radioactivity with a NaI-detector and multichannel-analyzer (Canberra Series 30, 1024 channels) showed unchanged background in the range covering 200-3000keV. Modern standard CO$_2$ is prepared by wet oxidation of NBS oxalic acid. The AD 1950 $^{14}$C count rate is 12.10 ± 0.08cpm at 20°C with normalization of the $\delta^{14}$C value of $-19.75\%$ to the standard $-19\%$. Counting periods are two days for background, sample, and standard. Samples are measured at least twice. Background is measured at least once a week. Routine $\chi^2$-analysis is applied to 100-minute print-outs. Age errors correspond to measured ± 1σ variations of sample, background, and standard. Calculated errors smaller
than 100 years are increased to this figure as a minimum. $^{13}$C/$^{12}$C measurements are not available for samples in the date list below. Thus, 80 years have been added to all bone measurements to give a theoretical correction for $\delta^{14}$C fractionation, with an additional ± 60 years squared added to the variance (Lerman, 1972). All dates are expressed in $^{14}$C years relative to AD 1950, using the half-life for $^{14}$C of 5568 years. Calendar estimates and archaeologic comments are based on calibrated dates (Pearson, Pilcher, & Baillie, 1983; Pearson & Baillie, 1983).

ACKNOWLEDGMENTS

Thanks are due Klaus Hnatek for valuable assistance to R P in the initial construction of the laboratory. We would like to express our gratitude to the late W F Libby, Rainer Berger, Jürgen Freundlich, Mebus Geyh, and Hans Quitta for submitting samples for cross-dating. Mebus Geyh and the staff of the Hannover Radiocarbon Laboratory kindly measured the $^{13}$C/$^{12}$C value of our modern standard and offered valuable information. Helpful discussions were also with Jürgen Freundlich and Rainer Berger. This work was financed by the Deutsche Forschungsgemeinschaft (DFG Pr 143/1, 143/3, 143/5, 143/7-1) and the Stiftung Volkswagenwerk and we greatly acknowledge their financial support for equipment and operating costs.

In 1982 special emphasis was placed on running a series of cross-checks, the results of which are shown in table 1.

SAMPLE DESCRIPTIONS

INTERLABORATORY CHECK SAMPLES

<table>
<thead>
<tr>
<th>Fra no.</th>
<th>Fra date</th>
<th>Other lab no.</th>
<th>Reported date</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fra-50</td>
<td>3970 ± 100</td>
<td>UCLA-928</td>
<td>4120 ± 120</td>
<td>R, 1966, v 8, p 482</td>
</tr>
<tr>
<td>-51</td>
<td>4245 ± 120</td>
<td>UCLA-739</td>
<td>4280 ± 80</td>
<td>R, 1965, v 7, p 352</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TB-38</td>
<td>4330 ± 160</td>
<td>R, 1976, v 18, p 357</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-569</td>
<td>4290 ± 90</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NPL-5</td>
<td>4310 ± 90</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LJ-1288</td>
<td>4370 ± 50</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BM-248</td>
<td>4160 ± 110</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BM-203</td>
<td>4150 ± 110</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ANTW-104</td>
<td>4390 ± 140</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BIRM-20a</td>
<td>4224 ± 97</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BIRM-20b</td>
<td>4206 ± 68</td>
<td></td>
</tr>
<tr>
<td>-58</td>
<td>6095 ± 130</td>
<td>Bln-176</td>
<td>5932 ± 100</td>
<td>R, 1966, v 8, p 31</td>
</tr>
<tr>
<td>-61</td>
<td>4370 ± 100</td>
<td>Bln-782</td>
<td>4310 ± 100</td>
<td>Quitta, pers commun</td>
</tr>
<tr>
<td>-62</td>
<td>3400 ± 100</td>
<td>Bln-2011</td>
<td>3445 ± 40</td>
<td>Quitta, pers commun</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LJ-5262</td>
<td>3490 ± 40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GrN-7319</td>
<td>3415 ± 25</td>
<td></td>
</tr>
<tr>
<td>-66</td>
<td>25,000 ± 1600</td>
<td>KN-10b</td>
<td>26,560 ± 1600</td>
<td>Freundlich, pers commun</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KN-10c</td>
<td>26,960 ± 1200</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KN-I.010</td>
<td>24,100 ± 300</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>H-2218/1537</td>
<td>25,480 ± 880</td>
<td></td>
</tr>
<tr>
<td>-57</td>
<td>5280 ± 120</td>
<td>KN-21</td>
<td>5370 ± 160</td>
<td>Freundlich, pers commun</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H-227/277</td>
<td>5150 ± 100</td>
<td></td>
</tr>
<tr>
<td>-59</td>
<td>3540 ± 100</td>
<td>KN-I.021</td>
<td>5080 ± 70</td>
<td>R, 1971, v 13, p 163</td>
</tr>
<tr>
<td>-79</td>
<td>4070 ± 100</td>
<td>BM-341</td>
<td>3500 ± 70</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>UCLA-1398</td>
<td>3330 ± 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bln-1470</td>
<td>4170 ± 60</td>
<td>Quitta, pers commun</td>
</tr>
</tbody>
</table>
Heldenbergen series

Charcoal, bone, and mortar samples from medieval site at Heldenbergen (50° 20' N, 8° 55' E) near Frankfurt/M. Excavations by B Pinsker, Inst Prehist, Univ Frankfurt/M revealed oval-shaped pit-house, superimposed by walled framework house. Top layer of pit-house contained burned remains of large loom and ca 30 ceramic weights found in situ. Charcoal and overlying stone debris contained pottery of Pingsdorf type. Heldenbergen Pingsdorf pottery is similar to that of Husterknupp site, Period II/III which dates archaeol to AD 1100-1200. Site is near Heldenbergen castle, first mentioned in 12th century AD and is supposed to represent nearby medieval village. Coll 1980 and subm by A Kluge and B Weninger, both of Inst Prehist, Univ Frankfurt/M.

**Fra-54. Heldenbergen loom** 1130 ± 100
Charcoal from burned loom.

**Fra-64. Heldenbergen pit** 1100 ± 100
Charcoal from pit of house yard, also containing Pingsdorf pottery. Coll 1981 to cross-check Fra-54.

**Fra-72. Heldenbergen walled framework house** 1180 ± 100
Large mortar fragments. Comment: sample washed and ca 30% of surface removed. Date processed on first HCl-evolved CO₂ fraction.

**Fra-55. Heldenbergen walled framework house** 1450 ± 100
Faunal bones. Comment: sample mixing is not ruled out and date is rejected.

General Comment: dates Fra-54 and -64 are ca 250 yr older than expected, probably due to well-known “old wood” reasons (cf Waterbolk, 1971; for medieval sites, Willkomm, 1980; 1983). Fra-54 is one of rare cases that sample can be archaeol judged and ¹³C age is not unexpected. Archaeol dating indicates experimental mortar date, Fra-72, is slightly contaminated by older carbon.

Hausen series

Charcoal from tumulus at Hausen (50° 5' 34'' N, 8° 52' 28'' E) near Offenbach/M at depth 60cm, from Urnfield culture (Ha Al) cremation, archaeol represented by bronze ornaments and sherds in tumulus center at same depth. Indeterminable no. of fragments of iron and several Late Iron age sherds suggested disturbance. Coll 1980 by R Plackinger, Mühlheim/M Archaeol Group. Subm 1982 by I Kubach-Richter, Inst Prehist, Univ Frankfurt/M. Bot analysis by K Leistikow, Bot Inst, Univ Frankfurt/M.

**Fra-74. Hausen, Area A** 1720 ± 100
Charcoal (*Rhamnus cathartica, Quercus petraea, or Quercus robur*) assoc with iron fragments.
Fra-78. Hausen, Area C/5 400 ± 100
Charcoal (Acer campestre). Comment: dates confirm suspicion that charcoal does not belong to cremation.

**Schwanheim series**
Wood from Neolithic and Bronze age site in area often flooded by Main R, Schwanheim (50° 5' N, 8° 10' E) near Frankfurt/M. Coll 1978 and subm 1982 by A Jockenhövel, Inst Prehist, Univ Frankfurt/M.

Fra-67. Schwanheim, Riedwiese 5340 ± 130
Wood from Sec II, Sq D8, coordinates x=25-65cm, y=55-95cm, depth z=160cm in peat. Assoc with Middle Neolithic “Michelsberg” pottery. Comment: HCl and NaOH treatment. Date agrees well with other Michelsberg dates, ranging from ca 5400-5000 BP (Pape, 1979). However, in view of measurements on sample Fra-69, below, from same site, contamination cannot be excluded and Fra-67 should also be viewed with reservation.

Fra-69a. Schwanheim, Riedwiese (insoluble fraction) 5700 ± 130
Wood (Alnus) from Sec II, Sq C8, coordinates x=0-50cm, y=0-50cm, depth z=187cm in peat. Comment: HCl treatment only.

Fra-69b. Schwanheim, Riedwiese (insoluble fraction) 4560 ± 100
Comment: HCl and NaOH treatment.

Fra-69c. Schwanheim, Riedwiese (insoluble fraction) 1970 ± 100
Comment: strong HCl and NaOH treatment and additional acetone treatment in soxhlet extractor.

**General Comment:** contaminated sample Fra-69 is from top filling of pit lined with Middle Bronze age pottery and was expected to date to ca 1400 BC. High level of contamination is not understood, although sample contained many small rootlets, which could not all be removed. Bot analysis by K Leistikow showed sample to be Alnus glutinosa, <40 yr old, at stage of transition between stem base and roots. Alnus usually grows in periodically flooded areas where stem base is under water. Possibility of flood redeposition cannot be excluded.

Fra-75. Manching, Pit 162d 1970 ± 100
Human bone from Celtic oppidum of Manching near Ingolstadt (48° 7' N, 11° 5' E), coll 1981 by W Krämer, Römisch-Germanische Komm, Frankfurt/M; subm 1982 by G Lange, Inst Anthropol, Univ Frankfurt/M. Adult femur from burial in settlement Pit 162d dug into sand. Comment: collagen with additional NaOH treatment. Since burials in Middle La Tène times (3rd-2nd century BC) were in graves, use of settlement pit for burial of individual in Pit 162d points to latest phase of
Late La Tène (1st century BC). Date supports archaeol expectation. Oppidum was not occupied after 15 BC (Krämer & Schubert, 1970).

**Fra-90. Lorsch, Grave 9**  

Human femur of male adult, ca 50 yr old, from cemetery in court of Benedictine monastery closely connected to Carolingian King’s Hall of Lorsch (49° 38’ N, 8° 34’ E). Cemetery was archaeol assumed to date either before AD 770 or after AD 1621 because location of Carolingian graves in front of entrance to King’s Hall would appear profane. Graves contain no artifacts. Sample coll 1982 by P Schnitzer, Landesamt f Denkmalspflege, Darmstadt; subm 1983 by G Lange. **Comment:** collagen with additional NaOH treatment. Age based on calibrated date: Carolingian.

**Fra-94. Weingarten, Grave 136**  


**Fra-86. Burgerroth, Loc 81/III, Level 5**  

Distal end of femoral diaphysis of *Bos sp* < 2 yr old, from Late Neolithic settlement on hill at Burgerroth (49° 32’ 30” N, 10° 2’ 5” E) near Würzburg. Archaeol single-component site shows affinities to Bernburg culture of E Germany. Special axe form from site is found also in Switzerland where it is dendrochronol dated to 3100-2900 BC (Spennemann, 1982; 1983). Sample is from refuse pit dug into limestone, Coll 1981 and subm 1983 by D Spennemann, Inst Prehist, Univ Frankfurt/M. Osteol analysis by G Lange. **Comment:** collagen with additional NaOH treatment. Fra-86 is first Bernburg date for S Germany; 13 Bernburg dates presently available (Pape, 1979; Breunig, 1983) all lie within limits 4100-4400 BP, with one exception. Due to extreme distortions of 14C time scale ca 3000 BC, these 300 14C yr correspond to only 150 calendar yr, allowing very confident calibrated reading of 3050-2900 BC for Bernburg culture. In comparison, Fra-86 calibrates to ca 2850 BC and date may thus be 50-100 calendar yr too young. Submitter notes that sample has late Bernburg context.

**Ulvesheim series**

Charcoal from settlement pits of Middle Neolithic Bischheim Group at Ulvesheim, near Worms (49° 40’ N, 9° 20’ E). Coll 1983 by W Plass, Inst Geol, Univ Frankfurt/M; subm 1983 by J Lüning, Inst Prehist, Univ Frankfurt/M.

**Fra-96. Ulvesheim, Pit D**  

Charcoal from Pit D at depth 1.5m in loess.

**Fra-97. Ulvesheim, Pit B**  

Charcoal from Pit B at depth 1.5m in loess. **Comment:** HCl and strong NaOH treatment. Dates are as expected.
Reiner Protsch and Bernhard Weninger

Kelsterbach, *M primigenius* femur 30,300 – 1900

Kelsterbach (8° 32' N, 50° 8' E) is adjacent to quarry at ca 14km from Frankfurt/M. From well-stratified deposit remains of *M primigenius* and mollusks, and from lower stratum, calotte of hominid (*H s sapiens*) were excavated. 

\[ {^{14}\text{C}} \] and amino-acid dates on fauna (bones and teeth) and hominid were measured by different labs from 1975 to 1983. Dates Hv-1297 (unpub), UCLA-2361 and -2359 (unpub) agree well with Frankfurt dates. Coll 1975-1977 and subm 1975 by R Protsch. Comment: collagen with additional NaOH treatment.

Sample, femur fragment (*M primigenius*) coll at depth 4.3m just below bones UCLA-2359, 23,675 ± 860 (unpub), and Hv-1297, 21,000 ± 1400 (unpub), and Hv-1296, 18,500 ± 950 (unpub). Teeth of *M primigenius* at ca 3.3m to 3.5m were dated to 15,810 ± 410, Hv-1961. Amino-acid date, 30,100, on same piece of bone with amino-acid lab no. Fra-A-10a. UCLA 14C date on hominid was 29,000 ± 1525, UCLA-2361, and amino-acid date, 32,000 BP, with amino-acid lab no. Fra-A-10 (see Protsch *et al*, in press). Absolute ages of fauna and hominid by 

\[ {^{14}\text{C}} \] and amino-acid dating agree well with strat-geol estimate of deposit.

Belgium

Martouzin-Neuville 4070 ± 100

Human bone from lower level of a Megalithic grave at depth 1.4m, dug into limestone on steep slope of hill near Martouzin-Neuville (50° 6' 51" N, 5° 1' 19" E) at alt +235m. Grave contained pottery of Seine-Oise-Marne (SOM) type and three collared flasks of Trichterbecher (TRBC) culture (Huysecon, 1978). Coll 1976 by F Hubert, Service Natle Fouilles, Bruxelles and subm 1983 by E Huysecon, Bruxelles. Comment: collagen with additional NaOH treatment. Agrees within limits of error with previous date, 3790 ± 90, Lv-1243, uncorrected for δ^{13}C fractionation (E Gilot, pers commun), from higher level of same grave. Martouzin-Neuville provides first TRBC dates for Belgium. Both dates coincide with dates of SOM culture, but appear rather young in comparison with TRBC dates for The Netherlands (Pape, 1979).

Switzerland

Witterswil series

Mortar samples from Church of St Katharina in Witterswil (47° 15' N, 7° 30' E), Kanton Solothurn. Excavations 1983 by H J Lehner identify several construction phases, ranging from medieval to modern times. Samples were analyzed as experiment to test possibility of mortar dating archaeol unassignable earlier structures. Coll and subm 1983 by H J Lehner, Kantonsarchaeol, Solothurn.

Witterswil 7890 ± 170

Mortar from altar historically dated to AD 1641.
Frankfurt Radiocarbon Dates I

Fra-107. Witterswil

Mortar from wall archaeol dated to ad 1300-1400. Comment: dates processed on first HCl-evolved CO2 fraction. Both samples are evidently contaminated, making value of further dating questionable.

Ireland

Carrowmore series

Charcoal from Ostrea-shell Kitchen Midden 15A near Carrowmore (54° 14' N, 8° 32' W), Co Sligo. Carrowmore is well known for its large Megalithic cemetery, considered one of the earliest in Europe. Settlement area has been object of large-scale archaeol research between 1977 and 1982 by G Burenhult, Hist Mus, Univ Lund, Sweden (Burenhult, 1980a, b). Depth of shell layers range from +2.5m to +4.5m and are partly eroded by sea. Midden is ca 2500m². Samples coll and subm 1981 by B Weninger. Sample nos. and coordinates from S Österholm in Burenhult (1981).

Fra-53. Carrowmore, Kitchen Midden 15A

Charcoal no. 21 from coordinates x+15.5m, y–6.60m, z+2.27m. Top layer.

Fra-63. Carrowmore, Kitchen Midden 15A

Charcoal no. 18 from coordinates x+14.98m, y–18.25m, z+2.01m. Top layer.

Fra-65. Carrowmore, Kitchen Midden 15A

Charcoal no. 14 from coordinates x+9.80m, y–22.20m, z+2.38m. Middle layer.

Fra-60. Carrowmore, Kitchen Midden 15A

Charcoal no. 19 from coordinates x+8.65m, y–21.00m, z+2.73m. Middle layer.

General Comment: HCl and NaOH treatment. Basal layer of midden was dated to 3780 ± 60, Lu-1759 (R, 1981, v 23, p 401) and 3970 ± 75, Lu-1948 (R, 1982, v 24, p 211). Middle layer samples Fra-65 and -60 derive from hearths at approx same depth and close (ca 1m) horizontal distance, archaeol expected to be of similar age, which is confirmed. Top layer sample Fra-63 was taken exactly 1m above Lu-1948 to study rate of deposit of midden. This is interesting in light of observation that width and thickness of Ostrea shells decrease in younger strata, perhaps due to overexploitation (Burenhult, 1980b, p 38; 1981, p 20). Top layer sample Fra-53 proves midden was used up to Viking period. Altogether, four distinct occupation periods over ca 3000 yr are demonstrated.

Hungary

Gorzsza series

Charcoal from Late Neolithic tell at Gorzsza near Szeged (46° 16' N, 20° 17' E). Cultural strata 2 to 3m thick, belong to Early and Late Tisza culture, with ceramics of tradition formerly called Gorzsza Group (Gazda-
Reiner Protsch and Bernhard Weninger


**Fra-76. Gorzsa, Level 10** 5650 ± 110
Charcoal from Block III, Level 10, depth 200cm, from House 2 destroyed by fire.

**Fra-77. Gorzsa, Level 10** 5670 ± 100
Charcoal from same House as Fra-76, ca 10m away, from depth 2.1m. *Comment:* HCl treatment only. Samples are from two ends of wooden structure of House 2. Archaeol assignment of Level 10 to Late Neolithic Herpály and Vinca C cultures as proposed by F Horvarth on basis of Herpály imported pottery and typol connections to Yugoslavia is confirmed by above dates when compared with dates 5575 ± 100 (Bln-509), 5871 ± 100 (Bln-510), 5775 ± 100 (Bln-513) (R, 1970, v 12, p 412-413), and 5845 ± 60 (GrN-1993) (R, 1963, v 5, p 184) for Hungarian Herpály-Csöszhalom site. This applies also to Vinca dates of Yugoslavian sites, Gornja Tuzla, 5580 ± 60 (GrN-1974), Banjica, 5710 ± 90 (GrN-1542), and Vinca, 5845 ± 160 (GrN-1537) (R, 1963, v 5, p 183-184).

**Fra-95. Gorzsa, Level 1** 5970 ± 100
Charcoal from Block III/b, Level 1, coordinates 7/a at depth 1.15m with Group 3 of pots. *Comment:* HCl and NaOH treatment. Fra-95 should date youngest Neolithic occupation and is older than expected. Secondary transport coming from lower level cannot be excluded for this sample (F Horvarth, pers commun). Date is within limits of Late Neolithic dates expected at this site.

**Fra-108. Gorzsa, Level 16** 5970 ± 100
Charcoal from Pits 2 and 3 of Level 16. *Comment:* HCl and NaOH treatment. Date is as expected for earliest Neolithic level in Gorzsa.

**Egypt**

**Qubbet el Hawa series**
Human bone from shaft graves cut into limestone at Qubbet el Hawa (Mountain of the Wind) near Assuan (24° 8' N, 32° 53' E). Most graves of this large cemetery were cut in 6th Dynasty for high Egyptian officials. Latest graves were cut in New Kingdom. Cemetery was continually used for secondary burials up to Saitic times and some grave shafts and entrances contain burials of over 100 individuals (Edel, 1973; Rösing, 1982). Coll and subm 1977 by F Rösing, Anthropol Inst, Univ Ulm.

**Fra-70. Qubbet el Hawa, Grave 103** 3860 ± 100
One bone, no. 103/148 (calcaneus) from Grave 103, providing date for four individuals. Expected date: 6th Dynasty.
Fra-92. Qubbet el Hawa, Grave 207  3730 ± 100
Two bones, no. 207/183/ISKA (calcaneus) and no. 207/185/ISKC (calcaneus) from Grave 207, providing date for 34 individuals. Expected date: 6th Dynasty or First Intermediate period.

Fra-71. Qubbet el Hawa, Grave 88  3450 ± 100
Four bones, no. 88/598/ISF (metacarpal), 88/396/IIIISF (fragment of mandible), 88/216/IIIISF (fragment of parietal), and 88/306/IVSF (fragment of femur) from Grave 88, providing date for 79 individuals. Expected date: 6th Dynasty.

Fra-80. Qubbet el Hawa  2430 ± 100
One bone, no. 0/145 (calcaneus) providing date for one individual. No expected date.

Fra-87. Qubbet el Hawa, Grave 89  3550 ± 100
Four bones, no. 89/24/IISF (metacarpal), 89/241/IISF (fragment of mandible), 89/192/IIISF (fragment of parietal), and 89/192/IIISF (fragment of femur) from Grave 89, providing date for 76 individuals. Expected date: 6th Dynasty.

Fra-100. Qubbet el Hawa, Grave 29  3850 ± 100
Two bones, no. 29b/135 (talus) and 29b/125/ISF (talus) from Grave 29, providing date for 44 individuals. Expected date: 6th Dynasty.

Fra-104. Qubbet el Hawa, Grave 30  4110 ± 100
One bone, no. 30b/1/ISF (calcaneus) from Grave 30, providing date for 20 individuals. Expected date: 6th Dynasty. Comment: all dates of small (ca 30 to 40g) samples were processed on total HCl-soluble organic fraction without NaOH treatment. Bones are well preserved and show thin, dark surface coloring of remaining skin. Fra-70, -92, and -100 confirm archaeol expectation. Fra-71 and -87 are younger, perhaps 12th Dynasty. Fra-80 is probably 26th Dynasty. Fra-104 is unexpectedly old.

South Africa

Broederstroom series

Fra-88. Broederstroom, Hut 24/73 AT  1320 ± 100
Charcoal at depth 15cm in NE corner of Hut 24/73 AT.

Fra-82. Broederstroom, Mound 24/73 Aze  1450 ± 100
Charcoal at depth 65 to 70cm in Sq DF/5, Mound 24/73 Aze. Agrees with previous date, 1600 ± 50 (KN-2643) (Mason, 1981), on same Mound.
Fra-85. **Broederstroom, Hut 24/73 Ar** 1360 ± 100
Charcoal at depth 15cm in SE edge of Ar panel in Hut 24/73 Ar.

Fra-84. **Broederstroom, Hut 24/73 Azz** 290 ± 100
Charcoal at depth 5cm at distance 35cm from N edge of Hut 24/73 Azz in hut plaster. Agrees with previous date on same hut, 830 ± 50 (KN-2642) (Mason, 1981). Both samples date Late Iron age stone wall overlying possible Early Iron age hut floor.

Fra-83. **Fa-Kgale, Site 43/73A** 260 ± 100
Charcoal from Sq C, at depth 75 to 100cm, from thick ash layers in Late Iron age mine at Ga-Kgale (25° 25' S, 24° 30' E). Site 43/73A, W of Gaberone, Botswana. Specularite and copper ore were extracted in this mine by sinking shafts and galleries to ore bodies at depth 5m or more. Stone anvils, hammers, and smelting furnace debris were found near mine (Cohen, 1977). Coll 1973 by R J Mason and subm 1977 by R Protsch. **Comment:** sample from same loc at depth 80 to 100cm dated to 115 ± 115 (Gx-7202, R J Mason, pers commun).

Sri Lanka

Beli Lena series
Charcoal from Mesolithic levels of Beli Lena cave at Kitulgala (7° 0' N, 80° 25' E). Bot analysis by A Krantz, Bot Inst, Univ Frankfurt/M, Coll 1979 by D Spennemann, and subm 1979 by S Deraniyagala, Archaeol Dept, Sri Lanka.

Fra-91. **Beli Lena** 11,780 ± 220
Sample consisting of 60% charred grain (millet) and 40% wood charcoal with site coordinates 11G/PL9/5 from St 5.

Fra-93. **Beli Lena** 8700 ± 220
Sample consisting of 30% charred grain (millet) and 70% wood charcoal with site coordinates 12G/PL13/7 from St 7. **Comment:** HCl and NaOH treatment. Strata of Beli Lena cave are very thin, with average thickness of a few cm. Both samples were coll by flotation in running water of local stream and contained modern plant remains. Samples were rigorously handpicked, ca 1 hr each, also for hairs of excavation brushes. Fra-91 agrees with previous date 11,550 ± 160 (BS-290, Deraniyagala, pers commun) on St 5 with coordinates 10G/5. Fra-93 is considerably younger than expected when compared to sample from coordinates 10G/7 dated to 11,520 ± 220 (BS-292, Deraniyagala, pers commun) from St 7.

**REFERENCES**
——— 1974, Background to the Transvaal Iron age — new discoveries at Olifantspoort and Broederstroom: Jour South African Inst Mining and Metallurgy, v 74, no. 6, p 211.
The following list consists of dates of soil samples, partly produced in the former Bonn laboratory and bearing the code designations, BONN, and partly in the present dating lab at Hamburg University. The list comprises Mollisols and Inceptisols from Germany, sampled by layer and dated as whole soil, hydrolysis residue, and hydrolysate. Other profiles represent selected Australian Vertisols and Krasnozems, sampled by layer as well. Dates derived from marshes of the Elbe River as well as from paleosols buried by coastal levees are also included in the list. Pretreatment of soil samples is described in Scharpenseel and Pietig (1969) and Scharpenseel (1972; 1977).

ACKNOWLEDGMENT

This work was supported by the Deutsche Forschungsgemeinschaft.

Germany

Soil profile dating was done on 5cm layers of Hapludoll in Würmian loess, near town of Söllingen, S of Brunswick (52° 5' N, 10° 59' E). First profile is highly organic and near surface. As much as possible, dates derived from original soil after removal of carbonate C were compared with dates of 6N HCl hydrolysate, of hydrolysis residue, and of acid phase used for carbonate destruction. Results, with other data sets, will contribute to integrated soil organic matter decomposition model, comprising initial phase of exponential decomposition of uniformly labeled plant material as well as steady-state slowed phase based on natural 14C measurements (Scharpenseel & Neue, in press). Tables 1 and 2 show our results.

Samples coll and subm 1976 by H W Scharpenseel and H Schiffmann. Histic Hapludoll (BONN-2225 to -2272) shows expected increased age with depth, but with inflection below 70cm. Observed repeatedly, this could reflect earthworm transport of young, nearsurface organics, deep into soil when worms descend for hibernation. As demonstrated, HAM-623 to -801 (R, v 19, p 177), first 6 N HCl hydrolysis residue is not much older than original carbonate-free soil. Hydrolysate, itself, lags behind apparent age of residue. All samples based on acid from carbonate destruction are very small. Ages obtained are erratic and represent mixtures of atmospheric and dissolved carbonate-C species.

Typic Hapludoll (BONN-2275 to -2289) reveals generally younger dates. We discovered after sampling, that area was covered temporarily by sugar beet earth silo. Leachates produced rejuvenation. Again, there was age inflection below 65cm, possibly due to earthworm transport. Hydrolysate residues are markedly older; hydrolysate itself on bomb carbon level. Obviously, acid hydrolysis could remove part but not all leached, rejuvenating C. Dates produced from C in acid from carbonate
### Table 1

Histic Hapludoll, 5km S of Söllingen

<table>
<thead>
<tr>
<th>BONN no.</th>
<th>Carbonate-free soil Depth (cm)</th>
<th>C content</th>
<th>Date</th>
<th>6 N HCl hydrolysate residue BONN no.</th>
<th>Date</th>
<th>6 N HCl hydrolysate BONN no.</th>
<th>Date</th>
<th>Acid from carbonate destruction BONN no.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2255</td>
<td>0-5</td>
<td>27.1</td>
<td>1430 ± 60</td>
<td>-2401</td>
<td>1470 ± 100</td>
<td>-2400</td>
<td>640 ± 60</td>
<td>-2438</td>
<td>1740 ± 70</td>
</tr>
<tr>
<td>-2256</td>
<td>5-10</td>
<td>19.7</td>
<td>1110 ± 60</td>
<td>-2403</td>
<td>1540 ± 100</td>
<td>-2402</td>
<td>830 ± 50</td>
<td>-2439</td>
<td>130 ± 50</td>
</tr>
<tr>
<td>-2257</td>
<td>10-15</td>
<td>22.9</td>
<td>1490 ± 50</td>
<td>-2405</td>
<td>1570 ± 70</td>
<td>-2404</td>
<td>850 ± 50</td>
<td>-2457</td>
<td>3550 ± 70</td>
</tr>
<tr>
<td>-2258</td>
<td>15-20</td>
<td>11.7</td>
<td>1190 ± 50</td>
<td>-2407</td>
<td>1510 ± 60</td>
<td>-2406</td>
<td>670 ± 60</td>
<td>-2456</td>
<td>3570 ± 70</td>
</tr>
<tr>
<td>-2259</td>
<td>20-25</td>
<td>8.9</td>
<td>1460 ± 50</td>
<td>-2409</td>
<td>1840 ± 70</td>
<td>-2408</td>
<td>1100 ± 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2260</td>
<td>25-30</td>
<td>7.7</td>
<td>1890 ± 60</td>
<td>-2411</td>
<td>2510 ± 80</td>
<td>-2412</td>
<td>3240 ± 70</td>
<td>-2445</td>
<td>880 ± 120</td>
</tr>
<tr>
<td>-2261</td>
<td>30-35</td>
<td>5.1</td>
<td>3610 ± 70</td>
<td>-2413</td>
<td>3270 ± 130</td>
<td>-2414</td>
<td>2960 ± 100</td>
<td>-2441</td>
<td>2250 ± 100</td>
</tr>
<tr>
<td>-2262</td>
<td>35-40</td>
<td>4.5</td>
<td>3820 ± 80</td>
<td>-2415</td>
<td>2210 ± 100</td>
<td>-2416</td>
<td>1180 ± 60</td>
<td>-2442</td>
<td>2930 ± 100</td>
</tr>
<tr>
<td>-2263</td>
<td>40-45</td>
<td>4.2</td>
<td>4280 ± 60</td>
<td>-2417</td>
<td>3350 ± 70</td>
<td>-2418</td>
<td>1450 ± 60</td>
<td>-2443</td>
<td>2700 ± 80</td>
</tr>
<tr>
<td>-2264</td>
<td>45-50</td>
<td>4.3</td>
<td>4570 ± 80</td>
<td>-2419</td>
<td>4680 ± 70</td>
<td>-2420</td>
<td>2550 ± 150</td>
<td>-2444</td>
<td></td>
</tr>
<tr>
<td>-2265</td>
<td>50-55</td>
<td>4.2</td>
<td>4920 ± 70</td>
<td>-2421</td>
<td>4840 ± 80</td>
<td>-2422</td>
<td>1910 ± 110</td>
<td>-2445</td>
<td></td>
</tr>
<tr>
<td>-2266</td>
<td>55-60</td>
<td>4.3</td>
<td>5770 ± 70</td>
<td>-2423</td>
<td>5550 ± 50</td>
<td>-2424</td>
<td>880 ± 120</td>
<td>-2446</td>
<td></td>
</tr>
<tr>
<td>-2267</td>
<td>60-65</td>
<td>2.3</td>
<td>5650 ± 70</td>
<td>-2425</td>
<td>5120 ± 80</td>
<td>-2426</td>
<td>2520 ± 250</td>
<td>-2447</td>
<td>2660 ± 230</td>
</tr>
<tr>
<td>-2268</td>
<td>65-70</td>
<td>2.1</td>
<td>6120 ± 90</td>
<td>-2427</td>
<td>6370 ± 80</td>
<td>-2428</td>
<td>1730 ± 260</td>
<td>-2448</td>
<td>2130 ± 210</td>
</tr>
<tr>
<td>-2269</td>
<td>70-75</td>
<td>1.8</td>
<td>4410 ± 60</td>
<td>-2429</td>
<td>4900 ± 100</td>
<td>-2429</td>
<td>700 ± 300</td>
<td>-2449</td>
<td>3080 ± 240</td>
</tr>
<tr>
<td>-2270</td>
<td>75-80</td>
<td>1.8</td>
<td>4870 ± 60</td>
<td>-2430</td>
<td>5620 ± 80</td>
<td>-2431</td>
<td>1140 ± 460</td>
<td>-2450</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2

Typic Hapludoll Söllingen, near old windmill

<table>
<thead>
<tr>
<th>BONN no.</th>
<th>Carbonate-free soil Depth (cm)</th>
<th>C content</th>
<th>Date</th>
<th>6 N HCl hydrolysate residue BONN no.</th>
<th>Date</th>
<th>6 N HCl hydrolysate BONN no.</th>
<th>Date</th>
<th>Acid from carbonate destruction BONN no.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2275</td>
<td>0-5</td>
<td>4.5</td>
<td>500 ± 60</td>
<td>-2476</td>
<td>3320 ± 80</td>
<td>-2475</td>
<td>111.2% mod</td>
<td>-2459</td>
<td>240 ± 90</td>
</tr>
<tr>
<td>-2276</td>
<td>5-10</td>
<td>3.9</td>
<td>950 ± 50</td>
<td>-2478</td>
<td>1450 ± 70</td>
<td>-2477</td>
<td>110.1% mod</td>
<td>-2460</td>
<td>103.8% mod</td>
</tr>
<tr>
<td>-2277</td>
<td>10-15</td>
<td>6.8</td>
<td>1040 ± 60</td>
<td>-2480</td>
<td>1650 ± 90</td>
<td>-2481</td>
<td>105.3% mod</td>
<td>-2461</td>
<td>106.4% mod</td>
</tr>
<tr>
<td>-2278</td>
<td>15-20</td>
<td>2.9</td>
<td>1100 ± 50</td>
<td>-2482</td>
<td>1770 ± 90</td>
<td>-2483</td>
<td>105.3% mod</td>
<td>-2462</td>
<td>101.0% mod</td>
</tr>
<tr>
<td>-2279</td>
<td>20-25</td>
<td>3.9</td>
<td>1190 ± 50</td>
<td>-2484</td>
<td>2170 ± 90</td>
<td>-2485</td>
<td>101.7% mod</td>
<td>-2463</td>
<td></td>
</tr>
<tr>
<td>-2280</td>
<td>25-30</td>
<td>3.5</td>
<td>1110 ± 50</td>
<td>-2486</td>
<td>2380 ± 70</td>
<td>-2487</td>
<td>105.3% mod</td>
<td>-2464</td>
<td></td>
</tr>
<tr>
<td>-2281</td>
<td>30-35</td>
<td>3.6</td>
<td>1240 ± 60</td>
<td>-2488</td>
<td>600 ± 60</td>
<td>-2489</td>
<td>115.1% mod</td>
<td>-2465</td>
<td></td>
</tr>
<tr>
<td>-2282</td>
<td>35-40</td>
<td>3.2</td>
<td>1320 ± 50</td>
<td>-2490</td>
<td>2500 ± 50</td>
<td>-2491</td>
<td>103.5% mod</td>
<td>-2466</td>
<td></td>
</tr>
<tr>
<td>-2283</td>
<td>40-45</td>
<td>1.9</td>
<td>1600 ± 50</td>
<td>-2492</td>
<td>3260 ± 60</td>
<td>-2493</td>
<td>101.7% mod</td>
<td>-2467</td>
<td></td>
</tr>
<tr>
<td>-2284</td>
<td>60-70</td>
<td>2.2</td>
<td>2450 ± 60</td>
<td>-2500</td>
<td>3040 ± 140</td>
<td>-2499</td>
<td>105.2% mod</td>
<td>-2468</td>
<td></td>
</tr>
<tr>
<td>-2285</td>
<td>65-70</td>
<td>1.7</td>
<td>960 ± 60</td>
<td>-2502</td>
<td>1860 ± 70</td>
<td>-2501</td>
<td>116.3% mod</td>
<td>-2469</td>
<td></td>
</tr>
<tr>
<td>-2286</td>
<td>70-75</td>
<td>1.6</td>
<td>520 ± 80</td>
<td>-2504</td>
<td>1680 ± 90</td>
<td>-2503</td>
<td>144.7% mod</td>
<td>-2469</td>
<td></td>
</tr>
</tbody>
</table>
destruction were all modern and consisted predominantly of atmospheric young carbon, bomb carbon levels being reduced by intermixture with small dissolved quantities of old carbonate C.

Five-cm layers from Eutrochrept profile near Hohentrüdingen in Jurassic (Dogger), loam and Haplaquept, on Isar terrace, loess, near Landshut/Ergolding, Hohentrüdingen, Nördlinger Ries crater (49° 0' N, 10° 42' E).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth Range</th>
<th>Radiocarbon Age (±% modern)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAM-635</td>
<td>5 to 10cm</td>
<td>102.6 ± 0.5% modern</td>
</tr>
<tr>
<td>HAM-636</td>
<td>10 to 15cm</td>
<td>200 ± 90</td>
</tr>
<tr>
<td>HAM-637</td>
<td>15 to 20cm</td>
<td>102.9 ± 0.4% modern</td>
</tr>
<tr>
<td>HAM-638</td>
<td>20 to 25cm</td>
<td>160 ± 70</td>
</tr>
<tr>
<td>HAM-639</td>
<td>25 to 30cm</td>
<td>860 ± 70</td>
</tr>
<tr>
<td>HAM-640</td>
<td>30 to 35cm</td>
<td>2110 ± 80</td>
</tr>
<tr>
<td>HAM-641</td>
<td>35 to 40cm</td>
<td>2700 ± 90</td>
</tr>
<tr>
<td>HAM-642</td>
<td>40 to 45cm</td>
<td>3020 ± 80</td>
</tr>
<tr>
<td>HAM-643</td>
<td>45 to 50cm</td>
<td>4170 ± 80</td>
</tr>
<tr>
<td>HAM-644</td>
<td>50 to 55cm</td>
<td>5160 ± 90</td>
</tr>
<tr>
<td>HAM-645</td>
<td>55 to 60cm</td>
<td>3880 ± 70</td>
</tr>
<tr>
<td>HAM-646</td>
<td>60 to 65cm</td>
<td>3550 ± 90</td>
</tr>
<tr>
<td>HAM-647</td>
<td>65 to 70cm</td>
<td>6700 ± 80</td>
</tr>
<tr>
<td>HAM-648</td>
<td>70 to 75cm</td>
<td>8500 ± 130</td>
</tr>
<tr>
<td>HAM-649</td>
<td>75 to 80cm</td>
<td>10,920 ± 140</td>
</tr>
<tr>
<td>HAM-650</td>
<td>80 to 85cm</td>
<td>10,980 ± 140</td>
</tr>
<tr>
<td>HAM-651</td>
<td>85 to 90cm</td>
<td>13,750 ± 190</td>
</tr>
<tr>
<td>HAM-652</td>
<td>90 to 95cm</td>
<td>13,250 ± 180</td>
</tr>
<tr>
<td>HAM-653</td>
<td>95 to 100cm</td>
<td>13,440 ± 180</td>
</tr>
<tr>
<td>HAM-654</td>
<td>100 to 105cm</td>
<td>16,770 ± 280</td>
</tr>
<tr>
<td>HAM-655</td>
<td>0 to 5cm</td>
<td>110.0 ± 0.6% modern</td>
</tr>
</tbody>
</table>

Samples coll and subm 1976 by H Schiffmann and B Hofmann, Bayernisches Geol Landesamt, München. Explorative samples of same area are HAM-47 to -49 (R, v 18, p 272). Age inflection of HAM-645 and -646 could be due to slightly vertic properties of soil by migration through cracks. Dates will be used for decomposition model.

Landshut/Ergolding, loess, lowest Isar terrace (48° 35' N, 12° 11' E).
<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth Range</th>
<th>Radiocarbon Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAM-656</td>
<td>5 to 10 cm</td>
<td>105.2 ± 0.8% modern</td>
</tr>
<tr>
<td>HAM-657</td>
<td>10 to 15 cm</td>
<td>105.6 ± 0.7% modern</td>
</tr>
<tr>
<td>HAM-658</td>
<td>15 to 20 cm</td>
<td>108.7 ± 0.9% modern</td>
</tr>
<tr>
<td>HAM-659</td>
<td>20 to 25 cm</td>
<td>720 ± 100</td>
</tr>
<tr>
<td>HAM-660</td>
<td>25 to 30 cm</td>
<td>180 ± 70</td>
</tr>
<tr>
<td>HAM-661</td>
<td>30 to 35 cm</td>
<td>2170 ± 80</td>
</tr>
<tr>
<td>HAM-662</td>
<td>35 to 40 cm</td>
<td>3440 ± 80</td>
</tr>
<tr>
<td>HAM-663</td>
<td>40 to 45 cm</td>
<td>4210 ± 90</td>
</tr>
<tr>
<td>HAM-664</td>
<td>45 to 50 cm</td>
<td>3810 ± 90</td>
</tr>
<tr>
<td>HAM-665</td>
<td>50 to 55 cm</td>
<td>4990 ± 80</td>
</tr>
<tr>
<td>HAM-666</td>
<td>55 to 60 cm</td>
<td>4980 ± 90</td>
</tr>
<tr>
<td>HAM-667</td>
<td>60 to 65 cm</td>
<td>5550 ± 80</td>
</tr>
<tr>
<td>HAM-668</td>
<td>65 to 70 cm</td>
<td>4970 ± 90</td>
</tr>
<tr>
<td>HAM-669</td>
<td>70 to 75 cm</td>
<td>5560 ± 80</td>
</tr>
<tr>
<td>HAM-670</td>
<td>75 to 80 cm</td>
<td>3990 ± 90</td>
</tr>
<tr>
<td>HAM-671</td>
<td>80 to 85 cm</td>
<td>2930 ± 80</td>
</tr>
<tr>
<td>HAM-672</td>
<td>85 to 90 cm</td>
<td>3090 ± 70</td>
</tr>
</tbody>
</table>

Samples collected and submitted 1976 by H. Schiffmann and B. Hofmann, Bayerisches Geologisches Landesamt, München. Age inflection of HAM-670 to -672 not easy to explain, but same trend was observed in other profiles, perhaps result of animal transport. Age vs depth series of dates to be used for decomposition model.

Humic matter in coastline levee along Eastern Sea coast near Heiligenhafen (54° 29' N, 10° 55' E).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description</th>
<th>Depth Range</th>
<th>Radiocarbon Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BONN-2367</td>
<td>Cliff wall, sampling spot G 75/2, 16 to 26 cm</td>
<td>300 ± 60</td>
<td></td>
</tr>
<tr>
<td>BONN-2368</td>
<td>37 to 47 cm</td>
<td>460 ± 60</td>
<td></td>
</tr>
<tr>
<td>BONN-2370</td>
<td>55 to 65 cm</td>
<td>880 ± 80</td>
<td></td>
</tr>
<tr>
<td>BONN-2372</td>
<td>Sampling spot G 75/3, 20 to 30 cm</td>
<td>360 ± 70</td>
<td></td>
</tr>
<tr>
<td>BONN-2373</td>
<td>40 to 50 cm</td>
<td>870 ± 70</td>
<td></td>
</tr>
<tr>
<td>BONN-2375</td>
<td>98 to 110 cm</td>
<td>2300 ± 70</td>
<td></td>
</tr>
<tr>
<td>BONN-2376</td>
<td>110 to 120 cm</td>
<td>1760 ± 70</td>
<td></td>
</tr>
<tr>
<td>BONN-2377</td>
<td>130 to 140 cm</td>
<td>1780 ± 100</td>
<td></td>
</tr>
<tr>
<td>BONN-2378</td>
<td>Sampling spot G 75/4, 10 to 20 cm</td>
<td>210 ± 70</td>
<td></td>
</tr>
</tbody>
</table>
Samples coll and subm 1975 by D Goetz, Ordin Bodenkunde, Univ Hamburg. Comment: results are supplemental to dates HAM-123 to -127 (R, v 18, p 279), helping date beach wall formation. Most C relics rather young, Sub-atlantic/Sub-boreal, except BONN-2385, reflecting origin in period of climatic optimum.

Elbe River marsh series, Allermöhe, Vier- und Marschlande, S Hamburg.

HAM-826. Allermöhe, Pastoratsweg, field plot near cemetery (53° 28' N, 10° 7' E) peat, 80 to 90cm. 2670 ± 80
HAM-827. 90 to 100cm 2090 ± 80
HAM-828. Allermöhe, cemetery between church and dike (53° 28' N, 10° 7' E) 430 to 440cm. 2220 ± 70
HAM-829. Peat, 440 to 450cm 2370 ± 80
HAM-830. Peat, 450 to 460cm 2640 ± 70
HAM-831. Allermöhe, church, below tower, old warft (settlement), peat (52° 28' N, 10° 7' E), 340 to 360cm. 2040 ± 70
HAM-832. Peat, 360 to 380cm 1470 ± 70
HAM-833. Peat, 380 to 400cm 2270 ± 80
HAM-834. Allermöhe, marsh, super-hwy line, peat (58° 28' N, 10° 9' E), 160 to 180cm. 1440 ± 70
HAM-835. Fossil A-horizon, 210 to 215cm 7420 ± 110
HAM-836. Allermöhe, church, buried fossil soil (A-horizon) (53° 28' N, 10° 7' E), 290 to 310cm. 1560 ± 70
HAM-837. Allermöhe, cemetery (old part), fossil A-horizon (53° 28' N, 10° 7' E), 275 to 295cm. 3970 ± 80
HAM-838. Humic clay, 355 to 375cm 2110 ± 70
HAM-839. Peat, 375 to 390cm 3240 ± 70
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Depth</th>
<th>Radiocarbon Age (± error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAM-840</td>
<td>Basal peat, 420 to 430cm</td>
<td>3790 ± 70</td>
<td></td>
</tr>
<tr>
<td>HAM-841</td>
<td>Allermöhe, cemetery (new part), peat, (58° 28’ N, 10° 7’ E), 245 to 255cm</td>
<td>2890 ± 80</td>
<td></td>
</tr>
</tbody>
</table>

Samples coll and subm 1976 by B Hintze. Comment: dated peats belong stratigraphically to same phase as samples, HAM-794 to -799 (R, v 19, p 179), Sub-boreal and early Sub-atlantic: divergent ages signify soil surfaces of different dates of origin (church and cemetery warft). They also relate to differing growth periods of peat layers and different grades of their compaction. Fossil Ah horizon of HAM-835 probably represents formation of Boreal soil at surface of early Holocene sands.

Peat samples underlying valley of Elbe River, sampled in three cross-sections E and W of Hamburg.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Description</th>
<th>Depth</th>
<th>Radiocarbon Age (± error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAM-1393</td>
<td>Hamburg-Allermöhe, peat, (53° 31’ N, 10° 6’ E), 80 to 90cm</td>
<td>3560 ± 70</td>
<td></td>
</tr>
<tr>
<td>HAM-1394</td>
<td>Hamburg-Moorfleet, peat, (58° 30’ N, 20° 6’ E), 140 to 150cm</td>
<td>3810 ± 80</td>
<td></td>
</tr>
<tr>
<td>HAM-1395</td>
<td>Peat, 130 to 140cm</td>
<td>3850 ± 80</td>
<td></td>
</tr>
<tr>
<td>HAM-1396</td>
<td>Peat, 110 to 120cm</td>
<td>3060 ± 80</td>
<td></td>
</tr>
<tr>
<td>HAM-1397</td>
<td>Peat, 170 to 180cm</td>
<td>2790 ± 80</td>
<td></td>
</tr>
<tr>
<td>HAM-1398</td>
<td>Hamburg-Moorfleet, peat (53° 30’ N, 10° 6’ E), 160 to 170cm</td>
<td>2220 ± 80</td>
<td></td>
</tr>
<tr>
<td>HAM-1399</td>
<td>Altes Land/Agathenburg, peat (53° 35’ N, 9° 33’ E), 500 to 510cm</td>
<td>4770 ± 80</td>
<td></td>
</tr>
<tr>
<td>HAM-1400</td>
<td>Altes Land/Agathenburg, peat (53° 34’ N, 9° 32’ E), 310 to 320cm</td>
<td>4590 ± 80</td>
<td></td>
</tr>
<tr>
<td>HAM-1401</td>
<td>Peat, 320 to 330cm</td>
<td>5320 ± 90</td>
<td></td>
</tr>
<tr>
<td>HAM-1402</td>
<td>Altes Land/Agathenburg, peat (53° 35.5’ N, 9° 34’ E), 540 to 550cm</td>
<td>4970 ± 80</td>
<td></td>
</tr>
<tr>
<td>HAM-1403</td>
<td>Haseldorfer Marsch, peat (53° 38’ N, 9° 37.5’ E), 620 to 630cm</td>
<td>4980 ± 80</td>
<td></td>
</tr>
<tr>
<td>HAM-1404</td>
<td>Hamburg-Neuland, basal peat (53° 27’ N, 10° 1.5’ E), 260 to 270cm</td>
<td>8140 ± 100</td>
<td></td>
</tr>
<tr>
<td>HAM-1405</td>
<td>Hamburg-Neuland, basal peat (53° 29’ N, 10° 3.5’ E), 190 to 200cm</td>
<td>3400 ± 70</td>
<td></td>
</tr>
<tr>
<td>HAM-1406</td>
<td>Altes Land/Agathenburg, peat (53° 34’ N, 9° 32’ E), 360 to 370cm</td>
<td>4700 ± 90</td>
<td></td>
</tr>
</tbody>
</table>

Samples coll and subm 1977 by B Hintze. Comment: two growth phases of peat can be distinguished in Elbe valley, dist Hamburg, older
one between 5000 and 4500 BP, which is limited to Altes Land and Haseldorfer Marsch regions; younger one between 4200 and 3000 BP in region of Vier and Marschlande.

$^{14}$C age at base of peat layer, which reaches depth up to 6m, eg, in Hamburg Neuland (HAM-1404), proves that peat began to form in this area during Boreal. Date also indicates that Elbe R did not reach this area before younger, Sub-atlantic period, since peat growth was nowhere interrupted by sedimentation phase.

**Australia**

Two typic Australian Vertisol and Oxisol (Krasnozem) profiles were dated by layers. Investigations of natural $^{14}$C scanning of Australian Vertisols and Krasnozems are continuing (see BONN-664 to -772; R, v 15, p 258-263) for testing C dynamics of these soils.

Vertisol (Chromustert) on gently undulating plain at +300m, in Chinchilla, 80m from profile 10c(B554) (Handbook of Australian Soils, 1968, p 88-90). Deeply weathered profile on Mesozoic sandstone, covered with *Acacia harpophylla* (26° 43’ S, 150° 36’ E).

| Sample  | % C, 0 to 10 cm | ±  | % C, 10 to 20 cm | ±  | % C, 20 to 30 cm | ±  | % C, 30 to 40 cm | ±  | % C, 40 to 50 cm | ±  | % C, 50 to 60 cm | ±  | % C, 60 to 70 cm | ±  | % C, 70 to 80 cm | ±  | % C, 80 to 90 cm | ±  | % C, 100 to 110 cm | ±  | % C, 110 to 120 cm | ±  | % C, 120 to 130 cm | ±  | % C, 130 to 140 cm | ±  | % C, 140 to 150 cm | ±  | % C, 150 to 160 cm | ±  | % C, 160 to 170 cm | ±  | % C, 170 to 180 cm | ±  | % C, 180 to 190 cm | ±  | % C, 190 to 200 cm | ±  | % C, 200 to 210 cm | ±  | % C, 210 to 220 cm | ±  | % C, 220 to 230 cm | ±  | % C, 230 to 240 cm | ±  | % C, 240 to 250 cm | ±  |
|---------|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|
| HAM-674 | 2.58%          | 0 to 10 cm | 100 ± 70       |    | 1.48%          | 10 to 20 cm | 110 ± 70       |    | 1.01%          | 20 to 30 cm | 120 ± 70       |    | 0.65%          | 30 to 40 cm | 660 ± 80       |    | 0.59%          | 40 to 50 cm | 1200 ± 80      |    | 0.53%          | 50 to 60 cm | 1350 ± 80      |    | 0.48%          | 60 to 70 cm | 2430 ± 80      |    | 0.42%          | 70 to 80 cm | 2500 ± 80      |    | 0.43%          | 80 to 90 cm | 2280 ± 100     |    | 0.37%          | 100 to 110 cm | 1090 ± 100     |    | 0.35%          | 110 to 120 cm | 2760 ± 90      |    | 0.33%          | 120 to 130 cm | 2730 ± 70      |    | 0.30%          | 130 to 140 cm | 4550 ± 60      |    | 0.24%          | 140 to 150 cm | 4670 ± 90      |    | 0.22%          | 150 to 160 cm | 6470 ± 100     |    | 0.18%          | 160 to 170 cm | 6510 ± 100     |    | 0.15%          | 170 to 180 cm | 7850 ± 110     |    | 0.15%          | 180 to 190 cm | 7700 ± 140     |    | 0.15%          | 190 to 200 cm | 8190 ± 270     |    | 0.13%          | 200 to 210 cm | 8190 ± 270     |    | 0.13%          | 210 to 220 cm | 8190 ± 270     |    | 0.13%          | 220 to 230 cm | 8190 ± 270     |    | 0.13%          | 230 to 240 cm | 8190 ± 270     |    | 0.13%          | 240 to 250 cm | 8190 ± 270     |
Vertisol (Chromustert) on lower edge of gently sloping pediment in Paget. Deeply weathered profile on lower Cretaceous sand and mudstone (27° 27' S, 150° 31' E).

HAM-734. 1.96% C, 10 to 20cm 102 ± 20
HAM-735. 1.47% C, 20 to 30cm 1360 ± 90
HAM-736. 1.29% C, 30 to 40cm 1760 ± 80
HAM-737. 1.10% C, 40 to 50cm 2290 ± 80
HAM-739. 0.96% C, 60 to 70cm 2780 ± 70
HAM-740. 0.94% C, 70 to 80cm 2870 ± 70
HAM-741. 0.86% C, 80 to 90cm 3250 ± 80
HAM-742. 0.85% C, 90 to 100cm 3270 ± 80
HAM-743. 0.77% C, 100 to 110cm 3360 ± 90
HAM-744. 0.66% C, 110 to 120cm 5560 ± 80
HAM-745. 0.72% C, 120 to 130cm 5170 ± 100
HAM-746. 0.66% C, 130 to 140cm 6540 ± 150
HAM-747. 0.50% C, 140 to 150cm 7790 ± 110
HAM-748. 0.51% C, 150 to 160cm 8840 ± 120
HAM-749. 0.49% C, 160 to 170cm 8220 ± 130
HAM-750. 0.50% C, 170 to 180cm 10,550 ± 130
HAM-751. 0.48% C, 180 to 190cm 10,670 ± 100
HAM-755. 0.42% C, 220 to 230cm 11,570 ± 210
HAM-758. 0.36% C, 250 to 260cm 10,890 ± 130

Eutrustoξ (Krasnozem) on plateau remnant above precipitous scarp in clay laterite, in Gabbinbar. Soil formation from early Tertiary basalt with strongly weathered saprolitic transition zone (27° 26' S, 159° 59' E).

HAM-719. 11.25% C, 0 to 8cm 117.7 ± 0.9% modern
HAM-720. 4.50% C, 8 to 20cm 110.4 ± 0.9
HAM-722. 1.71% C, 34 to 47cm 30 ± 70
HAM-723. 1.09% C, 47 to 60cm 370 ± 70
HAM-724. 0.91% C, 60 to 80cm 1170 ± 70
HAM-725. 0.52% C, 80 to 100cm 1160 ± 80
HAM-726. 0.36% C, 100 to 120cm 1810 ± 80
HAM-731. 0.14% C, 200 to 220cm 3380 ± 120

Eutrustox (Krasnozem) on plateau, with escarpment up to 8° slope in Beechmont. Deeply weathered profile on soft weathered Tertiary basalt, covered by subtropical rainforest (28° 10' S, 153° 12' E).

HAM-703. 7.92% C, 0 to 10cm 111.0 ± 1% modern
HAM-704. 4.53% C, 10 to 20cm 102.2 ± 1.2% modern
HAM-705. 2.88% C, 20 to 30cm 240 ± 60
HAM-706. 2.01% C, 30 to 40cm 320 ± 70
HAM-707. 1.15% C, 40 to 60cm 260 ± 60
HAM-708. 0.85% C, 60 to 80cm 1530 ± 50
HAM-709. 0.75% C, 80 to 100cm 2020 ± 70
HAM-711. 0.58% C, 120 to 140cm 2000 ± 70

Samples of all four profiles coll and subm 1977 by G D Hubble, CSIRO, Cunningham Lab, St Lucia, Queensland. Vertisol dates comply quite well with former Australian Vertisol profile dates from Caniva dist, Victoria (R, v 15, p 258-263), which were interpreted with help of conventional analysis and micromorphology data (Blackburn, Sleeman, & Scharpenseel, 1979). Dates will be used for soil organic matter decomposition model, which attempts to integrate fast exponential and slower steady-state decomposition phases. Eutrustox (Krasnozem) data are rather young and repeat trends observed in previous Krasnozem dates (BONN-664 to -772: R, v 13, p 198-200). Since Oxisols are generally considered to be old soils, either Krasnozem type on basalt weathering is different, or more likely, profiles consist of relatively high members of erosion catenas, standing in erosion equilibrium with much transported younger material as well as with newly formed soil and humus.

References


This radiocarbon laboratory began operation in 1980 using the benzene scintillation method. The benzene synthesizer is essentially identical with that of Ikeda (1976). A liquid scintillation counter is Aloca LSC-LB1. Samples dated are wood, charcoal, shell, and coral.

Pretreatment of wood and charcoal is a standard acid-alkali procedure, using 2% HCl and 2% NaOH at elevated temperatures. Charcoal is further heated in concentrated HNO₃ for one hour, diluted in water, stands one night, and is washed and dried. Pretreated wood and charcoal are carbonized before combustion. The combustion products are passed over CuO, and are collected in an ammonium hydroxide bubbler system, and precipitated with calcium chloride.

Carbonate samples such as shell and coral are washed in diluted HCl and, subsequently, organic matter in carbonate is carbonized before conversion to CO₂.

Standard oxalic acid is oxidized by the wet method of Valastro, Land, and Varela (1977). CO₂ is converted to benzene through lithium carbide and acetylene basically by the methods of Noakes, Kim, and Stipp (1965) and Kim, Ikeda, and Ruch (1969). The catalyst used to synthesize benzene can be easily made in the laboratory. The silica alumina catalyst base is activated by boiled ammonium metavanadate solution, allowed to stand one night, and is washed and dried.

Memory effect in the stainless steel reaction vessel can be removed by using an exchangeable inner vessel and by baking it in the air.

Counting efficiency is 65% and background rate is 0.9cpm for a mixture of 4ml benzene and 2ml scintillator in a low potassium glass vial and 1.8cpm for a mixture of 15ml benzene and 5ml scintillator in a teflon vial. Each sample including background and sealed reference standard is placed in the counter and counted sequentially for 50 min. The cycle is repeated as often as desired with a minimum of 20 cycles, 1000 min/sample, for each series of determinations.

Quenching is corrected, especially for young samples, because it varies the counting efficiency range of ±1.5%.

Dates are calculated based on 0.95 of the activity of NBS oxalic acid (SRM-4990) and the Libby half-life for ¹⁴C of 5570 ± 30 years. Errors quoted are 2σ statistical error. The maximum measurable age under routine condition of 3ml benzene sample and 1000 minute counting is 40,000 years.

The activity of the NBS standard (SRM 4990) is measured to be 13.99 ± 0.30 (2σ) dpm/gC and that of the New NBS standard (RM 49) is measured to be 18.34 ± 0.25 (2σ) dpm/gC. Paleozoic limestone is measured for a blank test to be >39,500 years BP under the routine condition of 2.2g carbon and 1000 minute counting.
Samples previously measured in other laboratories were dated in our laboratory. The results of this cross checking are given in table 1 which shows that obtained dates are in good agreement with reported dates.

ACKNOWLEDGMENTS

Thanks are due S Ikeda, Tokyo Technical University, and H Shira-kawa, Tsukuba University, for their kind advice. We would like to thank K Kigoshi and S Suzuki, Gakushuin University, for helpful suggestions and samples for cross checking. We wish also to express our thanks to Y Maeda, Kobe Educational Institute, Y Hayakawa, Tokyo University, and N Issiki and H Yamazaki, Geological Survey of Japan, for providing the samples for cross checking.

SAMPLE DESCRIPTIONS

GEOLoGIC SAMPLES

Asama Volcano series

Charcoal from tree in First Pumice Flow deposit of Asama Volcano, central Japan. Col1 1981 by S Togashi.

JGS-16. Asama 13,500 ± 500

Charcoal from river cut at Manza-kazawaguchi, Gumma (36° 31' 40" N, 138° 31' 15" E), 30m below surface.

JGS-36. Asama 13,700 ± 400

Same sample as JGS-16.

JGS-37. Asama 13,600 ± 400

Charcoal from Komoro, Nagano (36° 21' 05" N, 138° 27' 15" E), 4m below surface.

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>JGS no.</th>
<th>JGS date</th>
<th>Other lab no.</th>
<th>Other dates</th>
<th>Difference between dates</th>
<th>Submitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>Wood</td>
<td>JGS-24</td>
<td>GaK. 9229</td>
<td>950 ± 110</td>
<td>10</td>
<td>Yamazaki</td>
</tr>
<tr>
<td>2</td>
<td>Charcoal</td>
<td>-48</td>
<td>-10046</td>
<td>1090 ± 100</td>
<td>80</td>
<td>Hayakawa</td>
</tr>
<tr>
<td>3</td>
<td>Wood</td>
<td>-20</td>
<td>-9312</td>
<td>2430 ± 110</td>
<td>70</td>
<td>Kigoshi</td>
</tr>
<tr>
<td>3'</td>
<td>Wood</td>
<td>-26</td>
<td>-9312</td>
<td>2430 ± 110</td>
<td>40</td>
<td>Kigoshi</td>
</tr>
<tr>
<td>4</td>
<td>Wood</td>
<td>-49</td>
<td>-10043</td>
<td>12,460 ± 520</td>
<td>580</td>
<td>Hayakawa</td>
</tr>
<tr>
<td>5</td>
<td>Wood</td>
<td>-57</td>
<td>-8745</td>
<td>21,810 ± 150</td>
<td>460</td>
<td>Kigoshi</td>
</tr>
<tr>
<td>6</td>
<td>Charcoal</td>
<td>-89</td>
<td>-1589</td>
<td>30,900 ± 700</td>
<td>3100</td>
<td>Ishiki</td>
</tr>
</tbody>
</table>

| 7**        | Charcoal| JGS-50       | GaK.10048     | >28,070     | —                        | Hayakawa  |
| 8          | Shell   | -61          | N-2942        | 5800 ± 110  | 0                        | Maeda     |
| 9          | Shell   | -59          | N-1305        | 5960 ± 120  | 80                       | Maeda     |
| 10         | Shell   | -60          | GaK. 3757     | 6600 ± 150  | 390†                     | Maeda     |
| 11         | Shell   | -11          | N-3085        | 7330 ± 120  | 30                       | Maeda     |

* Samples 1-6 are the same as GaK samples under “Other lab no.”

** Samples 7-11 are different but from the same formations and outcrops as those under “Other lab no.”

† The large difference in the dates of sample 10 may be attributed to the difference in samples. However, both dates are consistent with the stratigraphy.
JGS-40. Asama 13,600 ± 400
Same sample as JGS-37.

O-shima Volcano series

JGS-99. O-shima, NI83042401 >41,600
Wood from sea cliff W of Okata, O-shima (34° 47' 11” N, 139° 23’ 13” E).
+ 5500

JGS-100. O-shima, NI83042402 39,000
Wood from same deposit as JGS-99.

Hachijo-jima Volcano

JGS-89. Hachijo, NI67091703 34,000
Charcoal from near N mouth of Osaka Tunnel, S of Osato, Hachijo-machi (33° 05' 50” N, 139° 47' 15” E).
+ 2500

JGS-46. Miyake-jima, NI82052702 3030 ± 310
Charcoal from W flank of Miyake-jima Volcano (34° 05' 10” N, 139° 29’ 35”).

JGS-85. Miyake-jima, NI82052702 2880 ± 180
Same sample as JGS-46.

Sakura River deposit series
Wood from deposit by Sakura R, Tsukuba, Ibaraki. Coll 1980 and 1981 by S Togashi, and H Ikeda and F Iseya, Tsukuba Univ. Sample measured to date route change of Sakura R.

JGS-27. 2460 ± 180
Wood from Yasumori, Tsukuba (36° 11’ 0” N, 140° 04’ 25” E), 2m below surface, middle part of deposit of Sakura R.

JGS-72. 21,740 ± 730
Wood from Tanaka, Tsukuba (36° 10’ 25” N, 140° 04’ 30” E), 2m below surface, bottom of deposit of Sakura R.
Tinian Island, southern Mariana Islands series
Coral from E coast of Tinian I. (15° 00' N, 145° 40' E). Coll 1982 by H Kayane, N Yonekura, and Y Ida, Tokyo Univ. Samples measured to date sea-level change along S Mariana Is. coast.

JGS-75. TINIAN-3.82  
32,700  
Coral from 2.9m above msl. Sample is aragonite.

JGS-76. TINIAN-5.82  
37,800  
Coral from 2.2m above msl. Sample is aragonite.

Rota Island, southern Mariana Islands series
Coral from W coast of Rota I. (14° 03' N, 145° 10' E). Coll 1982 by H Kayane, N Yonekura, and Y Ida. Samples measured to date sea-level change along S Mariana Is. coast.

JGS-77. ROTA D-1.82  
16,500 ± 400  
Coral from 5m above msl. Sample is aragonite, including 3% Mg-calcite.

JGS-78. ROTA D-2.82  
4070 ± 190  
Coral from 3.3m above msl. Sample is aragonite, including 1% Mg-calcite.

JGS-79. ROTA D-3.82  
31,300  
Coral from 4.7m above msl. Sample is aragonite, including 1% calcite.

JGS-80. ROTA D-4.82  
4040 ± 190  
Coral from 3.1m above msl. Sample is 99% aragonite.

JGS-81. ROTA D-5.82  
3780 ± 200  
Coral from 1.6m above msl. Sample is aragonite.

JGS-82. ROTA D-6.82  
5010 ± 200  
Coral from 1.2m above msl. Sample is aragonite.

Mangaia Island, southern Cook Islands series
Coral from drill hole at W coast of Mangaia I. (22° 00' S, 157° 40' W). Height of drilled coral surface is recent sea level. Coll 1982 by N Yonekura and Y Matsushima, Kanagawa Pref Mus, and Y Maeda, Kobe Educ Inst. Samples measured to date sea-level change along Cook Is.

JGS-63. MANGAIA 20.21  
2290 ± 160  
Coral from 0.8m below msl.


JGS-64. MANGAIA 37
Coral from 1.8m below msl.

JGS-65. MANGAIA 63.64
Coral from 3.8m below msl. Sample is aragonite, including 6% calcite.

Mangaia Island, southern Cook Islands series
Coral from coast at NW coast of Mangaia I. (22° 00' S, 157° 40' W). Coll 1982 by N Yonekura, Y Matsushima, and Y Maeda. Samples measured to date sea-level change along Cook Is.

JGS-62. MANGAIA 4.82
Coral from 1.1 to 1.3m above msl. Sample is aragonite, including 1% calcite.

JGS-96. MAN 3.82
Coral from 1.8m above msl.

JGS-97. MAN 1.82
Coral from 1.8 to 2.3m above msl.

Aitutaki Island, southern Cook Islands series
Coral from drill hole at N coast of Aitutaki I. (18° 40' S, 160° 02' W). Height of drilled coral surface is recent sea level. Coll 1982 by N Yonekura, Y Matsushima, and Y Maeda. Samples measured to date sea-level change along Cook Is.

JGS-66. AUTITAKI-16
Coral from 0.7m below msl.

JGS-67. AUTITAKI-48.49
Coral from 2m below msl.

Rarotonga Island, southern Cook Islands series
Coral from drill hole at N coast of Rarotonga I. (21° 00' S, 160° 00' W). Height of drilled coral surface is recent sea level. Coll 1982 by N Yonekura, Y Matsushima, and Y Maeda. Samples measured to date sea-level change along Cook Is.

JGS-73. RAROTONGA 24
Coral from 1.4m below msl.

JGS-74. RAROTONGA 36.37
Coral from 1.9m below msl.

Viti Levu, Fiji Islands series
Shell and wood from drill holes at S coast of Viti Levu, Fiji. Coll 1982 by A Sugimura, Kobe Univ, Y Matsushima, E Matsumoto, Y Maeda, K Berryman, New Zealand Geol Survey, and T Ishii and N Yonekura, Tokyo Univ.
JGS-51.  FIJI St I  
2640 ± 330
Shell from 2.25 to 2.5m below msl at drill hole St I (18° 10' S, 178° 20' E).

JGS-55.  FIJI St III  
4400 ± 200
Shell from 1 to 1.25m below msl at drill hole St III (18° 10' S, 178° 20' E).

JGS-98.  FIJI St III  
1630 ± 250
Wood from 1.75m above msl at drill hole St III (18° 10' S, 178° 20' E).

References
INTRODUCTION

This date list includes most of the archaeologic and geologic samples dated in this laboratory since publication of our last date list (R, 1981, v 23, p 227-240), as well as some samples dated previously which lacked adequate sample information.

All samples were pretreated with 3N HCl and some, where noted, were given additional pretreatment with 2% NaOH for the removal of possible humic acid contaminants.

The BP ages are relative to AD 1950, and have been calculated with the half-life value of 5568 yr using our mid-19th century AD calibration samples which have an average age of 145 yr. When corrected for this age, these calibration samples have $^{13}$C contents equal to 95% of the NBS oxalic acid standard. $\delta^{13}$C, where included, has been measured on this laboratory’s Micromass 622 mass spectrometer, reported with respect to PDB, and the results corrected accordingly for isotopic fractionation. All samples were counted at least twice for periods of not less than 1000 min each. Errors quoted for each sample include the sum of the statistical counting uncertainties in the measurement of the sample, the background, and several counts of our mid-19th century AD oak sample, but do not include the possible half-life errors.

In addition to our two 8L counters, a small 1L counter is employed for counting undersized samples. Larger errors associated with these dates are a direct result of small sample size and consequently reduced number of counts. Use of the small counter is indicated by an asterisk (*) after the uncertainty of the BP date. In all counters we continue to use pure CO$_2$.

The calibrated dates which appear in the sample comments are designated either as CRD-1$\sigma$ or Stuiver corrected. CRD-1$\sigma$ refers to BC era dates calibrated with tables based on the same data base and statistical methods as found in “Calibration of radiocarbon dates: tables based on the consensus data of the Workshop on Calibrating the Radiocarbon Time Scale” (R, v 24, p 103-150) but where the range represents a 67% confidence interval instead of 95% confidence interval (Jeffrey Klein, un-pub). Stuiver corrected refers to AD era dates that have been calibrated using “A high-precision calibration of the AD radiocarbon time scale” (R, v 24, p 1-26). Both of the above-mentioned calibrations include the uncertainties assoc with the counting statistics of the sample and those assoc with the calibration itself. Where there is no calibrated date in an individual sample comment, it is because that date is beyond the range of currently available correction factors (BP 7230, 5568 half-life). For those readers interested in an age calculated with the 5730 year half-life, the given radiocarbon age should be multiplied by 1.029.
Cyprus

Kalavasos-Tenta series

Kalavasos-Tenta, 2.25km SSE of Kalavasos village, Larnaca Dist, Cyprus (34° 41′ N, 33° 18′ E), is a stratified habitation site representing both Aceramic and Ceramic Neolithic phases (Todd, 1978; 1982a,b). Coll and subm 1977 and 1978 by I A Todd, Dept Oriental Studies, Brandeis Univ, Waltham, Massachusetts. For previous dates from this site, see P-2458 to -2555 (R, v 20, p 218-219).

General Comment: except for P-2780 all samples are from Aceramic Neolithic contexts.

P-2975. Sample K-T 21 6970 ± 310*
Soil and charcoal from Sq F11 C, E baulk, deposit no. 2.5. Deposit lies outside any structures and is quite close to top soil (possibly disturbed by plough); dates Aceramic occupation of lower S face of site. Comment: CRD-1σ: 6335 to 5390 BC.

P-2976. K-T 22 8870 ± 500*
Soil and charcoal from Sq F11 C, deposit no. 3.6, hearth outside structures and under caliche layer (from same basic area as P-2975, above, and est date probably similar).

P-2974. Sample K-T 10 8020 ± 90
Mud and charcoal from Sq G9 D, deposit 3.6, dates occupation of mud-brick Structure 58, at top of site.

P-2977. Sample K-T 23 6570 ± 290*
Soil and charcoal from Sq G10 A, deposit no. 4.1, from pit that post-dates and is dug into Structure 28 on top of site. Comment: CRD-1σ: 5830 to 5200 BC.

P-2973. Sample K-T 19 8010 ± 360*
Soil and charcoal from Sq G10 A/G10 C; sample from Structure 34 (dates actual mudbrick structure or period immediately after).

P-2972. Sample K-T 18 9240 ± 130
Soil and charcoal from Sq G11 C, deposit no. 13.2/16.1; from one of earliest pits in lower S area of site.

P-2781. Sample K-T 11 6300 ± 80
Charcoal from Sq G11 C, deposit no. 9.2, representing Aceramic Neolithic open-air hearth. Comments: CRD-1σ: 5350 to 5085 BC; (IAT): date unexpectedly young; should be similar to P-2552, -2553, and -2555 (R, 1978, v 20, p 218-219).
Barbara J Hurst and Barbara Lawn

P-2782. Sample K-T 12

Charcoal from Sq G11 C, deposit no. 5.9, from Aceramic Neolithic open air area outside Structure 9; should be contemporaneous with P-2781 (above).

P-2783. Sample K-T 13

Charcoal from Sq G11 C, deposit no. 5.5; Aceramic Neolithic open-air Area E of Structure 9 and contemporaneous with it.

P-2784. Sample K-T 14

Charcoal from Sq G12A, deposit no. 5.8.

P-2789. Sample K-T 9

Charcoal from Sq G12 D, deposit no. 4.2; dates to early phase of stone architecture. Comment: NaOH pretreatment: CRD-1o:- 6235 to 5635 Be.

P-2785. Sample K-T 15

Charcoal from Sq G12 D, deposit 5.1, from hearth (hollow cut in bedrock) S of E end of Aceramic Neolithic Structure 1 (Dikaios' main wall).

P-2978. Sample K-T 24

Soil and charcoal from Sq H12 A, deposit no. 2.4, open area, close to present ground surface in lower S part of site and close to inner face of wall (probable outer wall of settlement’s early phase).

P-2780. Sample K-T 10

Charcoal from Sq B7 C, deposit no. 2.4, Ceramic Neolithic deposit. Comments: CRD-1o: 4755 to 4565 BC; (Frank Koucky): not archaeol in situ—deposited by water action.

P-2980. Kalavasos Village-Panayia Church, Sample 1

Charcoal found near Middle Bronze age vessel (no. 27), level 3/4 in Tomb 2 at site E of Panayia Church, Kalavasos Village (34° 46’ N, 33° 18’ E) from rescue excavation before new construction. Comments: CRD-1o: 3190 to 2865 BC; (IAT): vessel dates tomb to Middle Bronze age on Cyprus (ca 1925 to 1600 BC). Calibrated date is earlier than conventional dating for Early Bronze age, but note that calibrated date for Episkopi-Phaneromeni (Late Bronze age IA in Cyprus) also appears to be 500 yr too early (R, 1977, v 19, p 189).

Greece

Voidokilioiia series

Tholos Tomb of Thrasymedes, NW of town of Voidokoilia, near Pylos (30° 22’ N, 21° 45’ E), which contains Neolithic sherds, shows long and continuous use during Mycenaean period. Originally excavated by Spyridon Marinatos in 1956 and 1957, tomb was re-examined in 1977. Samples coll by G S Korres, Univ Athens and subm 1978 by H N Michael, Univ Mus, Univ Pennsylvania.
**P-2846. Sample V-1978-2**  
5810 ± 410*  
Six small samples of charcoal and soil from depth 0.53 to 1.75m in NE sec of tholos. Comments: CRD-1σ: 5245 to 4325 BC; (GSK): stratum disturbed by digging in 1923.

**P-2848. Sample V-1978-4**  
4810 ± 280*  
Three small samples of charcoal and soil from interior of tholos. Comment: CRD-1σ: 3895 to 3345 BC.

**P-2850. Sample V-1978-5B**  
4360 ± 350*  
Fourteen small samples of charcoal and soil from loci of pithos 1 and 5 in SE sec of tholos. Comment: NaOH pretreatment, CRD-1σ: 3520 to 2620 BC.

**P-2852. Sample V-1978-7**  
4000 ± 280*  
Charcoal from vessel α (alpha) in dromos. Comment: CRD-1σ: 2930 to 2155 BC.

**P-2853. Sample V-1978-8**  
4090 ± 260*  
Soil with charcoal and ash from vessel γ (gamma) from dromos interior. Comment: CRD-1σ: 3035 to 2315 BC.

**P-2854. Sample V-1978-9**  
4970 ± 270*  
Charcoal and burned soil contained in vessel β (beta) from interior of dromos. Comment: CRD-1σ: 4105 to 3495 BC.

**P-2855. Papoulia Tumulus, Sample PAP-1978-1**  
3420 ± 60  
Ash and charcoal from Papoulia Tumulus, a horseshoe-shaped structure of stone construction between villages of Platanos and Papoulia, in Pylos dist (30° 22' N, 21° 45' E). Sample from right-central part of interior in niche. Coll 1978 by G S Korres, Unv Athens and subm by H N Michael. Comments: CRD-1σ: 1880 to 1675 BC; (GSK): date expected to be Middle Helladic (1900 to 1600 BC) or perhaps Early Helladic.

**Ayios Stephanos series**  

**P-2568. Sample 1 (1973)**  
3160 ± 60  
Charcoal from Tr N (Γ) T.1A, Level 4, (20) ca 1.1m below surface. Comments: CRD-1σ: 1570 to 1380 BC; (WT): potsherds dated Middle Minoan/Late Helladic I.

**P-2569. Sample 2 (1973)**  
3070 ± 240*  
Charcoal from Tr N (Γ) T.I, Level 5, Rm II (35), ca 1.2m below surface. Comments: CRD-1σ: 1650 to 1085 BC; (WT): no potsherds later than end of MH.
P-2966. **Sample 7 (1977)**

Charcoal and soil from Tr N/Γ1, Level 44-W, balk (56). *Comment: CRD-1σ: 2945 to 2515 BC.*

P-2969. **Sample 12 (1977)**

Charcoal from wooden plank, Tr N 1, threshold to apse of apsidal bldg. *Comments: CRD-1σ: 1970 to 1740 BC; (WT): should be appreciably older than bldg.*

P-2965. **Sample 6 (1977)**

Charcoal and soil from Tr N.1, Level 44-SW (52). *Comments: CRD-1σ: 2890 to 2305 BC; (WT): sample found in apse, sealed by debris and collapsed bldg material, of large MH II apsidal bldg (burned). General context is similar to P-2966, -2969 (above) and P-2967 (below).*

P-2967. **Sample 8 (1977)**

Charcoal from Tr N 1, Levels 44-SE, 44-E, balk (53) (59). *Comments: CRD-1σ: 2555 to 2325 BC; (WT): sample from main rm of large MH II apsidal bldg (burned) and sealed by debris and thick layer of collapsed bldg material. General context similar to P-2965, -2966, and -2969.*

P-2790. **Sample 8 (1974)**

Carbon and soil from Tr N 2, Level 12 (44). *Comments: CRD-1σ: 2900 to 2650 BC; (WT): sample from MH III level, same level as P-2965. ^14C date corresponds closely with pottery.*

P-2958. **Sample 10 (1974)**

Charcoal from Tr N 2, Level 13 (45). *Comments: CRD-1σ: 2905 to 2315 BC; (WT): sample found inside almost complete kantharos from MH III level; almost certainly related to P-2959. ^14C date corresponds closely with pottery.*

P-2959. **Sample 9 (1974)**

Charcoal from Tr N 2, Level 13 (45). *Comments: CRD-1σ: 2435 to 1765 BC; (WT): sample found surrounding almost complete kantharos from MH III level; clearly related to P-2958.*

P-2964. **Sample 5 (1977)**

Charcoal and soil from Tr N 2, Level 48 (48). *Comments: CRD-1σ: 2135 to 1580 BC; (WT): sample from fill of shaft above large MH III cist tomb (shaft grave). Tomb is sealed by floor on and above which P-2790, -2959, and -2958 were coll. Pottery dates tomb to MH III.*

P-2968. **Sample 10 (1977)**

Charcoal from Tr N 2, Level 50 (58). *Comments: CRD-1σ: 2435 to 1910 BC; (WT): sample from fill above and on beaten earth floor due S of large MH II apsidal bldg. Assoc pottery is early MH II. Deposit and bldg are probably contemporaneous.*
P-2570. Sample 3 (1973) 3870 ± 210*
Charcoal from Tr H, Level 3, ca 50cm below surface, on level with infant Burials 7 and 8 (42). Comments: CRD-1σ: 2655 to 2105 BC; (WT): potsherds predominately MH and sample seems to agree.

P-2571. Sample 4 (1973) 3550 ± 220*
Charcoal from Tr H, Level 3 (47), found ca 80cm below surface, on level with infant Burial 10. Comments: CRD-1σ: 2190 to 1680 BC; (WT): pure MH stratum, but late, seems to be same date as P-2570, although from different sec of trench.

P-2962. Sample 4 (1977) 3900 ± 250

P-2963. Sample 5 (1977) 3620 ± 60
Charcoal and soil from Tr A3/A4, Level XXXVI (98). Comments: CRD-1σ: 2155 to 1890 BC; (WT): sample found below Floor 9, dated by decorated Minyan goblet MH II (?late), and above deposit containing ladle, MH II (?early).

P-2961. Sample 4 (1977) 4080 ± 60
Charcoal from Tr I/II/III, Area ep/ex (120). Comments: NaOH pre-treatment; CRD-1σ: 2870 to 2545 BC; (WT): sample possibly from wooden post; latest pottery MH II. 

P-3046. Sample P:1 4200 ± 240*
Charred wood from Akrotiri, Thera, Santorini I. (36° 21’ N, 24° 26’ E). Sample from Middle Cycladian, Akrotiri region, N entrance delta, E side, E of LM house with broken staircase (House Delta); found with older pumice pebbles. Coll 1978 by W L Friedrich, Aarhus Univ, Denmark and H Pichler, and subm 1979 by P P Betancourt, Univ Pennsylvania. Comment: CRD-1σ: 3075 to 2545 BC.

Egypt
E Karnak series


General Comment: all samples are wood (id by Rowena Gale, Jodrell Royal Botanic Gardens, Surrey, England) and from destruction of large and imposing bldg, possibly from roofing beams.

P-3113. Sample HA I (14) 2590 ± 60
Wood from black stratum beneath Stratum 7. Comment: NaOH pre-treatment; CRD-1σ: 815 to 765 BC.
P-3111. Sample HA III (4) 2550 ± 50
Wood (hazel, Corylus sp) from same loc. Comment: NaOH pretreatment; CRD-1σ: 800 to 740 BC.

P-3114. Sample HA III (12) 2550 ± 50
Wood (Acacia sp) from same loc. Comment: NaOH pretreatment; CRD-1σ: 800 to 740 BC.

P-3112. Sample HA IV (9) 2860 ± 40
Wood (Tamarix sp and palm) from same loc. Comment: NaOH pretreatment; CRD-1σ: 1125 to 1010 BC.

P-3115. Sample HA IV (6) 2210 ± 50
Wood (Acacia sp) from same loc. Comment: NaOH pretreatment. CRD-1σ: 400 to 175 BC.

Eshkaft-e Gavi series

P-2861. Sample Lot 16 >27,610*
Charcoal; depth ca 95 to 105cm.

P-2862. Sample Lot 17 >27,970*
Charcoal; depth ca 95 to 105cm.

P-2863. Sample Lot 18 24,240
Charcoal; depth ca 95 to 105cm.

P-2864. Sample Lot 19 18,020
Charcoal; depth 105 to 113cm.

P-2865. Sample Lot 22 19,230
Charcoal; depth 105 to 122cm.

P-2866. Sample Lot 24 >27,260*
Charcoal; depth 122 to 135cm.

Tepe Hissar series
Tepe Hissar is loc at Damghan (36° 09' N, 59° 22' E). In 1931 and 1932, Erich Schmidt conducted excavations at this complex of mounds for Univ Mus, Univ Pennsylvania. Most artifacts and pottery discussed by Schmidt (1933; 1937) came from graves rather than occupation levels. This cemetery data formed the basis of his sequence. In 1976, a joint Hissar Restudy Proj was organized by Univ Mus, Turin Univ and Iran
Center for Archaeol Research. One major goal of this restudy was to examine stratigraphy of site in order to construct revised chronol linked directly to occupation levels. Samples reported here were coll 1976 and subm by R H Dyson, Jr, with significant revision of Schmidt’s dating of architectural remains (Dyson & Howard, in press).

**General Comment (RHD):** samples were selected from four parallel sequences of site: Main Mound, N Flat, S Hill, and Twins. These should agree horizontally and be internally consistent. The following represent 1976 results:

*Period I* (earliest levels reached in 1976: later painted pottery (Schmidt IC (IIA)) 1st half, 4th millenium BC (P-2622, -2774, -2519, -2623, -2764).

*Period II* (earliest levels with majority of gray pottery (largely Schmidt IIB)) 2nd half, 4th millennium BC (P-2703, -2617, -2706, -2698, -2615, -2700, -2704, -2699, -2715, -2773, -2766, -2759, -2767, -2708, -2710, -2621, -2707, -2711, -2709, -2760). Lapis lazuli working and copper smelting fully documented in this time range.

*Period III* (later gray pottery levels (Schmidt (IIIB)), 2nd half, 3rd millennium BC (P-2618, -2701).

*Period III* (end of sequence (Schmidt IIIC)), 1st quarter, 2nd millennium BC (P-2620).

Chronology indicates date in 2nd half of 3rd millennium BC for Burned Bldg and redates exposed architecture of Main Mound (Bldgs 1, 2, and 3) to Period II (originally dates IIIB by Schmidt (1937)). In 1976 revision, use of Schmidt’s A, B, C subdivisions has been dropped since they were not defined on basis of actual stratigraphy at site. Schmidt’s Periods and 1976 Revision Stages will be reported as SP and RS, respectively. Comments on S Hill samples by Maurizio Tosi (MT), ISMEO, Rome.

**Samples from Main Mound**

**P-2620. Sample H76-CS6**


**P-2618. Sample H76-CS75**

Charcoal and soil, DG20. Comments: NaOH pretreatment. CRD-1α: 2640 to 2390 BC; (RHD): immediately below row of four hearths, SP-IIIB, RS-B/C (= Period III).

**P-2708. Sample H76-CS51**


**P-2710. Sample H76-CS30**

Charcoal, CG90 [7] Lot 37, Rm [7], Floor 2. Comments: NaOH pretreatment, CRD-1α: 3175 to 2920 BC; (RHD): Rm [7] built slightly later
than Kitchen [1] and Kiln [3]. (Rm 7 is actually in DG 00), SP-IIIB, RS-D (= Period II).

**P-2621-A. Sample H76-CS10**  
4550 ± 70  

**P-2707. Sample H76-CS31**  
4530 ± 60  

**P-2709. Sample H76-CS4**  
4540 ± 60  

**P-2711. Sample H76-CS29**  
4570 ± 60  

**P-2622. Sample H76-CS73**  
5060 ± 320*  
Charcoal and soil, DF09 [12] Lot 12, Balk 13 (12). *Comments*: *CRD-1σ*: 4345 to 3515 BC; (RHD): trash lenses against lowest exposed walls below Bldg 2 which is contemporary with CG90 Kitchen [1] and Kiln [3], SP-I, RS-F (= Period I).

**P-2774. Sample H76-CS72**  
5750 ± 60  
Charcoal and soil, DF09 Lot 5, Balk 13 (9). *Comments*: *CRD-1σ*: 4590 to 4545 BC; (RHD): sample was strat above P-2622 and should have been younger. It is below Bldg 2 (Stage D), SP-I, RS-E (= Period I).

**P-2760. Sample H76-CS20**  
4530 ± 50  
Charcoal, CG90 Balk [P] (4) Lot 15. *Comments*: NaOH pretreatment, *CRD-1σ*: 3375 to 3150 BC; (RHD): sample was below P-2620, RS-Period II.

_Samples from N Flat_

**P-2703. Sample H76-CS14**  
4270 ± 60  

**P-2701. Sample H76-CS13**  
3860 ± 60  
Charcoal, CF47, gray ash layer below W compound. *Comments*: *CRD-1σ*: 2420 to 2290 BC; (RHD): walls assoc with early Burned Bldg, SP-IIIB, RS-Period III.
P-2617. Sample H76-CS2 4420 ± 50
Charcoal, CF37, below Burned Bldg [1]. Comments: NaOH pretreatment, CRD-1α: 3355 to 2955 BC; (RHD): sample was below P-2701, cf P-2708 (above), RS-Period II.

P-2706. Sample H76-CS18 4240 ± 70
Charcoal, CF58 (3) [2]. Comments: NaOH pretreatment, CRD-1α: 3000 to 2855 BC; (RHD): burned roof collapse in room attached to Buttressed Bldg, cf P-2615, -2698, -2700 (below), RS-Period II.

P-2615. Sample H76-CS53A 4350 ± 50
Charcoal, CF38 (3) [2]. Comments: NaOH pretreatment, CRD-1cr: 3165 to 2905 BC; (RHD): burned roof collapse in room attached to Buttressed Bldg, cf P-2615, -2698, RS-Period II.

P-2698. Sample H76-CS53 4280 ± 70
Charcoal, CF58 (3) [2]. Comments: NaOH pretreatment, CRD-1α: 3040 to 2880 BC; (RHD): burned roof collapse in room attached to Buttressed Bldg, cf P-2615, -2698, RS-Period II.

P-2700. Sample H76-CS26 4370 ± 70
Charcoal, CF58 (3) [3]. Comments: NaOH pretreatment, CRD-1α: 3170 to 2915 BC; (RHD): burned roof collapse in room attached to Buttressed Bldg, cf P-2615, -2698, RS-Period II.

P-2704. Sample H76-CS16 4340 ± 60
Charcoal, CF57 [16]. Comments: NaOH pretreatment, CRD-1α: 3160 to 2900 BC; (RHD): 2nd bldg level below ash and W compound walls (P-2701); lower than P-2701, higher than P-2699, RS-Period II.

P-2699. Sample H76-CS67 4410 ± 60
Charcoal and soil, CF57 [16]. Comments: NaOH pretreatment, CRD-1α: 3355 to 2945 BC; (RHD): burned floor of niche in SW room of sq; lower than P-2704, higher than P-2619, RS-Period II.

P-2619. Sample H76-CS69 4830 ± 60
Charcoal and soil, CF57 [16], base of Lot 3. Comments: NaOH pretreatment, CRD-1α: 3685 to 3525 BC; (RHD): ash in deep test trench along W balk; lower than P-2699, higher than P-2623, RS-Period I.

P-2623. Sample H76-CS15 5200 ± 70
Charcoal and soil, CF57 [16]. Comments: NaOH pretreatment, CRD-1α: 4120 to 3875 BC; (RHD): from deepest ash level in SW corner of CF57; lower than P-2619, RS-Period I.

Samples from SHill

P-2715. Sample H76-CS48 4450 ± 60
Charcoal, DG61 [15], from burned fill sealed in blocked door of reused burned structure at E end of SHill. Comments: NaOH pretreatment, CRD-1α: 3365 to 3010 BC; (RDH): cf P-2773, RS-Period II.
P-2773. Sample H76-CS60 4500 ± 50
Charcoal and soil, DG80 [W] (2). Comments: NaOH pretreatment, CRD-1σ: 3370 to 3050 BC; (MT): lapis working debris, cf P-2715, RS-Period II.

P-2766. Sample H76-CS65 4700 ± 50
Charcoal and soil, DF89 [3], top of (3) sec, open areas S of buttressed stairway bldg, above yellow phase (5-6). Comments: CRD-1σ: 3650 to 3370 BC; (MT): Cu/lapis working area, RS-Period II.

P-2759. Sample H76-CS52 4790 ± 60
Charcoal and carbonized wood, DF89 [10]. Comment: NaOH treatment, CRD-1σ: 3670 to 3500 BC.

P-2763. Sample H76-CS63 4870 ± 70
Charcoal, DF79 [1] (2) from kiln debris. Comments: NaOH pretreatment, CRD-1σ: 3790 to 3635 BC; (RHD): date is Period I, but context needs clarification.

P-2765. Sample H76-CS59 5020 ± 70

Samples from the Twins

P-2767. Sample H76-CS40 4410 ± 60
Charcoal, FF94 (3). Comments: CRD-1σ: 3355 to 2945 BC; (RHD): early gray pottery levels above painted pottery levels; RS-Period II.

P-2764. Sample H76-CS38 4910 ± 70
Charcoal, FF95 (13), N of burned wall. Comments: CRD-1σ: 3860 to 3650 BC; (RHD): dates terminal burned structure of painted pottery period, RS-Period I.

Israel

Haifa series


P-3099. Sample M23 2560 ± 360*
Charcoal. Comment: CRD-1σ: 1120 to 375 BC.

P-3226. Sample Hahotrim-M23 2500 ± 110*
Wood or charred wood. Comment: CRD-1σ: 800 to 420 BC, smaller uncertainty than that for P-3099 is due to extended counting period.
Jordan

Baq'ah Valley series

Series of Late Bronze age burial caves are assoc with settlement at Khirbet Umm ad-Dananir, Baq'ah Valley (35° 40' 20" N, 32° 40' 10" E) (McGovern, 1979; 1980; 1981a,b; 1982; McGovern, Harbottle, & Wnuk, 1982; McGovern, Piggott, & Notis, 1982). Coll and subm 1981 by P E McGovern, MASCA, Univ. Mus.

General Comment (PMcG): there are no previous ¹⁴C dates for Late Bronze age on Transjordan plateau. Cultural sequence may be staggered vis-a-vis W Bank and Israel. Pottery sequence, 1600 to 1100 BC.

P-3209. Sample B3.41/8 & B3.51/8 3200 ± 60
Charcoal from Cave B3, Jebel al-Qesir, Basket B3.41, Loc 8, area along back W wall of cave upper burial layer. Comments: NaOH pretreatment, CRD-1σ: 1655 to 1405 BC; (PEMcG): Late Bronze II (ca 1400 to 1200 BC).

P-3210. Sample B3.46/8 3350 ± 70
Charcoal from Cave B3, Jebel al-Qesir, Basket B3.46, Loc 8, upper burial layer along back W wall of cave, S of Crania 1 and 2. Comments: CRD-1σ: 1760 to 1590 BC; (PEMcG): same context at P-3209.

P-3216. Sample V2.54/18-1 3440 ± 60
Charcoal from Khirbet Umm ad-Dananir, Field V, upper ashy layer covering and S of Wall 20, Area 2, Basket V2.54, Loc 18. Comments: CRD-1σ: 1890 to 1685 BC; (PEMcG): fill mixed with potsherds of Late Bronze I (ca 1600 to 1400 BC) and Iron Age IIC (ca 650 to 500 BC) from strat settlement site of Late Bronze age to Byzantine and Ottoman periods.

P-3217. Sample V2.54/18-2 3770 ± 70
Charcoal from Khirbet Umm ad-Dananir, Field V, lower ashy layer covering and S of Wall 20, Area 2, Basket V2.54, Loc 18. Comment: CRD-1σ: 2335 to 2135 BC.

P-3218. Sample V2.13/6 250 ± 50
Dessicated wood from Khirbet Umm ad-Dananir, Field V, surface of Loc 6, S side of Area 2, Basket V2.13. Comments: Stuiver corrected: AD 1795 to 1540; (PEMcG): Surface 6 is ca 1m above ashy layer, Loc 18 of P-3217. Probably Ottoman (ca AD 1500 to 1900) floor, with re-use of Early Roman III (ca 4 BC to AD 73) bldg.

P-3219. Sample V2.55/19-5 3580 ± 70
Charcoal from Khirbet Umm ad-Dananir, Field V, Area 2, Loc 19, Basket V2.55, carbonized beams covering burned animal bones and pottery. Comments: NaOH pretreatment, CRD-1σ: 2120 to 1865 BC; (PEMcG): pit is just below ashy layer, Loc 18 of P-3217.
Lebanon

Sarafand series

Sarafand (ancient Sarepta) (33° 28' N, 35° 18' E) is adjacent to harbor of village of Sarafand, ca 12.87km S of Sidon on road to Tyre. Site represents most extensive and best strat remains of Phoenician civilization yet excavated. Coll and subm 1974 by J B Pritchard (1975), Univ Mus. For previous dates from this site, see P-1944 to -1948, -1950, and -1951 (R, 1974, v 16, p 222-223).

P-2857. Sample II-A-2, Level 4-4  
2480 ± 40
Charcoal from Hellenistic stratum. Comment: NaOH pretreatment, CRD-1σ: 780 to 540 BC.

P-2858. Sample II-A-8, Level 7  
2930 ± 50
Charcoal from Late Bronze age level. Comments: NaOH pretreatment, CRD-1σ: 1265 to 1045 BC.

P-2859. Sample II-A-9, Level 7  
3030 ± 250*
Charcoal from Late Bronze age level. Comment: CRD-1σ: 1655 to 1010 BC.

P-2860. Sample II-A-9, Level 8  
2950 ± 40
Charcoal from Late Bronze age level. Comment: NaOH pretreatment, CRD-1σ: 1335 to 1095 BC.

USSR

Turkmenian SSR

P-3079. Sumbar Cemetery, Sample I.I 977  
4860 ± 60
Charcoal and feces from bottom of Grave 174, depth 1.2m, catacomb tomb in Sumbar Cemetery, Kara Kala township, Kara Kala region (38° 30' N, 50° 10' E). Cemetery related to Gray Ware, pottery culture of N Iran (Late Bronze-Early Iron age) (Dolukhanov, 1979; Khlopin, 1977; Okladnikov, 1956). Coll 1976 by I N Khlopin and subm 1978 by P M Dolukhanov, Inst Archaeol, Leningrad. Comments: NaOH pretreatment, CRD-1σ: 3790 to 3555 BC; (PMD): est age: 1300 to 1000 BC.

Djebel Cave series

Djebel Cave is near town of Djebel, Krasnovodsk Oblast' (39° 40' N, 50° 10' E). Site was originally excavated in 1956 by A P Okladnikov. Cave is cut in Upper Cretaceous limestone, S extremity of Great Balkan Ridge. Coll 1976 and subm 1978 by P M Dolukhanov. For previous date from this site, see Le-1, 6030 ± 240 (R, 1965, v 7, p 226).

General Comment (PMD): strat deposits of Mesolithic-Early Neolithic age. Sequence reflects evolution of local Neolithic tradition based on food gathering; more or less contemporaneous with early agricultural civilization of Djefitoun, further E.

P-3080. Sample Djebel 1  
2170 ± 210*
Charcoal and one feces from depth 0.2 to 0.25m. Comment: CRD-1σ: 420 BC to AD 20.
University of Pennsylvania Radiocarbon Dates XXII

P.3083. Sample Djebel 2
Charcoal from depth 0.3m. Comment: CRD-1σ: AD 450 to 880.

P.3082. Sample Djebel 3
Charcoal and feces from depth 0.4m. Comment: CRD-1σ: 3650 to 2905 BC.

P.3081. Sample Djebel 4
Charred twigs from depth 0.8 to 0.85m. Comment: CRD-1σ: 5255 to 4940 BC.

Far East

India

Dimapur, Nagaland series

Dimapur is medieval site ca 77km NW of Kohima, Nagaland (25° 54' N, 93° 45' E to 94° 0' E). Samples coll 1980 by Vikuosa Nienu, Univ California, Berkeley and subm 1982 by George Dales, Dept S and SE Asian Studies, Univ California, Berkeley.

P.3124. Sample, Layer 4
Charcoal from 1.2cm below surface level. Comments: Stuiver corrected: AD 270 to 660; (VN): Medieval period.

P.3125. Sample, Layer 5
Charcoal from 1.35cm below surface level. Comments: Stuiver corrected: AD 570 to 940; (VN): Medieval period.

Puraka, Nagaland series


P.3122. Sample, Layer 2
Charcoal from 25cm below surface level. Comments: Stuiver calibrated: AD 430 to 780; (VN): from post hole, Neolithic or Iron age.

P.3123. Sample, Layer 3
Charcoal from 85cm below surface level. Comments: CRD-1σ: 900 to 420 BC; (VN): Neolithic; traits of Hoabinhian culture are also present.

Thailand

Sites of Ban Chiang, Ban Tong, Ban Phak Top, Don Klang, Ban I Loet, Ban Puan Phu, and Non Khaw Wong were excavated 1974 through 1978 by NE Thailand Archaeol Project under joint auspices of Univ Mus, Univ Pennsylvania and Thai Fine Arts Dept.

Ban Chiang series

Ban Chiang, on N Khorat Plateau, Changwat (Prov) Udon Thani (17° 24' N, 103° 15' E) was excavated by NE Thailand Archaeol Proj in 1974 and 1975 under joint direction of late Chester Gorman, Univ Mus,
and Pisit Charoenwongsa, Thai Fine Arts Dept (Gorman & Charoenwongsa, 1976; White, 1982). Comments by Joyce White, Univ Mus.

General Comment (JW): this site is important in establishing broad chronol framework for settlement of N Khorat Plateau and for sociocultural development of lowland agrarian socs in region (pre-metal, bronze, and iron using periods). Two seasons of excavation, designated BC (1974) and BCES (1975), were conducted at non-adjacent parts of mound. Burials were numbered consecutively beginning with Burial 1 for each season. Since each square of each season was excavated as separate unit, layer nos. do not necessarily correspond. Archaeol discussions of dates in individual sample comments are based on calibrated dates.

**P-2240. BC Bag 907**

3120 ± 220*

Charcoal and soil from BC Sq B5, Layer 10, depth 1.58m while exposing Burial 20. Comments: CRD-Iσ: 1675 to 1220 bc; (JW): Burial 20 had unique assemblage of bone artifacts (White, 1982, p 24).

**P-2265. BC Bag 987**

4830 ± 310*

Soil and charcoal from BC Sq B6, Layer 14, in soil matrix near, but apparently not assoc with Burial 25, depth 2.2 to 2.33m at beginning of sterile soil horizon. Comments: CRD-Iσ: 3915 to 3340 bc; (JW): with P-2452 (below) may date to initial settlement of site.

**P-2262. BC Bag 1019**

2090 ± 230*

Soil and charcoal from BC Sq C3, SW quad, surface of Layer 7, depth 1.5m, Burial 19. Comments: CRD-Iσ: 400 bc to AD 55; (JW): assoc with red painted pottery. Date consistent with P-2241 and -2244 (cf below), also assoc with Late Period painted pottery.

**P-2242. BC Bag 1102**

3790 ± 240*

Charcoal and soil from BC Sq C3, SE quad, Layer 8, from excavation of artificial 10cm split. Comments: CRD-Iσ: 2550 to 1950 bc; (JW): Burial 34 and curvilinear incised infant burial jar with serpentine appliqué was found ca 20cm beneath surface of Layer 8. Samples P-2245, -2271, and -2456 (cf below) produced comparable dates from contexts which overlie or are closely assoc with curvilinear incised pottery.

**P-2406. BC Bag 500 (?)**

1720 ± 190*

Charcoal from BC Sq C4, SE quad, surface of Layer 4. Comments: Stuiver calibrated: AD 35 to 570; (JW): charcoal probably assoc with collapsed sherds of untyped pot. This is most recent date from site.

**P-2241. BC Bag 756**

2090 ± 40

Charcoal and soil sandwiched between stacked sherds projecting out from E baulk BC Sq C4, SE quad, Layer 7, Feature 1, depth 1.01m. Comments: CRD-Iσ: 190 to 10 bc; (JW): sherds of painted ware; date consistent with P-2244 (cf below) and P-2262 (cf above) which are also assoc with red painted ware.
P-2243. BC Bag 1202 3020 ± 40

Charcoal and soil from BC Sq C4, SE quad, surface of Layer 14, depth 2.07 to 2.1m. Comments: CRD-1σ: 1395 to 1230 BC; (JW): possible hearth area with unclear relationship to burial sequence. Apparent insect and root activity and possibility of old erosion surface may account for somewhat late date relative to depth.

P-2245. BC Bag 1205 3570 ± 230*

Soil and charcoal from BC Sq C4, SW quad, surface of Layer 14, depth 1.86 to 2.08m. Comments: CRD-1σ: 2205 to 1685 BC; (JW): assoc with Burial 40, curvilinear incised infant jar (White, 1982, p 23). Date inconsistent with P-2242 (cf above), -2271, and -2456 (cf below) which also overlie or are closely assoc with curvilinear incised pottery.

P-2266. BC Bag 1335 4590 ± 300*

Soil and charcoal from BC Sq C4, SW quad, Layer 14, depth 1.96m. Comments: CRD-1σ: 3680 to 2910 BC; (JW): assoc with Burial 40 (curvilinear incised burial jar). However, since P-2245 (cf above), also excavated in assoc with Burial 40, is more consistent with other samples assoc with curvilinear incised pottery such as P-2271 (cf below), P-2266 may derive from matrix into which Burial 40 intruded.

P-2246. BC Bag 1018 3040 ± 50

Charcoal and soil from BC Sq C5, SW quad, Layer 10, depth 1.75m, possibly assoc with Burial 23. Grave goods include bronze bangles, bronze adze head, baked clay pellets, and cordmarked pot with painted and incised design (White, 1982, p 42). Comments: CRD-1σ: 1405 to 1240 BC; (JW): field records indicate that this sample and P-2261 (cf below) are assoc with Burial 23, but continued excavation in area and subsequent lab analysis revealed that Burial 23 cut into Burial 31 (P-2264, cf below) and possibly another burial feature from earlier cultural phase which casts doubt on exact relationship of samples and reported feature assoc. Date of P-2246 is, however, consistent with P-2272 (cf below) which is assoc with burial of similar orientation and ceramics to Burial 23. See P-2454 (cf below) which also has burial and ceramic style related to Burial 23.

P-2261. BC Bag 1083 3270 ± 230*

Charcoal and mud from BC Sq C5, S quads, Layer 11, depth 1.75 to 1.92m, possibly assoc with Burial 23. Comments: CRD-1σ: 1865 to 1365 BC; (JW): same doubtfull sample relationship as for P-2246 (cf above). This date is however same as that for P-2454 (cf below) which is assoc with burial and ceramic style related to Burial 23.

P-2264. BC Bag 1211 3130 ± 210

Soil and charcoal from BC Sq C5, NW quad, Layer 11, depth 1.86m. Comments: CRD-1σ: 1680 to 1225 BC; (JW): assoc with Burial 31 which was cut by Burial 23. See comments for P-2246 and -2261.
P-2244. BC Bag 681  2110 ± 40
Charcoal from BC Sq C6, NW quad, Layer 8, depth 0.62 to 0.74m. Comments: CRD-1σ: 195 to 20 BC; (JW): assoc with Burial 1 and red painted ceramics. Date consistent with P-2241 and -2262 (cf above), also assoc with Late Period red ceramics.

P-2247. BC Bag 918  3610 ± 230*
Soil and charcoal from BC Sq C6, SE quad, Layer 10, depth 1.02m. Comments: CRD-1σ: 2315 to 1710 BC; (JW): sample found 10cm N of Burial 14 jaw which included red painted pottery, high tin wire necklaces, and opaque glass beads. Date unacceptably old in comparison with other samples assoc with comparable pottery; see P-2241, -2244, and -2262 (cf above). Burial was extensively disturbed by insects and roots.

P-2272. BC Bag 1167  2950 ± 210*
Charcoal and soil from BC Sq C6, SE quad, surface of Layer 15, depth 1.54m. Comments: CRD-1σ: 1430 to 865 BC; (JW): assoc with Burial 35; includes cordmarked and painted pottery comparable to Burial 23; see P-2246 and -2261 (above).

P-2271. BC Bag 1374  3570 ± 230*
Soil and charcoal from BC Sq C6, N quads, surface of Layer 18, depth 1.97m, 10cm from right arm of Burial 43. Comments: CRD-1σ: 2205 to 1685 BC; (JW): large curvilinear incised and appliqued pot found directly above Burial 43; see P-2271 (above).

P-2263. BC Bag 1377  4250 ± 290*
Soil and charcoal from BC Sq C6, N quads, Layer 19, depth 2.06m. Comments: CRD-1σ: 3365 to 2535 BC; (JW): charcoal concentration between Burials 43 and 45, interred one atop the other. Curvilinear incised appliqued pot found directly above Burial 43; see P-2271 (above).

P-2664. BCES Bag 1383, 1785, and 1794  2300 ± 50

P-2665. BCES Bags 1279, 1667, 1705, and 1714  2520 ± 50
Soil and charcoal from BCES Sq D4, SE quad, surface of Layer 17, Feature 3, from sherd scatter overlying Burial 19. Comments: CRD-1σ: 795 to 585 BC; (JW): due to greater coherence of combined sample proveniences, assoc of P-2665 with Burial 19 seems at least as acceptable as P-2669 (cf above). Date assoc with Middle Period scatter burial with white carinated pots and carinated pots with incised and painted shoulders (White, 1982, p 68). Date overlies Burial 24 and assoc bronze-iron spearpoint, oldest iron recovered from excavation.
P-2457. BCES Bag 2162

Charcoal and soil from BCES Sq D4, SE quad, 10cm spit into Layer 24. Comments: NaOH pretreatment; CRD-Iσ: 1675 to 1430 BC; (JW): three cordmarked and appliqued infant burial jars were found in Layer 27 of D4, SE quad, ca 20cm under Layer 24.

P-2634. BCES Bag 2110

Charcoal and soil from BCES Sq D4, NW quad, Layer 21, depth 272cm. Comments: NaOH pretreatment, CRD-Iσ: 930 to 825 BC; (JW): sample coil from remnants of red-brown soil as it was removed from surface of gray soil stratum; may date beginning of red-brown soil stratum and possibly initiation of ritual involving shattering of white carinated pots over body (White, 1982, p 25).

P-2455. BCES Bag 2248

Charcoal from BCES Sq D4, SE quad, Layer 26. Comments: NaOH pretreatment, CRD-Iσ: 1115 to 875 BC; (JW): sample is from charcoal feature in SE quad, possibly hearth, but date is somewhat recent for depth (see P-2457, above). It is possible that sample derived from base of post hole cut down from surface of gray stratum (Levels 21 and 22) directly over and to same depth (299cm) as so-called hearth. If this is so, P-2455 is consistent with P-2634 (cf below) from interface of red/gray strata.

P-2454. BCES Bag 2306

Soil and charcoal from BCES Sq D4, SW quad, surface of Layer 27, Feature 12, grave cut of Burial 59. Comments: NaOH pretreatment, CRD-Iσ: 1115 to 875 BC; (JW): Burial 59 includes globular cordmarked pot, style of which is related to that of BC Burial 23 (P-2246 and -2261, above); and is stratified over Burials 69 (P-2405, below) and 65 (P-2404, below).

P-2405. BCES Bag 2656

Soil and charcoal from BCES Sq D4, SW quad, surface of Layer 29, Feature 23, excavated during removal of skeleton from Burial 69. Comments: CRD-Iσ: 1765 to 1340 BC; (JW): Burial 69 cuts flexed Burial 65 (P-2404, below) and is under Burial 59 (P-2454, above).

P-2404. BCES Bag 2678

Soil and charcoal from BCES Sq D4, S quads, surface of Layer 29, within grave cut of Burial 65. Comments: CRD-Iσ: 1545 to 1015 BC; (JW): grave is flexed burial cut into yellow sterile soil matrix, and is cut by Burial 69 (see P-2405, above) and overlain by Burial 59 (P-2454, above). Date appears somewhat recent for strat position.

P-2452. BCES Bag 2111

Charcoal and soil from BCES Sq D5, NW quad, Layer 27, removal of 10 to 20cm spit. Comments: NaOH pretreatment: CRD-Iσ: 3785 to 3335 BC; (JW): sample from top of yellow sterile soil horizon, may date early settlement of site (see P-2265, above).
**P-2456. BCES Bag 2030**

Soil and charcoal from BCES Sq D5, W quads, surface of Layer 27, Feature 37, grave cut of Burial 45. *Comments: CRD-Iσ: 2340 to 1755 BC; (JW): Burial 45 contained straight-sided, flat-bottomed, footless cord-marked pots with everted rim, probably contemporary with Beaker-style pot found in Burial 76 (P-2398, below). Burial 45 lies directly over Burial 57 which contains curvilinear incised pot and is disturbed.*

**P-2453. BCES 2285**

Charcoal and soil from BCES Sq D5, NW quad, surface of Layer 30, Feature 3. *Comments: NaOH pretreatment; CRD-Iσ: 6290 to 5705 BC; (JW): possible hearth; surrounding area is basically sterile soil matrix with no assoc sherds. Hearth is sealed by Burial 57 which contained curvilinear incised pot. This is oldest date and may derive from brief use of this site possibly by mobile group of people prior to settlement in 4th millennium BC by more sedentary population; see P-2265 and P-2452 (above).*

**P-2451. BCES Bag 2322**

Soil and charcoal from BCES Sq D6, NE quad, surface of Layer 31, grave cut of Burial 60. *Comments: CRD-Iσ: 2215 to 1690 BC; (JW): Burial 60, cut into sterile soil, appears badly disturbed, as only skull and small incised pot were present.*

**P-2450. BCES Bag 2651**

Charcoal and soil from BCES Baulk D6/D7, surface of Layer 16, Feature 1 cut from surface of Layer 14. *Comments: NaOH pretreatment, CRD-Iσ: 800 to 375 BC; (JW): date supports likelihood that sample derived from red layer (over gray layer). P-2634 and probably P-2455 (above) are dates from red/gray interface.*

**P-2668. BCES Bag 2770**

Soil and charcoal found while exposing Burial 31, from BCES Baulk D6/D7, Layer 20. *Comments: CRD-Iσ: 1100 to 840 BC; (JW): sample, along with P-2633 (below), appears unacceptably young for strat context well within gray stratum, its Early Period grave style and ceramics which, based on overall chronol picture, should antedate ca 1500 BC. Burial 31 overlies Burial 76 (P-2398, below).*

**P-2633. BCES Bag 2773**

Soil and carbon from BCES Baulk D6/D7, surface of Layer 21, Burial 31. *Comments: CRD-Iσ: 820 to 765 BC; (JW): see comment for P-2668 (above).*

**P-2398. BCES Bag 2834**

Charcoal and soil from BCES Baulk D6/D7, surface of Layer 27, Feature 5 from under pelvic area of Burial 76, flexed burial cut into sterile soil and assoc with bronze spearpoint and Beaker-type jar (White, 1982, p 35). *Comments: CRD-Iσ: 820 to 395 BC; (JW): date seems unaccount-
ably young for context and grave style; see P-2633 and -2668 (above). Based on overall chronol sequence, grave should antedate ca 1500 BC, and possibly 2000 BC; see P-2456 (above).

**Petchabun Piedmont Survey**

Archaeol survey and three test excavations (Ban Puan Phu, Non Khaw Wong, and Ban I Loet) were conducted 1978 in area along piedmont of Petchabun Mts which form W border of Khorat Plateau, NE Thailand (Penny, ms), revealing relatively shallow and homogeneous archaeol deposits (excluding some apparently intrusive hist artifacts in Ban Puan Phu excavation). Most ceramics from excavations were similar to each other, to prehist surface collts from this survey, and to three surface collts from contiguous area of Pa Mong Survey (Bayard, 1980), but not similar to ceramics from other available sites on Khorat Plateau. Above three sites also had similar array of other artifacts including iron and iron slag.

**Ban Puan Phu series**


*General Comment* (JSP): site is apparently late “metal age” and hist.

**P-2938.** BPP Bag 446 2440 ± 50

Single large piece of charcoal from fired clay feature of unknown function from NEQ, Level 6, Feature 3. *Comment*: NaOH pretreatment, *CRD-1σ*: 630 to 415 BC.

**P-2939.** BPP Bag 427 2680 ± 210*

Charcoal from SEQ, Level 7, Burial 1. *Comments*: NaOH pretreatment, *CRD-1σ*: 1105 to 745 BC; (JSP): strat relation of date to deposit is not precisely known, but there does not appear to be any possibility that date relates to earlier (pre-iron) level, since none apparently exists at site.

**Non Khaw Wong series**


*General Comment* (JSP): pre- or proto-hist “metal age” with possibility of pre-iron basal level.

**P-2943.** NKW Bag 258 1980 ± 180*

Charcoal and soil from Feature 3, NE half, Level 14. *Comments*: *CRD-1σ*: 195 BC to AD 230; (JSP): this feature contained probable lid which is strikingly similar to painted lids from Don Klang (below) (Schauffler, 1976, Figs 3 and 4).

**P-2944.** NKW Bag 195 2210 ± 190*

Charcoal and soil coll from Level 7, arbitrary level near bottom of cultural deposit. *Comment*: *CRD-1σ*: 435 to 5 BC.
P-2945.  NKW Bag 202  
2070 ± 170*
Charcoal and soil from Level 7, arbitrary level near bottom of cultural deposit. Comments: CRD-1σ: 275 BC to AD 45; (JSP): this date and P-2944 overlap quite well at 1σ.

Ban I Loet series
Ban I Loet site is in NE Thailand (16° 57' N, 101° 50' E). Coll 1978 by J S Penny and subm by late C F Gorman. General Comment (JSP): pre- or proto-hist “metal age."

P-2940.  BIL Bag 311  
2340 ± 230*
Charcoal from Level 8, arbitrary level near base of excavation. Comment: CRD-1σ: 650 to 175 BC.

P-2941.  BIL Bags 332 and 337  
2460 ± 210*
Charcoal from Feature 2, Levels 10 and 11 at base of excavation. Comments: CRD-1σ: 815 to 390 BC; (JSP): this feature apparently separated from higher deposits by erosion surface.

Ban Phak Top series
Ban Phak Top is ca 30km W of Ban Chiang, Changwat (Prov) Udon Thani (17° 19' N, 103° 2' E). Coll and subm 1975 by W M Schauffler (1976), Univ Mus.

P-2407.  Bag S188 (C14-26)  
3900 ± 70
Charcoal (from burned log or piece of wood) and soil from Layer 13. Comment: CRD-1σ: 2435 to 2310 BC.

P-2445.  Bag S127 (C14-16)  
2760 ± 170*
Charcoal and soil from NEQ and SEQ, Layer 8a. Comment: CRD-1σ: 1120 to 790 BC.

P-2446.  Bag S134 (C14-17)  
3050 ± 60
Charcoal and soil from NWQ and SWQ, Layer 8a. Comment: NaOH pretreatment, CRD-1σ: 1410 to 1245 BC.

P-2686.  Bags S120 (C14-12), S121 (C14-13), S122 (C14-14), and S124 (C14-15)  
3090 ± 50
Charcoal and soil from Layer 8 NEQ, SEQ, NWQ, and SWQ. Comment: NaOH pretreatment, CRD-1σ: 1440 to 1275 BC.

P-2726.  Bag S178 (C14-24)  
3510 ± 210*
Charcoal and soil from Layer 12, SWQ soil matrix. Comment: CRD-1σ: 2165 to 1660 BC.

P-2731.  Bag S66 (C14-5)  
3170 ± 300*
Charcoal from surface of Layer 5, Feature 2. Comment: CRD-1σ: 1865 to 1090 BC.
**University of Pennsylvania Radiocarbon Dates XXII**

**P-2732. Bag 106 (C14-9)**  
3240 ± 50  
Charcoal and soil from Layer 7, SWQ. Comments: NaOH pretreatment, CRD-1σ: 1675 to 1430 BC.

**Don Klang series**  
*General Comment* (WMS): first material from site to be reported.

**P-2416. Bag S427 (C14-54)**  
2140 ± 60  
Charcoal and soil underlying Burial 8. Comment: CRD-1σ: 255 to 145 BC.

**P-2417. Bag S337 (C14-44)**  
1870 ± 190*  
Charcoal and soil from EQ, Layer 5. Comments: CRD-1σ: 155 BC to AD 380; (WMS): assoc with pot near E corner.

**P-2448. Sample 38**  
1900 ± 200*  

**P-2674. Bag S500 (C14-60)**  
2440 ± 50  
Soil and charcoal from WQ, Layer 8, and surface of Layer 9, Feature 3. Comment: CRD-1σ: 630 to 415 BC.

**P-2675. Bag S308 (C14-33)**  
1920 ± 50  
Soil and charcoal from Layer 4, NQ. Comment: CRD-1σ: 5 BC to AD 75.

**P-2694. Bag S380 (C14-46, -47, -48, -49)**  
2040 ± 50  

**Ban Tong series**  
Ban Tong is in Changwat (Prov) Udon Thai (17° 22’ N, 103° 16’ E). Coll and subm 1975 by W M Shauffler (1976).

**P-2418. Bag S1613 (C14-135)**  
2860 ± 250*  
Charcoal from Layer 18, NEQ and SEQ, Burial 2. Comment: CRD-1σ: 1400 to 795 BC.

**P-2419. Bag S1640 (C14-142)**  
4360 ± 240*  
Charcoal from Layer 20, SEQ. Comment: CRD-1σ: 3365 to 2800 BC.

**P-2447. Bag S1614 (C14-138)**  
2460 ± 170*  
Charcoal and soil from Layer 18, NEQ, and SEQ, Burial 2. Comment: CRD-1σ: 800 to 400 BC.
Central America

Belize
Santa Rita Corozal series

Santa Rita Corozal site, 1.6km from Chetumal Bay, outside modern Corozal (18° 23' N, 88° 23' E), is possible regional capital in N Maya Lowlands (Chase, 1982a). Coll and subm by DZ Chase, Dept Anthropol, Univ Pennsylvania.


P-2691. Bags S1571 (C14-121), S1578 (C14-123), S1580 (C14-120, -122), S1584 (C14-124), S1588 (C14-125), and S1589 (C14-126, -127) 3130 ± 50

Soil and charcoal from Layer 16. Comment: CRD-1σ: 1550 to 1360 BC.

P-2723. Bags S1026 (C14-78) and S1060 (C14-81, -82) 2670 ± 170*

Charcoal and soil from NEQ 6 assoc with B1 and Feature 2. Comment: CRD-1σ: 915 to 765 BC.

P-2724. Bag S1362 (C14-105) 3220 ± 200*

Charcoal and soil from Layer 11, SEQ. Comment: CRD-1σ: 1750 to 1270 BC.

P-2725. Bag S1472 (C14-113) 3080 ± 180*

Charcoal and soil from Layer 14, NWQ. Comment: CRD-1σ: 1655 to 1095 BC.

P-2727. Bags S1322 (C14-99) and S1323 (C14-100) 3360 ± 200*

Charcoal and soil from SWQ, coll from entire sq (not localized area). Comment: CRD-1σ: 1945 to 1420 BC.

P-2730. Bags S1161 (C14-85), S1163 (C14-86), and S1167 (C14-87) 3040 ± 190*

Charcoal and soil from Layer 8, NEQ. Comment: CRD-1σ: 1575 to 1035 BC.

Santa Rita Corozal series

Belize

Central America
1425) sealed by several floor levels and covering contemporaneous midden deposit containing bone and pottery. Comments: NaOH pretreatment. Stuiver corrected: AD 1290 to 1390.

**P-3073. Sample P8C/9-1** 740 ± 50
Charcoal from Excavation P8C, ca 40cm below surface, Structure 81. Sample may represent construction beam, Late Postclassic (AD 1425 to 1550). Comments: NaOH pretreatment. Stuiver corrected: AD 1260 to 1290.

**P-3075. Sample P8C/9-1** 700 ± 50
Charcoal (family Meliceae) from Excavation P8C, within altar area, ca 90cm below surface, Structure 81. Sample assoc with individual burial from early phase of Late Postclassic (AD 1400) and may represent construction beam. Comment: Stuiver corrected: AD 1265 to 1375.

**P-3077. Nohmul, Sample P1E/20-3** 1300 ± 40
Nohmul, N Maya-Lowlands (18° 14' N, 80° 35' E), is island site with relatively long hist of occupation (Chase, 1982a; 1982b; Chase & Chase, 1982). Charcoal from Excavation P1E, in Terminal Classic/Early Postclassic (AD 900 to 1200) structures ca 3.2m below surface. Comments: CRD-1(r: AD 615 to 785. Early Postclassic (AD 900 to 1200).

**Guatemala**

**Quirigua series**

General Comment (RJS): samples relate to Maya calendric dates and should add to calendric correlation as well as expand known sequence of construction and occupation at Quirigua.

**P-3084. Sample 16A/16** 1310 ± 40
Carbon sealed in construction 4.6 to 4.8m below summit of Structure 1A-11 (N side of Ballcourt Plaza in site core). Comments: NaOH pretreatment, Stuiver corrected: AD 660 to 765; (RJS): est date, 7th to 9th century AD.

**P-3085. Sample 19R/2-1 and 2** 1830 ± 170*
Carbon from hole dug by vandals under disturbed “altar”, assoc with platform of Structure 3C-14. Comments: Stuiver corrected: AD 15 to 40; (RJS): est date, ca AD 500.

**P-3086. Sample 6F/45** 1450 ± 50
Charcoal from Acropolis, Tr 1, construction Stage 2. Comments: NaOH pretreatment, Stuiver corrected: AD 545 to 640; (RJS): Kinich-Ahau-wall platform construction or destruction of earlier wall, est date,
Should be intermediate in date between: P-2536 (AD 590 ± 50), P-2533 (AD 830-850 ± 50), P-2535 (AD 860-880 ± 180), P-2538 (AD 890 ± 170), (R, 1978, v 20, p 230-232).

**P-3087. Sample 6J/26**

1440 ± 40

Carbon abuts Structure 1B-6-2nd (E side of Acropolis) which underlies PRANCE feature, construction Stage 3. Comments: Stuiver corrected: AD 570 to 640; (RJS): est date, ca AD 724 to 737.

**P-3088. Sample 6L/33-1**

1290 ± 40

Charcoal from Acropolis, redeposited midden on floor of Structure 1B-Sub 3, construction Stage 2. Comments: Stuiver corrected: AD 1330 to 1250; (RJS): est date, ca AD 724 to 737.

**P-3089. Sample 19R/65-1 and 2**

1970 ± 50

Carbon directly underlying clay floor of cache (SD 21) and sealed within Structure 3C-14. Comments: CRD-1o: 35 BC to AD 55; (RJS): est date, ca AD 500.

**P-3095. Sample 9B/22-1 and 2**

1800 ± 50

Charcoal from underlying Structure 1A-10 (E flank of Great Plaza). Comments: Stuiver corrected: AD 130 to 320; (RJS): probably contemporary with or earlier than cache (SD 11); antedates construction of Structure 1A-10. Est date, ca AD 787 to 775.

**P-3096. Sample 6J/50-1**

1730 ± 50

Carbon from charcoal and sherd layer underlying Structure 1B-6-2nd (E side of Acropolis) and overlaying chamber burial (SD 14), construction Stage 4. Comments: Stuiver corrected: AD 235 to 395; (RJS): est date, earlier than AD 724.

**P-3097. Sample 10K/23**

420 ± 40

Charcoal from within collapse debris of Structure 2, Group A. Comments: NaOH pretreatment. Stuiver corrected: AD 1435 to 1485; (RJS): postdates abandonment (although carbon may have been in structure during use). Est date, 9th century AD.

**P-3098. Sample 18L/6-1 and 2**

1830 ± 50

Charcoal from ca 200m N of site-core (ditch Jn). Comments: Stuiver corrected: AD 75 to 235; (RJS): probably bldg material or furnishing for stone construction feature. Est date, 5th to 6th century AD.

**P-3100. Sample 19R/12-1**

1970 ± 50

Carbon from disturbed summit of Structure 3C-14. Disturbance is ancient; deposit was sealed under more than 1m flood silts and later cultural materials. Comments: CRD-1o: 35 BC to AD 55; (RJS): est date, 6th century AD.
P-3101. Sample 19R/36-1 1970 ± 170*
Carbon from Structure 3C-14, outwash of use or abandonment debris/collapse, sealed by flood silts and later cultural deposits. Comments: CRD-1σ: AD 175 to 220; (RJS): est date, 6th century AD.

P-3102. Sample 19R/47 1910 ± 60
Carbon on earlier floor assoc with Structure 3C-14, sealed by later floor and postabandonment deposits. Comments: Stuiver corrected: AD 5 to 205; (RJS): est date, ca AD 500, probably equivalent to P-3105 (below).

P-3105. Sample 19R/48 2660 ± 190*
Carbon on earlier floor assoc with Structure 3C-14, sealed by later floor and postabandonment deposits. Comments: CRD-1σ: 1095 to 590 BC; (RJS): est date, ca AD 500.

P-3106. Sample 18F/1 1540 ± 210*
Charred wood from NNE of site-core (ditch En), from presumed occupation layer assoc with Structure 2 of Loc 141. Comments: Stuiver corrected: AD 255 to 660; (RJS): est date, 8th century AD.

P-3108. Las Quebradas, Sample 24C/14-1 1640 ± 50

P-3062. Cenote, Peten, Sample T2A/6 1920 ± 40
Carbonized wood fragments from Cenote, Dept Peten (16° 80' N, 89° 57' E). Sample sealed by floor of Strata T4-2nd, 1.9 to 1.95m below ground surface (Chase, 1979; 1983). Coll 1971 by Miguel Orrego and subm 1980 by A F Chase, Univ Mus. Sample id as Pinus sp, white pine group, by R B Miller, Forest Prod Lab, US Dept Agric, Madison, Wisconsin. Comments: NaOH pretreatment, CRD-1σ: 5 BC to AD 75; (AFC): Lowland Maya early Late Classic, ca 500 to 700 AD.

P-3208. Sakajut, Alta Verapaz 2880 ± 190*
Carbon from Sakajut, Alta Verapaz (15° 25' N, 90° 20' E), small earthen mound of Preclassic date (Sedat & Sharer, 1972). Sample from interface of Feature 3 (occupation layer) and construction fill (Strata 3). Coll 1971 by D W Sedat and subm 1980 by R J Sharer. Comments: CRD-1σ: 1385 to 815 BC; (RJS): few Preclassic sites are known from region and claims are often made of little or no occupation in region during this period. Sample should date to earliest occupation/construction of site, Early-Middle Preclassic, 900 to 400 BC.

South America

Chile

P-2702. Quebrada da Los Conchas, Sample 4 9400 ± 160
Quebrada da Los Conchas is shell heap 9km to N of Antofagasta, 2a

P-2588. Abtao-5, Sample 1

Abtao-5 is shell heap 18km from Quebrada da Los Conchas, on S side of Mejillones Peninsula, Prov Antofagasta, 2a Region (23° 30' 3" S, 70° 31' 7" W). Coll and subm 1977 by Augustin Llagostera-Martinez (1979). Charcoal and soil from Layer 10C, depth, 205cm. Comments: CRD-1σ: 420 to 380 BC; (ALM): debris from hearth.

P-2587. Punta Blanco, Sample 2


GEOLOGIC SAMPLES

Greece

Santorini Island series

Charred wood from Santorini I. from two loci, Millo region of Therasia (36° 26' N, 24° 21' E) and Akrotiri, Thera, near caldera rim (36° 27' N, 24° 26' E). Coll 1978 by W L Friedrich, Aarhus Univ, Aarhus, Denmark, and H Pichler, and subm 1979 by P P Betancourt, Univ Pennsylvania.

General Comment: represents so-called Akrotiri/Millo palaeosol at base of characteristic ignimbrite layer (Friedrich, Pichler, & Kussmaul, 1977).

P-3128. Sample IV, V, VIII

Charred wood from Milo region, Therasia, Akrotiri/Millo palaeosol, ca 20cm below ignimbrite.

P-3131. Sample XI

Charred wood with ignimbrite from Akrotiri region, Millo palaeosol.

P-3129. Samples VII, IXa, IXb

Charred wood from Akrotiri region, Millo palaeosol, 5m below Upper Pumice series (Bo).

United States

P-2970. Dutchess Quarry Cave #8, Samples

Charred wood from Breccia 1, Unit B, depth, 2.3 to 2.4m. Coll and subm by J S Kopper, Dept Sociol & Anthro-
pol, Long Island Univ, Greenvale, New York. Comment (JSK): directly assoc with two “Clovis” type fluted points and caribou bone (Rangifer sp). Artifacts, food debris, and utilized cobbles indicate area was not living floor but occasional occupation site. Breccia probably deposited during warm, wet period—Two Creeks interstadial, ca 12,500 BP, or between Chocrane and Valders readvances, ca 10,000 BP.

References
——— in press, Archaeology in the Maya heartland: the Tayasal-Paxcaman zone, El Peten, Guatemala: Archaeology, in press.
Chase, D Z, 1982a (ms), Spatial and temporal variability in post classic northern Belize: PhD diss, Dept Anthropol, Univ Pennsylvania.
——— 1982b, The Ikilik ceramic complex at Nohmul, northern Belize: Ceramica Cultura Maya, v 12, p 71-81.


UNIVERSITY OF SASKATCHEWAN RADIOCARBON DATES X

A A RUTHERFORD, JURGEN WITTHENBERG, and B C GORDON
National Museum of Canada and Saskatchewan Research Council,
Radiocarbon Dating Laboratory, 30 Campus Drive,
Saskatoon, Saskatchewan

This series reports some of the measurements made since publication of the last list (R, 1981, v 23, p 94-135). Also included are a number of earlier dates previously withheld pending submitter evaluation. For some the authors have been unable to obtain appropriate comment. References to other publication of these dates are given where known.

Acetylene proportional gas counting methods essentially remain as described in Saskatchewan II (R, 1960, v 2, p 73). Bone dating is carried out on soluble collagen extract (Longin, 1971) since 1978.

SAMPLE DESCRIPTIONS

GEOLOGIC SAMPLES

S-224. Edmonton, Alberta


S-226. Hazel Lake, Saskatchewan

Marl from 18.3m sand unit overlying Marine Shales of Upper Cretaceous age, in test hole (sec 29-42-23-W2) near Melfort (52° 39’ N, 105° 17’ W), from 134m depth, 3m above non-calcareous bedrock. Coll and subm 1968 by W A Meneley, Saskatoon. Comment (WAM): min date for alluvial sedimentation of pre-glacial Hatfield Valley in central Saskatchewan.

S-230. Medicine Hat, Alberta


S-231. Mission Creek, British Columbia


S-446. Delta Marsh, Manitoba

Gyttja from 104 to 108cm below water-sediment interface, Cadham

**Saskatoon site series, Saskatoon**

Mammoth bone and tusk fragments from salvage site, sewage plant construction N of Saskatoon (52° 10' N, 106° 35' W). From sand deposit within tills of Floral Fm (Christiansen, 1968). Abundant faunal remains from seven taxa id.: Gastropod, Pelecypod, Camelops, Mammothus (Parelephas sp), Equus (Eques) cf niobarensis, Bison sp, and Cervid (Lammers, 1968). Bone fractures may indicate presence of man (Pohorecky & Wilson, 1968). Est age 18,000 to >34,000 yr BP. Coll 1968 and subm 1968, 1970 by Z S Pohorecky, Univ Saskatchewan, Saskatoon.

**S-482. Tusk fragments, Units 1 and 4** 12,000 ± 320

**S-498. Same as S-482, Feature 1, Unit 5** 14,650 ± 360

**S-483. Mammoth bone** >34,200

From ca 2.4m above S-482 position.

**S-499. Skull fragments, Unit 6** 20,200 ± 500

*Mammothus (Parelephas)* sp.

*General Comment* (AAR): inconsistent dates for apparent homogeneous unit; S-482, -498 similar to other regional mammoth dates (S-232: R, 1973, v 15, p 193; S-918: R, 1979, v 21, p 72) but appear too recent for geol position. S-483 and -499 are more acceptable for Floral Fm (E A Christiansen, pers commun).

**S-579. Hinsdale Co, Colorado** 2590 ± 180

Charcoal from buried A soil horizon, 33cm below surface, near sub-alpine-alpine transition zone, Mesa Seco, San Juan Mts, Hinsdale Co (38° 02' 30" N, 107° 14' W). *Picea* sp, probably englemanii indicates burn-off prior to present willow (*Salix brachycarpa*) vegetation. Coll and subm 1970 by K I. Johnson, Univ Manitoba, Winnipeg. *Comment* (KLJ): timberline, once higher probably lowered to present position by fire, may date event (Johnson, 1970).

**Reindeer Lake series, Manitoba**


**S-914. 15 to 20cm** 1440 ± 100

**S-915. 65 to 70cm** 4250 ± 130

**S-916. 95 to 100cm** 5370 ± 130

**Precambrian Shield series, Saskatchewan**

Wood, peat, gyttja, and carbonaceous silt deposit series related to Quaternary geol of Precambrian Shield, N Saskatchewan. Coll and subm
1974 to 1979 by E A Christiansen, D W Alley, and B T Schreiner, Saskatchewan Research Council.

**S-949. Gyttja** 7310 ± 100
From base of deposit overlying sand and silt, Wheeler Creek (55° 35’ N, 104° 47’ W).

**S-1065. Peat** 5900 ± 80
From base of deposit overlying recent and glaciolacustrine silt, Deschambault Lake (54° 55’ N, 103° 23’ W).

**S-1070. Peat** 6910 ± 100
From base of frozen deposit overlying sand and silt, Mile 25, Hwy 105 (56° 37’ N, 103° 36’ W).

**S-1223. Peat** 5660 ± 70
From base of deposit overlying sandy till, Mile 100, Hwy 105 (57° 29’ N, 103° 36’ W).

**S-1332. Peat** 8340 ± 160
From cut exposure in recently drained Rabbit Lake bottom above till (58° 12’ N, 103° 42’ W).

**S-1487. Peat** 6980 ± 100
From base of deposit overlying sandy silt, Sholte Lake (57° 40’ N, 109° 28’ W).

**S-1560. Peat** 6860 ± 110
From palsa, 1.2m below surface above ground ice, Black Lake (59° 08’ N, 104° 08’ W).

**S-1659. Peat** 4690 ± 70
From base of deposit overlying sand and till, Carswell Lake shore (58° 31’ N, 109° 24’ W).

**S-1743. Wood** >34,800
From 10m below surface under till, Michael Lake (57° 52’ N, 103° 55’ W).

**S-1744. Carbonaceous silt** >35,600
From 9m below surface under till, Collins Bay (58° 17’ N, 103° 37’ W).

**S-1746. Peat** 5850 ± 70
From frozen deposit 3m below surface, Phelps Lake (59° 10’ 30” N, 103° 06’ 20” W).

**S-2055. Woody peat** 7760 ± 140
From 1.75m above deposit base overlying sand, Lake Athabasca (59° 02’ N, 108° 52’ W).
S-2166. **Carbonaceous silt**

From 10m depth at base of eolian sand covering fluvio-lacustrine sediments, Nipawin (53° 18' N, 104° 04' W).

*General Comment* (BTS): significance discussed elsewhere (Schreiner, 1983a, b).

S-1046. **Aujansh Volcano, British Columbia**


S-1222. **Robson Lake, Saskatchewan**

Peat overlying till, from 2.4m below surface, auger testhole Mile 70, Hwy 105 (57° 06' N, 103° 51' 45" W). Coll and subm 1976 by B T Schreiner. *Comment*: base sample till uncertain.

S-1369. **Dalmeny, Saskatchewan**

Wood from water-well borehole, in sand horizon overlain by till, 21.3m below surface (52° 18' N, 106° 43' W). Coll and subm 1977 by P Puodziunas, Saskatchewan Research Council.

**Somerset Island series, Northwest Territories**

Driftwood, peat, whale and walrus bone from raised beaches, Somerset I, NWT. Part of series of dates used to construct emergence curves for Cape Anne, Cunningham Inlet, Rodd Bay, and Creswell R lowland (Dyke, 1979). Initial dates for S-1381, -1386, -1388 by 1N HCl pretreatment appeared anomalously young and were redated using soluble collagen extract procedure (Rutherford & Wittenberg, 1979) which yielded more acceptable results (Dyke, 1980). Other dates for driftwood and marine shells used in analyses reported elsewhere (Dyke, 1979; Lowdon & Blake, 1979). Coll and subm 1977 by A S Dyke, Geol Survey Canada, Ottawa.

**Cape Anne series**

S-1391. **Whale vertebra**

Partly embedded in raised beach 4m asl, 2km SW of Cape Anne (74° 04' 50" N, 94° 47' W).

S-1383. **Whale vertebra**

Partly embedded in raised beach 7.5m asl, 4km SW of Cape Anne (74° 04' N, 94° 48' 30" W).

S-1389. **Whale bone**

Nearly complete skeleton scattered along raised beach 18m asl, 5.5km SW of Cape Anne (74° 03' 20" N, 94° 48' 30" W).
S-1386. Whale rib 7110 ± 90
Partly embedded in raised beach 28m asl, 5km SW of Cape Anne (74° 03' 30" N, 94° 48' W). 1N HCl date: 4470 ± 90 yr BP.

S-1384. Whale bone 8010 ± 160
Almost completely embedded in raised beach 50m asl, 9km SW of Cape Anne (74° 01' 20" N, 94° 48' W). 1N HC1 date: 4470 ± 90 yr BP.

S-1381. Whale vertebra 9590 ± 120
Embedded in raised beach 69m asl, 7.8km SSW of Cape Anne (74° 01' 50" N, 94° 48' W). 1N HC1 date: 6140 ± 170 yr BP.

S-1392. Walrus bone (NMC-34510) 2420 ± 70
Nearly whole skeleton scattered on and partly embedded in gravel beach 180m asl, 9km SW of Cape Anne (74° 02' 30" N, 94° 51' W). Also dated at 2440 ± 180 yr BP (GSC-3081: unpub). Comment: date is anomalously young; unrelated to uplift.

Rodd Bay series

S-1405. Whale bone 1860 ± 80
On surface of raised beach 4.5m asl, 12km W of Rodd Bay (73° 57' 45" N, 90° 38' W).

S-1393. Whale bone 3830 ± 80
On surface of raised beach 10m asl, 11km W of Rodd Bay (73° 57' 30" N, 90° 38' W).

S-1387. Whale bone 4570 ± 90
Embedded in raised beach 14m asl, 11km W of Rodd Bay (73° 57' 15" N, 90° 38' W).

S-1375. Driftwood 5970 ± 80
From raised beach 18m asl, 7km W of Cape Admiral McClintock (74° 00' 30" N, 91° 19' W).

S-1390. Whale bone 9210 ± 120
Partly embedded in raised beach 76m asl, 10km W of Rodd Bay (73° 55' 40" N, 90° 37' 30" W).

Creswell River lowland (sealevel) series

S-1385. Whale rib 4430 ± 70
From basal gravel unit 11m asl overlain by 2m of probable alluvial-fan gravels, detrital plant mats and beach gravels, 5km NW of Creswell River mouth (72° 57' 10" N, 90° 38' W).

S-1376. Detrital peat 4760 ± 70
From overlying alluvial-fan gravels containing whale rib (S-1385).
S-1377. Detrital peat 4280 ± 140
From below beach gravel extending to 13m asl and overlying S-1375 and -1376.

S-1382. Whale skull 4310 ± 90
Partly embedded in raised beach 22m asl, 10km NNW Creswell R mouth (72° 52’ 20” N, 93° 37’ 30” W).

S-1388. Whale bone 8810 ± 100
Partly embedded in raised beach 73m asl, 9km NW Creswell R mouth (72° 51’ 40” N, 93° 34’ W). 1N HCl date: 5205 ± 70 yr BP.

Creswell River lowland (mudboil) series
Dates on subducted vegetal organic material from mudboil developed in 160m asl till, 10km NW Creswell R mouth (72° 52’ 20” N, 93° 37’ 30” W). Dates included with other dating of mudboils (Dyke & Zoltai, 1980).

S-1378. Vegetal organics 7370 ± 150
From lowest organic layer of mudboil, 95cm below surface, probably immobilized in upper permafrost for several thousand yr.

S-1380. Vegetal organics 2140 ± 50
From 67 to 76cm below surface, overlying modern permafrost.

S-1379. Vegetal organics 1040 ± 60
From 45cm below surface.

General Comment (ASD): indicates early Holocene emergence of 8 to 11m per century with late Holocene reduced rate of 28 to 46cm per century. Mudboil edge erosion minimal.

Gilbert Glacier site series, British Columbia

S-1459. Wood 2220 ± 80
From lower till, 1428m asl.

S-1460. Wood 4360 ± 80
From fluvial gravels overlying lower till, near contact at 1433m asl.

S-1461. Wood 2180 ± 80
From fluvial gravels above 2nd till and below organic layer of gravel unit, 1450m asl.

S-1572. Organic debris 2040 ± 40
From organic layer including moss and fir needles within fluvial gravel unit.
S-1462. Wood  \[3420 \pm 70\]

From fluvial gravels above organic layer, 1457m asl.

*General Comment* (JMR): S-1460 and -1462 anomalously old overlying apparent younger sediments, probable rework of older moraines. Other dates acceptable and suggest glacier expansion with till deposition prior to 2000 yr BP.

**Bridge Glacier Nunatak site series, British Columbia**


S-1463A. Wood  \[680 \pm 50\]

Tree trunk on nunatak surface, 1750 asl.

S-1463B. Same as S-1463A  \[990 \pm 70\]

S-1571. Wood  \[540 \pm 50\]

Tree root recovered from palaeosol.

*General Comment* (JMR): dates max for late Neoglaciar advance of Bridge Glacier.

**Bridge Glacier South sites series, British Columbia**

Charcoal, charred bark, peat, and wood, *Tsuga heterophylla* (id. by S Rowe) from exposures 1km (50° 49’ 50” N, 123° 29’ 45” W) and 2km (50° 49’ 49” N, 123° 29’ 45” W) S sites, 5m NE of Bridge Glacier snout, S Coast Mts. Should provide dates for Late Pleistocenic deglaciation and series of ice-marginal lakes assoc with period to Neoglaciar max. Coll 1977, 1978 by B Thomson, K Drabinsky, and J M Ryder; subm 1977, 1978 by R M Ryder.

1km S site series

S-1464. Charcoal and charred bark  \[6590 \pm 140\]

From lower Late Wisconsin till underlying lacustrine silts.

S-1465. Wood  \[530 \pm 70\]

From lower till overlying lacustrine silt contact, sec overlain by more recent till assoc with Neoglaciar max position.

S-1467. Wood  \[660 \pm 60\]

From contact of lacustrine deposits and upper till of Neoglaciar max.

S-1468. Wood  \[690 \pm 60\]

From contact of beach sands and lacustrine silts, lowest strandline of late Neoglaciar ice-marginal lake series.
2km S site series

S-1466. Wood 380 ± 60  
From highest ice-marginal lake, upper 12cm of gravel bed overlain by 30cm of fluvial sands.

S-1569. Peat 1120 ± 40  
From creek bed exposure, below 1.8m lacustrine deposit overlying thin 0.2m sand on till base.

General Comment (JMR): S-1464 indicates that lower till antedates known Neoglacial events in SW British Columbia, and that it is either early Holocene or late Wisconsin age. S-1465, -1467, and -1468 unacceptable for strat relationships of enclosing deposits. S-1466 dates growth of delta and provides min est for highest lake ponding by Bridge Glacier at late Neoglacial max; S-1569 provides max est for lake ponding.

S-1469. Mount Queen Bess, British Columbia 320 ± 100  
Wood from fresh stream bank exposure 5km SE of Mount Queen Bess, S Coast Mts (51° 15' 30" N, 124° 31' W). Date should be max for most extensive late Neoglacial advance, ca 300 yr BP. Coll 1977 by K Drobinsky and J M Ryder; subm 1977 by J M Ryder.

Lower Tiedemann Glacier site series, British Columbia  

S-1470. Wood 3350 ± 120  
From Ah horizon, palaeosol on lowest till overlain by stratified sands, ca 920m asl.

S-1471. Wood 2360 ± 60  
From 25cm below contact of middle till overlying stratified sands, ca 927m asl.

S-1472. Wood 70 ± 100  
From silt and sands between middle and upper tills, ca 960m asl.

General Comment (JMR): S-1470 min date for start of glacier expansion resulting in middle till deposition. S-1471 max date for subsequent glacier recession also bracketed by GSC-938 and -948 dates. S-1472 not significant.

Upper Tiedemann Glacier site series, British Columbia  
Wood, Tsuga heterophylla and Abies sp (id. by S Rowe) from natural exposure of two superimposed tills in lateral moraine, N side of Tiedemann Glacier, 13km NW of Tiedemann Creek, Mosely Creek, and Ho-

**S-1473. Wood**

1330 ± 80
From fluvial sand between tills, 1358m asl.

**S-1474. Wood**

300 ± 60
From upper till, ca 1368m asl.

*General Comment (JMR):* S-1473 dates interval between two glacial advances with recession higher than present to allow fluvial sand deposition. S-1474 max date for deposition of upper till.

**S-1475. Franklin-Dauntless Glacier Junction, British Columbia**

150 ± 70
Wood, *Tsuga heterophylla* (id. by S Rowe) from gully exposure, 17km SW of Mount Waddington, S Coast Mts (51° 15' 45" N, 125° 23' 20" W). From 2.65m below top of lacustrine sands, ice-marginal lake formed by most recent Franklin Glacier moraine, drained since AD 1929. Coll 1977 by B Thomson; subm 1977 by J M Ryder. *Comment (JMR):* date not significant, more precise bot dating evidence available.

**Babbage River series, Yukon**

Peat from Babbage R delta, Yukon Coast. Coll and subm 1977 by D L Forbes and M Church, Univ British Columbia, Vancouver.

**S-1479. Peat, low tide exposure**

2780 ± 110
From base at 67cm, max depth uncertain, estuary W shore S of Niakolik (69° 14' 30" N, 138° 30' W).

**S-1480. Peat, right bank exposure**

3380 ± 150
From 2.6 to 2.64m below top of 2.88m organic alluvium sec, Babbage R above 2nd distributary to Deep Creek (60° 10' 30" N, 158° 18' W). Downstream site dated 1270 ± 40 yr BP (GSC-2157: unpub).

**S-1481. Peat, delta plain**

3080 ± 180
From 62 to 63cm below surface, stratified peat, silt, and sand sec near delta front, left bank of main channel (60° 13' N, 138° 26' W). Previous dates at nearby site 2100 ± 80 and 1380 ± 80 yr BP (GSC-2323, -2330: unpub).

*General Comment (DLF):* dates S-1480 and GSC-2157 from lower valley exposures provide accretion rate estimates of 0.78 and 0.63mm/yr, respectively. Deltaic deposits S-1481, -1482 considered to be in part reworked but provide min sedimentation estimates on delta plain for late Holocene developments on central Yukon Coast.

**S-1485. Kennedy Lake, British Columbia**

3520 ± 150
Gyttja, 32 to 40cm below water interface, main basin of Kennedy Lake, Vancouver I. (49° 04' N, 125° 30' W). Coll and subm 1978 by J G Stockner, Environment Canada, Vancouver.
S-1486. Descharine Lake, Saskatchewan 1800 ± 70
Peat overlying gravels, from base of deposit 9.8m below surface, NE of Descharine Lake (57° 08' N, 109° 05' W). Coll and subm 1978 by B T Schreiner. Comment (BTS): dates initial peat accumulation.

Pacific Ocean—Northwest Fjords series, British Columbia
Carbonate, wood, and shell from gravity and piston core sampling, NE Pacific Ocean and NW British Columbia fjords. Coll and subm 1978 by B D Bornhold, Pacific Geosci Centre, Sidney.

Pacific Ocean series
Carbonate from (END 77-29) core (48° 34’ 14” N, 133° 56’ 41” W).

S-1497. 20cm depth >35,160
S-1498. 150cm depth >29,700
S-1499. 190cm depth >28,130
S-1500. 320cm depth >28,130
S-1501. 590 to 598cm depth >35,160

Northwest Fjords series

S-1492. VEC 77-32 4060 ± 510
Wood, 37cm depth, Fisher Channel (52° 09’ 36” N, 127° 51’ 48” W).
S-1494. VEC 77-62 6780 ± 190
Wood, 162cm depth, Kitimat Arm (53° 56’ 19” N, 128° 41’ 21” W).
S-1496. VEC 77-82 1300 ± 220
Wood, 20cm depth, Douglas Channel (53° 41’ 24” N, 129° 07’ 24” W).
S-1499. VEC 77-100 >29,270
Shell, 42 to 47cm depth, Squally Channel (53° 06’ 33” N, 129° 21’ 48” W).
S-1491. VEC 77-100 4140 ± 140
Wood, 51cm depth, Squally Channel (53° 06’ 33” N, 129° 21’ 48” W).
S-1489. VEC 77-121 2040 ± 250
Shell, 408 to 412cm depth, Observatory Inlet (55° 13’ 28” N, 129° 31’ 42” W).
S-1561. VEC 78-21 370 ± 90
Wood, 143cm depth, Upper Dean Channel (52° 42’ 18” N, 125° 57’ 27” W).
S-1562. VEC 78-21 990 ± 70
Wood, 195cm depth, Upper Dean Channel (52° 42’ 18” N, 125° 57’ 27” W).
S-1563. VEC 78-30 2020 ± 70
Wood, 152cm depth, S Bentinck Arm (52° 16' 47" N, 126° 57' 27" W).
S-1564. VEC 78-117 4420 ± 190
Shell, 148cm depth, Portland Canal (55° 11' 43" N, 130° 05' 35" W).

General Comment (BDB): S-1494, -1496 discussed in pub on sedimentation of Douglas Channel and Kitimat Arm (Bornhold, 1983).

West Naniskak Lake series, Saskatchewan
  S-1502. 335 to 350cm depth 7680 ± 90
  S-1503. 167 to 184cm depth 3840 ± 130

La Ronge North series, Saskatchewan
- Gyttja from basal sediments, unnamed lake 36km N of La Ronge (55° 20' N, 105° 03' W). Coll and subm 1977 by M Wilson and J Terasmae.
  S-1504. 435 to 450cm depth 8060 ± 160
  S-1505. 217 to 234cm depth 3270 ± 110
  S-1507. Fort Smith, Northwest Territories 9830 ± 360
  Wood fragments from test hole, Fort Smith townsite (60° 01' N, 111° 53' W), from 13.4m depth in deltaic sands. Coll 1978 by T Topilka; subm 1978 by B T Schreiner.

S-1555. Cluff Lake, Saskatchewan 3680 ± 100

S-1556. Fort McMurray, Alberta 6750 ± 160
- Carbonaceous sediment exposure, 1.5m below surface within alluvial silt underlying clay (56° 46' N, 111° 24' W). Coll and subm 1978 by E A Christiansen, Saskatoon.

Uranium City series, Saskatchewan
  S-1557. Gyttja, 2m depth 3430 ± 100
  S-1558. Peat, 3m depth 3220 ± 100

General Comment (BTS): min date for peat accumulation.

S-1559. Cree Lake, Saskatchewan 2180 ± 70
252  A A Rutherford, Jurgen Wittenberg, and B C Gordon

S-1558.  Carwell Lake, Saskatchewan  320 ± 40
Peat from road cut exposure, N shore Carwell Lake (58° 41' N, 109° 15' W), from between two tills, possible ice-rafted rampart. Coll and subm 1979 by B T Schreiner.

S-1555.  Goat Lake, British Columbia  >31,500
Wood from inter-till sand and silt road cut exposure, 150m asl, ca 4km S of Weldwood Camp, E side of Goat Lake (50° 03' 20" N, 124° 14' 18" W). Coll 1978 by K Drabinsky and J M Ryder; subm 1978 by J M Ryder. *Comment* (JMR): date indicates sand and silt unit antedates late Wisconsin Fraser Glaciation. Strat and organic matter suggests unit may be equivalent to Cowichan Head Fm (Armstrong & Clague, 1977) although elev is relatively high.

Klinakline Glacier site series, British Columbia
Wood from palaeosol, gully exposure in complex lateral moraine, W side of Klinakline Glacier, ca 4km above snout, S Coast Mts (51° 19' 20" N, 125° 49' 20" W). Coll and subm 1978 by B Thomson and J M Ryder.

S-1566.  Root  400 ± 45
From palaeosol at 535m asl on 1m till overlain by late Neoglacial gravel and sands and underlain by >30m ice-contact gravels.

S-1567.  Stump  900 ± 40
From outer portion buried at 400m asl in growth position by late Neoglacial till.  
*General Comment* (JMR): separate trees destroyed by thickening glacier advance up adjacent valley slopes during late Neoglacial period; S-1567 min date for start of glacial expansion.

S-1568.  Franklin-Confederation Glacier, British Columbia  840 ± 45
Wood from gully exposure, N side of Franklin Glacier near confluence with Confederation Glacier, SW of Mount Waddington, S Coast Mts (51° 16' 35" N, 125° 26' 00" W). From Ah horizon of palaeosol buried by more recent moraine deposits. Coll 1978 by B Thomson and J M Ryder; subm 1978 by B Thomson. *Comment* (BT): min date for start of Franklin Glacier expansion during late Neoglacial period.

S-1570.  Bridge Glacier Bog, British Columbia  9810 ± 160
Peat from base of 4.51m bog underlain by silts, ca 5km NE of Bridge Glacier (50° 51' 30" N, 123° 26' 00" W). Late Wisconsin recession dated 9510 ± 160 yr BP (GSC-999: R, 1971, v 13, p 300) at Tiedemann Glacier. Coll and subm 1978 by J M Ryder. *Comment* (JMR): min est for late Wisconsin recession of Bridge Glacier to near present position.

S-1588.  La Ronge South, Saskatchewan  10,200 ± 110
Marl from 350 to 366cm below water interface, small unnamed lake 4.5km S of La Ronge (55° 03' N, 105° 26' W). Coll and subm 1977 by M
Wilson and J. Terasmae. Comment (MW): date ca 2500 yr too old compared to pollen and spores present; erroneous age probably due to carbonate from underlying Cretaceous bedrock.

**Quesnel Lake series, British Columbia**

Gyttja from basal sediments, Quesnel Lake (52° 33' N, 120° 59' W). Coll and subm 1978 by J G Stockner.

**S-1616. Station 2, 35 to 44 cm depth**

220 ± 45

**S-1617. Station 3, 23 to 33 cm depth**

1610 ± 60

*General Comment (AAR): dates indicate sediment age range, separate sample sites precludes est of accumulation rate.*

**S-1745. Wapiyao Lake, Saskatchewan**

Peat from 70 cm depth overlain by 20 cm till, test pit near Wapiyao Lake (59° 33' N, 103° 52' W). Coll and subm 1979 by S McNamara, Saskatchewan Research Council.

**Archibald Lake series, Saskatchewan**

Carbonaceous buried soil horizons below sand dunes (59° 00' N, 108° 40' W). Present and buried soils weakly developed Eluviated Dystric Brunisols. Coll and subm 1979 by D F Acton, Agric Canada, Saskatoon.

**S-1773. LH6 horizon, 40 cm depth**

380 ± 150

**S-1774. LH61 horizon, 75 cm depth**

1670 ± 150

**S-1772. LH62 horizon, 90 to 100 cm depth**

2820 ± 100

*General Comment (DFA): acceptable dates for June activity of present backslope and earlier ridges.*

**Antler series, Saskatchewan**

Carbonaceous material and snail shells from apparent buried A horizons below small upland depression of kettled hummocky morainal landform near Antler (49° 35’ N, 101° 30’ W). Coll. and subm 1979 by W Eilers, Univ Saskatchewan, Saskatoon.

**S-1801. Carbonaceous layer**

11,050 ± 860

From 147 to 161 cm depth.

**S-1802. Carbonaceous layer**

11,310 ± 470

From 161 to 176 cm depth.

**S-1803. Shells**

18,140 ± 6610

From 190 to 192 cm depth.

*General Comment (WE): dates relate to final deglaciation stages and early soil formation periods.*

**Rabbit Creek series, Saskatchewan**

Carbonaceous material from auger test holes along Hwy 2, ca 32 km
S of La Ronge (54° 52' 30" N, 105° 22' W). Coll and subm 1979 by B T Schreiner.

**S-1809. Organic residue horizon** >33,000
From 3m below surface at base of 2.1m silt sec.

**S-1808. Carbonaceous silt** >33,000
From 9.4m below surface at top of clayey silt sec underlying 6.4m sandy glacial till.

**S-1782. Carbonaceous silt** >35,550
From 17m below surface in silty clay sec overlying glacial till.

*General Comment (BTS): samples regarded to be contaminated with coal during deposition.*

**S-1885. Karen Lake, Saskatchewan** 3690 ± 90
Organic matter and plant debris at 60cm depth between sandy till secs, apparent former bog area of Karen Lake (59° 07' N, 104° 23' W). Coll and subm 1980 by S Earle, Saskatchewan Mining Development Corp, Saskatoon.

**Saskatoon Gowen site series, Saskatchewan**

**S-2035. Organic clay** 9460 ± 240
From cut exposure, 3m depth at base of aeolian and fluvial sands overlying clay. Probable date for glacial lake drainage.

**S-2183. Organic clay** 8020 ± 290
From auger test at 4.1m depth below stratified sands. Probable high water marker for adjacent river or temporary glacial lake.

**S-2184. Organic clay** 8930 ± 320
From auger test at 4.3m depth below non-organic clay zone.

*General Comment (BTS): dates glacial lake retreat from area.*

**Way Lake series, Saskatchewan**
Gyttja and wood from Way Lake sediments (57° 08' N, 104° 52' W). Coll 1982 by T Donkes and E A Christiansen; subm 1982 by B T Schreiner.

**S-2229. Gyttja** 5180 ± 100
From 8.5m organic layer at 2m below water interface.

**S-2234. Wood** <100
From separate loc, near top of lake bottom fluvial sand unit.
ARCHAEOLOGIC SAMPLES

S-225. Lockport, Manitoba 380 ± 80
Charcoal from floor of burial mound, E bank of Red R near Lockport (50° 05' N, 96° 56' W). Multiple mode burial mound, 1m above terrain surface and 1m deep. Coll and subm 1963 by T Fiske, Univ Manitoba, Winnipeg.

The de site series, Ontario

S-621. Charcoal 870 ± 360
From Area B, Features 519, 524, 527.

S-622. Charcoal 1480 ± 110
From Feature 1, E40N9, E45N3, and Feature 2, E36N3, E36N12.

Estuary Bison Trap site series, Saskatchewan

S-640. Upper occupation, 52cm depth 1070 ± 70
S-641. Lower occupation, 100cm depth 1190 ± 170

JcRw-7x site series, Northwest Territories

S-643. Charcoal, 8 to 10cm depth 830 ± 150
S-642. Charcoal, 18cm depth 320 ± 90

JcRw-40 site series, Northwest Territories

S-645. Charcoal, 10cm depth 5590 ± 980
S-644. Charcoal, 19cm depth 2470 ± 240

Pointed Mountain site series, Northwest Territories
S-695.  Charcoal  2240 ± 170
From Sq 121N97W, 11 cm depth, microblade horizon.

S-696.  Charcoal  3990 ± 120
From Sq 142N103W, hearth above weathered till, microblade horizon.

S-697.  Charcoal  2960 ± 180
From Sq 111N108W, 19 to 20 cm depth, disturbed overburden, microblade horizon.

S-699.  Charcoal  2820 ± 90
From Sq 0-50N0-35W, 5 to 15 cm depth.

S-798.  Charcoal  2150 ± 140
Composite from 5 to 10 cm below base of humus, possible forest fire residue assoc with microblade horizon.

S-1255.  Charcoal (NMC-907)  540 ± 120
From Component II hearth.

S-1256.  Bone (NMC-908)  1640 ± 310
Assoc with Component II hearth (S-1255, S-695).

**Julian site series, Northwest Territories**

S-700.  Charcoal  4280 ± 80
From Sq 132, 5N12W, 60 cm below ash layer, top of lowermost component.

S-701.  Bone  3540 ± 70
From Sq 101.5, 10N10W, assoc with lowermost component.

S-702.  Bone fragments  7980 ± 140
Composite from ca 90 cm below base of humus, lowermost component.

S-903.  Bone  580 ± 160
From Sqs 75, 7N1W and 9, 9N1E, composite from 0 to 4 cm below ash layer, Component II.

S-906.  Bison bone  4720 ± 160
Composite from 68 to 85 cm below ash layer, lowermost component.

S-1254.  Bone  650 ± 100
Assoc with hearth feature.

**Blackwater Lake site series, Northwest Territories**
Charcoal and bone from K1Rk-1 site, Blackwater Lake (63° 54' N,
123° 04' W). From Test Pit 1, 1 to 25cm depth, assoc with microblades. Coll 1972 by G Hilderman; subm 1973 by J V F Millar.

**S-704. Charcoal**  \[1570 \pm 60\]

**S-705. Bone**  \[380 \pm 220\]

**Notigi Lake site series, Manitoba**

Charcoal from Notigi Lake site UNR23 (55° 54’ 22” N, 99° 22’ 55” W). Large stratified site containing Selkirk, Laurel, and Archaic components. Assoc with Laurel tradition dentate pottery ca AD 0 to 600 (Wright, 1967). Coll 1973 by W Wiersum; subm by O L Mallory, Univ Winnipeg.

**S-744. Charcoal, Level 3**  \[920 \pm 150\]

**S-745. Charcoal, Level 5**  \[470 \pm 170\]

**S-746. Charcoal, Level 11**  \[1200 \pm 130\]

*General Comment (AAR):* evidence of disturbance throughout levels; S-744 and -746 acceptable for Laurel ceramics; S-745 may relate to Terminal Woodland occupation (Dickson, 1976).

**Green Acres site series, British Columbia**

Charcoal from EeQw-6 site, NW bank S Thompson R near mouth of Neskinlith Creek, ca 13km from Chase Bridge (50° 45’ N, 119° 45’ 10” W). House and cache pits, cultural material indicates Kamloops phase occupation ca AD 1250 to 1700. Coll 1972 by S Baldwin, M Friesinger, J Stewart, and S Johnson; subm 1972 by S J Fladmark, Simon Fraser Univ, Burnaby.

**S-757. Housepit 9, (NMC-596)**  \[560 \pm 70\]

From Test Pit 4, house fill, 45cm depth.

**S-758. Housepit 7, (NMC-597)**  \[550 \pm 70\]

From Test Pit 2, house fill, 30 to 40cm depth.

**S-759. Housepit 8, (NMC-598)**  \[860 \pm 80\]

Composite from Test Pit 1, house floor, N sec of pit, 30 to 35cm depth.

**S-760. Housepit 1, (NMC-599)**  \[590 \pm 70\]

From Level 5 living floor, 48cm depth; only housepit with considerable amt of native mussel shell present.

**S-761. Tate site, British Columbia**  \[1200 \pm 80\]

Charcoal (NMC-600) from EfQu-19 site near Sorrento (50° 40’ 45” N, 119° 23’ 30” W). Site has ca 26 housepits; upper components indicate Kamloops occupations, lower, a pre-Kamloops component. From Housepit 1, Test Pit 3, hearth feature of 2nd component separated by 2 to 3cm sterile deposits from upper occupation. Coll 1972 by S Baldwin; subm 1972 by S J Fladmark.
S-762. Ev Qv-5 site, British Columbia 800 ± 110
Charcoal (NMC-601) from Ef Qv-5 site, E side Adams R (50° 42’ 45” N, 119° 37’ 10” W), six housepits; material indicates pre-Kamloops occupation but different from lower Ef Qu-19 site. Corner-notched points suggest possible Lillooet phase, ca AD 1 to 400. Coll 1972 by J Campbell and S Baldwin; subm 1972 by S J Fladmark.

Martin-Bird site series, Ontario

S-772. Charcoal (NMC-531), Level 1 1470 ± 120
From Area A, Sq 1, probable immediate pre-European contact.

S-773. Charcoal (NMC-532) 3480 ± 70
From Area A, Sq 5, N wall Pit 11, 33 to 38cm depth; should date first occupation period.

S-774. Charcoal (NMC-533), Level 3 180 ± 140
From Area A, Sq 9, 10 to 15cm depth, ca AD 1400.

S-775. Charcoal (NMC-534), Level 2 660 ± 70
From Area A, Sq 12, 5 to 10cm depth, ca AD 1600.

S-851. Charcoal (NMC-535), Level 3 890 ± 130
From Area A, Sq 12, S wall 80cm wide, hearth area, ca AD 1400.

S-852. Charcoal (NMC-536), Level 1 320 ± 90
From Area B, Sq 4, 0 to 5cm depth, ca AD 1450.

S-853. Charcoal (NMC-537), Level 2 1750 ± 210
From Area B, Sq 5, ca AD 1200.

S-890. Charcoal (NMC-538), Level 1 2280 ± 150
From Area B, Sq 9, copper cache pit NE quad.

S-891. Charcoal (NMC-539), Level 3 1150 ± 60
From Area B, Sq 9, 15 to 20cm depth, copper cache pit NE quad, should date fire area used in preparation of copper tools ca AD 1200.

S-892. Charcoal (NMC-540) 1320 ± 90
From Area C, hearth ash and soil surrounding burial mound ca AD 1300.

S-776. Donaldson site, Ontario 1950 ± 80
Human bone (NMC-555) from Bdhi-1 site, N side Saugeen R, ca 3.2km from mouth, Annabel Twp, Bruce Co (44° 30’ 30” N, 81° 21’ W), from Middle Woodland period, Saugeen focus site, ca AD 0 ± 300. Burial
assoc with copper pan pipe cover over three cut mica sheets, modified wolf maxilla, and stone ear spool. Coll 1971 and subm 1972 by W D Finlayson.

**Southern Indian Lake site series, Manitoba**


**S-778. Bone**

980 ± 140
From 20 cm below surface.

**S-779. Charcoal**

2700 ± 600
From 38 cm below surface.

**S-780. Charcoal**

3170 ± 70
From 35 to 40 cm below surface.

**S-966. Charcoal**

1010 ± 100
From Units 455 and 550, Level 2, 5 to 6 cm below surface.

**S-967. Charcoal**

3340 ± 70
From Unit 599, Level 3, 15 to 20 cm below surface.

**S-968. Bone**

90 ± 50
From Unit 779, Level 2, throughout hearth 10 cm deep.

**S-1077. Bison bone**

3510 ± 90
From Test Pit 5, Level 4, 25 cm below surface.

**S-1078. Charcoal**

240 ± 70
From Units 515 and 520, Level 2, 3 to 8 cm below hearth (S-968).

*General Comment* (AAR): dates S-779, -780, -967, -1077 and lack of assoc ceramics confirms Archaic occupation. S-966 is earliest acceptable date for assoc with Clearwater Lake and Grass River occupation ceramics. S-778, -968, and -1078 are too recent for depth and apparent associations (Dickson, 1976).

**S-781. MacBride River, Manitoba**

460 ± 100

**Glenrose Cannery site series, British Columbia**

Charcoal from DgRr-6 site, left bank S Arm Fraser R, 4 km downstream from river bifurcation (49° 09' 45" N, 122° 56' W). Stratified shell midden with three main discernible stratigraphic units; Unit 1 possibly
A A Rutherford, Jurgen Wittenberg, and B C Gordon

intermediate between Marpole and Lacarno Beach phases; Unit II strong ties with lowest levels of St Mungo (DgRr-2) site 0.8km downriver, appears to antedate Lacarno Beach; Unit III contained artifactual material not previously observed in Fraser Delta, thought to antedate Mayne I phase ca 4000 yr BP. Coll 1972 by W Peacock, P Gose, M Bell, and T H Loy; subm 1973 by T H Loy, British Columbia Prov Mus, Victoria.

S-787. Charcoal (NMC-612) 2300 ± 70
From Unit I, Pit 3, 0.39m below surface, est age, ca 1500 yr BP.

S-790. Charcoal (NMC-615) 2340 ± 120
From Unit I, Pit 6, 0.93m below surface.

S-788. Charcoal (NMC-613) 4190 ± 110
From Unit II, Pit 2, 1.36m below surface, est age, ca 3500 to 4000 yr BP.

S-789. Charcoal (NMC-614) 4290 ± 80
From Unit II, Pit 1, 1.9m below surface.

Armstrong site series, Wisconsin

S-799. House 1 840 ± 120
S-801. House 1, Feature 3 860 ± 120
S-802. House 1, Feature 5 980 ± 110
S-803. House 1, outside Feature 14 800 ± 110
S-800. House 2 830 ± 110

General Comment (AAR): for site discussion, see Hurley (1978).

Namu Midden site series, British Columbia
Charcoal and shell from E1Sx-1 site, large midden area, ca 6m deep near Namu (51° 51’ 32” N, 127° 57’ 50” W). Coll 1970 by J A Beezley and R A Luebbers; subm 1971 by R Wilmeth, Natl Mus Canada, Ottawa.

S-884. Shell (NMC-472) 3770 ± 70
From Pit 10, Level 14.

S-886. Shell (NMC-474) 3160 ± 70
From Pit 10, Level 15.

S-889. Charcoal (NMC-477) 5890 ± 90
From Pit 9, Level 4, should date sea-level change indicated by iron-bearing layer over microblade manifestation, ca 7000 yr BP.
S-887. Charcoal (NMC-475) 4370 ± 70
From Pit 9, Level 5, upper extent of microblades.

S-885. Charcoal (NMC-473) 6010 ± 80
From Pit 9, Level 8.

S-888. Charcoal (NMC-476) 3350 ± 70
From Pit 9, Level 8, intermediate microblade manifestation, ca 4000 to 7000 yr BP.

S-895. Hynes site, Quebec 2040 ± 70
Charcoal (NMC-606) from BlGf-2 site, E end Allumette I., near foot of Paquette Rapids (45° 53’ 20” N, 76° 56’ 20” W). From 15 to 35 cm below surface hearth (Sq T3C) in 5 to 23 cm cultural stratum containing Middle Woodland pottery, scrapers, flake knife, and notched projectile points including Robbins-like point. Pottery appears to have greater Hopewelian influence than most sites in Ottawa R basin. Should date sherds with exterior nodes and notched rim which has exterior dentate and interior rocker stamping, ca AD 0 to 200. Coll 1957 and subm 1973 by C C Kennedy, Ottawa.

Morrison’s Island—2 site series, Quebec
Charcoal and human bone from BkGg-10 site on narrow bench between Lost Channel and Allumette Rapids, Morrison’s I. (45° 48’ 40” N, 77° 02’ W). At least three cultural components represented in several bench sites: upper includes Iroquoian pottery and Contact trade goods; Middle Woodland; and lower Archaic. Charcoal from apparent Middle Woodland hearth containing dentate, rocker, and pseudo-scallop shell-stamped pottery fragments, partial reconstruction showed conical-shaped bottom. Human bone from red ocher burial; grave goods included 212 native copper beads, 2 large-stemmed and barbed flint projectile points, large blade (Hopewell preform) with convex sides and angular base, large blade with convex sides and angular base, and large convex-sided flint blade with rounded base. Est age, ca 1750 to 2050 yr BP. Coll 1958, 1959 and subm 1973 by C C Kennedy.

S-896. Human bone (NMC-607) 1990 ± 100

S-897. Charcoal (NMC-608) 400 ± 100

S-898. Marshall’s Bay—1 site, Ontario 3280 ± 120
Charcoal (NMC-609) from BiGb-1 site, shore of Lac des Chats, Marshall’s Bay, Ottawa R (45° 26’ 06” N, 76° 18’ W). From hearth immediately below minor Contact materials which extended to 15 cm below surface; Middle Woodland projectile points, scrapers, knives, and pottery with coil breaks and conical bottoms. Should date pottery with dentate, rocker and pseudo-scallop shell stamping, ca 500 BC to AD 200. Coll 1972 and subm 1973 by C C Kennedy.
S-899. Morrison's Island—3 site, Quebec  3800 ± 90
Charcoal (NMC-610) from BkGg-13 site, Morrison's L, Ottawa R (45° 48' 40" N, 77° 02' W). Evidence for Contact period, Middle Woodland, and Archaic occupations to 38cm below surface. Archaic material included 4 nearly complete sandstone plummets, Adena-like projectile point, side-notched point, pitted stone and numerous whetstones. Hearth, 25 to 36cm below surface, contained broken ground-slate point. Absence of Middle Woodland artifacts implies Archaic occupation, ca 2500 to 4500 yr BP. Coll 1959 and subm 1973 by C C Kennedy.

S-900. Meilleurs Bay—1 site, Ontario  4370 ± 90
Charcoal (NMC-611) from CaGj-1 site, Ottawa R (46° 10' 06" N, 77° 37' 30" W), from concentration of calcined bone and broken quartz fragments, 38 to 46cm below surface. Cultural affiliation uncertain, possibly earlier than Laurentian Archaic. Artifacts included quartz stemmed point base, 2 lanceolate blades or projectile points, and scrapers of flint and quartz. Worked quartz was more common than flint. Coll 1957 and subm 1973 by C C Kennedy.

Kitandach site series, British Columbia

S-924. Charcoal (NMC-702)  4970 ± 100
From Sq 4, Level 12, est age, 3500 yr BP.

S-925. Charcoal (NMC-703)  620 ± 100
From Sq 5, Level 9, est age, 2000 yr BP.

S-926. Charcoal (NMC-704)  1890 ± 70
From Sq 5, Level 14, est age, 3500 to 4000 yr BP.

S-927. Charcoal (NMC-705)  4460 ± 120
From Sq 6, Level 14, basal gravels, should date earliest occupation, ca 4000 yr BP.

S-1408. Charcoal (NMC-923)  4100 ± 140
From Sq 2, Level 14.

Tulabi Falls Portage site series, Manitoba
Charcoal and charred bone from EcKt-15 site, N of Whiteshell Prov Park on Bird R near inflow to Tulabi Lake (50° 28' 55" N, 95° 15' 50" W). Multicomponent, Historic to Early Archaic or Paleo-Indian site on Tulabi Falls portage, major occupation Late Woodland Manitoba or Selkirk phase but variant ceramics to other area sites. Twelve side-notched projectile points were recovered, 8 complete points of similar size and gray chert material from hearth, Unit 16, Level E, 13cm depth. Coll 1973 by T Tottle; subm 1973 by W M Hlady, Manitoba Archaeol Soc, Winnipeg.
S.939. Charcoal (NMC-697) 1510 ± 200
S.940. Bone (NMC-698) 430 ± 100

Selkirk (Eveline St) Burial site series, Manitoba
Charcoal from EaLf-10 site, within town of Selkirk, W bank, Red R (50° 09' N, 96° 55' W), from burial of four individuals, flexed and dis-articulated, under capping of limestone slabs and rocks. Cultural affiliation uncertain, ca AD 600 to 1600. Coll 1973 by T Tottle; subm 1973 by W M Hlady.

S.942. Charcoal (NMC-700) 780 ± 70
From Unit 5, Level F, 42 to 47cm depth.

S.943. Charcoal (NMC-701) 510 ± 110
From Unit 5, Level F, 51 to 53cm depth.

General Comment (AAR): for site discussion, see Saylier (1978).

S.946. Boomcamp—1 site, Ontario 1590 ± 120
Human bone (NMC-391) from road construction discovery (disturbed), McNab Twp, Renfrew Co (45° 26’ 18” N, 76° 19’ 42” W). Red ocher burial with 2 shell gorgets, 2 slate bayonet blades, ca 25cm long, copper knife, and 21 shell disk beads. Possible Glacial Kame group of Archaic period, ca 3500 yr BP. Coll 1970 and subm 1974 by C C Kennedy.

Wapisu Lake site series, Manitoba
Charcoal and bone from UNR26 site, N Manitoba (55° 45’ 33” N, 99° 08’ 33” W). Lithics include concave-base projectile points, scrapers, chopper, drill, chert flakes, and Laurel pottery, ca AD 100 to 500. Coll 1974 by L Houle, D Rogosen, B Guiviak, and W Wiersum; subm 1974 by W Wiersum, Univ Winnipeg.

S.958. Bone Modern
From 92N112W and 94N112W, Level 1, 0 to 5cm below humus surface.

S.956. Charcoal 1920 ± 90
From 88N122W, Level 2, Feature 17, 8cm below surface.

S.959. Bone 1650 ± 200
From 90N122W, Level 2, 8 to 10cm below surface.

S.957. Bone 800 ± 180
From 90N122W, Level 3, Feature 11, 8 to 12cm below surface.

General Comment (AAR): primarily Initial or Middle Woodland period site with traces of Terminal Woodland occupation, also historic canoe building location. S-956 and -959 acceptable for Initial Woodland Laurel ceramic assoc; S-957 too recent, more likely Terminal Woodland period which is represented elsewhere at site (Dickson, 1976).
Southern Indian Lake, Manitoba  300 ± 170

Mammal bone from Sandhill Bay S1L 184 site (56° 59′ N, 98° 39′ W), from 2 to 3 cm below surface at moss-clay interface. Selkirk focus ca AD 1000 to 1600. Site was burned by 1973 forest fire. Coll and subm 1974 by M E Kelly, Univ Winnipeg. Comment (AAR): acceptable for Clearwater Lake phase, compares favorably to other locality sites (Dickson, 1976).

Wuskwatim Lake series, Manitoba

Bone from UNR-48 site, Burntwood R (55° 30′ 50″ N, 98° 35′ 25″ W); possible date for Terminal Woodland pottery after AD 1000 (Wiersum & Tisdale, 1975). Coll 1975 by L Bruce and J Carbot; subm 1975 by G Dickson.

Bone, Levels 1 and 2  470 ± 70

Bone, Level 3  490 ± 90

General Comment (AAR): tentatively accepted for Blackduck components in N Manitoba (Dickson, 1976).

Oscar Point site, Manitoba  1140 ± 70

Moose, beaver, fish, and turtle bone fragments from PAH5 site (53° 06′ 15″ N, 100° 32′ 37″ W), from test Unit 2AW1 Terrace, assoc with Laurel ceramics, 6 to 12 cm below surface. Coll 1975 by P Filteau; subm 1975 by G Dickson. Comment (AAR): not significantly different from other locality site dates assoc with Laurel ceramics (Dickson, 1976).

Lite site series, Ontario

Charcoal and carbonized food remains from BbGi-1 site, Lots 31 and 32, Sidney Twp, Hastings Co (44° 13′ N, 77° 28′ W), palisaded Iroquoian hilltop village of S Division Huron. Ceramics fit with Huron sequence at Black Creek time, ca AD 1500; included cordwrapped stick-decorated rim sherd and shape and motif types such as Huron Incised, Lawson Incised, and Lawson Opposed. Date should determine if cordwrapped stick-impressed pottery is local anomaly or related to Iroquois Oak Hill horizon (Pendergast, 1972). Coll 1967 and subm 1975 by J F Pendergast, Natl Mus Canada.

Charcoal (NMC-231), 30 to 36 cm depth  610 ± 60

Carbonized food remains (NMC-232)  490 ± 120

Cactus Flower site series, Alberta

Charcoal from EbOp-16 site on flood plain of S Saskatchewan R (50° 15′ N, 110° 38′ W), stratified campsite with ten definite occupations separated by periodic river flood alluvium. Occupations designated from latest (I) to earliest (X): I and II Pelican Lake phase, III to IX attributed to McKean complex, X undefined. Coll 1974 by L Bitz and R Freeman; subm 1975 by J Brumley, Univ Calgary.
S-1209. Occupation III 3740 ± 100
Charcoal (NMC-852) from Feature 33, shallow earth pit in XU-6, SqS 16S6W and 18S6W. Previously dated, 3980 ± 110 yr BP (S-1013: R, 1981, v 23, p 105).

S-1210. Occupation VIII 4220 ± 130
Charcoal (NMC-853) from Feature 14, basin hearth in XU-1, Sq 4S10W. Previously dated, ca 4100 yr BP (S-782, -783, -821: R, 1975, v 17, p 351-352).

South Klondike (JcRw-3c) site series, Northwest Territories
Charcoal from S sec of JcRw-3 site extending ca 110m along old shoreline of Fisherman Lake (60° 22' N, 123° 50' W). Coll 1967 and subm 1976 by J F V Millar.

S-1217. Charcoal (NMC-257) 4790 ± 340
From Floor 12-1, assoc with one of several lower occupations, est age, 3000 yr BP.

S-1218. Charcoal (NMC-258) 5430 ± 170
From Floor 14-3, hearth feature, est age, 2000 yr BP.

Julian site series, Northwest Territories

S-1219. Charcoal (NMC-384) 760 ± 130
Should date Julian complex.

S-1254. Bone (NMC-905) 650 ± 100
From hearth, Sq 67, 8N1W; previously dated, 3610 ± 110 yr BP (I-3195: unpub).

Cressman site series, Ontario
Charcoal from DfJn-1 site, on sand point ca 6.4km SW mouth of Savanne R, Lacs Des Mille Indian Reserve (48° 54' N, 90° 18' W). Laurel, Blackduck, and Historic component site, from hearth, Test Pit 7. Coll and subm 1976 by M P McLeod, Lakehead Univ.

S-1246. Blackduck-Historic 440 ± 40
From ca 8cm depth.

S-1247. Blackduck 2130 ± 750
From ca 8 to 15cm depth.
S-1248. Laurel \[1330 \pm 190\]

From below 25cm depth.

*General Comment (MPM)*: S-1246 is too early for Historic period ca AD 1700, but acceptable for Blackduck period. S-1247 is unacceptable. S-1248 is acceptable for Laurel period and compares to Laurel component for Heron Bay site: AD 610 ± 170, AD 410 ± 160, AD 790 ± 130 (GSC-208, -445, -449; R, 1969, v 11, p 22-42). AD 700 ± 60 (S-171: R, 1975, v 17, p 333), although considered too recent (Wright, 1967).

S-1249. Nyman site, Ontario \[380 \pm 50\]

Charcoal from C11f-11 site, N shore Lake Superior, 0.4km upstream from mouth of Michipicte River at Michipicte River (47° 57' N, 84° 54' 30" W), from hearth feature, Level 2, Stratum 2, Sq IOWON, ca 18cm depth. Terminal Woodland period Algonkian culture, prehistoric and historic artifacts. Coll 1971 by K C A Dawson; subm 1976 by M P McLeod. *Comment (MPM)*: acceptable date (Dawson, 1978b).

S-1252. Central Klondike site, Northwest Territories \[1480 \pm 120\]

Bone (NMC-909) from JcRw-3B site, on terrace, NW corner of Fisherman Lake (60° 22' N, 123° 52' W). Stratified site with seven prehistoric components. From Component III, Sq 53, 7S6W, 10cm below surface, est age, ca 2000 yr BP. Coll 1967 by B C Gordon; subm 1976 by J F V Millar.

S-1253. South Klondike site, Northwest Territories \[6550 \pm 100\]

Bone fragments (NMC-906) from JcRw-1 site, on lowest terrace, NW corner of Fisherman Lake (60° 22' N, 123° 51' W). From Cultural Level A, Geol Unit 14, est age, 3000 to 3500 yr BP. Coll 1967 by G Federchuk; subm 1976 by J F V Millar.

S-1281. Chimi site, Yukon \[6420 \pm 110\]

Charcoal (NMC-892) from JjVi-7 site, on 5 to 6m bluff above Aishihik Lake, ca 2km NE of Aishihik Village (61° 36' 30" N, 137° 30' W). Stratified site; Aishihik phase above White River volcanic ash, Taye Lake phase with basal date, 950 ± 130 BC (GSC-940: R, 1970, v 12, p 472-485) and significantly older occupation of uncertain affiliation below ash. From lower peat deposit, excavation 0-5S25-30W, yielding animal bone and non-diagnostic artifacts of pre-Taye Lake occupation, ca 2000 to 3000 BC (Workman, 1974; 1978). Coll 1968 by K Hayaski; subm by W Workman, Univ Wisconsin.

S-1286. Skull Gulch site, California \[870 \pm 70\]

S-1318. Camp Raynor site, Saskatchewan 1600 ± 110

Bison bone from EgNr-2 site, Lake Diefenbaker shore near Birsay (51° 02’ 30” N, 107° 49’ 50” W), multicomponent occupation and kill site, from 15cm below surface assoc with Avonlea points. Coll and subm 1976 by T S Phenix, Archaeol Soc, Saskatoon. Comment (TSP): acceptable date for Avonlea occupation.

S-1370. Renshaw site, Ontario 3420 ± 80

Charcoal from DaJi-1 site, on relic shoreline of Lake Superior, Jarvis Dist, Thunder Bay (48° 06’ 21” N, 89° 21’ 36” W), from small pit containing considerable chipping debris. Late Copper Archaic period. Coll and subm 1977 by M P McLeod. Comment (MPM): acceptable date for late Nipissing stage beach of site loc (McLeod, 1981), following Algoma stage which allegedly commenced ca 3200 yr BP (Scainisto, 1975).

Wabinosh River site series, Ontario

Charcoal from Eajf-1 site, on N shore below rapids 1km upstream from mouth of Wabinosh R (50° 03’ 10” N, 88° 57’ 06” W), from lower terrace of Area B, assoc with Laurel ceramics, possibly contemporaneous with Blackduck occupation also evident at site. Coll and subm 1977 by P Filteau, Lakehead Univ.

S-1394. Charcoal 160 ± 70

From Test Pit 10, 5 to 12cm below surface.

S-1395. Charcoal 470 ± 60

From Test Pit 3, 10 to 18cm below surface.

Abeki Point site series, Ontario


S-1396. Charcoal 870 ± 110

From hearth yielding Iroquoian materials.

S-1397. Charcoal 670 ± 110

From test trench, 40cm depth, assoc with Peninsular Woodland ceramics.

King Edward Spit—West site series, Yukon


S-1942. Charcoal (NMC-1163) 550 ± 80

From Hearth 1, Sq S7W8.
S-1943. Bone (NMC-1164) 800 ± 70
From Hearth 1, Sq S7W8.

S-1944. Charcoal (NMC-1165) 390 ± 90
From Hearth 3, Sq S1E11.

S-1945. Bone (NMC-1166) 180 ± 70
From Hearth 3, Sq S1E12.

S-1946. Charcoal (NMC-1167) 3630 ± 1070
From Hearth 4, Sq S6W20.

S-1947. Bone (NMC-1168) 250 ± 70
From Hearth 4, Sq S6W20.

Nunguvik site series, Northwest Territories

Plant material, wood, and bone from PgHb-1 site, W coast of Navy Board Inlet, Borden Peninsula, Baffin I. (73° 01' 30" N, 80° 38' W), extensive and important N Baffin I. site occupied throughout most of Dorset and Thule periods. House 73, contrary to other houses, has paved entrance passage and several stone structures of undetermined purpose. Secs previously dated in AD 400 to 860 range (S-846, -879, -1204, -1205, -1206: R, 1981, v 23, p 98-110). House 46, with early Dorset assemblage, yielded dates of 705 BC (S-672: R, 1975, v 17, p 343), AD 70, and AD 675 (S-880, -1207: R, 1981, v 23, p 99, 110); expected age, ca 300 BC. Coll and subm 1977 to 1979 by Fr G Mary-Rousselière, Catholic Miss, Pond Inlet.

S-1443. Plant material (NMC-958), House 73 1510 ± 70
From Sq 35, front portion of house complex, 50 to 60cm below surface.

S-1445. Plant material (NMC-960), House 73 1770 ± 100
From Sq 35, front portion of house complex, 65cm below surface.

S-1444. Caribou antler (NMC-959), House 73 1860 ± 120
From Sq 30; excavation revealed 2, possibly 3 earlier occupation levels below sterile gravel; intermediate horizon yielded bones and several artifacts including early type harpoon head, 65 to 70cm below surface.

S-1614. Plant material (NMC-1020), House 73 1740 ± 130
From Sq 47, SW sec of main occupation, House 73 complex, 35 to 40cm below surface.

S-1615. Wood (NMC-1021), House 73 670 ± 50
From Sq 40, 55cm level under large stone and at bottom of earth-filled fissure extending several meters on both sides of house complex; exhibited nail holes and assoc with similar piece in permafrost.

S-1940. Plant material (NMC-1157), House 73 1440 ± 90
From Sq 69, 30cm depth on pavement of structure of uncertain use, E part of house complex.
S-1941. Willow twigs (NMC-1158), House 73  1320 ± 80
From Sq 71, W portion of house complex, 45cm below surface.

S-1613. Caribou bone (NMC-1019), House 46  2320 ± 50
From assoc midden, 11m asl.

EeRj-71 site series, British Columbia

S-1453. Charcoal, oven matrix  2120 ± 70
From base of sands overlying till.

S-1642. Charcoal, oven periphery  2250 ± 50
From till 50 to 60cm below surface.

S-1454. EeRj-46 site, British Columbia  1550 ± 60
Charcoal from EeRj-46 site, Hat Creek Valley (50° 43’ 55” N, 121° 36’ 02” W), from sand and cobble matrix assoc with construction or use of earth oven, possibly late prehistoric Kamloops phase (Stryd, 1973). Coll 1976 by S Zacharias; subm 1977 by D Pokotylo.

S-1455. EeRj-55 site, British Columbia  1220 ± 70
Charcoal from EeRj-55 site (50° 47’ 27” N, 121° 37’ 10” W), from near base of cultural zone, assoc with fire-cracked rock overlying glacial till. Artifact typology suggests Middle Nesikep tradition, ca 2000 to 5000 yr BP (Sanger, 1970). Coll 1977 by W Hanson; subm 1977 by D Pokotylo.

S-1456. EeRj-101 site, British Columbia  2090 ± 70
Charcoal from EeRj-101 site (50° 46’ 43” N, 121° 22’ 20” W), from fire-cracked rock matrix overlying glacial till, 28 to 31cm below datum. Coll 1977 by H Lemon; subm 1977 by D Pokotylo.

S-1476. Mound Island site, Ontario  Modern
Charcoal from DbJf-2 site, on island at E end of Whitefish Lake (48° 14’ 36” N, 89° 58’ 03” W). Site regarded as late Initial Woodland period, ca AD 600 to 800, with short occupation during Terminal Woodland period (Dawson, 1978a). From NW corner Sq 2, assoc with Laurel rim, 15cm depth. Coll 1977 and subm 1978 by M P McLeod. Comment (MPM): area also used by modern campers and winter ice fishermen.

S-1488. Gowen site, Saskatchewan  6070 ± 200
Burned bone from main excavation area, FaNq-25 site on terrace of S Saskatchewan R, within city limits of Saskatoon (52° 05’ 45” N, 106° 42’ 20” W), from 480.4m ash processing area, Early Plains Archaic affiliation, ca 6000 yr BP (Schroedl & Walker, 1978; Walker, 1980). Coll 1977 by E Walker and A R Schroedl; subm 1978 by A R Schroedl, Univ Saskatchewan.
270  A A Rutherford, Jurgen Wittenberg, and B C Gordon

S-1531. KeNi-4 site, Northwest Territories 2580 ± 80

Charcoal in sand (NMC-978) from KeNi-4 site, 10.4m above shoreline of Whitefish Lake, SE Mackenzie Dist (62° 46' 25" N, 106° 58' 0" W). Sandhill deposit was adjacent to caribou crossing, with five levels and several sublevels: Levels 1 to 4, Late, Middle, and Early Taltiehei traditions; Level 5, mixture of Plains and Shield Archaic. Previous dates range from 1670 BC to AD 1545 (S-1259, -1260, -1261: R, 1979, v 21, p 90 and S-1434, -1435, -1436, -1437, -1440, -1441, -1529, -1530, -1531: R, 1981, v 23, p 122-123). From Area A, off main excavation, main Level 3, Early Taltiehei over Pre-Dorset artifacts, est age, AD 500-500 BC. Col! 1977 by L Jackson and D Jackson; subm 1978 by B C Gordon, Natl Mus Canada.

Lake site series, Northwest Territories

Bone from KkHh-2 site on beach ridge ca 0.4km inland on Southampton I. (63° 47' 30" N, 82° 30' W), from Late Thule period, nine semisubterranean dwelling site, ca AD 1600. Coll 1977 and subm 1978 by B Clark, Natl Mus Canada.

S-1545. Bone (NMC-979), House 2 630 ± 60

From floor level at edge of sleeping platform.

S-1546. Bone (NMC-980), House 2 410 ± 60

From fill on sleeping platform.

Beinakerling site series, Iceland

Horse bone (id. by S Adalsteinsson, Agric Research Inst, Reykjavik) from inside crude stone cairn, 1 of 19 built on bedrock of gravel desert area between large glaciers, central Iceland (64° 53' 30" N, 18° 06' W). No evidence of disturbance, incomplete skeleton bone of horse and sheep found, possible offering altar. Site 1 of 4, first mentioned in area route description by Eirikur Haflidason to Landsnefnd (Royal Comm) at Althing in AD 1770. Route sites relocated, 1 by K Eldjarn in 1979, remaining 3 in 1977, 1978, and 1980 expeditions. Coll and subm 1978 by B Jons-son, Swan River, Manitoba.

S-1576. Meta-carpus Modern

S-1577. Femur 360 ± 40

S-1578. Femur 330 ± 40

General Comment (BJ): S-1577 and -1578 acceptable although earlier date was expected. For Beinakerling custom pertaining to cairns and expedition accounts, see Jonsson (1978; 1979).

EeRj-1 site series, British Columbia

Charcoal from EeRj-1 site, Upper Hat Creek Valley (50° 47' 40" N, 121° 36' 30" W), from housepit and earth oven with two fire-cracked rock pavements overlying fluvial sand and gravel. Coll 1978 by R Mackie; subm 1978 by P Beirne, Univ British Columbia.
S-1579. Charcoal 970 ± 60
From oven feature, upper pavement, 29 to 38cm below surface.

S-1580. Charcoal 2030 ± 50
From oven feature, lower pavement, 110cm below surface.

S-1582. Charcoal 140 ± 50
From house pit, 20 to 25cm below surface.

S-1581. EeRj-55 site, British Columbia 600 ± 40
Charcoal from EeRj-55 site, Hat Creek Valley (50° 44’ 37” N, 121° 37’ 10” W), from fire-cracked rock feature, 28 to 33cm below surface. Coll 1978 by J Snell; subm 1978 by P Beirne.

Battle Creek Coulee site series, Saskatchewan

S-1626. Charcoal 3180 ± 80
From Layer 007, dark gray silts.

S-1625. Charcoal 3780 ± 50
From Layer 009, gray to brown silts.

S-1624. Charcoal 4110 ± 60
From Layer 009, same as S-1625.

General Comment (JSM): site lacked diagnostic artifacts for attributing hearth to prehistoric culture.

Augustine Burial Mound site series, New Brunswick

S-1634. Charcoal 2630 ± 50
From pit fill near top, scattered over level, assoc with grave contents, Feature 12.

S-1635. Charcoal 2670 ± 50
From pit fill near top, assoc with local quartz bifaces, Feature 9.

S-1656. Charcoal 2350 ± 60
From pit fill, assoc with infant burial, Feature 11.

S-1657. Charcoal 2490 ± 60
From pit fill, assoc with Feature 11.
S-1655. Charcoal 2950 ± 80
From base of pit among bone fragments, interpreted as cremation remains.

**Fulton Island site series, New Brunswick**

Nut shells, charred nut shells, and charcoal from BIDn-12 site, Fulton I., S of Lakeville Corners, Sunbury Co (45° 54' 05" N, 66° 15' 05" W). Site of fire-cracked rock, hearths, lithic artifacts, and debitage with Middle Woodland ceramic fragments and historic material. Coll 1973, 1974 by D Burley, C J Turnbull, and B Heckbert; subm 1979 by E Foulkes, C J Turnbull and D L Keenlyside, Natl Mus Canada.

S-1639. Nut shells 2080 ± 50
From Unit 4H2, hearth Feature 40, 9.87cm depth.

S-1638. Charcoal and charred nut shells 1680 ± 70
From Unit 4F1, Feature 35, 10.13cm depth.

S-1824. Charcoal (NMC-1116) 1960 ± 70
From Unit 4F1, Feature 35, 10cm depth, assoc with ceramic sherds, lithic artifacts, calcined bone, fire-cracked rock, and possible post molds.

S-1637. Charcoal 1780 ± 40
From Unit 4G1, Feature 32, 10.13 to 10.25cm depth.

S-1825. Charcoal (NMC-1117) 1610 ± 60
From Unit 4H1, Feature 14, 10.09 to 10.38cm depth, assoc with hearth containing flakes, two cores, scraper, and possible pottery-tempering material.

S-1826. Charcoal (NMC-1118) 2660 ± 90
From Test Cut 13, 0-50N125-145E, in fine brown sand and red oxidation stain, 100 to 103cm below surface, assoc with contracting stemmed Adena-like point.

**Melhagen site series, Saskatchewan**


S-1640. Bone, Bed 4 1910 ± 70

S-1641. Bone, Bed 3 1710 ± 50

General Comment (AAR): acceptable date for Besant or Sonota occupation.

**Oxbow site series, New Brunswick**

Charcoal from CfDi-1 site, N bank of Little SW Miramishi R, W of Red Bank, Northumberland Co (46° 57' 25" N, 65° 51' 30" W). Cultural

**S-1654. Charcoal, datum level A/1028 to 1030**  
2980 ± 80  
From Unit 78-10, assoc with projectile point, flakes, and sherds.

**S-1651. Charcoal, datum level A/1028 to 1030**  
1750 ± 70  
From Unit 78-10, Level 7, assoc with projectile point and pecked design pottery.

**S-1636. Charcoal, datum level A/1050 to 1053**  
2000 ± 50  
From Unit 78-11, burned area N of house structure.

**S-1653. Charcoal, datum level A/1059 to 1062**  
2600 ± 60  
From Unit 78-11, assoc with projectile point, cord-wrapped decorated and plain pottery.

**S-1652. Charcoal, datum level A/1109**  
2120 ± 70  
From Unit 78A, assoc with hearth point and dentate decorated pottery.

**S-1805. Charcoal, 140cm depth**  
2480 ± 110  
From Unit 78-12, Level 14, assoc with straight stemmed point.

**S-1806. Charcoal, datum level A/1121 to 1131**  
2080 ± 60  
From Unit 78-12, Levels 15 and 16, assoc with hearth and pottery.

**S-1823. Charcoal, datum level A/1014 to 1016**  
1080 ± 90  
From Unit 79-14, Level 6, assoc with cord-wrapped stick decorated pottery.

**S-1804. Charcoal, datum level A/1037 to 1040**  
2060 ± 100  
From Unit 79-14, assoc with straight stemmed point.

**Ridley Island site series, British Columbia**

Charcoal from GbTn-19 site, N end Ridley I., Prince Rupert Harbour (54° 14' 00'' N, 130° 19' 42'' W). Small shell midden outside of main concentration sites in harbor area, probable seasonal camp for exploiting offshore resources. Coll 1978 by J May; subm 1979 by R Inglis.

**S-1668. Charcoal (NMC-1050)**  
2000 ± 60  
From Unit 1-5S1-3W, 160 to 170cm below datum.

**S-1669. Charcoal (NMC-1051)**  
2040 ± 50  
From Unit 4-5S1-3W, 180 to 190cm below datum.

**S-1670. Charcoal (NMC-1052)**  
1800 ± 60  
From Unit 0-1N10-17E, 140 to 150cm below datum.
S-1671. Charcoal (NMC-1053) 4610 ± 60
From Unit 4.9-5.0S 0.4-0.SW, 113cm below datum.

S-1672. Charcoal (NMC-1054) 4890 ± 80
From Unit 5-7S 1.5-2.SW, 123 to 127cm below datum.

S-1673. QjLd-21 site, Northwest Territories 2210 ± 120

Wyght site series, Ontario
Charcoal and wood from BfGa-11 site, 7.5km E of Rideau Ferry on SE shore of Lower Rideau Lake, S Elmsley Twp, Leeds Co (44° 51' 00" N, 76° 08' W). Multicomponent site, predominantly Woodland Point ceramics and features, first in Rideau Lake area. Est age, AD 0 ± 500. Coll 1978, 1979 and subm 1979 by G D Watson, Ottawa.

S-1675. Charcoal (NMC-1028) 1650 ± 70
From Sq H19, Feature 1, assoc with ceramics and flat sandstone slabs.

S-1676. Charcoal (NMC-1029) 830 ± 70
From Sq J14, assoc with Woodland ceramics S of Feature 4, stone lined pit.

S-1677. Charcoal (NMC-1030) 2300 ± 60
From Feature 2, assoc with ceramics and flat sandstone slabs.

S-1678. Charcoal (NMC-1031) 940 ± 40
From Feature 6, assoc with ceramics and circular area of small stone, ash and charcoal mix; more recent appearance than other hearth features at site.

S-1679. Charcoal (NMC-1032) 1700 ± 70
From Feature 5, assoc with ceramics, flint flakes, scraper, and ash.

S-1680. Charcoal (NMC-1033) 2460 ± 70
From occupation level assoc with boiling stones but not directly with artifacts.

S-1681. Charcoal (NMC-1034) 940 ± 60
From disturbed area assoc with ceramics.

S-1841. Charcoal (NMC-1131) 7600 ± 270
From Unit H17, assoc with dentate-stamped Woodland pottery.

S-1842. Charcoal (NMC-1132) 8030 ± 1970
From small component horizontally displaced from main site, assoc with Woodland pottery and underlying light colored flakes.
S-1843. Charcoal (NMC-1133) 2530 ± 120
From Sq J16, Feature 3, assoc with pseudo-scallop shell and linearly incised Woodland pottery.

S-1844. Charcoal (NMC-1134) 3410 ± 320
From Feature 2, assoc with Woodland pottery with criss-cross trailed rims and dentate-stamped alternating right and left oblique panels separated by pairs of trailed vertical lines.

S-1845. Charcoal (NMC-1845) >33,000
From Feature 7, area of concentrated flint flakes assoc with horizontally decorated pseudo-scallop shell rim Woodland pottery.

S-1846. Charcoal (NMC-1136) 2360 ± 250
Assoc with and below Woodland dentate-stamped and criss-cross trailed pottery cluster.

S-1847. Charcoal (NMC-1137) 4500 ± 640
From Feature 8, cluster of water-rounded white quartz pebbles covering a few calcined bone fragments.

S-1848. Charcoal (NMC-1138) <100
From Feature 9, elongated area of ash and charcoal assoc with small quantity of linear and dentate-stamped Woodland pottery.

S-1849. Wood (NMC-1139) 760 ± 60
Assoc with anvil stone at occupation floor level and Woodland pottery.

S-1850. Charcoal (NMC-1140) 1020 ± 110
From Component C on 3m terrace separated from main component on lower terrace near present edge of water. Assoc with dentate-stamped Woodland pottery.

S-1851. Charcoal (NMC-1141) 620 ± 120
From Component C, assoc with dentate-stamped Woodland pottery of linearly incised rim with pronounced rolled everted form.

S-1852. Charcoal (NMC-1142) 1290 ± 250
From component C, Feature 2.

General Comment (GDW): S-1841 and -1842, from lowest levels assoc with chert flakes, indicate possibility of early Archaic or late Paleo-Indian occupation in vicinity of main excavation, placing multicomponent site habitation from 6035 BC to AD 1335. S-1845, believed to be small fragments of charcoal, strongly assoc with lithic flake concentration, suggests possible use of coal or bitumen as fire fuel or cement for attaching projectile points to shafts. Charcoals are from several hearth features or zones assoc with 23 of >100 ceramic vessels represented. Although site was only ca 15cm deep and without visible stratigraphy, significant correlation is evi-
A Rutherford, Jurgen Wittenberg, and B C Gordon

dent between $^{14}$C date and depth of charcoal recovery over range 2500 BC to AD 1120 (coefficient 0.93). Linear regression equation has permitted temporal seriation of 23 ceramic vessels in which 3 stylistically differing groups are id. (Watson, 1980; 1981).

**Campbell Bay site series, Ontario**


S-1682. Charcoal (NMC-1038) 5210 ± 90
From Sq N0E0, Feature 1, est age, AD 1600.

S-1683. Charcoal (NMC-1039) 480 ± 60
From Sq N0W4, Feature 2, est age, AD 1600.

**Frank Bay site series, Ontario**

Charcoal and bone from CbGw-1 site on sandy beach, Frank Bay, Nipissing (46° 12' 15" N, 79° 48' 45" W), possible Archaic to Contact period site for Nipissing area. Assoc with 6 dog burials that may relate to Feast of Dead Ceremony recorded in Jesuit Relations. Coll 1978 by M Brizinski; subm 1979, 1980 by R Wilmeth.

S-1684. Charcoal (NMC-1040) 1390 ± 40
From 10-R55, Level 17, may date poorly defined Laurel stratum.

S-1685. Charcoal (NMC-1041) 1000 ± 50
From 10-R60, Stratum 1.

S-1686. Charcoal (NMC-1042) 900 ± 60
From 10-R55, Stratum 1.

S-1687. Charcoal (NMC-1043) 890 ± 70
From 10-R60, Stratum 1.

S-1688. Frank Ridley site, Ontario 990 ± 40
Charcoal (NMC-1044) from Frank Ridley site, Frank Bay, Lake Nipissing (46° 11' 52" N, 79° 48' 43" W), from Sq N0E4, Level 5, stratified site with components dating to Terminal Woodland-Contact period. Coll 1978 by M Brizinski; subm 1979 by R Wilmeth.

**Knetchel Island site series, Ontario**

Clam shell and fish bone from BbHj-2 site, Lot 54 Con 9, Sec A, Kincardine Twp, Bruce Co (44° 15' 20" N, 81° 35' 30" W), stratified Archaic site (Wright, 1972). Shell and bone sample comparison to previous char-

S-1707. Clam shell (NMC-1057) 4080 ± 60
From adjacent units, Test Sec II and Sq A, both Stratum II. Charcoal dated, 2888 ± 45 yr BP (BGS-34; unpub).

S-1708. Clam shell (NMC-1058) 4210 ± 60
From adjacent Sqs E and F, both Stratum III. Charcoal dated, 3040 ± 40 yr BP (BGS-37; unpub).

S-1709. Fish bone (NMC-1059) 3130 ± 50
From adjacent Sqs E and F, both Stratum V. Charcoal dated, 3690 ± 45 yr BP (BGS-35; unpub).

Nodwell site series, Ontario

S-1710. Immature bear bone (NMC-1060) 710 ± 40
From House 8, Unit 69, Feature 77.

S-1711. Mature bear bone (NMC-1061) 920 ± 70
From House 8, Unit 62, Feature 82.

S-1712. Deer bone (NMC-1062) 800 ± 40
From House 8, Units 53, 63, and 89, Features 536, 487, and 153, respectively.

S-1713. Fish bone (NMC-1063) 1460 ± 50
From House 8 composite sample.

S-1714. Beaver bone (NMC-1064) 900 ± 40
From House 8, Units 53, 88, and 89, Features 558, 73, 150, and 155, respectively.

S-1715. Clam shell (NMC-1065) 1850 ± 50
From House 8, composite sample.

S-1716. Carbonized bone (NMC-1066) 2700 ± 70
From House 8, composite sample.

S-1717. Deer bone (NMC-1067) 780 ± 120
From House 7, Tr 3, Units G, D, and E, Features 1035, 1081, and 1104, respectively.
S-1718. Fish bone (NMC-1068) 910 ± 110
From House 7, composite sample.

S-1719. Carbonized corn (NMC-1069) 90 ± 50
From House 7, composite sample.

S-1720. Carbonized corn (NMC-1070) 790 ± 60
From House 10, composite sample.

S-1737. Gore Creek site, British Columbia 8250 ± 120
Human bone (NMC-1085) from EeQw-48 site, on N side of S Thompson R, across from Pritchard Village, 40km E of Kamloops (50° 41' 45" N, 120° 49' 30" W). Right humerus, partial wash-out exposure in fine aeolian silt and compacted glacio-lacustrine deposits below Mazama Ash lens, no assoc artifacts or features. Coll 1975 by British Columbia Archaeol Advisory Board; subm 1979 by J S Cybulski.

Aboriginal Watercraft Project series, Eastern Canada
Wood from dugout canoes from various loci in E Canada; part of series related to design and period of use. Subm 1980 by G F MacDonald, Natl Mus Canada.

S-1742. Wood (NMC-1090) 220 ± 50
Recovered 1976 without written or photographic record from St Lawrence R bank near Coughnawaga Indian Reserve, Quebec.

S-1827. Wood (NMC-1119) 310 ± 50
Recovered from Lake Missinaibi area near Timmins, Ontario, subm to L Alexander, Timmins Mus.

S-2030. Wood (NMC-1175) 330 ± 80
Recovered 1980 by C Hett, from Lac à l'Eau Claire in passage between mouth of Riviére du Loups and Tombeau I., Quebec.

Sjovold site series, Saskatchewan
Bison bone and hearth soil fill from EiNs-4 site, on bench, N edge of Suicide Coulee Creek, at junction with S Saskatchewan R (51° 25' 09" N, 107° 05' 25" W). Small habitation site of at least 21 buried components to depth of 4.1m below datum. Coll and subm 1979 by I G Dyck, Saskatchewan Nat Hist Mus, Regina.

S-1757. Bison bone (NMC-1102), Layer I 580 ± 190
From Units 0N0W, 0N2W, and 0N4W at 0.5m below datum.

S-1758. Bison bone (NMC-1103), Layer II 730 ± 190
From Units 0N0W, 0N2W, and 0N4W at 0.62m below datum.

S-1759. Bison bone (NMC-1104), Layer IIIb 950 ± 190
From Units 0N0W, 0N2W, and 0N4W at 0.75m below datum.
S-1760. Bison bone (NMC-1105), Layer IV 1320 ± 190
From Units 0N0W, 0N2W, and 0N4W at 0.94m below datum.

S-1761. Bison bone (NMC-1106), Layer V 1340 ± 190
From Units 0N0W, 0N2W, and 0N4W at 1.02m and 1.04m to 1.15m below datum, assoc with late form of side-notched point with convex base.

S-1762. Bison bone (NMC-1107), Layer VIa 1380 ± 200
From Units 0N0W, 0N2W, and 0N4W at 1.17m below datum, assoc with Avonlea materials, including ceramics.

S-1763. Bison bone (NMC-1108), Layer VIc 1380 ± 190
From Units 0N0W, 0N2W, and 0N4W at 1.25m below datum.

S-1764. Bison bone (NMC-1109), Layer VIIa 1630 ± 200
From Units 0N0W, 0N2W, and 0N4W at 1.38m below datum; possible Avonlea complex through Layer VII horizons.

S-1765. Bison bone (NMC-1110), Layer VIIb 1860 ± 200
From Units 0N0W, 0N2W, and 0N4W at 1.44m below datum.

S-1766. Carbonaceous soil (NMC-1111), Layer VIII 2710 ± 200
From hearth fill within and below Layer VII.

S-1807. McCallum site, Saskatchewan 210 ± 100
Charred bone (NMC-1145) from GkNp-2 site, on Churchill R at entrance to Snake Rapids channel which joins Sandy Lake to McDonald Bay of Pinehouse Lake (55° 44' 15" N, 106° 34' 09" W), from hearth, 4.5 to 8.5cm below surface of humus and peat layer, SW edge, Sq 18SOE and NW edge, Sq 19SOE. Test excavation yielded Oxbow-type projectile point, Winnipeg Fabric-impressed potsherds and native copper projectile points. Should date pottery of Clearwater Lake phase, ca AD 1600. Coll and subm 1979 by D Meyer, Saskatchewan Research Council. Comment (DM): reasonable date, congruent with other Clearwater Lake phase dates for N Saskatchewan.

Nakwantlun site series, British Columbia

S-1811. Charcoal (NMC-1091), House 11 2500 ± 120
From top upper floor level, probably latest occupation.

S-1995. Charcoal (NMC-1176), House 11 1290 ± 60
From upper floor level, NE quad, E582 S231, 8cm below datum.
S-1812. Charcoal (NMC-1092), House 11 980 ± 60
From lower floor W of hearth, probably earliest occupation.

S-1996. Charcoal (NMC-1177), House 11 1190 ± 160
From lower floor level, NE quad, E510S135, 89cm below datum.

S-1813. Charcoal (NMC-1093), House 11 1210 ± 60
From lowest part of hearth, probably earliest of 2 or 3 occupations.

S-1999. Charcoal (NMC-1180), House 11 480 ± 70
From 18cm below lower floor, NE quad, E708N69, 115cm below datum.

S-1998. Charcoal (NMC-1179), Pit 12 1600 ± 80
From E422S583, 31.5cm below House 11 floor, 117cm below datum.

S-2000. Charcoal (NMC-1181), Pit 12 1840 ± 280
From E455S583, 47cm below surface, 113cm below datum.

S-2001. Charcoal (NMC-1182), Pit 12 1520 ± 160
From E435S598, 52cm below surface, 118cm below datum.

Gordon Island North site series, Ontario
Charcoal from BbGa-2 site, on N end of Gordon I. in Thousand I. Group, near Ganonoque, St Lawrence River (44° 19' 59" N, 76° 16' 10" W), stratified site containing features in 1500 BC to historic time range, main occupation Point Peninsula culture, 700 BC to AD 700. Coll 1979 by J MacDonald, P Kersey, J Ravenhurst, and J V Wright; subm 1979 by J V Wright.

S-1814. Charcoal (NMC-1094) 2860 ± 60
From Tr 1, Sq 8, Feature 10, 17cm depth, assoc with late Point Peninsula pottery.

S-1821. Charcoal (NMC-1101) 1870 ± 270
From Tr 1, Sq 9, 50N77E, 15cm depth, bottom of Level 3.

S-1815. Charcoal (NMC-1095) 220 ± 60
From Tr 2, Sq 4, 5 to 10cm depth, Level 2 assoc with textile-impressed pottery.

S-1816. Charcoal (NMC-1096) 4460 ± 70
From Tr 2, Sq 9, 15 to 20cm depth.

S-1820. Charcoal (NMC-1100) 770 ± 70
From Tr 2, Sq 6, 5 to 10cm depth.

S-1817. Charcoal (NMC-1097) 290 ± 50
From Tr 3, Sq 1, 11 to 15cm depth.
S-1818. Charcoal (NMC-1098) 240 ± 60
From Tr 3, Sq 1, 5 to 10cm depth.

S-1819. Charcoal (NMC-1099) 430 ± 50
From Tr 3, Sq 1, 5 to 10cm depth.

S-1822. Schaeffer site, Ontario 480 ± 50
Human bone (NMC-1114) from Pelee I. No. 4 site, Pelee I., Essex Co
(41° 45' 30" N, 82° 38' W). Single component burial mound assoc with
cultural material similar to late Hopewellian manifestation at McGraw
site in S Ohio, ca AD 200 to 500. From 30cm below surface, upper zone,
plow-disturbed but burial context reliable. Previously dated, 450 ± 55 yr
BP (S-972: R, 1979, v 21, p 76). Coll 1969 and subm 1979 by D L Keenly-
side.

Rat Indian Creek site series, Yukon
Charcoal from MjVg-1 site, on bank of Porcupine R. ca 75m upstream
from mouth of Rat Indian Creek (67° 35' N, 138° 20' W). Stratified site
on alluvial terrace; six cultural levels recognized, uppermost Level 1, his-
toric. Lower prehistoric levels yielded assemblage similar to Klo-kut site
subm 1979 by R LeBlanc and J Cinq-Mars, Natl Mus Canada.

S-1830. Charcoal (NMC-1122), Level 2 1160 ± 100
From hearth, Unit SIW15, Feature 1.

S-1828. Charcoal (NMC-1120), Level 3 770 ± 110
From hearth, Units N2W6 and N3W6, Feature 1.

S-1829. Charcoal (NMC-1121), Level 3 570 ± 70
From hearth, Unit N2W13, Feature 3.

S-1831. Charcoal (NMC-1123), Level 6B 2430 ± 60
From small hearth, Unit N4W5, Feature 2, lowest cultural level at
site.

Old Chief site series, Yukon
Charcoal from JjVk-7 site, on high terrace ca 275m asl, along bank
of Porcupine R, ca 3km upstream from Klo-kut site and ca 12.5km up-
stream from Old Crow Village (67° 54' N, 139° 41' W). Site extends over
c4km segment of terrace, characterized by thin stratigraphy containing
three main levels and series of ground caches and subterranean house
structures. Materials recovered represent early contact transitional arti-
facts, late prehistoric Athapaskan assemblage, and earlier components,
including microblade-bearing horizon. Coll by R Gotthardt and S Greer;
subm 1979 by J Cinq-Mars.

S-1832. Charcoal (NMC-1124) 1690 ± 80
From Unit N7W1, Feature 1, shallow hearth assoc with microblades,
stratigraphically under portion of Housepit I lip.
S-1833. Charcoal (NMC-1125) 1620 ± 110

From Unit N5W1, composite from hearth lying on upper floor zone of Housepit I.

Dog Creek site series, Yukon

Charcoal from NcVi-3 site, on prominent bedrock ridge above Black Fox Creek, ca. 3.5 km downstream from mouth of Dog Creek (68° 22' N, 138° 52' W). Site consists of series of surficial and buried cultural deposits on several knolls. Recovered lithic material representative of various cultural complexes spanning lengthy period, possibly late Pleistocene to mid-or recent Holocene. Cultural affiliation of most prominent assemblage, characterized by burin and bifacial technology, uncertain. Coll 1978 by J Dale and J Cinq-Mars; subm 1979 by J Cinq-Mars.

S-1834. Charcoal (NMC-1126) 2260 ± 130

Composite from hearth zone, Test Pits L and M, Landing Knoll site sec.

S-1835. Charcoal (NMC-1127) 1750 ± 70

Composite from hearth area, Test Pit 2, in S portion of Mid-ridge.

Inukjuak River 3 site series, Quebec

Charcoal from IcGm-4 site, on land rise ca. 70 m from Inukjuak R, E Hudson Bay (58° 27' 50" N, 78° 05' 25" W). Site on level ground with occupation indicated by some stones and slabs. Evidence for five hearths assoc with apparent Dorset artifacts. Coll 1979 by H Oweetaluktuk, J Epoo, and D Weetaluktuk; subm 1979 by D Weetaluktuk, Makivik Corp, Montreal.

S-1836. Charcoal (NMC-1128) 1850 ± 120

From Unit E-1, 7 cm below surface assoc with chert flakes and soapstone lamp fragment.

S-1837. Charcoal (NMC-1129) 7470 ± 970

From Unit F-1, 4 to 7 cm below surface, Hearth 3 in general area.

S-1838. Charcoal (NMC-1130) 2020 ± 230

From Unit E-1, 3 to 5 cm below surface, cluster apart from stone and slab occupation features.

S-1839. Renard site, Ontario 1180 ± 90

Charcoal (NMC-1112) from CbHs-5 site, NE shore Fox I., Mississagi Delta, Cobden Twp (46° 11' 12" N, 83° 01' 57" W). Prehistoric Terminal Woodland site of Algonkian affiliation, at 183 m asl. From SW corner of Sq 595W18, Level 6, 20 to 24 cm depth, assoc with Feature 2. Coll 1977 by M J Brizinski; subm 1979 by M M Bertulli and R Wilmeth.

S-1840. Bruce Boyd site, Ontario 900 ± 60

Human bone (NMC-1113) from AdHc-4 site, on sandy knoll, Lots 8 and 9, Concession B, S Walsingham Twp, Norfolk Co (42° 36' N, 80° 28')
University of Saskatchewan Radiocarbon Dates X


Inderwick site series, Ontario
Charcoal from BeGb-1 site, on small promontory in Nobles Bay, Big Rideau Lake (44° 47’ 56” N, 76° 12’ 58” W). Site considered to be Archaic to Woodland transitional period, ca 1000 ± 200 bc. Coll 1978 and subm 1979 by G D Watson.

**S-1853. Charcoal (NMC-1143)**
1810 ± 200
From Sq 018, assoc with red quartzite lithic detritus, Genesee projectile points, worked steatite, and single undecorated pottery sherd.

**S-1854. Charcoal (NMC-1144)**
1280 ± 100
From Sq 018, large piece of charcoal, same assoc as S-1853.

*General Comment* (DGW): dates too recent for site Archaic Broadpoint phase evidence (Watson, 1981).

Cape Cove—1 site series, Newfoundland
Charcoal from Cape Cove—1 site, on beach between Freels and Newtown (49° 14’ 43” N, 53° 29’ 16” W). From hearth assoc with chipped projectile points, contracting stemmed lance, groundstone objects, and detritus. Coll and subm 1979 by S Austin, Memorial Univ, St John’s.

**S-1860. Charcoal, Level 1**
3620 ± 120
From uppermost cultural stratum, Proto-Beothuk.

**S-1859. Charcoal, Level 4**
4540 ± 140
From lowest cultural stratum, Maritime Archaic.

*General Comment* (SA): acceptable dates; S-1859 is one of earliest occupation dates for the region. S-1860 suggests Level 1 dates to late Maritime Archaic.

**S-1861. Cape Cove—2 site, Newfoundland**
1820 ± 60
Charcoal from hearth feature, on peat ridge above beach between Cape Freels and Newtown (49° 14’ 17” N, 53° 29’ 21” W). Single cultural stratum assoc with notched projectile points, triangular bifaces, and scrapers. Beothuk site ca 1000 to 1800 yr BP. Coll and subm 1979 by S Austin. *Comment* (SA): acceptable date but slightly earlier than expected considering major evidence of historic Beothuk.

Cape Cove—3 site series, Newfoundland
Charcoal from Cape Cove—3 site, on beach between Cape Freels and Newtown (49° 01’ 33” N, 53° 29’ 21” W), from hearth feature, single occupation assoc with bifacially worked projectile points, ca 1000 to 1800 yr BP. Coll and subm 1979 by S Austin.
<table>
<thead>
<tr>
<th>Site</th>
<th>Description</th>
<th>Date ± Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1862.</td>
<td>Charcoal, Level 2 From Feature 10.</td>
<td>1870 ± 110</td>
</tr>
<tr>
<td>S-1863.</td>
<td>Charcoal, Level 2 From Feature 11.</td>
<td>1920 ± 130</td>
</tr>
<tr>
<td>General Comment (SA):</td>
<td>acceptable date for prehistoric Beothuk occupation. Feature 11 exhibited micropoint technology usually uncommon in Beothuk assemblages; cultural placement uncertain.</td>
<td></td>
</tr>
<tr>
<td>S-1922.</td>
<td><strong>British Block Cairn site, Alberta</strong></td>
<td>2720 ± 220</td>
</tr>
<tr>
<td></td>
<td>Charcoal (NMC-1159) from EdOp-1 site on NW Sec 14, Twp 19, R5, W4, within Suffield Military Reserve (50° 36' 26&quot; N, 110° 35' 26&quot; W). Medicine wheel complex of one large and several small cairns assoc with 51 tipi rings. From Feature 8, apparent burned stake 10cm below surface, tipi ring 46. Coll 1979 by B Kooyman; subm 1980 by J Finnigan, Univ Saskatchewan.</td>
<td></td>
</tr>
<tr>
<td>Bérubé site series, Quebec</td>
<td>Bone from DdGt-5 site, E shore of Lake Abitibi, ca 3.2km from mouth of Duparquet R, Palmarolle Mun (48° 39' N, 79° 19' W); cultural affiliation undetermined. Coll 1972, 1973 by P Leblanc, R Lachajelle, J Trudel, and P Gauthier; subm 1979 by R Marios, Natl Mus Canada.</td>
<td></td>
</tr>
<tr>
<td>S-1928.</td>
<td><strong>Bone (NMC-1147), Level 2, Zone A</strong></td>
<td>730 ± 510</td>
</tr>
<tr>
<td></td>
<td>From Sq N3E5, 7cm below surface, assoc with pottery fragments and rifle cartridges.</td>
<td></td>
</tr>
<tr>
<td>S-1932.</td>
<td><strong>Bone (NMC-1151), Level 2, Zone A</strong></td>
<td>6230 ± 160</td>
</tr>
<tr>
<td></td>
<td>From Sq S6E1, 7cm below surface, assoc with pottery fragments and projectile points.</td>
<td></td>
</tr>
<tr>
<td>S-1929.</td>
<td><strong>Bone (NMC-1148), Level 3, Zone A</strong></td>
<td>5330 ± 1310</td>
</tr>
<tr>
<td></td>
<td>From Sq N1E3 and N2E3, ca 22cm below surface, assoc with pottery fragments and lithic materials.</td>
<td></td>
</tr>
<tr>
<td>S-1930.</td>
<td><strong>Bone (NMC-1149), Level 2, Zone B</strong></td>
<td>2870 ± 490</td>
</tr>
<tr>
<td></td>
<td>From Sq N2E3, 12cm below surface, assoc with pottery fragments and two knives.</td>
<td></td>
</tr>
<tr>
<td>S-1927.</td>
<td><strong>Bone (NMC-1146), Level 2, Zone C</strong></td>
<td>1710 ± 290</td>
</tr>
<tr>
<td></td>
<td>From Sq N3, 17cm below surface, assoc with pottery fragments.</td>
<td></td>
</tr>
<tr>
<td>S-1931.</td>
<td><strong>Bone (NMC-1150), Level 2, Zone C</strong></td>
<td>1010 ± 230</td>
</tr>
<tr>
<td></td>
<td>From Sq N2E3, 17cm below surface, assoc with pottery fragments, scraper, and knife fragments.</td>
<td></td>
</tr>
<tr>
<td>S-1933.</td>
<td><strong>Margo site, Quebec</strong></td>
<td>3950 ± 950</td>
</tr>
<tr>
<td></td>
<td>Calcined bone from DdGt-6 site, adjacent to DdGt-5 (Bérubé) site on E shore of Lake Abitibi, Palmarolle Mun (48° 39' N, 79° 19' W); cultural affiliation undetermined. From Sq 04, Level 2, Zones A and B, ca 7cm</td>
<td></td>
</tr>
</tbody>
</table>
below surface. Assoc with small pottery fragments, scraper, and broken knife. Coll 1971 and subm 1979 by R Marios.

Lazarus site series, Yukon

Charcoal and bone from MjVk-4 site, on 8m terrace, E bank of Porcupine R, ca 16km upstream from Old Crow Village (67° 35′ N, 139° 32′ W). Campsite includes several hearths and midden-like deposits and semi-subterranean housepit feature. Material believed to belong to yet uncharacterized culture, similar to that at nearby Old Chief site, but different from Late Prehistoric Athapaskan assemblage at Klo-kut site. Coll 1978 by S Greer; subm 1980 by J Cinq-Mars.

S-1934. Bone (NMC-1154) 1250 ± 100
From Test Pit 7, apparent midden deposit, top of soil C horizon.

S-1936. Charcoal (NMC-1156) <100
From Test Pit 7, apparent midden deposit, near bottom of rich organic zone.

S-1935. Charcoal (NMC-1158) 1700 ± 120
From Test Pit 8, small basin-shaped hearth deposit overlying soil C horizon.

Ault Park site series, Ontario

Charcoal from BgFr-1 site, on Sheek I, near Long Sault Rapids, now flooded by St Lawrence Seaway (45° 00′ 35″ N, 74° 51′ 20″ W). Multi-component site with dominant occupation of Point Peninsula culture. Coll 1956 by R Pehl; subm 1980 by R Wilmeth.

S-1937. Charcoal (NMC-1160), Level III 970 ± 70
From Area 7, Tr 6, Sq P11, assoc with pottery.

S-1938. Charcoal (NMC-1161), Level III 2420 ± 70
From Area 2, Tr 1, Sq o/o, assoc with hearth and pottery.

S-1939. Charcoal (NMC-1162), Level III 2400 ± 110
From Area 1, Tr 1, Sq B15 and B16, assoc with hearth and pottery.

S-1948. Auda site, Ontario 1070 ± 110
Carbonized wood (NMC-1153) from A1Go-29 site, ca 1.6km N of Lake Ontario and 24km W of Port Hope (43° 57′ 35″ N, 78° 24′ 30″ W). Single and multiple family (10 house) village site. Artifacts indicate Middle to Late Woodland transitional period, ca AD 500 to 700. Coll 1979 and subm 1980 by M Kapches, Royal Ontario Mus, Toronto.

Swamp site series, Manitoba

Bone, charcoal, and peat from FbMi-5 site, 350 to 358m asl; below Upper Campbell Beach Ridge of Glacial Lake Agassiz, near Swan R (52° 11′ N, 101° 28′ W), Archaic site within shallow peat bog. Lithic materials include large side-notched projectile points, Oxbow and Pelican Lake

S-1951. **Bison bone** (NMC-1171), Level V 310 ± 70
From Unit 28N2W, peat-gray clay interface.

S-1952. **Charcoal** (NMC-1172) 1670 ± 70
From Unit 30N2W, basal peat overlying clay zone.

S-2028. **Mammal bone** (NMC-1202) 12,980 ± 3190
From Unit 17S45E, base of gray sand horizon overlying yellow sand horizon, assoc with lithic debris and bone fragments.

S-2029. **Peat** (NMC-1203) 720 ± 60
From balk between Units 26N2W and 24N2W, basal peat overlying gray sandy loam horizon.

*General Comment* (AAR): for site discussion, see Badertscher (1980).

**Gowen—2 site series, Saskatchewan**

Unburned bison bone and carbonaceous soil from FaNq-32 site on terrace of S Saskatchewan R, within Saskatoon city limits, Queen Elizabeth Power Sta (52° 05' 42" N, 106° 42' 20" W): early Plains Archaic site. Coll and subm 1980 by E G Walker.

S-1970. **Bison bone** (NMC-1173) 5920 ± 130

S-1971. **Bison bone** (NMC-1174) 6080 ± 160

S-2036B. **Bison bone** 5910 ± 170

S-2036A. **Bison bone** (same as S-2036B) 5080 ± 150
Analysis by former 1N HCl pretreatment method.

S-2037. **Carbonaceous soil** 5670 ± 110
Assoc with S-2036A and S-2036B.


**Below Forks site series, Saskatchewan**

Charcoal and bone from FhNq-25 site, on valley bottom flood plain N bank of Saskatchewan R, 2.5km below forks of N and S Saskatchewan Rivers (58° 14' 55" N, 105° 03' 35" W). Erosion exposure of several occupation levels to depth 2.3m below surface. Coll and subm 1980 by D Meyer.

S-1994. **Charcoal** (NMC-1205) 5740 ± 100
From Sq 982E, 1.75m below surface.
University of Saskatchewan Radiocarbon Dates X

**S-2034. Bone (NMC-1215)**

4060 ± 270

From Sqs 11S1E, 11S2E and 11S3E, 1.76 to 1.83m below surface.

**Harper Valley site series, Saskatchewan**

Charcoal and bone from FgNi-24 site, on low flat SE side of S Saskatchewan R, 2.2km N of Muskoday Indian Reserve (53° 09’ 40” N, 105° 25’ 40” W). Late prehistoric bison kill site now largely disturbed by cultivation. Pottery, lithic artifacts, and large quantities of smashed bison bone exposed. Undisturbed border excavation revealed hearth feature. Coll 1980 by B Clark and D Meyer; subm 1980 by D Meyer.

**S-1995. Charcoal (NMC-1212)**

1460 ± 100

From Sq 90N22E, upper occupation level, 50 to 55cm below surface.

**S-2032. Bone (NMC-1214)**

1910 ± 70

From Sqs 88N22E, 89N22E, and 90N22E, fragments from lower occupation level, 70 to 80cm below surface.

**S-2033. Bone (NMC-1213)**

990 ± 120

From Sq 90S95E, fragments of hearth area, 30 to 35cm below surface.

**S-2002. McRa-10 site, Northwest Territories**

3300 ± 160

Charcoal (NMC-1183) from McRa-10 site, 0.5km inland N shore of McTavish Arm, Great Bear Lake (66° 24’ 30” N, 120° 11’ 15” W). Site cultural affiliation undetermined; contained flakes, bifaces, and leveled flakes including generalized point tip from knife. Sample from hearth feature. Coll 1979 and subm 1980 by D W Clark, Natl Mus Canada. Comment (DWC): antedates appearance of Arctic Small Tool tradition at Great Bear Lake.

**S-2003. MdPg-1 site, Northwest Territories**

<100


**S-2005. MdPs-7 site, Northwest Territories**

1760 ± 270


**Melvior site series, Ontario**

Bone and shell from BfFv-1 site, on ridge E of S Nation R, 3.2km NE of Spencerville, Edwardsburg Twp, Grenville Co (44° 51’ 30” N, 75° 30’

**S-2006. Bear bone (NMC-1195) 480 ± 70**
From Unit C, Sq C, midden.

**S-2007. Clam shell (NMC-1196) 1350 ± 70**
From E midden.

**S-2008. Fish bone (NMC-1147) 980 ± 80**
From Units A, B, and C; Sq C, W, and E, midden deposits.

**S-2009. Deer bone (NMC-1198) 410 ± 100**
From Units B and C, midden.

**S-2010. Human bone (NMC-1199) 430 ± 80**
From Unit C, Sq A, midden.

**S-2011. Bone charcoal (NMC-1200) 430 ± 70**
From Sqs A, B, and C, midden. Bone charcoal fraction separated from burned deer bone (S-2064) prior to bone pretreatment and dating.

**S-2064. Deer bone (NMC-1200) 1050 ± 330**
From Sqs A, B, and C, midden.

**S-2012. Beaver bone (NMC-1201) 530 ± 80**
From Unit C, Sqs A, B, and C, midden.

**S-2013. MfVa-9 site, Yukon 7580 ± 420**
Charcoal (NMC-1204) from MfVa-9 site, on ridge above Cornwall Creek branch of Rock R, 2 to 3km W of Dempster Hwy, W foothills of Richardson Mts (66° 55' N, 136° 30' W). Composite sample from organic lenses in yellow loess deposit, two separate upslope units that merge and become discontinuous downslope as loess thins out. Artifacts include modified blade assoc with organic layers. Lens may represent hiatus in loess accumulation and temporary stable surface. Coll 1980 by R Gotthardt, B Smith, and P Hunking; subm 1980 by J Cinq-Mars.

**Morris site series, Nova Scotia**
Charcoal from BhDe-2 site, on 9 to 12m plateau NE Cape D'Or Lighthouse, Bay of Fundy (45° 17' N, 64° 46' W). Late prehistoric lithic work site, possible habitation. Cultural affiliation uncertain. Coll 1980 by L Jackson, G Hall, and D L Keenlyside; subm 1980 by D L Keenlyside.

**S-2014. Charcoal (NMC-1206), Levels IV and V 1380 ± 70**
From Test Unit 1, hearth area, 15 to 25cm below surface.

**S-2015. Charcoal (NMC-1207), Level III 900 ± 80**
From Test Unit 2, assoc with artifactual material, 10 to 15cm below surface.
General Comment (DLK): dates within expected temporal range, suggest repeated occupations.

S-2016. MacDonald site, Prince Edward Island 1400 ± 160
Charred bone (NMC-1208) from CcGm-12 site, on S Lake mainland shore near East Point (46° 25’ 24” N, 62° 01’ 52” W), late prehistoric shell midden deposit site with mid-17th century historic French component. From Area A, Test Pit 1, Level 4, 31cm below surface, assoc with rim sherd. Coll 1980 by L Jackson and D L Keenlyside; subm 1980 by D L Keenlyside. Comment (DLK): acceptable date although earlier than expected.

S-2017. Cape D’Or site, Nova Scotia 2040 ± 200
Charcoal (NMC-1209) from BhDe-1 site, on bluff overlooking W beach, Cape D’Or Lighthouse, Bay of Fundy (45° 17’ N, 64° 46’ W). Heavily used prehistoric knapping workshop site. Assoc with ceramics similar to Fulton I. site, New Brunswick, and native copper. Sample from Area A, Test Pit 6. Coll and subm 1980 by D L Keenlyside. Comment (DLK): excellent date for diagnostic material.

Wakelin site series, Prince Edward Island
Charcoal from CcGm-9 site, N end of S Lake mainland shore, near East Point (46° 25’ 45” N, 62° 01’ 21” W). Single component site, would appear to be seasonal encampment consisting of several house (wigwam) activity areas; cultural affiliation uncertain. Cultural material similar to other surface collns on Prince Edward I., but first in undisturbed context. Coll and subm 1980 by D L Keenlyside.

S-2018. Charcoal (NMC-1210) 620 ± 150
From Test Pit 1, hearth fill, 20cm below surface.

S-2019. Charcoal (NMC-1211) 750 ± 150
From Test Pit 1, Area A, Level 5, hearth fill assoc with decorated ceramic fragments, 20cm below surface.

Clachan site series, Northwest Territories
Wood from NaPi-2 site, Cape Hearne coast, Coronation Gulf, MacKenzie Dist (68° 09’ 45” N, 114° 50’ 30” W). Thule house site, 4m asl, 80m inland from coast, ca AD 1100 to 1500. Coll and subm 1980 by D Morrison, Natl Mus Canada.

S-2020. Wood (NMC-1187), Level C 1070 ± 60
From S10W18, house floor, last occupation.

S-2024. Wood (NMC-1191), Level C 820 ± 80
From S14W16, house wall, 40 to 50cm depth.

S-2025. Wood (NMC-1192), Level C 1030 ± 70
From S14W16, house wall, 40 to 50cm depth.
S-2026. Wood (NMC-1193), Level C  840 ± 60
From S14W18, house entrance passage floor.

S-2023. Wood (NMC-1190), Level E  1280 ± 70
From S14W16, house wall, basal gravel, 60 to 70cm depth.

S-2027. Wood (NMC-1194), Level 2  840 ± 60
From S10W14, mid-range date for midden.

S-2021. Wood (NMC-1188), Level F  1090 ± 70
From S14W16, basal portion of midden.

S-2022. Wood (NMC-1189), Level 3  1170 ± 60
From S18W14, basal portion of midden.

General Comment (DM): dates too early for Middle Thule occupation indicated at site. All dated material is wooden house posts with probable contamination by seal oil and fats causing earlier apparent ages.

Billet site series, Saskatchewan

Charcoal and bone from EKnv-36 site, low flat area on edge of sandhills, on boundary of NW and NE1/4 of Sec 11, Twp 32, R12, W3; 1.1km W of Harris (51° 44' 03" N, 107° 35' 52" W). Extensive habitation site with several hearths, predominantly Hanna culture, although Oxbow materials present in some loci. Where both are present, stratigraphy separation is uncertain; Area C-3 yielded Hanna material only. Coll 1978, 1979 and subm 1981 by W Pendree, Eston.

S-2053. Charcoal (NMC-1223)  1560 ± 160
From Area C-3, Units 173-L29 and 173-L30, basin-shaped hearth feature, undisturbed sec.

S-2054. Bone (NMC-1224)  3100 ± 60
From Area C-3, Units 173-L29 and L-30, 174-L29 and L30, immediately adjacent to hearth feature.

S-2063. Charcoal (NMC-1225)  3470 ± 120
From Area C-2, Unit 122-L1, immediately adjacent to hearth feature, directly below bison mandible. Area C-2 yielded mostly Hanna materials, although some Oxbow artifacts were also present.

References
Badertscher, Patricia, 1980. The 1979 excavations at FbMi-5, Swan River, Manitoba: Prelim rept no. 6, Papers in Manitoba Archaeol, Winnipeg.
Dickson, G A, 1976, Recent radiocarbon dates from northern Manitoba: Misc papers no. 3, Papers in Manitoba Archaeol, Winnipeg.


——— 1979, Logberg Heimskringla (March 23, 30 issues), Winnipeg (English summary).


Lammers, G E, 1968, A note on the Saskatoon site, Saskatoon, Saskatchewan and its contained paleofauna: Napao, v 1, no. 2, p 32-34.


Orr, P C, 1968, Prehistory of Santa Rosa Island: Santa Barbara Mus Nat Hist, Santa Barbara, California.


——— 1975, University of Saskatchewan radiocarbon dates VI (sic): Radiocarbon, v 17, p 328-353.


———. 1983b, Quaternary geology of the Precambrian Shield, Saskatchewan: Saskatchewan Energy and Mines rept no. 221 (ms in preparation).


UDINE RADIOCARBON LABORATORY DATE LIST II

VALERIO BARBINA, FRANCO CALLIGARIS, ADRIANO DEL FABBRO, and ALESSANDRO TURELLO
Centro di Ricerca Applicata e Documentazione
Viale Leonardo da Vinci 16, 33100 Udine, Italy

INTRODUCTION

This list includes the measurements carried out from 1977-1978. Procedures of synthesis of benzene, counting method, and performance figures of results were previously described (R, 1982, v 24, p 214-216; CRAD, 1977; Barbina, Calligaris, & Ciuti, 1979). Samples were pretreated according to generally applied methods, depending on type of material and particular archaeologic and geologic features.

SAMPLE DESCRIPTIONS

CROSS-CHECK SAMPLES

The following samples were dated in order to check the reliability of laboratory procedures and measurements, by comparison with the results obtained on the same samples by other laboratories, and with archaeologic dating.

UD-16. Mezzano II, 35 D
Charcoal from Late Bronze age layers in Mezzano little crater lake in caldera of Latera, Vulsini Mts, volcanic region, Comm Valentano, prov Viterbo, Latium, Italy (46° 36' 30" N, 11° 46' 08" E). Subm 1976 by G Belluomini, Radiocarbon Dating Lab, Univ Rome. Comment: date perfectly agrees with results obtained in Rome, R-994B:2970 ± 60.

Sahara series

UD-17.

UD-73. Deir el Medina—Luxor

ARCHAEOLOGIC SAMPLES

Coal and ash samples

UD-1. Wadi el Bouzna
Coal and ashes from clayey layers of Wadi el Bouzna, Fezzan, Libya (26° 24' 29" N, 14° 21' 15" E). Coll 1971 by A Del Fabbro (1970) and V Barbina (Reygasse, 1934). Banks of Wadi el Bouzna have yielded many flint implements, such as biconvex axes, broad cutters, and chisels. Lithic
industry typology suggests likeness between Gargano and Teneré stations and Wadi el Bouzna, whereas pottery typology shows remarkable differences from Campignian culture. Comment: $^{14}$C date agrees with expected age range inferred by $^{14}$C measurements of Teneré layers (Alimen, Beucher, & Conrad, 1966; Beucher, 1971).

**Pozzuolo series**

Charcoal from cremation tombs of Pozzuolo necropolis, Italy ($45^\circ 50' 18''$ N, $13^\circ 10' 39''$ E) (Candussio, 1980; Cassola, 1980). Graves were dug in silty-clayey soil, and dated by assoc archaeol material, such as pottery and bronze objects. $^{14}$C dates agree with archaeol estimated age and TL pottery dating.

**UD-57. Tombe No. 1**

Charcoal from cremation tomb No. 1 of Pozzuolo necropolis. Coll and subm 1977 by A Del Fabbro and A Candussio, Dept Antiquities, Udine, Italy.

**UD-58. Tombe No. 2**

Charcoal from cremation tomb No. 2 of Pozzuolo necropolis. Coll and subm 1977 by A Del Fabbro and A Candussio.

**Wood samples**

**UD-33. Tempietto Longobardo—Cividale del Friuli**

Wood from beam found above plaster walls of Lombard chapel, “Tempietto Longobardo”, Cividale del Friuli, Italy (Civiletti, 1960) ($46^\circ 05' 30''$ N, $13^\circ 25' 50''$ E) during restoration in 1977 after 1976 earthquake. Coll by A Del Fabbro and V Barbina and subm by G Del Basso, Municipality Cividale del Friuli. Comment: recent age of sample suggests restoration was undertaken ca AD 1520, due to 1511 earthquake.

**Wood samples**

**UD-41. Palazzo delle Albere-Trento**

Sample found during geognostic drillings in Palazzo delle Albere area, Trento, Italy ($46^\circ 12' 31''$ N, $11^\circ 07' 14''$ E) in gray-blue silt of Adige R at depth 10m. Sand and gravel layer, deposited by Fersina stream, overlays these sediments. Coll and subm 1977 by Tridentine Mus Nat Hist, Trento, Italy. Comment: $^{14}$C dating allowed assessment of rate of alluviation of Adige valley, and period during which Fersina R sediments reached this area.

**UD-42. Tovel Lake**

Fragment from uprooted tree trunk at depth 15m in Tovel lake, Dolomiti di Brenta, Trento, Italy ($46^\circ 15' 30''$ N, $10^\circ 57' 12''$ E). Coll by Sub Club “Trento” and subm 1977 by G Tomasi, Tridentine Mus Nat Hist. Comment: $^{14}$C age suggests lake level was lower than at present, correlated with cold climate of alpine region during that period.
Peat and mollusk shell samples

Results reported here are part of study of paleography of lagoon of Venice made by 1st Studio della Dinamica delle Grandi Masse CNR, Venice, Italy, as previously described (R, 1982, v 24, p 214-216; Gatto, 1980).

Laguna di Venezia

Ca' Bianca series


UD-10. 24,100 ± 1500
Peat from drilling 8 at depth 28.1m.

Lido series


UD-43. 4820 ± 150
Carbonate (mollusk shells) from drilling 11 at depth 10.3m.

UD-44. 21,800 ± 300
Peat from drilling 11 at depth 22.55m.

S Andrea series

Carbonate from lagoon of Venice, S Andrea (45° 26' 01" N, 12° 22' 53" E). Coll 1974 by P Da Roit and subm by P Gatto.

UD-45. 5970 ± 100
Carbonate (mollusk shells) from drilling 13 at depth 8.4m.

Cavallino Punta Sabbioni series


UD-54. 24,500 ± 1000
Silty peat from drilling at depth 28.52m.

Sottomarina Lido series


UD-60. 1800 ± 80
Peat from drilling 1 at depth 8.8m.

Sottomarina series


UD-63. 10,630 ± 100
Sandy peat from drilling 2 at depth 22.6m.
Cavallino Ca’ Ballerin series


**UD-64.**

4670 ± 150
Peat from drilling at depth 12.75m.

**UD-64.**

20,500 ± 800
Carbonate from drilling 18 at depth 16.55m.

Cavallino Ca’ Pasquali series

Peat from lagoon of Venice, Cavallino Ca’ Pasquali (45° 28’ 21” N, 12° 33’ 48” E). Coll 1974 by P Da Roit and subm by P Gatto.

**UD-68.**

5410 ± 70
Peat from drilling 18 at depth 10.5m.

REFERENCES


Reygasse, M., 1934, Découverte d’une technique campignienne dans le paléolithique inférieur de Sud Costantinois: Mem préhist de France, Cong, 11th, p 570-573.
American Journal of Science

PUBLICATIONS

SPECIAL VOLUMES

Studies in Metamorphism and Metasomatism — (Orville v.) contains 24 papers by outstanding petrologists, 625 p., v. 283-A, $50.00 per copy prepaid

The Jackson Volume — in 2 pts: Part 1 contains Cumulus processes and layered intrusions (5 articles) and Ophiolites and related rocks (10 articles). Part 2 contains Mantle xenoliths and their host magmas (11 articles) and Hawaiian and other oceanic volcanism (8 articles). 34 articles (868 p.), v. 280-A, 1980. $50.00 per copy prepaid

Summary and critique of the thermodynamic properties of rock-forming minerals — by Harold C. Helgeson, Joan M. Delany, H. Wayne Nesbitt, and Dennis K. Bird — v. 278-A, 1978 — $25.00 per copy prepaid

Tectonics and Mountain Ranges (Rodgers v.) — Contains 16 papers, from authors all over the world, discussing mountain ranges and tectonic belts throughout the world. 16 articles (516 p.), v. 275-A, 1975. $25.00 per copy prepaid

The Byron N. Cooper Volume — The papers reflect the status of research into problems of Appalachian regional geology at the time of publication. 29 articles (566 p.), v. 273-A, 1973. $15.00 per copy prepaid

The Schairer Volume — 28 articles devoted to experimental petrology. V. 267-A (582 p.), 1969. $15.00 per copy prepaid

The Bradley Volume — Covers the entire breadth of geology. 37 articles, v. 258-A (434 p.), 1960. $8.50 per copy prepaid

Theoretical prediction of the thermodynamic behavior of aqueous electrolytes at high pressures and temperatures — Parts I through IV — by Harold C. Helgeson, David H. Kirkham, and George C. Flowers — A limited number of bound reprints (585 pages in all) plus Subject Index (39 pages) is available from the office of the American Journal of Science at $85.00 per copy prepaid.

SPECIAL ISSUE
April 1982

Four Articles on Geochemical Cycles of Nutrient Elements
by Michel Meybeck; Robert A. Berner; P. N. Froelich, M. L. Bender, N. A. Luedtke, G. R. Heath, and T. DeVries; and G. Billen
$10.00 per copy prepaid

GENERAL INDEX

A general index for the years 1976-1980 (volumes 276-280 and including volumes 278-A and 280-A) is available at $10.00 per copy prepaid.

Order from American Journal of Science, Kline Geology Laboratory, Yale University, P.O. Box 6666, New Haven, CT 06511.
CONTENTS

Time Series Analysis of Low Level Gas Counting Data
Laurie Kaihola, Henry Polach, and Hannu Kojola 159

DATE LISTS

DE  In Che Yang
US Geological Survey, Denver, Colorado Radiocarbon Dates IV .............................................. 166

Fra  Reiner Protsch and Bernhard Weninger
Frankfurt Radiocarbon Dates I ................................................. 185

HAM  H W Scharpenseel, Heinrich Schiffmann, and Bernd Hintze
Hamburg University Radiocarbon Dates III ............ 196

JGS  Shigeko Togashi and Eiji Matsumoto
Geological Survey of Japan Radiocarbon Dates I 206

P  Barbara J Hurst and Barbara Lawn
University of Pennsylvania Radiocarbon Dates XXII .................................................. 212

S  A A Rutherford, Jurgen Wittenberg, and B C Gordon
University of Saskatchewan Radiocarbon Dates X 241

UD  Valerio Barbina, Franco Calligaris, Adriano Del Fabbro, and Alessandro Turello
Udine Radiocarbon Laboratory Date List II ........ 293