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NOTICE TO READERS AND CONTRIBUTORS

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

In recent years, Radiocarbon has also been publishing technical and interpretative articles on all aspects of ^{14}C. 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 In addition, we will be publishing compilations of published *and unpublished* dates along with interpretative text for these dates on a regional basis.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 for submitting manuscripts is:

For	*Date*
Vol 29, No. 1, 1987	Sept 1, 1986
Vol 29, No. 2, 1987	Jan 1, 1987
Vol 29, No. 3, 1987	May 1, 1987

Half life of ^{14}C. 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 ^{14}C 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 cal AD/BC, citing the specific calibration curve used to obtain the estimate. Calibrated dates will now be reported as "cal BP" or "cal AD/BC" according to the consensus of the Twelfth International Radiocarbon Conference, Trondheim, Norway, 1985.

Medning of $\delta^{14}C$. In Volume 3, 1961, we endorsed the notation Δ (Lamont VIII, 1961) for geochemical measurements of ^{14}C activity, corrected for isotopic fractionation in samples and in the NBS oxalic-acid standard. The value of $\delta^{14}C$ 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 $\delta^{14}C$ as the observed deviation from the standard. At the New Zealand Radiocarbon Dating Conference it was recommended to use $\delta^{14}C$ 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 $\delta^{13}C = -19‰$.

In several fields, however, age corrections are not possible. $\delta^{14}C$ 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.

*Suggestions to Authors of the Reports of the United States Geological Survey, 6th ed, 1978, Supt. of Documents, U S Govt Printing Office, Washington, DC 20402.

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SPATIAL AND TEMPORAL DISTRIBUTION OF RADIOCARBON AGES ON RODENT MIDDENS FROM THE SOUTHWESTERN UNITED STATES

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INTRODUCTION

The analysis of rodent middens, principally deposited by packrats (*Neotoma* sp), has rapidly become the most important paleoecologic and paleoclimatologic tool in the southwestern United States. The recent discovery of rodent middens created by stick-nest rats (*Leporillus* sp) and rock wallabies (*Petrogale* sp) in Australia (Green *et al,* 1983; P S Martin, oral commun, 1984) and by dassie rats (*Petromus typicus*) in South Africa (L Scott, oral commun, 1984) portends the use of midden analysis in arid regions worldwide. Several recent reviews of southwestern paleoecology (eg, Spaulding *et al,* 1983) rely heavily on rodent middens for ecologic and climatic reconstructions.

Here I provide a compilation of the spatial and temporal distribution of ^{14}C dates on rodent middens from the Southwest, superseding that of Mead, Thompson, and Long (1978). Packrat middens are usually unstratified, are possibly occupied at different times, and commonly require multiple ^{14}C dates (Spaulding, 1983). Therefore, the chronology of rodent middens depends entirely upon ^{14}C dates. The sampling bias and statistical distribution of ^{14}C dates in time and space strongly affect regional paleoecologic interpretations derived from rodent middens.

METHODS

^{14}C dates and the latitude, longitude, and elevation were collected from all published and selected unpublished studies of rodent middens in the southwestern United States and northern Mexico (see Bibliography). "Rodent middens" refers to predominantly indurated deposits formed by packrats (*Neotoma* sp) and also include several porcupine (*Erethizon dorsatum*) middens from New Mexico, Arizona, and Colorado (Van Devender, Betancourt & Wimberly, 1984). Unpublished dates were obtained from the files of the Paleoenvironmental Laboratories at the University of Arizona and from many individuals associated with midden research. Multiple ^{14}C dates for several middens were included as separate samples because each date, not necessarily each midden, is the basis for age determinations.

RESULTS

A total of 910 ^{14}C dates on rodent middens was obtained for analysis and an additional 42 "modern" middens were dated by the presence of chlorophyllous materials. The University of Arizona analyzed 57% of the dates; 15 other laboratories analyzed the remaining 43%. During 1983–84, researchers obtained 39 of the 910 ^{14}C dates from small samples using the University of Arizona tandem accelerator mass spectrometer (TAMS) (Donahue *et al,* 1983).

A histogram of ^{14}C dates (fig 1) indicates a bimodal distribution with sharp peaks at 0 and 10,000 yr BP. This distribution decays asymptotically towards a frequency of 0 at 50,000 yr BP, the oldest date obtained. "Infinite" dates beyond the age range of ^{14}C analysis are plotted at their minimum age. The >10,000 yr BP section of the histogram can be modelled with the exponential decay function

$$N = 38e^{(-0.92\,(T-10{,}000))},\ r^2=0.79 \qquad (1)$$

where N = the number of samples in the age interval T.

The >10,000 yr BP section is suggestive of a Gamma probability distribution (Haan, 1977). The Gamma distribution is a two parameter distribution with a shape factor n and a scale factor Y; the distribution resembles an exponential-decay curve for $n < 1$. The cumulative Gamma distribution, fit to the >10,000 yr BP data using standard procedures (Haan, 1977), closely matches the cumulative frequency of ^{14}C dates with $n = 0.81$ (fig 2A).

A Gamma probability distribution was fit to the >10,000 yr BP frequency distribution after the 34 "infinite" dates were removed. The resulting cumulative Gamma distribution (fig 2B), with $n = 0.78$, compared favorably with the resulting cumulative frequency of ^{14}C dates. The sum of squared differences between the cumulative Gamma and the empirical cumulative frequency distributions decreased by one half after the "infinite" dates were removed, indicating a better fit. Both the exponential-

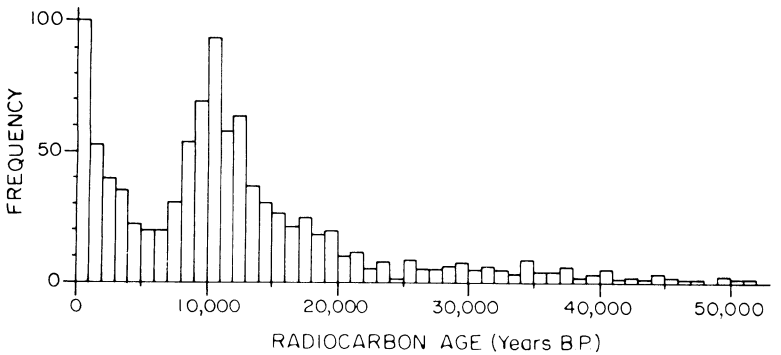

Fig 1. Histogram showing the distribution of 910 ^{14}C dates and 42 "modern" rodent middens from the southwestern United States.

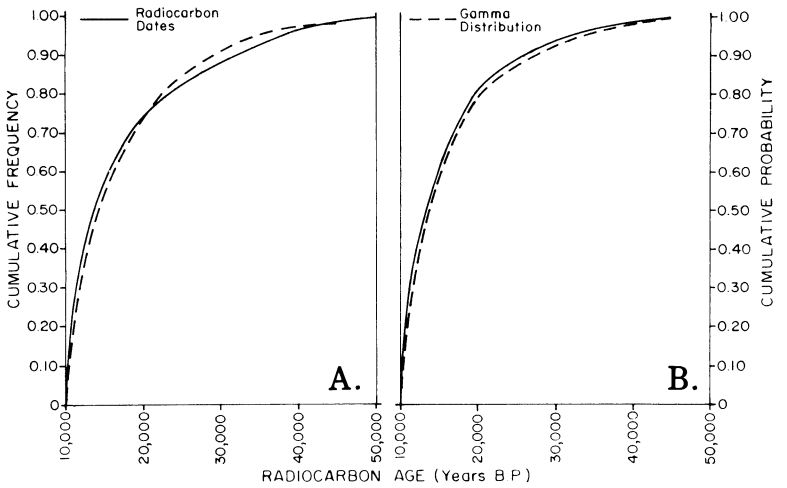

Fig 2. A. Comparison of cumulative frequency of all >10,000 yr BP ^{14}C dates on rodent middens and a cumulative Gamma probability distribution with n = 0.81 and Y = $1.03*10^{-4}$. B. Comparison of cumulative frequency of >10,000 yr BP ^{14}C dates (without "infinite" dates) and a cumulative Gamma probability distribution with n = 0.78 and Y = $1.21*10^{-4}$.

decay model and the Gamma probability distribution of >10,000 yr BP ^{14}C dates support the expectation that the probability of preservation of middens should exponentially decrease with increasing age.

The spatial distribution of ^{14}C dates (fig 3) reveals a concentration of research in several regions. The histogram of dates by latitude and longitude showed a strong bias around latitudes 32° N ± 30′ and 36° N ± 30′ wherein 19 and 36% of the middens were collected, and between longitudes 114°W ± 30′ and 116°W ± 30′ wherein 50% of the middens were collected. Nevada has yielded more ^{14}C dates on macrofossil middens (28%) than any other state. However, few middens have been collected from central Arizona, central and eastern New Mexico, most of Utah, and western Colorado, and only 9 middens have been dated from northern Mexico.

Little bias was present in either elevation or aspect which could not be attributed to the natural topography of the Southwest. Although middens were collected from sea level to 2700m elevation, 95% were collected between 300 and 2100m. The aspect, available for 526 middens, showed no preferential azimuth. Scatterplots of elevation and aspect *vs* ^{14}C age (not shown) revealed no significant relationship which could not be attributed to the spatial distributions of dates by age class.

The ^{14}C dates were divided into age classes to check for sampling bias as a function of age (fig 4). The late Holocene (0–4000 yr BP) age class, which contained 179 dated middens and 42 "modern" middens, had a scattered pattern. Fifty-two percent of these middens were collected from Nevada and the lower Colorado River area (fig 4A) and 72% were collected between 1400 and 2000m elevation. The middle Holocene (4000–8000 yr BP) contained 90 ^{14}C dates, few from any site or region (fig 4B). The early Holocene (8000–11,000 yr BP) age class contained 217 ^{14}C dates, 60% of

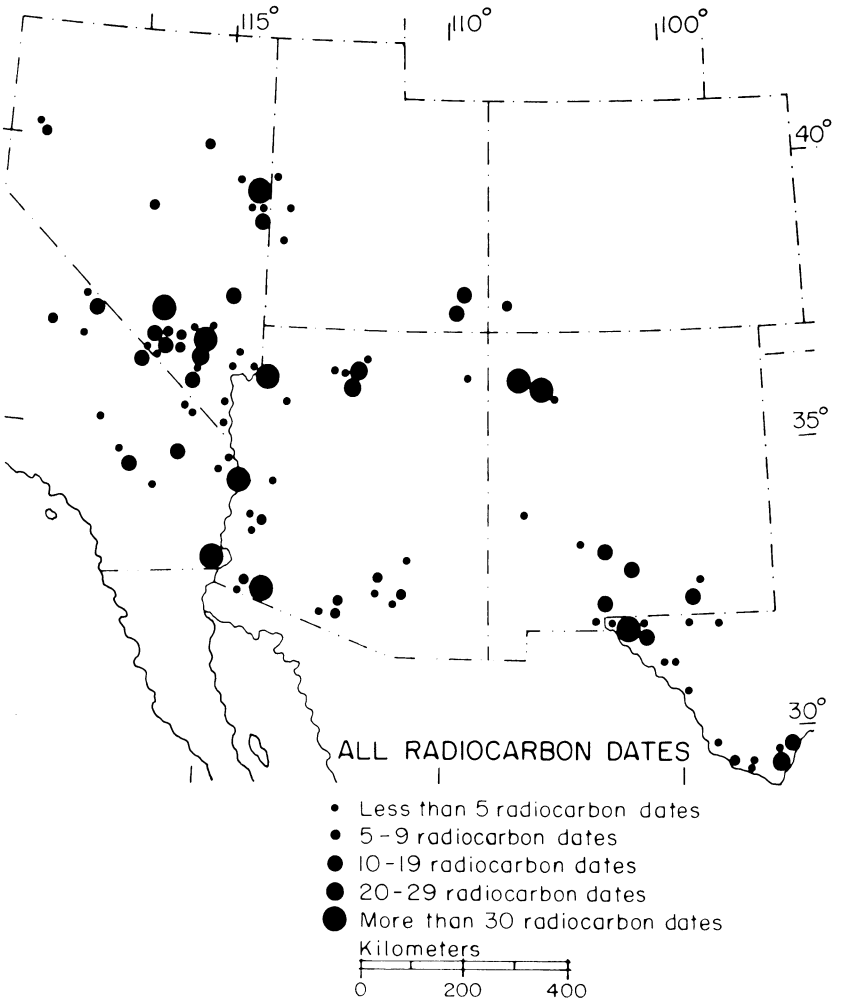

Fig 3. Map of the southwestern United States showing the spatial distribution of all ^{14}C dates on rodent middens.

which were from the lower Colorado River area and southern Nevada (fig 4C).

The distribution of Pleistocene middens reflects specific midden studies. The latest Pleistocene (11,000–15,000 yr BP) age class, with 186 ^{14}C dates, and the full glacial (15,000–22,000 yr BP) age class, with 128 ^{14}C dates, were predominantly collected from southern Nevada (eg, Spaulding, 1983) or the Grand Canyon (eg, Cole, 1982, Mead & Phillips, 1981). The interstadial and infinite (>22,000 yr BP) age class contained 111 ^{14}C dates, 34 of which were of infinite age. These middens were collected primarily from Nevada (61%) and Big Bend National Park (21%), with 33% from replicate dating of two middens from Nevada (Spaulding, 1983).

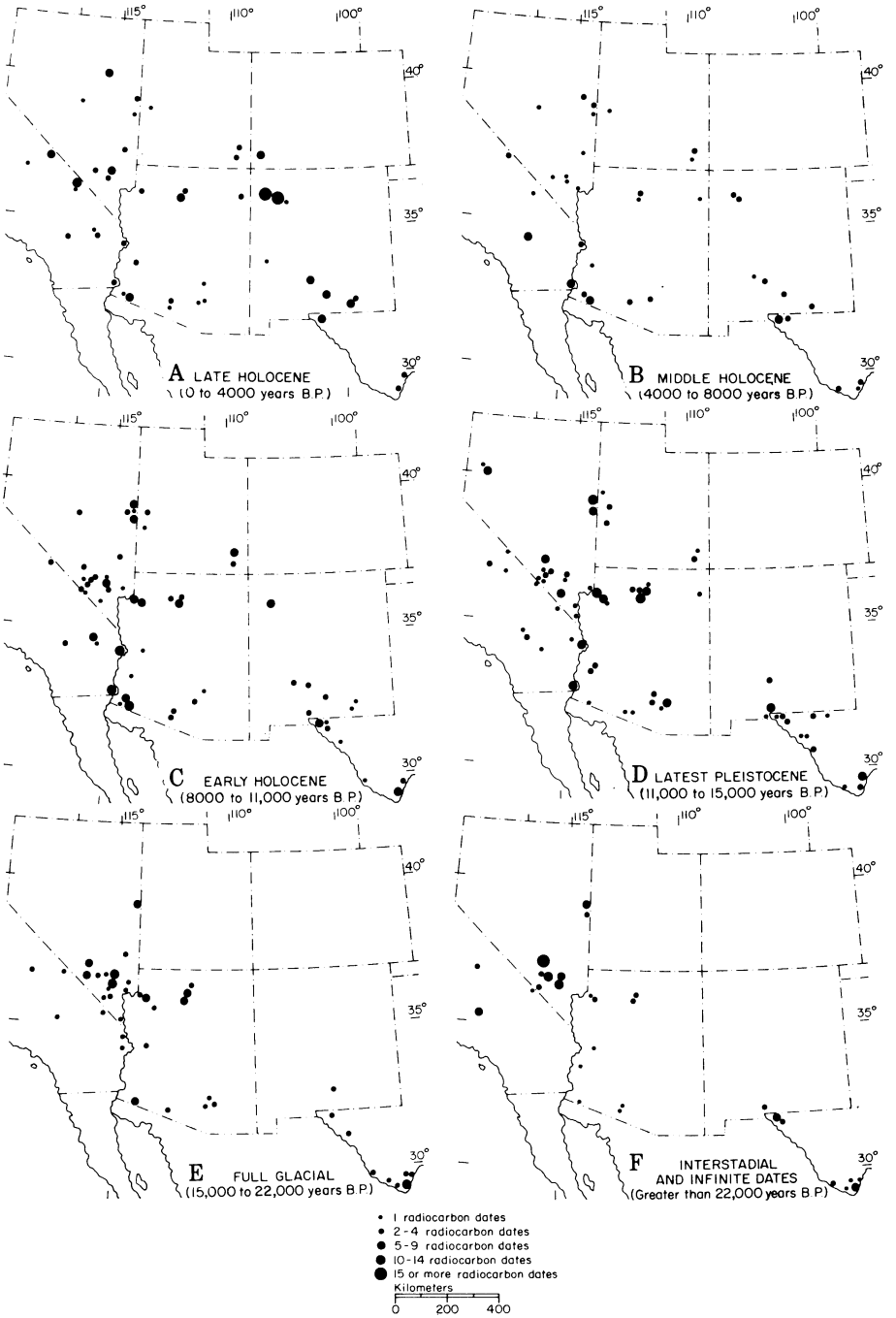

Fig 4. Maps of the southwestern United States showing the spatial distribution of ^{14}C dates on rodent middens by age class. A. Late Holocene. B. Middle Holocene. C. Early Holocene. D. Latest Pleistocene. E. Full Glacial. F. Interstadial and Infinite.

DISCUSSION

The temporal and spatial distributions of ^{14}C dates on rodent middens raise questions concerning preservation of middens, inherent sample bias, and sample design for future midden research. The temporal distribution of ^{14}C dates >10,000 yr BP suggests that the probability of occurrence of a ^{14}C date in a given age class decreases exponentially with increasing age. Indeed, the observed dates can be fit with an exponential-decay model (eq 1) or Gamma probability distribution (fig 2).

The bimodal distribution of ^{14}C dates (fig 1) can be best explained using researcher bias and the Gamma probability distribution. The shape of the histogram from 0 to 6000 yr BP is suggestive of the Gamma distribution of a lesser number of samples (284) compared with the number of pre-10,000 yr BP samples (520). However, a Gamma distribution cannot be fit because a different statistical population of ^{14}C dates begins at 7000 yr BP. The peak centered on 10,000 yr BP, and the gradual rise from 7000–10,000 yr BP could be caused by selective midden collection, because many studies had a goal of determining biogeographic displacements during the Pleistocene and early Holocene (eg, Van Devender & Spaulding, 1979). The collection of middens containing macrofossils of species now at higher elevations, and rejection of all other middens, created a selective bias towards middens older than 8000–10,000 yr BP. If two sampling populations of ^{14}C dates are assumed, then their bimodal distribution (fig 1) can be interpreted as two Gamma probability distributions with different starting age classes at 0 and ca 10,000 yr BP.

Future research on rodent middens will benefit from the recognition of the present sample bias. Until now, midden sampling has been heavily biased spatially towards the lower Colorado River (including Grand Canyon National Park), southern Nevada, southern New Mexico, and Big Bend National Park regions (figs 3 and 4), and temporally towards >10,000 yr BP ^{14}C dates. While this type of sampling allows intensive site-specific analyses and the comparison of, eg, late Pleistocene plant assemblages in the Mojave, Sonoran, and Chihuahuan Deserts, it does not allow reconstruction of a paleoclimatic "gradient" between these areas (Wells, 1979). Systematic midden collection in central Arizona, Utah, and New Mexico is needed before any regional paleoecologic gradients across the Southwest can be quantified.

ACKNOWLEDGMENTS

J L Betancourt and P S Martin provided ideas and enthusiasm crucial to the completion of this research. T R Van Devender, K L Cole, R S Thompson, and W G Spaulding generously provided ^{14}C dates for middens they collected. O K Davis, R M Turner, P S Martin, T R Van Devender, J L Betancourt, and V R Baker critically reviewed the manuscript. I am especially thankful to R M Turner and C Sternberg for the drafting.

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ERRATUM

MOSCOW MV LOMONOSOV STATE UNIVERSITY RADIOCARBON DATES II SEA LEVEL INDICATORS FROM COASTAL USSR

N I GLUSHANKOVA, O B PARUNIN, A O SELIVANOV, A I SHLUKOV, and T A TIMASHKOVA

(Radiocarbon, Vol 25, No. 3, 1983, P 892–898)

An error in the geographic coordinates appears throughout the date list. All the data recorded as minutes should have been tenths of a degree. For example, the first date, MGU-IOAN-129 should read 78.6° N rather than as published, 78° 6′ N.

[RADIOCARBON, VOL 28, NO. 1, 1986, P 9–68]

GIF NATURAL RADIOCARBON MEASUREMENTS X

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The following date list includes archaeologic and geologic samples dated by Gif Radiocarbon Laboratory mostly from 1973 to 1975. Volcanic samples reported here were dated up to 1981. Measurements were made in the same manner as previously reported (R, 1972, v 14, p 280). For undersized samples, a 0.1L CO_2 proportional counter was used with 5000-minute standard measurements. Ages listed are conventional ^{14}C ages based on the 5568-year Libby half-life; uncertainties are 1σ statistical standard error. Results are based on 95% of NBS oxalic acid activity. Some dates have been calibrated using the correction curve of Klein *et al* (1982)*.

ACKNOWLEDGMENTS

We thank M Kolbach and M Rousseau for sample preparation, as well as J P Garnier and M Jaudon for measurements and maintenance of electronic equipment.

ARCHAEOLOGIC SAMPLES

France

Palaiseau series, Essonne

Charcoal from archaeol levels on Plateau de Palaiseau (48° 43′ N, 2° 14′ E). Coll and subm 1971–1975 by M Cattant, Palaiseau.

Gif-2332. Palaiseau A **550 ± 110**

Charcoal from Middle Age occupation.

Gif-3799. Palaiseau B **1420 ± 90**

Charcoal from Merovingian level.

General Comment: dates agree with expected ages.

Gif-3961. Vauhallan, Essonne **850 ± 90**

Bones in sarcophagus, from Roman Chapel under church of Vauhallan (48° 43′ N, 2° 14′ E). Coll and subm 1976 by M Cattant.

Bois de Saponay series, Aisne

Charcoal samples from level overlying Tardenoisian level of Bois de Saponay site (49° 12′ N, 3° 32′ E). Coll and subm 1972 by J Hinout, Chateau-Thierry, Aisne.

* Calibrated dates will now be reported as "cal BP" according to the consensus of ^{14}C daters at the 12th International Radiocarbon Conference.

Gif-2450. Bois de Saponay, P 19-145 **3010 ± 100**

Gif-2451. Bois de Saponay, N 20-150 **3190 ± 100**

General Comment: younger than Tardenoisian age, as expected from strat position of charcoal.

Gif-2403. Crèvecoeur-en-Auge, Calvados **580 ± 90**

Wood from ancient drawbridge of castle of Crèvecoeur-en-Auge (49° 07′ N, 0° 01′ E). Coll and subm 1971 by R Jost, Mus Schlumberger, Crèvecoeur-en-Auge. *Comment:* date is consistent with hist data.

Gif-2307. Le Plessis-Grimoult, Calvados **1340 ± 70**

Charcoal at 3.5m depth, under circular rampart around medieval bldg, Le Plessis-Grimoult (48° 57′ N, 0° 36′ W). Coll 1970 by M Rio and subm 1971 by M de Bouard, Centre Recherche Archaeol Médiévales, Caen. *Comment:* dates limit for bldg.

Montgasteau series, Saint Denis-les-Ponts, Eure et Loir

Charcoal from Neolithic mound inside rampart of promontory camp of Mongasteau (48° 04′ N, 1° 17′ E). Coll by M Haricot and subm 1973 by J Allain, Dir Antiquités Préhist, Bourges.

Gif-2772. Montgasteau, SP, 72-06 **4790 ± 130**

Depth 3.4m.

Gif-2773. Montgasteau, SP, 72-07 **4860 ± 130**

Depth 2.9m.

Gif-2774. Montgasteau, SP, 72-08 **4550 ± 130**

Depth 1.7m.

General Comment: dates this type of military structure.

Gif-2455. Chaudron, Maine et Loire **1200 ± 90**

Charcoal from artificial souterrain of La Ravaillière, Chaudron (47° 17′ N, 0° 59′ W). Coll and subm 1972 by J L'Helgouach, Dir Antiquités Préhist, Nantes.

Gif-2290. Lavardin, Bellevue, Sarthe **1270 ± 100**

Ashes in hearth, from ancient furnace from iron foundry settlement, Lavardin (48° 05′ N, 0° 05′ E). Coll and subm 1971 by A Pioger, Le Mans, Sarthe. *Comment:* iron mining in Sarthe is dated to 8th century.

Gif-2745. Saint-Fort, Mayenne **1380 ± 90**

Wood in filling of ancient gold mine, Saint-Fort (47° 49′ N, 0° 42′ W). Subm 1973 by J Guignes, Bur Recherche Géol et Min, Rennes. *Comment:* dates medieval gold mining in Mayenne.

Gif-2463. Rauville-La-Place, Manche **1530 ± 100**

Wood from dug-out canoe found in silty sediments of La Taute R, Rauville-la-Place (49° 22′ N, 1° 30′ W). Coll and subm 1972 by M de Bouard.

Gif-3206. Plonevez-Porzay, Kervel, Finistère **1950 ± 90**

Charcoal from ancient salt industry site Plovenez-Porzay (48° 04′ N, 4° 05′ W). Coll and subm 1973 by R Sanquer, Lab Archaeol Brest. *Comment:* cal 175 BC–AD 235. Date agrees with expected date, AD 275, from ceramics.

Pluguffan, Kerbernard series, Finistère

Charcoal from Kerbernard barrows, Pluguffan (47° 57′ N, 4° 12′ W). Coll 1973 and subm 1974 by J Briard, Fac Sci, Rennes.

Gif-3202. Kerbernard 2 **3640 ± 100**

Classic Breton Bronze age tombstone. *Comment:* date agrees with archaeol data.

Gif-3203. Kerbernard 3 **1620 ± 90**

Charcoal from chest, assoc with Chalcolithic industry. *Comment:* date is too young, indicating site disturbance.

Gif-3201. Priziac, Morbihan **3930 ± 110**

Charcoal from Early Bronze age barrow, at Priziac (48° 04′ N, 3° 06′ W). Coll 1973 and subm 1974 by J Briard.

Laniscat series, Côtes du Nord

Charcoal from Megalithic tomb, Laniscat (48° 13′ N, 3° 08′ W). Coll 1973 and subm 1975 by C T Le Roux, Fac Sci, Rennes.

Gif-3200. Laniscat, 3 T 4 **2860 ± 100**

Charcoal under flagstone.

Gif-3099. Laniscat, 2 **5140 ± 100**

Charcoal from entrance of Megalithic monument.

General Comment: Gif-3099 gives good date for closing of tomb; Gif-3200 indicates later re-use.

Gif-3204. Pedernec, Trezean, Côtes du Nord **2260 ± 90**

Charcoal in Chamber A from Iron Age souterrain, Pedernec, Trezean (48° 34′ N, 3° 18′ W). Coll and subm 1973 by P R Giot, Fac Sci, Rennes. *Comment:* fits archaeol evidence.

Gif-3205. Kermoysan, Quimper, Finistère **2120 ± 90**

Charcoal from hearth, at base of furnace, Kermoysan (48° 00′ N, 4° 06′ W). Coll 1972 and subm 1973 by R Sanquer. *Comment:* cal 400 BC–AD 40,

agrees with expected date (AD 10-25) for first Roman settlement of Quimper.

Colpo series, Morbihan

Samples from Cairn II, part of littoral Megalithic site of Larcuste, Colpo (47° 51′ N, 2° 47′ W). Coll and subm 1972–1973 by J L'Helgouach.

Gif-2828. Colpo 5 **2230 ± 100**

Charcoal from E side, S entrance of cairn.

Gif-2453. Colpo 1 **3980 ± 110**

Charcoal from E side, inside cairn.

Gif-2827. Colpo 4 **4060 ± 120**

Charcoal from N side, inside cairn.

Gif-2454. Colpo f 2 **4610 ± 110**

Charcoal from same strat position as Gif-2453, but inside cairn.

Gif-2826. Colpo 3 **5490 ± 120**

Charcoal from passage-grave a-b, assoc with Neolithic ceramics.

General Comment: Gif-2826 is most interesting date, from construction level of passage-grave.

Ancenis series, Loire Atlantique

Samples from ancient dike of Loire R, Ancenis (47° 23′ N, 1° 10′ W). Coll and subm 1972 by J L'Helgouach.

Gif-2456. Ancenis I **970 ± 90**

Wood from pile.

Gif-2457. Ancenis II **1010 ± 90**

Wood from another pile. *Comment:* dates bldg of dikes of Loire R.

Gif-2901. Saint-Michel-Chef-Chef, Loire Atlantique **5200 ± 90**

Charcoal from Paleolithic site in Loire estuary, Saint-Michel-Chef-Chef (47° 11′ N, 2° 09′ W). Coll by M Allard and subm 1973 by J L'Helgouach. *Comment:* dated charcoal was not *in situ,* probably from upper archaeol levels.

Gif-2347. Courcoury, Charente Maritime **2800 ± 70**

Ox bones found in barrow of Courcoury (45° 44′ N, 0° 38′ W), 5m from top. Subm 1971 by M Hours, Dir Mus France, Paris. *Comment:* dates this large barrow, 12m high, 70m diam, for which no archaeol data are available.

Grotte du Queroy series, Charente Maritime

Samples from protohist levels of Grotte du Queroy (45° 39′ N, 0° 19′ E). Coll and subm 1973–1978 by J Gomez, Dir Antiquités Préhist, Poitou, Charentes.

Gif-2742. Grotte du Queroy, Level 2 **2400 ± 110**

Charcoal in hearth of La Tène age.

Gif-2741. Grotte du Queroy, Level 3a, Pit 5 **1820 ± 100**

Charcoal, end of First Iron age.

Gif-3283. Grotte du Queroy, Level 3a **2070 ± 90**

Charcoal, end of First Iron age.

Gif-4677. Grotte du Queroy, Level 4 **2610 ± 90**

Charcoal from Level 4 of pit in entrance, end of First Iron age.

Grotte-3284. Grotte du Queroy, Hearth 1 **2670 ± 100**

Charcoal from Hearth 1 in habitation soil with Late Bronze age-Hallstatt B3 industry (Venat Group), lying on Level 5.

Gif-3775. Grotte du Queroy, Hearth 2 **2730 ± 100**

Charcoal in Hearth 2 from same level as Hearth 1. *Comment:* with Gif-3284, dates precisely first appearance of iron objects at site.

Gif-2740. Grotte du Queroy, Level 5 **2820 ± 110**

Scattered charcoal from level with typical "Venat Group" industry.

Gif-4678. Grotte du Queroy, B **2940 ± 100**

Charcoal, Late Bronze III, from another part of Cave.

Gif-2739. Grotte du Queroy, Level 7 **3040 ± 110**

Charcoal, from Middle Bronze to early Late Bronze age.

Gif-4127. Grotte du Queroy, Level 8 **3170 ± 100**

Charcoal from carbonized post, Middle Bronze age II-III.

Gif-3285. Grotte du Queroy, Level 9 **4260 ± 110**

Charcoal in ossuary in reworked level of Artenac level; assoc with copper objects.

General Comment: except for unexplained dates of Gif-2741 and -3283, this series provides good chronology for Bronze and Iron ages in W France.

Gif-2743. Pierre-Dure, Voeuil-et-Giget, Charente Maritime 4150 ± 130

Charcoal from Neolithic camp of Pierre-Dure (45° 36′ N, 0° 10′ E). Coll 1969 and subm 1973 by J Gomez. *Comment:* fits very well for this site of Artenac culture (Gomez, 1975).

Gencay series, Vienne

Samples from anterior level to present ruins of ancient castle of Gencay (46° 25′ N, 0° 23′ E). Coll and subm 1972 by A Vignaud, Dir Antiquités Préhist, Poitiers.

Gif-2645. **810 ± 90**
Burned corn.

Gif-2646. **1050 ± 90**
Charcoal.

General Comment: dates are coherent with hist data, castle was built during 13th century.

Grotte du Bois-Ragot series, Gouex, Vienne

Samples from Late Magdalenian levels of Grotte du Bois-Ragot, Gouex (45° 23′ N, 1° 38′ W). Coll 1971 and subm 1972 by A Chollet, Chatellerault, Vienne.

Gif-3580. Grotte du Bois-Ragot, Level VI **10,990 ± 160**
Charcoal.

Gif-2537. Grotte du Bois-Ragot, Level V **11,030 ± 140**
Carbonaceous ashes.

Gif-3579. Grotte du Bois-Ragot, Level VI **10,180 ± 160**
Carbonaceous earth.

General Comment: dates agree with reindeer bone industry found in these levels (Chollet, Reigner, & Boutin, 1974). Azilian level of site was dated, 8800 ± 220, Gif-1588 (R, 1974, v 16, p 25).

Gif-2419. Thiers, Puy de Dôme **1770 ± 100**
Wood from ancient water pipe, near Thiers (45° 51′ N, 3° 33′ E). Coll 1971 by J Tournet and subm 1972 by G Camus, Univ Clermont-Ferrand. *Comment:* date agrees with Roman age attributed to aqueduct.

Grotte du Rond du Barry series, Polignac, Haute Loire

Samples from Grotte du Rond du Barry, Polignac (45° 04′ N, 3° 52′ E). Coll and subm 1972-73-75 by R de Bayle des Hermens, Mus l'Homme, Paris (de Bayle des Hermens, 1977).

Gif-3738. Grotte du Rond du Barry, 75-1 **860 ± 60**
Charcoal from Middle age level.

Gif-2671. Grotte du Rond du Barry, Level D, 72-1 **12,380 ± 280**
Carbonaceous earth from hearth in Upper Magdalenian level.

Gif-2672. Grotte du Rond du Barry, Level E, 72-2 **15,400 ± 400**
Burned bones from Hearth 2 in Upper Magdalenian level.

Gif-3492. Grotte du Rond du Barry, Level E, 73-3 12,800 ± 170

Burned bones from Hearth 4 in Upper Magdalenian level.

Gif-3038. Grotte du Rond du Barry, Level F, 73-5 17,100 ± 450

Splintered bones from Upper Magdalenian level.

General Comment (RBH): all dates agree well with archaeol evidence, but Gif-3492, from same level as Hearth 2, is too young.

Gif–2312. "Couvent des Fieux," Miers, Lot 1150 ± 90

Charcoal from dolmen of "Couvent des Fieux" (44° 51′ N, 1° 41′ E). Coll and subm 1971 by M Carrière, Vayrac, Lot. *Comment:* date is much younger than expected.

Le Frau series, Cazals, Tarn et Garonne

Samples from First Iron age barrow, Le Frau, near Cazals (44° 07′ N, 1° 40′ E). Coll and subm 1971 by B Pajot, Mus Hist Nat, Toulouse.

Gif-2461. Le Frau, Barrow 1 2140 ± 100

Charcoal from Barrow 1, Sq H 8.

Gif-2462. Le Frau, Barrow 2 1170 ± 90

Charcoal from Barrow 2, Sq D 7. *Comment:* probably dates re-use of site.

Marquay series, Grotte des Partisans, Dordogne

Samples from burial cave of Middle Bronze age, Marquay (44° 55′ N, 1° 07′ E). Coll and subm 1975 by J Roussot-Larroque, CNRS, Bordeaux.

Gif-3595. Marquay, 1 2540 ± 120

Charcoal in mass of fallen earth. *Comment:* younger than expected; contamination with younger charcoal is suspected.

Gif-3793. Marquay, 2 3520 ± 110

Charcoal from Level 1a-1b. *Comment:* agrees with archaeol estimate.

Gif-3596. Grotte de Leygonie, Neuvic-sur-l'Isle, Dordogne 3660 ± 150

Charcoal from sepulchral cave of Leygonie (45° 05′ N, 0° 30′ E). Coll and subm 1975 by J Roussot-Larroque. *Comment:* probably dates last occupation of cave, Late Chalcolithic period; undersized sample.

Gif-2384. Grotte d'Eybral, Coux-et-Bigaroque, Dordogne 4140 ± 140

Charcoal from burial cave with remains of 60 skeletons, Coux-et-Bigaroque (44° 50′ N, 0° 59′ W). Coll and subm 1971 by J Roussot-Larroque. *Comment:* agrees with assoc Late Neolithic industry.

Fontaine de la Demoiselle series, Saint-Léon-sur-l'Isle, Dordogne

Samples from Neolithic site, La Fontaine de La Demoiselle (45° 06′ N, 0° 30′ E). Coll and subm 1972 by J Roussot-Larroque.

Gif-2617. Fontaine de La Demoiselle, 1 **4250 ± 140**

Charcoal from Layer B1.

Gif-2618. Fontaine de La Demoiselle, 3 **4230 ± 140**

Charcoal from Layer A2 underlying B1.

General Comment: dates agree with Neolithic period with Artenac assoc; dates confirm previous dates for site (R, 1974, v 16, p 25).

Gif-2570. "Pont d'Ambon", Bourdeilles, Dordogne **9830 ± 180**

Bones from Azilian site, Pont d'Ambon, Bourdeilles (49° 10′ N, 0° 35′ E). Coll and subm 1972 by G Celerier, Univ Bordeaux.

La Ferrassie series, Dordogne

La Ferrassie (44° 56′ N, 1° 02′ E) is important archaeol site, with accumulation of deposit 7 to 8m thick, containing abundant lithics from Mousterian to Perigordian periods. Site is well known for discovery of 6 Neandertal skeletons in lower level during first excavation period, 1896–1929. H Delporte and A Tuffreau resumed excavations in 1968 (Delporte, 1985). Charcoal was found in only one level. Dating was attempted on abundant faunal bones found in all levels. Bone collagen was extracted according to Longin (1971). Samples come from 2 perpendicular secs: sagittal and frontal; subm 1972–74 by H Delporte, Mus Saint-Germain-en-Laye.

Sagittal section

Gif-2696. La Ferrassie, D 2 **24,000 ± 550**

Bones from Level D 2, Perigordian V industry assoc.

Gif-2698. La Ferrassie, D 2 **24,600 ± 550**

Bones from Level D 2, Perigordian V industry assoc.

Gif-2699. La Ferrassie, D 2 **22,500 ± 500**

Bones from Level D 2, Perigordian V industry assoc.

Gif-2701. La Ferrassie, EL s **23,600 ± 550**

Bones from Level EL s, Aurignacian IV industry assoc.

Gif-4263. La Ferrassie, E 1 s A **11,150 ± 120**

Bones from Level E 1 s A, Aurignacian IV industry assoc. *Comment:* date is aberrant.

Gif-4264. La Ferrassie, EL s B **23,700 ± 250**

Bones from Level EL s B, Aurignacian IV industry assoc.

Gif-4266. La Ferrassie, G O **26,100 ± 210**

Bones from Level G O, Aurignacian III industry assoc.

Gif-4267. La Ferrassie, G 1 **21,100 ± 170**

Bones from Level G 1, Aurignacian III industry assoc.

Gif-4268. La Ferrassie, G 1 s b/c **22,700 ± 240**

Bones from Level G 1 s b/c, Aurignacian III industry assoc.

Gif-4269. La Ferrassie, G 1 s c **23,700 ± 240**

Bones from level G 1 s c, Aurignacian III industry assoc.

Gif-4270. La Ferrassie, G 1 s c/d **23,000 ± 240**

Bones from Level G 1 s c/d, Aurignacian III industry assoc.

Frontal section

Gif-2700. La Ferrassie, E 1 **22,500 ± 500**

Bones from Level E 1, Perigordian V industry assoc.

Gif-4265. La Ferrassie, F **22,200 ± 650**

Bones from Level F, Aurignacian III-IV industry assoc.

Gif-4271. La Ferrassie, I 1 **28,700 ± 250**

Bones from Level I 1, Aurignacian III industry assoc.

Gif-4272. La Ferrassie, I 2-I **25,500 ± 250**

Bones from Level I 2, Aurignacian III industry assoc.

Gif-4272bis. La Ferrassie, I 2-11 **6300 ± 100**

Mineral fraction of bones from Level I 2. *Comment:* date shows contamination.

Gif-4273. La Ferrassie, J **26,750 ± 250**

Bones from Level J, Late Aurignacian II industry assoc.

Gif-2427. La Ferrassie, K 3 a **28,800 ± 1500**

Charcoal from Level K 3 a, Aurignacian II industry assoc. *Comment:* undersized sample.

Gif-4274. La Ferrassie, K 2 **27,500 ± 280**

Bones from Level K 2, assoc Aurignacian II industry.

Gif–2428. La Ferrassie, K 2/3 **15,180 ± 130**

Bones from Level K 2/3, assoc Aurignacian II industry.

Gif-4275. La Ferrassie, K 3 b **27,100 ± 320**

Bones from Level K 3 b; assoc Aurignacian II industry.

Gif-4277. La Ferrassie, K 4 **31,300 ± 300**

Bones from Level K 4, assoc Aurignacian II industry.

Gif-4278. La Ferrassie K 5 **≥31,250**

Bones from Level K 5, assoc Late Aurignacian industry.

Gif-2423. La Ferrassie, K 6 **8500 ± 180**

Bones from Level K 6, assoc Aurignacian I industry. *Comment:* date is aberrant.

Gif-4279. La Ferrassie, K 6 **≥35,000**

Bones from Level K 6, assoc Aurignacian I industry.

Gif-4584. La Ferrassie, M 2 e I **≥35,000**

Long bones from Level M 2 e, assoc Mousterian industry.

Gif-4584bis. La Ferrassie, M 2 e II **4270 ± 70**

Carbonate fraction of long bones, Gif-4584. *Comment:* date shows contamination.

Gif-4584 IV. La Ferrassie, M 2 e III **10,800 ± 120**

Organic fraction from long bones, Gif-4584, obtained during first HCl treatment of bones, in order to destroy mineral fraction before extraction of "collagen" fraction.

Gif-4584ter. La Ferrassie, M 2 e IV **≥36,000**

Ethmoid bones from Level M 2 e, assoc Mousterian industry.

Gif-4584V. La Ferrassie, M 2 e V **5820 ± 120**

Carbonate fraction of ethmoid bones, Gif-4584ter.

Gif-4583bis. La Ferrassie, M 2 c I **3300 ± 100**

Carbonate fraction of bones from Level M 2 c. Insufficient collagen for dating; Mousterian industry assoc.

Gif-4583IV. La Ferrassie, M 2 c II **17,800 ± 400**

Organic fraction obtained after first HCl treatment of bones from Level M 2 c, as for Gif-4584IV.

Gif-4583ter. La Ferrassie, M 2 c III **18,040 ± 230**

Total organic fraction obtained after slow destruction of mineral fraction of bones by HCl treatment.

Gif-4585. La Ferrassie, L 3 b I **24,300 ± 400**

Bones from Level L 3 b, assoc Mousterian industry.

Gif-4585bis. La Ferrassie, L 3 b II **18,000 ± 500**

Organic fraction of bones from level L 3 b obtained after first HCL treatment, as Gif-4584IV.

General Comment: some of these dates are too young because of recent contamination of bones *in situ,* which shows importance of this effect on old bones. Thus, all dates might be suspect, yet older age obtained for each

level could be best. Some dates for Aurignacian V, IV, and III are quite coherent with archaeol. Gif-2427 gives good date for charcoal from Aurignacian II level; it is ref age for better chronology of site.

Gif-2418. Gironde estuary **1120 ± 90**

Wood from piece of wreckage in mud, Gironde estuary (45° 30′ N, 0° 20′ W). Coll and subm 1971 by M Colle, Mus Royan, Charente.

Gif-3597. Roquefort, Lugasson, Gironde **3960 ± 140**

Charcoal from Neolithic grave in occupation level of Roquefort site (44° 45′ N, 0° 10′ W). Coll and subm 1975 by J Roussot-Laroque. *Comment:* younger than expected; dated level is attributed to "Civilisation des Matignons" (Middle-Late Neolithic).

Gif-2258. Rhodes II, Arignac, Ariège **12,160 ± 160**

Bones from Hearth 5 in Layer 2, in Rhodes II rockshelter (42° 51′ N, 1° 36′ W). Coll and subm 1971 by R Simmonet, Foix, Ariège. *Comment:* dates assoc industry which corresponds to transition between Late Magdalenian and Azilian culture (Clottes & Simmonet, 1977; Simmonet, 1967).

Gif-2513. Lons, Pyrénées Atlantiques **2100 ± 70**

Charcoal from Barrow 4, Lons (43° 20′ N, 0° 23′ W). Coll 1969 and subm 1972 by J Seigne, Dir Antiquités Hist Aquitaine, Bordeaux. Assoc with artifacts of Hallstatt period. *Comment:* younger than expected.

Gif-2514. Artix, Pyrénées Atlantiques **4170 ± 80**

Charcoal from Barrow 1, Artix (43° 24′ N, 0° 34′ W). Coll 1970 and subm 1972 by J Seigne. *Comment:* dates typical Neolithic ceramics, "Pot de Fleurs," from that region.

Gif-2515. Lescar, Pyrénées Atlantiques **3840 ± 80**

Charcoal from Barrow VI, Lescar (43° 20′ N, 0° 24′ W). Coll 1968 and subm 1972 by J Seigne. *Comment:* same ceramics as Artix.

Gif-2516. Sauvagnon, Pyrénées Atlantiques **3620 ± 80**

Charcoal from Barrow II, Sauvagnon (43° 22′ N, 0° 23′ W). Coll 1970 and subm 1972 by J Seigne. *Comment:* dates assoc Polypod vases.

Port-Leucate series, La Corrège, Aude

Samples from important Cardial site submerged by water, Port-Leucate (42° 50′ N, 3° 00′ E). Coll and subm 1972 by R Montjardin, Sete.

Gif-2747. Port-Leucate Point I A **5410 ± 140**

Carbonized wood.

Gif-2748. Port-Leucate Point I B **3210 ± 110**

Charcoal.

Gif-2749. Port-Leucate Point 2 **5900 ± 140**

Charcoal.

General Comment: good agreement with assoc Cardial Neolithic ceramics. Validity of Sample I B, coll in superficial layer, is questionable.

Settiva series, Petreto-Bicchisano, Corsica

Samples from burial under Bronze age dolmen, Settiva (41° 47′ N, 8° 57′ E). Coll and subm 1972 by R Grosjean, CNRS, Sartène, Corsica.

Gif-2566. Settiva, 1 **2320 ± 100**

Charcoal, 0.5m depth in level with vases.

Gif-2567. Settiva, 2 **1510 ± 100**

Charcoal, 0.4m depth, above level with vases.

Gif-2870. Settiva, 4 **≤90**

Bones from burial.

General Comment: dates re-use of monument and obvious disturbance of site.

Araguina-Sennola series, Bonifacio, Corsica

Charcoal from Early Neolithic site under rockshelter at Araguina-Sennola (41° 23′ N, 9° 10′ E). Coll and subm 1971 by F de Lanfranchi and M C Weiss, Inst Corse Etudes Préhist, Ajaccio (Gagnière *et al,* 1969).

Gif-2324. Araguina-Sennola, Level XVII e **6430 ± 140**

Hearth F 3′, depth 425cm. *Comment:* date agrees with assoc Early Mediterranean Neolithic burial.

Gif-2325. Araguina-Sennola, Level XVII c **6650 ± 140**

Hearth overlying burial, depth 392cm, assoc with Cardial ceramics. *Comment:* same age as Gif-2324, in limits of statistical error.

Gif-2705. Araguina-Sennola, Level XVIII a **8520 ± 150**

Hearth, in level with lithic industry but without ceramics, at 5m depth under Level XVII e.

Syam-Crans series, Jura

Syam-Crans site, S Champagnole (46° 44′ N, 5° 55′ E) was suggested by M Berthier, Conservateur Mus Nat, Paris, as possible site of Alesia Battle of Caesar *vs* Vercingetorix, 52 BC. Charcoal coll and subm 1972 by M Berthier.

Gif-2601. Syam-Crans A **840 ± 90**

Gif-2622. Syam-Crans B **710 ± 90**

General Comment: dates do not support hypothesis.

Syam series, Jura

Samples in pits, from "Grange d'Aufferin" site, Syam (46° 42′ N, 4° 03′ E). Coll and subm 1972 by B Edeine.

Gif-2725. Syam 1 **850 ± 90**

Wood.

Gif-2726. Syam 2 **1200 ± 100**

Charcoal.

General Comment: dates are coherent with assoc ceramics.

Gif–2727. Crans, Jura **980 ± 90**

Charcoal in Tumulus I, Crans (46° 43′ N, 5° 58′ E). Coll and subm 1972 by B Edeine; depth 0.6–0.85m. *Comment:* date does not confirm Roman occupation of site, as expected.

Gif-2301. Boissia, Jura, VI b **1900 ± 90**

Charcoal from Late Hallstatt age, Boissia (46° 34′ N, 5° 45′ E). Coll and subm 1971 by P Pétrequin, Dir Antiquités Préhist Franche-Comté, Besançon. *Comment:* date is younger than expected.

Gif-2639. Besançon, Saint-Paul, Jura **2550 ± 110**

Charcoal from potter's kiln, 6, N III, Besançon (47° 14′ N, 6° 02′ E). Coll and subm 1972 by P Petrequin. *Comment:* good date for Middle Hallstatt of assoc Saint-Paul ceramics. Expected age: 500 to 550 BC.

Gif-2656. Dampierre, Doubs **2740 ± 110**

Charcoal from Late Bronze age settlement site, Dampierre-sur-le-Doubs (47° 29′ N, 6° 46′ E). Coll and subm 1972 by P Pétrequin. *Comment:* date agrees with archaeol (Pétrequin, Urlacher, & Vuaillat, 1969).

Chalain Lake series, Jura

Samples from lacustrine stas, Chalain Lake (46° 40′ N, 5° 47′ E). Coll and subm 1972 and 1977 by P Pétrequin.

Gif-2637. Chalain, No. 1 **4220 ± 140**

Fragment of wood stake, from submerged Sta 1. *Comment:* dates set of ceramics and lacustrine Neolithic village.

Gif-2638. Chalain, No. 2 **4280 ± 140**

Fragment of wood stake, from submerged Sta 2. *Comment:* dates palisade between Neolithic and Late Bronze III villages.

Gif-4369. Chalain, Marigny **4400 ± 110**

Piece of wood from littoral village, Marigny, Ilôt de la Prise d'Eau.

Gif-2553. Grotte de Nevy-sur-Seille, Jura **≥35,000**

Wood from fossil tree trunk, revealed after rocks fell from roof of karstic cave, Nevy-sur-Seille (46° 45′ N, 5° 36′ E). Coll and subm 1972 by P Bichet, Pontarlier.

Spain

La Cueva del Nacimiento series, Pontones, Jaen

Charcoal from La Cueva del Nacimiento, Pontones (38° 05′ N, 2° 18′ W). Coll and subm 1971 by G Rodriguez, Agde, Hérault. Except for Gif-5421 and -5422, coll and subm 1980 by Pilar Lopez, Mus Arquaeol Natl, Madrid.

Gif-2367. La Cueva del Nacimiento, Level A, Layer I, 1 **840 ± 90**

Middle Neolithic level. *Comment:* date conflicts with expected age probably because this superficial level was contaminated.

Gif-5421. La Cueva del Nacimiento, Level A, Layer I, 2 **3990 ± 120**

Middle Neolithic level.

Gif-5422. La Cueva del Nacimiento, Level A, Layer II **5480 ± 120**

Early Neolithic level.

Gif-2368. La Cueva del Nacimiento, Level A, Layer II, 2 **6780 ± 130**

Early Neolithic level.

Gif-3741. La Cueva del Nacimiento, Level B, Layer III **7620 ± 140**

Mesolithic level.

Gif-3742. La Cueva del Nacimiento, Level C, Layer IV **11,200 ± 200**

Late Paleolithic level.

General Comment: precisely dates lasting occupation of site.

Portugal

La Gruta Nova series, Bombarral, Estramadure

Carbonaceous earth from hearths in Mousterian levels, La Gruta Nova (39° 15′ N, 9° 09′ E). Coll and subm 1972 by J Roche, CNRS, Paris.

Gif-2703. La Gruta Nova, Level 16 **26,400 ± 750**

Gif-2704. La Gruta Nova, Level 20 **28,900 ± 950**

General Comment: dates are evidently too young; should be considered lower limit of ages.

Greece

Grotte de Kitsos series, Laurion

Samples from Neolithic Kitsos cave (37° 44′ N, 21° 41′ E). Coll and subm 1972 by N Lambert, CNRS, Paris, to complete study of site (see R, 1974, v 16, p 54–55, for first series).

Gif-2538. Grotte de Kitsos **5950 ± 150**

Charcoal, Ref B II, d9, Level 3.

Gif-2539. Grotte de Kitsos **5840 ± 150**

Charcoal, Ref B I, b 7, Level 4.

Gif-2541. Grotte de Kitsos **5680 ± 150**

Charcoal, Ref B II, c 8, Level 7.

General Comment: dates agree with previous ones.

Dikili Tash series, Macedonia

Charcoal from Middle Neolithic levels of Dikili Tash site (41° 00′ N, 24° 15′ E). Coll and subm 1972 by J Deshayes, Univ Paris I.

Gif-2627. Dikili Tash, DT 1972, No. 1 **6370 ± 170**

2.5m depth.

Gif-2630. Dikili Tash, DT 1972, No. 4 **6720 ± 160**

Gif-2628. Dikili Tash, DT 1972, No. 2 **7020 ± 170**

3m depth.

Gif-2629. Dikili Tash, DT 1972, No. 3 **6250 ± 160**

3m depth; same level as Gif-2628. *Comment:* too young, unexplained result.

General Comment: dates agree with those already obtained for site (R, 1974, v 16, p 53).

Gif-2452. Mallia, Crete **3060 ± 100**

Charcoal from burning level, Mallia (35° 15′ N, 25° 30′ E). Coll and subm 1972 by R Treuil, Ecole Fr Athènes. *Comment:* disagrees with expected age, 1800 BC; unexplained result.

Egypt

Ramses II series

Two samples of wrapping coll 1977 on mummy of Ramses II while at Mus de l'Homme, Paris, for restoration. Subm by L Balout, Inst Anthropol

Humaine, Paris, to establish different ages of two pieces of wrappings, one of which allegedly came from restoration shortly after mummification. Dated wrappings, more or less tinged with yellow-brown, were well-preserved pieces of weaving. Coloring was extracted by repeated pretreatments with chloroform.

Gif-4018. Ramses II, 36 **3040 ± 60**

From bundle of wrappings under heel. *Comment:* cal ca 1340–1370 BC.

Gif-4019. Ramses II, 17 **2840 ± 60**

From bundle of wrappings in abdomen. *Comment:* cal ca 1030–1100 + 70 BC.

General Comment: difference of these samples indicates that mummy was restored shortly after initial inhumation, as expected. Gif-4018 must be taken as ^{14}C age of mummy.

Tunisia

Gif-5115. Bir Oum Ali, Gabès **14,370 ± 110**

Ostrich egg shell from snail midden, at Bir Oum Ali, Gabès. (37° 07′ N, 9° 10′ E). Coll by M Harbi and subm 1976 by G Camps, Aix-en-Provence.

Bir Oum Ali series

Shell (*Helix*) from Capsian site, Bir Oum Ali (34° 07′ N, 9° 10′ E). Coll by M Riaji and subm 1976 by G Camps.

Gif-4057. Level 1 **5600 ± 150**

Gif-4058. Level 2 **8260 ± 180**

Gif-2770. Carthage, TU 34 RL **1640 ± 90**

Wood from coastal wreckage, Carthage (36° 54′ N, 10° 16′ E). Coll by diving and subm 1972 by M Amanieu, Lab Hydrobiol, Montpellier. *Comment:* confirms antiquity of these remains.

Algeria

Gif-5116. Oued Guettarra Cave, Bredia **6810 ± 330**

Human bones from cave of Oued Guettarra (35° 46′ N, 0° 48′ W). Coll 1968 and subm 1979 by G Camps. *Comment:* dates early Neolithic age in Algeria.

Tahabort, Ahaggar series

Charcoal from protohistoric site, Tahabort (23° 05′ N, 7° 53′ E), Ahaggar massif, 2000m alt, allegedly last occupation in region by "Isabaten" people. Coll by Fr-Am mission and subm 1973 by J P Maître, LAPEMO, Aix-en-Provence.

Gif-2900. No. 519/524 **2560 ± 100**

0.2 to 0.5m depth.

Gif-3324. No. 105 **1110 ± 100**

0 to 0.1m depth.

Gif-2898. No. 110/111 **1050 ± 100**

0 to 0.1m depth.

Gif-3325. No. 518 **930 ± 100**

0 to 0.1m depth.

Gif-3258. No. 517 **570 ± 90**

0.10 to 0.2m depth.

General Comment (JPM): recent contamination of last two samples is possibly due to animal burrows.

Gif-3408. Hassi Menikel **5810 ± 150**

Ostrich egg shell from Neolithic surface site, Hassi Menikel. Coll and subm 1973 by G Aumassip, CRAPE, Alger.

Gif-3409. "Le Signal" **6080 ± 150**

Ostrich egg shell from Neolithic surface site, Le Signal (31° 25′ N, 4° 44′ E), Sahara. Coll and subm 1973 by G Aumassip.

Gif-3410. Ouhadia **4490 ± 140**

Ostrich egg shell from Neolithic surface site, Ouhadia. Coll and subm 1973 by G Aumassip.

Gif-3411. Saf Saf Wadi **5390 ± 140**

Ostrich egg shell from Neolithic surface site, Saf Saf Wadi (29° 56′ N, 3° 58′ E). Coll and subm 1973 by G Aumassip.

Ouargla series

Ostrich egg shell in open-air surface sites, N Ouargla (32° 02′ N, 5° 15′ E). Coll and subm 1972 by G Aumassip.

Gif-2649. "Les Burins" **6950 ± 170**

Gif-2650. Site 7205 **7090 ± 170**

Gif-2651. Site 7206 **6680 ± 170**

Gif-3412. Site 7207 **7070 ± 170**

Gif-3413. No. AU 731 **7560 ± 170**

General Comment: dates agree well with expected ages; industry assoc with Epipaleolithic age in region.

Gif-2600. Iherir **7130 ± 170**

Pieces of straw in wall from ruins of bldg, Iherir, Tassili-n-Ajjer (25° 24′ N, 8° 25′ E). Coll and subm 1972 by H Lhote. *Comment:* date is surprising and unexplained.

Morocco

Gif-2420. Bouskour **1240 ± 90**

Wood from ancient copper mine, Bouskour. Coll and subm 1972 by M Saadi Moussa, Service Mines, Rabat, Morocco.

Gif-2560. Souk Jema el Gour **1310 ± 90**

Charcoal from Berber protohistoric tomb, Souk Jema el Gour (33° 51′ N, 5° 18′ W). Coll 1960 and subm 1972 by G Camps, Univ Provence, Aix-en-Provence.

Gif-2652. Tarfaya **2790 ± 110**

Ostrich egg shell with antelope engraving, from site on dune, near Tarfaya (27° 51′ N, 12° 31′ W). Coll and subm 1972 by D Grebenart, LAPEMO, Aix-en-Provence. *Comment:* does not confirm Epipaleolithic age expected from part of industry.

Mauritania

Drayja Malichigdane series

Samples from Neolithic sites on dunes, near Akjoujt (19° 19′ N, 14° 30′ W). Coll and subm 1972 by J P Carbonnel, Univ Paris VI.

Gif-2550. MAU 72-25 **2030 ± 100**

Organic remains in ceramic vessels.

Gif-2551. MAU 72-44 **3120 ± 110**

Human bones.

Gif-2552. MAU 72-46 **4850 ± 130**

Organic remains in ceramic vessels.

Gif-2769. Chigettomi, R'Kiz Massif **1400 ± 90**

Human bones from Medieval site under rock shelter (17° 25′ N, 10° 26′ W). Coll and subm 1973 by Richir, French Archeol Mission in Mauritania, Bordeaux. *Comment:* date indicates pre-Islamic site, as expected.

Senegal

Dioron Boumak series

Samples from Shell Midden C in Saloum delta (13° 50′ N, 16° 30′ W). Accumulation of shells (mainly *Arca senilis*) in this part of delta forms artificial island, surface 10ha. Coll and subm 1972 by C Descamps, Fac Sci, Perpignan.

Gif-2712. Dioron Boumak **1270 ± 90**

Otholites, 1.5m depth.

Gif-2711. Dioron Boumak **810 ± 90**

Human bones, 1.7m depth.

Gif-2713. Dioron Boumak **850 ± 90**

Charcoal, 2.2m depth.

General Comment: Gif-2712 is corrected for $\delta^{13}C$ but not for apparent age of sea water; thus, it appears too old. Dates agree with very rapid accumulation rate of these shells, which was measured 10m in 500yr in another part of island (Descamps, Thilmans, & Thommeret, 1974).

Gif-2508. N'Dalane **4770 ± 120**

Charcoal from Neolithic site of N'Dalane, at 330 to 360cm depth. Coll and subm 1971 by Cyr Descamps.

Niger

Tezamak series, Aïr

Charcoal from ruins of Tezamak, 50km N-NE of Agadez. Coll and subm 1974 by H Lhote, Mus Homme, Paris.

Gif-3525. Tezamak 1 **400 ± 80**

In refuse pit.

Gif-3526. Tezamak 2 **330 ± 80**

In blacksmith hearth.

Gif-3527. Aghroum Balkarène, Aïr **200 ± 80**

Charcoal in refuse pit from ruins of village, Aghroum Balkarène, 32km ENE of Agadez (17° 00′ N, 7° 56′ E). Coll and subm 1974 by H Lhote.

Gif-3522. Anisamane, Aïr **230 ± 80**

Charcoal in cooking pot with food remains, from ruins of Anisamane, 31km NW of Agadez. Anisamane was ancient capital of Aïr. Coll and subm 1974 by H Lhote.

Tadeïni series, Aïr

Charcoal from blast furnace in Medieval village, Tadeïni, 15km E of Jola, Aïr. Coll and subm 1974 by H Lhote.

Gif-3523. Tadeïni 1 **250 ± 80**

Gif-3524. Tadeïni 2 **350 ± 80**

Tadeliza series

Charcoal from ruins of citadel, Tadeliza, Aïr (17° 05′ N, 8° 03′ E). Coll and subm 1972 by H Lhote.

Gif-2593. Tadeliza, surface **510 ± 90**

Gif-2594. Tadeliza **720 ± 90**

30 to 40cm depth.

General Comment: dates agree with expected age.

Marandet series

Charcoal from forge workshops, Marandet, Aïr (16° 23′ N, 7° 25′ E). Coll and subm 1972 by H Lhote.

Gif-2595. Marandet, Site A **1430 ± 100**

Gif-2596. Marandet, Site D **1360 ± 100**

20 to 40cm depth.

Gif-2597. Marandet, Site D **1310 ± 100**

100 to 150cm depth.

Gif-2598. Marandet, Site O **1160 ± 100**

5 to 20cm depth.

Gif-2599. Marandet, Site G **1420 ± 100**

25cm depth.

General Comment: this important forge where 30,000 crucibles were found, is dated to 6th century AD.

Gif-3516. Tiguermaouine, Aïr **4220 ± 110**

Charcoal near skeleton of woman dressed in leather with child, in Neolithic site, Tiguermaouine, 30km N of Arlit (17° 00′ N, 7° 56′ E). Coll and subm 1974 by H Lhote.

Gif-3517. Taoulaoualt, Aïr **4150 ± 110**

Charcoal with ceramics in Neolithic kiln, Taoulaoualt, similar to those found at Arlit. Coll and subm 1974 by H Lhote.

Arlit series, Aïr

Samples from Neolithic sites of Arlit (18° 44′ N, 7° 43′ E). Coll and subm 1973–1974 by H Lhote.

Gif-2933. Arlit 2 **4650 ± 130**

Charcoal, scattered in ground, 1.5m depth.

Gif-2934. Arlit 3 **5240 ± 140**

Charcoal, 1.5m depth.

Gif-2935. Arlit 4 **2290 ± 110**

Piece of carbonized wood, Sq I, 1.65m depth.

Gif-2937. Arlit 5 **4040 ± 110**

Mussel shell fragments, Sq III, between surface and 1m depth.

Gif-3057. Arlit **5380 ± 130**

Organic matter from habitation soil, 1.92 to 1.97m depth, in contact with skeleton.

Gif-3518. Arlit I **4840 ± 130**

Charcoal, 1.8 to 2.2m depth.

Gif-3519. Arlit II **4960 ± 130**

Charcoal between surface and 1m depth.

Gif-3521. Arlit IV **4950 ± 150**

Bone fragments, Sq 25–27, between surface and 1m depth.

General Comment: mussel shells indicate existence of permanent rivers in present desert and abundant lithic and ceramic industries indicate important human occupation; also, favorable climatic conditions between 4000 and 5000 BP in Arlit region.

Gif-2938. Ifanghalene, Aïr **3410 ± 100**

Mussel shells from Ifanghalene, 5km W of Arlit. Coll and subm 1973 by H Lhote.

Gif-2936. Tibakaratin, Aïr **4540 ± 130**

Charcoal from Neolithic site of Tibakaratin, SW of Arlit. Coll and subm 1973 by H Lhote.

Gif-2939. In-Gall **≥38,000**

Carbonized wood, found during well digging, In-Gall region (16° 51′ N, 7° 01′ E), 40m depth. Subm 1973 by H Lhote.

Chad

Koro Toro series

Charcoal from Iron age mounds in Koro Toro region. Coll and subm 1972–73–77 by F Treinen-Claustre, CNRS, Toulouse.

Gif-2613. Nemra **730 ± 90**

0.1 to 0.3m depth (16° 17′ N, 18° 33′ E), from Late Iron age.

Gif-2611. Bochianga 5A **1500 ± 100**

0.8m depth at Bochianga (16° 06′ N, 18° 26′ E).

Gif-2612. Bochianga 5B **1500 ± 100**

1.35m depth.

Gif-2895. Bahali **630 ± 90**

0.15 to 0.2m depth at Bahali (16° 13′ N, 18° 26′ E).

Gif-4201. Bahali, Site 110 **1540 ± 90**
0.2m depth.

Gif-2896. Toungour Salado **1340 ± 100**
0.3m depth.

Gif-4202. Kebir Rosa A, Site 34 **2360 ± 100**
0.1 to 0.15m depth, Kebir Rosa (16° 05′ N, 18° 45′ E).

Gif-4193. Kebir Rosa B, Site 34 **1480 ± 100**
0.15 to 0.2m depth.

Gif-4199. Koro Toro A, Site 4 **1170 ± 90**
0.1 to 0.15m, Koro Toro (16° 05′ N, 18° 45′ E) from iron workshop on mound.

Gif-4198. Koro Toro B, Site 4 **1230 ± 100**
0.35m depth.

Gif-4194. Koro Toro C, Site 4 **1580 ± 100**
0.8m depth.

Gif-4195. Koro Toro E, Site 4 **1400 ± 100**
2.2m depth.

Gif-4196. Krimé A, Site 3 **670 ± 100**
0.3m depth, Krimé (15° 05′ N, 18° 28′ E) from iron workshop on mound.

Gif-4197. Krimé B, Site 3 **1410 ± 100**
1m depth.

Gif-4200. Goz Kerki, Site 97 **1250 ± 90**
0.2m depth.

General Comment: dates Iron age in Chad; oldest site dated to 5th century BC.

Messo series

Charcoal from habitation mound, Messo, site of type Sao III, 58km NNW of Fort-Lamy (12° 10′ N, 14° 59′ E). Coll and subm 1973 by J P Lebeuf, CNRS, Paris.

Gif-2784. Messo, Pt III, Level 2 **260 ± 90**
0.6m depth.

Gif-2786. Messo, Pt III, Level 8 **320 ± 90**
2.5m depth.

Gif-2785. Messo, Pt III, Level 9 **320 ± 90**

2.7m depth.

Gif-2787. Messo, Pt IV **Modern**

0.5m depth beside skeleton. *Comment:* recent burial in archaeol site.

Cameroon

Sou series

Charcoal from habitation mound, Sou, site of type Sao II (12° 12′ N, 14° 42′ E), Logone-et-Chari. Coll and subm 1977–1979 by J P Lebeuf, M D Lebeuf, and J Rapp.

Gif-4150. Sou, Pt I, 103 **150 ± 80**

1.7m depth.

Gif-4149. Sou, Pt I, 118 **580 ± 80**

1.9m depth.

Gif-4152. Sou, Pt II, 392 **520 ± 80**

0.5m depth.

Gif-4148. Sou, Pt III, 102 **Modern**

0.6m depth.

Gif-4151. Sou, Pt XI, 330 **650 ± 80**

Level II.

Gif-4504. Sou, Pt XI, 1221 **620 ± 80**

Under Gif-4151.

Gif-4932. Sou, Pt XI, 1756 **850 ± 90**

4.2m depth.

Gif-4933. Sou, Pt XX, 1732 **1340 ± 90**

7.3m depth.

Sou Blame Radjil series

Charcoal from habitation mound, Sou Blame Radjil, site of type Sao I (12° 13′ N, 14° 42′ E). Coll by J Rapp and subm 1978 by J P Lebeuf.

Gif-4820. Sou Blame, 168-6 **500 ± 60**

Level 1a, 0.49m depth.

Gif-4821. Sou Blame, 114 **2340 ± 1100**

Level 3a, 2.78m depth.

Gif-4934. Sou Blame, 168-329 **2800 ± 110**

Level 6, 4m depth.

General Comment: dates agree well with other results for Sou Blame: for Level 3a, 2310 ± 150: Ly-2003, 2280 ± 170: Ly-2004, and for Level 4/5, 2530 ± 120: Ly-2005 (R, 1983, v 25, p 91). Dates from Sou Blame, Sou and Masso mounds, as well as previous results from similar mound, Mdaga (R, 1972, v 14, p 294) establish chronology of Sao culture from 9th century BC to 19th century AD.

Argentina

Quimili Paso series

Charcoal from Quimili Paso site, Prov Santiago del Estero (28° 30′ S, 63° W). Coll 1968 and subm 1971 by A M Lorandi, Mus Ciencas Nat, La Plata. Ceramics belong to Middle Sunchituyoj culture.

Gif-2308. Quimili Paso, QP SICI, 2 **670 ± 60**

At depth 0.3cm.

Gif-2309. Quimili Paso, QP SICI, 3 **730 ± 60**

At depth 0.45cm.

Gif-2310. Quimili Paso, QP SICI, 4 **590 ± 60**

At depth 0.6cm.

General Comment: dates are consistent with archaeol data.

Brazil

Gif-3223. Toca do Gongo, Piaui **2090 ± 110**

Charcoal from Burial 3 in rock shelter, Toca do Gongo (9° S, 42° W). Coll by N Guidon and subm 1974 by A Emperaire, CNRS, Paris.

Gif-3225. AQN, Piaui **1690 ± 110**

Charcoal from AQN village (9° S, 42° W), level 20 to 30cm depth. Coll by N Guidon and subm 1974 by A Emperaire.

Gif-3909. Toca do Bananeira, Goias **740 ± 90**

Charcoal from rock shelter Toca do Bananeira (15° 57′ S, 50° 07′ W), 200km from Brasilia. Coll and subm 1976 by A Emperaire. Assoc with fine industry of chipped stones.

Gif-3910. Gruta do Salitre, Goias **1230 ± 90**

Charcoal in cave, Gruta do Salitre (15° 57′ S, 50° 07′ W), 200km from Brasilia. Coll and subm 1976 by A Emperaire. Assoc with fine industry of chipped stones.

Lapa Vermelha IV series, Minas Gerais, Lagoa Santa

Charcoal samples from rockshelter site of Lapa Vermelha IV (19° 40′ S, 43° 54′ W) (Laming-Emperaire, 1979). Coll and subm 1972–73–75–76 by A Laming-Emperaire. Shelter's walls are covered with many rupestral paintings and engravings.

Gif-2735. Lapa Vermelha IV, base, Level I, 2001 **320 ± 80**

At depth 0.2m; corresponds to appearance of ceramics, in Lagoa Santa region.

Gif-2732. Lapa Vermelha IV, B, 1008 **300 ± 110**

At depth 1.15m.

Gif-2733. Lapa Vermelha IV, B, 1019 **3740 ± 110**

At depth 1.5m.

Gif-2545. Lapa Vermelha IV, A, 2010 **3720 ± 120**

Gif-2734. Lapa Vermelha IV, B, 1025 **3660 ± 110**

At depth 2.1m.

Gif-2543. Lapa Vermelha IV, C, 1099 **4170 ± 120**

At depth 4.35m, Level 7.

Gif-2544. Lapa Vermelha IV, C, 3019 **4400 ± 120**

At depth 5m.

Gif-3222. Lapa Vermelha IV, Unit 23 F **1620 ± 100**

Base level B.

Gif-3220. Lapa Vermelha IV, Unit 25 B **1880 ± 140**

Surface.

Gif-3211. Lapa Vermelha IV, Unit 24 D **3260 ± 110**

Gif-3219. Lapa Vermelha IV, Unit 24 E **3430 ± 130**

Base level C.

Gif-3221. Lapa Vermelha IV, Unit 25-26-27 DEF **3070 ± 110**

Level D.

Gif-3218. Lapa Vermelha IV, Unit 24 D **3370 ± 110**

Base level D.

Gif-3210. Lapa Vermelha IV, Unit 25-26 EF **3580 ± 130**

Level E, Hearth 8.

Gif-3209. Lapa Vermelha IV, Unit 25 E **3750 ± 110**

Level E, Hearth 9.

Gif-3213. Lapa Vermelha IV, Unit 24-25 DC **4550 ± 130**

Level F.

Gif-3215. Lapa Vermelha IV, Unit 25 CD **4350 ± 120**

Level G, 1st layer.

Gif-3214. Lapa Vermelha IV, Unit 25 CD **5120 ± 130**
Level G, 3rd layer, in hearth.

Gif-3216. Lapa Vermelha IV, Unit 24-25 DCB **8490 ± 160**
Level H.

Gif-3217. Lapa Vermelha IV, Unit 25 BC **6950 ± 140**
Level I.

Gif-3207. Lapa Vermelha IV, Unit 33 D **6830 ± 150**
At depth 9.65m.

Gif-3907. Lapa Vermelha IV, Unit 32 B, 1975–87 **5400 ± 500**
At depth 12.95 to 13.15m; undersized sample.

GIF-3208. Lapa Vermelha IV, Unit 33 C **9580 ± 200**
At depth 10.3 to 10.8m.

Gif-3727. Lapa Vermelha IV, Unit 32-33, 1975-28 **10,200 ± 220**
At depth 11.7 to 11.9m.

Gif-3726. Lapa Vermelha IV, Unit 27-28-29 BA, 1975-48 **11,680 ± 500**
At depth 11.7m; undersized sample.

Gif-3906. Lapa Vermelha IV, Unit 32 B, 1975-48 **12,960 ± 300**
At depth 12.6 to 12.8m, in red sediment.

Gif-3905. Lapa Vermelha IV, Unit 32-33 BA, 1975-121 **15,300 ± 400**
At depth 13.55 to 14.5m.

Gif-3725. Lapa Vermelha IV, Unit 32-33 CB, 1975-14 **≥25,000**
At depth 11.7 to 11.8m, in yellow sediment. *Comment:* undersized sample; result may be less reliable than others.

Gif-3908. Lapa Vermelha IV, Unit 32-33 B **22,410 ± 400**
At depth 12.6 to 13.55m, in yellow sediment. *Comment* (AP): very interesting date but obtained with some mixed samples not very well identified. However, confirms antiquity of site.

General Comment: evidence of human occupation in all levels of site; presence of human skull at depth 12.9m.

Almeida series, Piraju

Charcoal samples from hearths in open-air site, Almeida (23° 10′ S, 49° 21′ W). Coll by L Pallestrini and subm 1973 by A Emperaire.

Gif-2730. Almeida, Hearth A **930 ± 90**

Gif-2731. Almeida, Hearth B **1700 ± 100**

Gif-2738. Fazenda, Minas Gerais 1971, Mangueira 4045 Lagoa Santa **4670 ± 130**

Charcoal from human occupation level, depth 0.9 to 1m, Minas Gerais (20° S, 44° W). Coll 1971 by A Prous-Poirier and subm 1973 by A Emperaire.

Gif-2737. Caieras, Minas Gerais 1971, 4010 Lagoa Santa **9500 ± 200**

Charcoal from rockshelter site of Caieras with rupestral paintings (19° 32′ S, 44° 04′ W). Coll 1971 by A Prous-Poirier and subm 1973 by A Emperaire.

Gif-2546. Piraju, Sao Paulo **3600 ± 120**

Charcoal from preceramic level just underlying ceramic level, 80 to 100cm depth, Piraju (23° 33′ S, 49° 39′ W). Coll 1971 by L Pallestrini and subm 1972 by A Emperaire.

Itapiranga series, Santa Catarina

Charcoal from Sec 1, Itapiranga (27° 11′ S, 53° 45′ W). Coll 1968 by J A Rohr and subm 1972 by A Emperaire.

Gif-2548. Itapiranga 1-C **7600 ± 160**

At depth 5.3m.

Gif-2547. Itapiranga 1-B **7560 ± 160**

At depth 6m.

Gif-2542. Itapiranga 1-A **8640 ± 180**

At depth 7.3m.

Peru

Tellarmachay series, Central Andes

Charcoal from rock shelter, Tallarmachay (11° 10′ S, 75° 50′ W). Coll and subm 1974–1975 by D Lavallée and M Julien, Mus Homme, Paris.

Gif-3481. Tellarmachay **3370 ± 180**

At depth 50 to 70cm; preceramic level. *Comment:* undersized sample.

Gif-3482. Tellarmachay **4400 ± 200**

At depth 70 to 130cm; preceramic level. *Comment:* undersized sample.

Gif-3772. Tellarmachay, Level II b **2190 ± 100**

Level with "Formative" ceramics.

Gif-3773. Tellarmachay, Level II c **2280 ± 100**

Level with "Formative" ceramics.

Gif-3774. Tellarmachay, Base level II c **2120 ± 100**

Level with "Formative" ceramics.

General Comment: dates "Formative ceramics" period.

Gif-3483. Ccollpa, Central Andes **2100 ± 150**

Charcoal from rock shelter, Ccollpa (11° 12′ S, 75° 50′ W), alt + 4100m, depth 25 to 30cm. Coll and subm 1975 by M Julien. Early level with ceramic occupations. *Comment:* corresponds to age for "Formative" at Tellarmachay.

Tantamayo series, Huamalies, Huanuco

Charcoal assoc with lithic industry from preceramic site with stone houses, Tantamayo region (9° 05′ S, 79° W). Coll 1970 and subm 1971 by L Girault, Mus Homme, Paris.

Gif-2306. Tantamayo 15 **3910 ± 130**

Charcoal from Layer 2.

Gif-2302. Tantamayo 2 **3930 ± 130**

Charcoal from Layer 3.

Gif-2305. Tantamayo 12 **3880 ± 130**

Charcoal from Layer 3.

Gif-2303. Tantamayo 5 **4030 ± 130**

Charcoal from Layer 4.

Gif-2304. Tantamayo 7 **4050 ± 130**

Charcoal from Layer 4.

General Comment: dates stage of preceramic culture in Andean region of Peru.

GEOLOGIC SAMPLES

Peat Bogs

France

Somme Valley series, Somme

Freshwater peat from cores in sediment of valley. Coll and subm 1975 by M F Huault, Univ Rouen. Alts related to present msl.

Gif-3705. Roudray, R 29 **1960 ± 100**

+2.10m (50° 06′ N, 1° 32′ E). Pollen zone: Sub-atlantic.

Gif-3706. Roudray, R 40 **5120 ± 120**

+1.30m (50° 06′ N, 1° 32′ E). Pollen zone: Sub-atlantic. *Comment:* strongly disagrees with expected age.

Gif-3707. Erondelle, E 35 **5820 ± 120**

+5.50m (50° 03′ N, 1° 27′ E). Pollen zone: beginning of Sub-atlantic. *Comment:* much older than expected.

Gif-3708. Erondelle, E 40 **3490 ± 100**

+5m (50° 03′ N, 1° 27′ E). Pollen zone: end of Sub-boreal.

Gif-3945. Avranches, Manche, 2740 **2320 ± 90**

Peaty clay from core 2470, (48° 42′ N, 1° 21′ W), −3.80m. Pollen zone: Atlantic-Sub-boreal limit. *Comment:* disagrees strongly with expected age.

Gif-3946. Avranches, Manche, 2451 **3410 ± 100**

Peaty clay from core 2451, −2.20m. Pollen zone: Sub-boreal.

Gif-3947. Pontorson, Manche, 2480 **3100 ± 100**

Freshwater peat, from core 2480 (48° 34′ N, 1° 30′ W), +4.80m. Pollen zone: Sub-atlantic.

Gif-3948. Pontorson, Manche, 2491 **5140 ± 120**

Plant remains in clay, from core 2491, +3.80m. Pollen zone: Sub-boreal.

Gif-2955. Wathiéhurt, Cayeux, Somme **7540 ± 140**

Peat from lower part of Quaternary deposits (50° 11′ N, 1° 30′ E), −10m. Coll and subm 1973 by P Broquet, Fac Sci, Amiens.

Seine Valley series, Seine Maritime

Samples from cores in valley and paleovalley of Seine R; subm 1973 by M F Huault. Alts are related to present msl.

Gif-2761. Core 22 A, 768 **8200 ± 160**

Clayey peat, −16.72m. Pollen zone: end Boreal/beginning of Atlantic. *Comment:* date disagrees with palynology.

Gif-2762. Core 35 B, 820 **7270 ± 140**

Saltwater peat, −14.60m. Pollen zone: Atlantic.

Gif-2763. Core 4 A, 3 **7780 ± 150**

Clayey peat, −12.30m. Pollen zone: Boreal/Atlantic limit; *Pinus* 34%.

Gif–2764. Core 37 A, 6 **9400 ± 170**

Clayey peat, −13.20m. Pollen zone: Boreal; *Pinus* 97%.

Gif-2875. Core 5 A, 2 **7680 ± 150**

Saltwater peat, −16.50m. Pollen zone: Boreal/Atlantic limit.

General Comment: dates agree with palynology, except for Gif-2761, which is too old. Gif-2762 and -2875, saltwater peat, provide good indications on sea level at 7270 and 7680 BP.

Bures-sur-Dives series, Calvados

Marsh in Dives estuary (49° 12′ N, 0° 10′ W). Coll and subm 1974 by M F Huault. Alts related to present msl.

Gif-3351. Bures-sur-Dives, 1402 **3100 ± 100**

Saltwater peat, +0.50m. Pollen zone: beginning of Sub-atlantic.

Gif-3352. Bures-sur-Dives, 1404 **3020 ± 100**

Freshwater peat, −1.20m. Pollen zone: end of Sub-boreal.

Gif-3353. Bures-sur-Dives, 1406 **6220 ± 140**

Saltwater peat, −3.20m. Pollen zone: end of Atlantic.

General Comment: presence of freshwater peat at −1.2m indicates short regression during Flandrian transgression, dated 3020 BP.

Orne estuary series, Calvados

Freshwater peat from core in sediment of Orne Valley, Hérouville (49° 06′ N, 2° 39′ W). Coll and subm 1975 by M F Huault. Alts related to present msl.

Gif 3747. Hérouville, 2355 **3260 ± 100**

−1.90m. Pollen zone: Sub-boreal.

Gif-3495. Hérouville, 2373 **5250 ± 120**

−3.50m. Pollen zone: Atlantic Sub-boreal limit.

Gif-3496. Hérouville, 2380 **5350 ± 120**

−4.40m. Pollen zone: Atlantic. *Comment:* date is too young for Atlantic zone.

Gif-3916. Genets II, Mont Saint-Michel Bay **8890 ± 160**

Peaty sand from soil, under dune, near Genêts (48° 41′ N, 1° 28′ W). Coll and subm 1976 by JP Lautridou, Centre Géomorphol, CNRS, Caen. *Comment:* does not confirm expected Alleröd age.

Gif-3917. Lingreville, Manche **3660 ± 110**

Charcoal from hearth, at depth 1.20m, in sequence of sand and peat (48° 57′ N, 1° 31′ W). Coll and subm 1976 by J P Lautridou.

Eastern Pyrénées

Results establish chronology of late glacial and postglacial vegetational and climatic stages (Jalut, 1974).

Fournas Brook series, Ariège

Bog along brook, Laurent Mts (42° 42′ N, 2° 03′ E). Alt +1510m. Coll and subm 1972 by G Jalut, Lab Bot, Fac Sci Toulouse.

Gif-2441. Palyn 36 **Modern**

Peat from 20 to 30cm depth.

Gif-2440. Palyn 37 **5590 ± 120**

Peat from 160 to 170cm depth. Pollen zone: Atlantic.

Gif-2439. Palyn 38 **6200 ± 130**

Organic debris in silty sediment, from level 200 to 210cm depth. Corresponds to important phase of deforestation. Pollen zone: Atlantic.

Gif-2438. Palyn 39 **5510 ± 120**

Silty sandy sediment, from 260 to 270cm depth. Pollen zone: Atlantic. *Comment:* date indicates recent contamination of sample.

General Comment: human influence on vegetation becomes perceptible from end of Atlantic in upper Têt Valley.

Laurenti Brook series, Ariège

Bog along brook (42° 04′ N, 2° 01′ E). Alt +1860m, E Pyrénées. Coll and subm 1972 by G Jalut.

Gif-2466. Palyn 40 **4800 ± 130**

Peat from 90 to 100cm depth. Pollen zone: beginning of Sub-boreal.

Gif-2467. Palyn 41 **6080 ± 140**

Peat from 190 to 200cm depth. Pollen zone: Atlantic.

Gif-2468. Palyn 42 **8230 ± 180**

Peat from 270 to 280cm depth. Pollen zone: beginning of Boreal.

Gif-2469. Palyn 43 **9250 ± 190**

Peat from 320 to 330cm depth. Pollen zone: Pre-boreal.

Gif-2470. Palyn 44 **8990 ± 190**

Peaty clay from 360 to 370cm depth. Pollen zone: Alleröd. *Comment:* date disagrees with palynology.

La Moulinasse II series, Aude

Bog at N side of Jau Col (42° 42′ N, 2° 14′ E). Alt +1380m. Coll and subm 1972 by G Jalut.

Gif-2657. Palyn 45 **1750 ± 100**

Peat from 120 to 130cm depth. Pollen zone: Sub-atlantic. First appearance of cultivation.

Gif-2658. Palyn 46 **3560 ± 110**

Peat from 200 to 210cm depth. Pollen zone: Sub-boreal.

Gif-2659. Palyn 47 **7420 ± 160**

Peat from 220 to 230cm depth. Pollen zone: beginning of Boreal. *Comment:* date disagrees with palynology; probably contaminated during sampling.

Gif-2660. Palyn 48 **7420 ± 160**

Peat from 250 to 260cm depth. Pollen zone: beginning of Pre-boreal. *Comment:* same as Gif-2659.

Gif-2661. Palyn 49 **7500 ± 160**

Peat from 300 to 310cm depth. Pollen zone: Pre-boreal. *Comment:* same as Gif-2659.

Gif-2662. Palyn 50 **12,140 ± 240**

Organic sand from 330 to 340cm depth. Pollen zone: end of Older Dryas.

Nohèdes series, E Pyrénées

Above glacial moraine (42° 38′ N, 2° 14′ E), alt +1680m, in Bassin de La Têt R. Coll and subm 1973 by G Jalut.

Gif-2982. Palyn 52 **920 ± 100**

Peat from 30 to 34cm depth. Pollen zone: Sub-atlantic.

Gif-2983. Palyn 53 **3020 ± 100**

Organic clay from 50 to 52cm depth. Pollen zone: Sub-boreal.

Gif-2984. Palyn 54 **4540 ± 130**

Clayey sandy sediment from 74 to 76cm depth. Pollen zone: Sub-boreal.

Gif-2985. Palyn 55 **7920 ± 500**

Clayey sandy sediment from 82 to 84cm depth. Pollen zone: Atlantic. *Comment:* undersized sample.

Gif-2986. Palyn 56 **9800 ± 100**

Sandy sediment from 107 to 109cm depth. Pollen zone: Pre-boreal.

Capvern series, Hautes Pyrénées

Bog (43° 06′ N, 0° 01′ E), alt +590. Coll and subm 1976 by G Jalut.

Gif-3801. Palyn 57 **390 ± 80**

Silty peat from 35 to 57cm depth. Pollen zone: Sub-atlantic.

Gif-3802. Palyn 58 **860 ± 90**

Silty peat from 119 to 121cm depth. Pollen zone: Sub-atlantic.

Ossun series, Hautes Pyrénées

Bog (43° 10′ N, 0° 03′ W), alt +375m. Coll and subm 1976 by S Omer and G Jalut.

Gif-3803. Palyn 59 **630 ± 80**

Peaty clay from 51 to 59cm depth. Pollen zone: Sub-atlantic.

Gif-3804. Palyn 60 **470 ± 90**

Peaty clay from 102 to 106cm depth. Pollen zone: Sub-atlantic.

Lhers Pond series, Ariège

Pond (42° 48′ N, 1° 20′ E), alt +1274m. Coll and subm 1976 by J V Kenla and G Jalut.

Gif-3911. Palyn 61 **750 ± 90**

Peat from 58 to 60cm depth. Pollen zone: Atlantic.

Gif-3912. Palyn 62 **1260 ± 90**

Peat from 148 to 150cm depth. Pollen zone: Sub-atlantic.

Gif-3913. Palyn 63 **2400 ± 110**

Peat from 200 to 202cm depth. Pollen zone: Sub-atlantic.

Gif-3914. Palyn 64 **2600 ± 110**

Peat from 249 to 251cm depth. Pollen zone: Sub-atlantic.

Gif-3915. Palyn 65 **5360 ± 140**

Peat from 260 to 261cm depth. Pollen zone: Sub-boreal.

General Comment: observed discontinuity of sedimentation between 250 and 260cm explains difference between ages for these levels.

Pla de Soulcem series, Ariège

Bog (42° 40′ N, 1° 26′ W), alt +1525m. Coll and subm 1977 by G Jalut.

Gif-4385. Palyn 66 **1160 ± 90**

Peaty sediment from 130 to 140cm depth.

Gif-4587. Palyn 67 **2180 ± 90**

Peaty sediment from 172 to 182cm depth.

Gif-4386. Palyn 68 **3320 ± 100**

Peaty sediment from 172 to 182cm depth.

General Comment: abundance of herbs and *Abies* indicate that deforestation was almost total by 3320 BP (Jalut, 1981).

Pla de Labinas series, Ariège

(42° 38′ N, 1° 26′ W), alt +1010m, Soulcem Valley. Coll and subm 1978 by G Jalut.

Gif-4805. Palyn 69 **Modern**

Peaty sediment from 15.5 to 17.5cm depth.

Gif-4806. Palyn 70 **330 ± 90**

Clayey peat from 29.5 to 30.5cm depth.

Gif-4807. Palyn 71 **610 ± 90**

Peat from level 50 to 51cm depth.

Gif-4808. Palyn 72 **1430 ± 90**

Peaty clay from base, 64 to 65cm depth.

General Comment (GJ): samples are from levels where pollen was especially abundant. This is explained by erosion due to intensive deforestation at these dates.

Pla de Crouts series, Ariège

(42° 40′ N, 1° 26′ W), alt +1850m. Coll and subm 1978 by G Jalut.

Gif-4809. Palyn 73 **500 ± 90**

Sandy peat from 19 to 20cm depth.

Gif-4810. Palyn 74 **1960 ± 100**

Sandy peat from 40 to 41cm depth.

Pinet series, Sault, Aude

(42° 52′ N, 1° 58′ E), alt +880m. Coll and subm 1972 by G Jalut.

Gif-2446. Palyn 31 **3680 ± 100**

Peat from 40 to 50cm depth. Pollen zone: Sub-boreal.

Gif-2445. Palyn 32 **4530 ± 110**

Peat from 100 to 110cm depth. Pollen zone: Sub-boreal.

Gif-2444. Palyn 33 **7350 ± 140**

Peat from 290 to 300cm depth. Pollen zone: beginning of Atlantic.

Gif-2443. Palyn 34 **8420 ± 150**

Peat from 400 to 410cm depth. Pollen zone: transition Pre-boreal/ Boreal.

Gif-2442. Palyn 35 **9160 ± 170**

Gray clay from 420 to 430cm depth. Pollen zone: Pre-boreal.

General Comment: results agree with expected ages from pollen study.

Squainfaing series, Vosges

(48° 07′ N, 6° 59′ E), alt +850m. Coll and subm 1975 by M Darmois, Univ Paris IV.

Gif-3622. Squainfaing, 30–50cm **Modern**

Gif-3623. Squainfaing, 250–260cm **5280 ± 130**

Pollen zone: end of Atlantic.

Gif-3624. Squainfaing, 480–500cm **2540 ± 100**

Comment: aberrant result can only be explained by sampling error.

Gif-3723. Squainfaing, 450–460cm **6940 ± 170**

Pollen zone: beginning of Atlantic.

Gif-3653. Col du Surceneux, Vosges **5030 ± 140**

(48° 06′ N, 6° 58′ E), alt +810m, at depth 360 to 380cm. Coll and subm 1975 by M Darmois. Pollen zone: beginning of Sub-boreal.

Gif-3872. Le Chargeoir, Vosges **2120 ± 100**

Peaty silt from base of bog (48° 06′ N, 6° 53′ E), alt +895m, at depth 160 to 180cm. Coll and subm 1977 by M Darmois.

Gif-3875. Belbriette, Vosges **2950 ± 110**

Peat from base of bog (48° 05′ N, 6° 59′ E), alt +810m, at depth 640 to 650cm. Coll and subm 1977 by M Darmois. Pollen zone: end of Sub-boreal.

Gif-4938. Saint-Bresson, Haute-Saône **5300 ± 300**

Peat from bog, Cirque des Mottots (47° 52′ N, 6° 33′ E), alt +564m, at depth 155 to 160cm. Coll and subm 1979 by M Darmois. Pollen zone: end of Atlantic.

Argentina

Peat from bogs, coll and subm 1973–1975 by V Markgraf, CFR, Gif-sur-Yvette, to study postglacial vegetational history in S hemisphere.

Gif-3656. Atuel, El Sosneado, Prov Mendoza **3370 ± 300**

Plant macrofossil layer at depth 558 to 561cm in bog (35° 10′ S, 66° 36′ W), alt +2000m.

Arroyo Seco series, Cordon del Plata, Prov Mendoza

(33° 10′ S, 60° 30′ W), alt +2500m.

Gif-4318. Arroyo Seco, 7 **820 ± 90**

Dark soil between two gravelly and sandy levels, at 20 to 35cm depth.

Gif-4317. Arroyo Seco, 1 **4090 ± 110**

Oldest dark soil, at 265 to 280cm depth.

Gif-4316. Cienaga Yalguarez Represa, Uspallata **3310 ± 100**

Organic fibers in gray clay at 100 to 140cm depth at base of bog (32° 10′ S, 67° W), alt +2100m.

Gif-3657. Mallin Auer, Patagonia **4390 ± 300**

Brownish gyttja with clay at 650 to 675cm depth at base of bog, (41° 20′ S, 71° 42′ W), alt +1000m.

Mallin Sonntag series, Patagonia

(41° 05′ S, 71° 33′ W), alt ca +800m.

Gif-3086. Mallin Sonntag 1, 460–485cm depth **2180 ± 110**

Gif-3080. Mallin Sonntag 2, 850–875cm depth **4890 ± 120**

Gif–3275. Mallin Chileno, Patagonia **860 ± 80**

(41° 14′ S, 71° 50′ W), alt ca +1500m, at 150 to 155cm depth.

Mallin Book series, Patagonia

Peat from bog (41° 20′ S, 71° 35′ W), alt +800m; base of core at 9.50m.

Gif-4035. Mallin Book 1, 185–195cm depth **1600 ± 190**

Gif-4036. Mallin Book 2, 375–385cm depth **6010 ± 280**

Gif-4037. Mallin Book 3, 550–560cm depth **8800 ± 170**

Gif-3867. Mallin Book 4, 650–655cm depth **12,900 ± 400**

General Comment: bog is near lake that was covered with pleniglacial glaciers. Gif-3867 gives min age for retreat of ice.

La Mision series, Tierra del Fuego

Bog (52° 30′ S, 67° 50′ W), 3.5km inland from present shore.

Gif-3869. La Mision 1 **8490 ± 400**

Black clay at 845 to 850cm depth.

Gif-3655. La Mision 2 **9300 ± 180**

Organic brown layer at 865 to 875cm depth: base of core: 900cm depth.

General Comment: profile is of interest because of its sensitivity to paleoclimatic change. Markgraf (1977) distinguished three zones in pollen diagram. Oldest is almost devoid of tree pollen; principal and longest zone reflects forest expansion, and uppermost zone reflects present treeless steppe. Before forest expansion began, at ca 8000 BP, pollen suggests transition period between steppe and forest with more humid climate from 9300 to 8490 BP.

Gif-3884. Rio Conrintos, Patagonia **10,100 $^{+1200}_{-750}$**

Uppermost organic varve from varved deposit (43° S, 71° 34′ W), alt +700m; deposit 10 to 20m thick.

Greenland

Samples from Thule area, NW Greenland. Coll and subm 1972 by J Malaurie, Centre d'Etudes Arctiques, Paris.

Kranak profile, Fjord Murchison

Peat from bog, 72cm thick, (77° 43′ N, 70° W).

Gif-3293. Kranak, 5–10cm depth **Modern**

Gif-3294. Kranak, 25–30cm depth **930 ± 110**

Gif-2794. Kranak, 30–35cm depth **1020 ± 100**

Kugkat profile, Fjord Robertson

Peat from bog, 210cm thick, (77° 45′ N, 70° 30′ W).

Gif-2799. Kugkat, 7, 30–35cm depth **1720 ± 100**

Gif-2791. Kugkat, 39, basal level **1820 ± 100**

Gif-2792. Kangerdluarssuk profile, Fjord Bowdoin **420 ± 90**

Basal level of bog, at 30cm depth, (77° 43′ N, 70° W), 5km from ice cap.

Atikorlog profile, Fjord Robertson

Organic deposit, 20cm thick, overlying sand and gravel, (77° 45′ N, 70° 30′ W).

Gif-2789. Atikorlog, 8 a, 10–15cm depth **Modern**

Gif-2790. Atikorlog, 8 b, 15–20cm depth **Modern**

Negri profile, near Neke

Bog, 1m thick, (77° 45′ N, 70° 30′ W).

Gif-2971. Negri 2, 5–10cm depth **Modern**

Gif-3323. Negri 5, 20–25cm depth **610 ± 90**

Gif-2972. Negri 8, 35–40cm depth **680 ± 90**

Gif-2973. Negri 9, 40–45cm depth **710 ± 90**

Gif-3297. Negri 10, 45–50cm depth **690 ± 90**

Gif-3026. Negri 17, 80–85cm depth **1990 ± 110**

Gif-2795. Negri 19, 90–95cm depth **3040 ± 100**

Agparssuit profile, Nakluyt Island

Peat from bog, 30cm thick, (77° 43′ N, 71° W).

Gif-3298.	**Agparssuit 2, 3–6cm depth**	**Modern**
Gif-3299.	**Agparssuit 5, 12–15cm depth**	**490 ± 90**
Gif-2796.	**Agparssuit 8–9, 21–27cm depth**	**1250 ± 100**

Uvdle profile, Fjord Volstenholme

Peat from bog, 2m thick, (77° 40′ N, 69° W), 6km from ice cap.

Gif-3300.	**Uvdle 2, 6–12cm depth**	**1780 ± 100**
Gif-3301.	**Uvdle 6, 30–36cm depth**	**3120 ± 110**
Gif-3302.	**Uvdle 13, 72–78cm depth**	**3720 ± 120**
Gif-3303.	**Uvdle 35, 144–150cm depth**	**3540 ± 120**
Gif-2797.	**Uvdle 35, 195–200cm depth**	**4700 ± 130**

Saunders profile, Saunders Island

Peat from bog, 56cm thick, (77° 40′ N, 69° W).

Gif-3959.	**Saunders 1, 0–6cm depth**	**1870 ± 90**
Gif-3017.	**Saunders 3, 12–18cm depth**	**3380 ± 100**
Gif-3018.	**Saunders 5, 24–30cm depth**	**3930 ± 110**
Gif-3019.	**Saunders 7, 36–42cm depth**	**3930 ± 110**
Gif-2797.	**Saunders 9, 50–56cm depth**	**4090 ± 140**

Krassissalik profile, Northemberland Island

Peat from bog, 25cm thick, (77° 43′ N, 71° W).

Gif-3304.	**Krassissalik, 0–5cm depth**	**Modern**
Gif-2798.	**Krassissalik, 20–25cm depth**	**1350 ± 100**

Alaska

Peat from basal level of coastal bogs. Coll and subm 1974 by J Malaurie.

Gif-3592. **Wales, 30–35cm depth** **320 ± 90**
(65° 38′ N, 168° 09′ W).

Gif-3593. **Shishmaref, 115–120cm depth** **1120 ± 100**
(66° 15′ N, 166° 11′ W).

Gif-3594. Teller, 60–65cm depth **1150 ± 100**
(65° 12′ N, 166° 23′ W).

Gif-3691. Nome 9, 40–45cm depth **Modern**
(64° 30′ N, 165° 30′ W).

Gif-3591. Nome 19, 130–135cm depth **Modern**

Glaciers

France

Gif-2747. Mont-Dore, Massif Central **8400 ± 160**

Plant branches in clayey lacustrine deposit, behind glacial moraine, 10m thick, Vallée de Chaudefour (45° 32′ N, 2° 51′ E), alt 1100m. Coll and subm 1972 by G Kieffer.

Gif-4128. Santoir Valley R, Cantal **13,580 ± 250**

Organic sediment in glacio-fluviatile terrace (45° 18′ N, 2° 47′ E), alt +900m. Coll and subm 1977 by Y Veyret, Inst Géog Clermont Ferrand. *Comment:* dates limits of glaciated land during Tardiglacial in French Massif Central (Veyret, Brousse & Delibrias, 1978).

Tautal-Haut series, Massif Central

Wood in morainic deposit, 8m thick (45° 54′ N, 3° 07′ E), alt +910m. Coll and subm 1982 by R Brousse.

Gif-5891. Tautal-Haut, 3 **≥35,000**

Gif-5892. Tautal-Haut, 1 **≥35,000**

Gif-5893. Tautal-Haut, 8 **≥35,000**

Switzerland

Grundelwald series

Tree trunks in moraines of glacier (46° 38′ N, 8° 03′ E). Coll and subm 1973 by E Le Roy Ladurie, Coll France, Paris.

Gif-2976. Stieregg, 4 **710 ± 100**
Alt 1680m.

Gif-2975. Stieregg, 2 **1140 ± 60**
Alt 1680m.

Gif-2977. Kalli, 6 **1340 ± 60**
Alt 1650m. Under Eiger.

Gif-2980. Zasenberg, 10 **910 ± 60**
Alt 1730m.

Gif-3311. Zasenberg, A **820 ± 60**

Tree was allegedly dead in AD 1071 according to dendrochonology.

Gif-3312. Zasenberg, B **1210 ± 60**

Tree was allegedly dead in AD 1270 according to dendrochronology. *General Comment:* dates indicate that Grundelwald fossil forest was alive between 7th and 8th centuries at site that is presently entirely denuded. This period corresponds to little climatic optimum of Middle age and of the year, AD 1000 (Delibrias, Le Roy Ladurie, E & M, 1975).

Chile

Andes series

Samples coll and subm 1973–77 by C Laugénie, Univ Pau, to establish chronology of different stages of glacial advances during last glaciation, in S Andes (Laugénie, 1982).

Gif-2614. Rio San Pedro, 4 Ri/sp 2 **27,500 ± 940**

Peaty level at top of paleosol, underlain by fluvio-glacial sequence, Pacuno (39° 45′ S, 72° 40′ N).

Gif-2893. Tablaruca cape, Chiloe I, CH/Ta I **≥40,000**

Tree trunk overlying morainic deposit and under neo-glacial terrace, in marine cliff (42° 55′ S, 73° 15′ W).

Gif-2808. Compu, Chiloe I, Level 4 **≥40,000**

Tree trunk in peaty level 4, under fluvial deposit in complex sequence of morainic, fluvio-glacial, and lacustrine deposits, in profile of Compu (42° 50′ S, 72° 50′ W).

Gif-2809. Compu, Chiloe I, Level 7 **≥49,000**

Plant remains from peaty level 7, under lacustrine level, in same complex as Gif-2808. *Comment:* samples Gif-2809 and -2808 correspond to very old glacial fluctuations, as expected.

Gif-2892. Caunahue Valley **11,990 ± 160**

Wood in lacustrine clay, 1m above river bed, Caunahue Valley, near estuary in Rancol Lake (41° 05′ S, 72° 25′ W). *Comment:* dates glacial retreat. Age is confirmed by date of other sample coll downstream: 12,200 ± 400: Gx-2935 (pers commun).

Gif-3796. Coihueco, Llanquihue **24,500 ± 500**

Peat between two fluvio-glacial sequences, in sec at Rio Coihueco (40° 50′ S, 72° 55′ W). *Comment:* dates interstadial of Laguna Bonita.

Gif-3798. Valcahue, Quemchi, Chiloe Island **14,200 ± 160**

Plant remains from thin soil between varved lacustrine silt level overlying moraine at base and fluvio-glacial deposit, at top near Valcahue (42° 30′

S, 72° 50′ W). *Comment:* indicates last glacial readvance began just after 14,200 BP.

Los Tacos series, Rinihue

Samples from sec resulting from seismic crumbling of filling in Los Tacos depression (39° 45′ S, 72° 30′ W).

Gif-2891. Los Tacos, Ri/Tac 3 **28,000 ± 800**

Peat from upper peaty paleosol in alluvial deposit, underlying upper moraine.

Gif-3797. Los Tacos, Ri/Tac IV **29,000 ± 700**

Plant remains from basal level of same paleosol as Gif-2891.

Gif-2615. Los Tacos, L/Ri/Tac I **≥34,000**

Peat from lower peaty paleosol, in alluvial deposit, overlying important lacustrine series which overlies lower moraine.

Gif-2616. Rio Ignao, Ranco L, L/Ra I **≥45,000**

Peat from upper part of sequence of alternated deposits of peat and ash, 2.5m thick, underlying upper-glacial moraine (40° 18′ S, 72° 37′ W). *Comment:* age confirmed by Seattle date of tree trunk at top of same level, QL-61: 56,000 $^{+2000}_{-1700}$.

SEA LEVEL

France

Jauney Valley series, Lachaize-Giraud, Vendée

Samples from Holocene fluviatile filling of Jauney Valley (46° 41′ N, 1° 47′ W). Coll and subm 1977 by M Ters. Levels are related to present msl.

Gif-4032. Jaunay 10 **1510 ± 90**

Tree trunk, 0m.

Gif-4224. Jaunay 8 bis **1690 ± 90**

Carbonized wood, −0.5m.

Gif-4031. Jaunay 17 **2450 ± 90**

Carbonized wood, −1m.

General Comment: dates only last stage of Holocene filling.

La Mère Valley series, Vendée

Samples from Holocene filling of La Mère Valley, overlying periglacial grave (46° 37′ N, 0° 46′ W). Coll and subm 1977 by M Ters, Inst Géog, Paris.

Gif-4226. Mère 2 **6200 ± 130**

Carbonized wood in peat.

Gif-4225. Mère 1 **6170 ± 130**

Peaty clay.

General Comment: both samples date transition between coarse fluviatile and fine Holocene alluviation.

Italy

Gif-2746. Punta Penne, Brindisi, DIG 125 **2200 ± 100**

Marine shell debris from deposit of Punta Penne (40° 41′ N, 17° 54′ E), +1.50m. Coll 1970 and subm 1972 by I di Geronimo, Inst Geol, Catania, Sicily. *Comment:* provides recent Holocene age for this deposit usually attributed to Tyrrhenian.

Brazil

Amazon estuary series

Bore holes were made down to 50m in Quaternary sediments of Marajo Is., Amazon estuary (1° S, 48° 58′ W). Organic levels subm 1973 by G Siffermann, ORSTOM (Tancredi *et al,* 1975).

Gif-2962. SE II, 20m depth **≥35,000**

Gif-3096. SE II, 12.75–14.10m depth **≥35,000**

Venezuela

Orinoco estuary series

Samples from cores in Orinoco estuary, coll by E N de Campos and subm 1979 by A Danielo, Nantes.

Gif-2963. Domingo Perez I, A 106 **920 ± 80**

Peat, at base of peaty level, 200 to 300cm depth, Profile A 106 (8° 33′ N, 61° 05′ W).

Gif-2964. Cano Guinamorena, B 257 **4080 ± 110**

Peat from peaty level, −2m, 340 to 400cm depth, Profile B 257 (9° 45′ N, 62° 15′ W), 30km from present coast.

General Comment: dates recent sedimentation in estuary, sedimentation related to Flandrian tansgression mainly for B 257.

Greenland

Thule Kranak profile series

Shell samples from uplift levels on left bank of Nagssuak Kuk R, 3km from estuary (77° 43′ N, 70° W).

Gif-3020. Kranak, +50m **8260 ± 150**

Gif-3021. Kranak, +40m **8400 ± 190**

Gif-3305. Kranak, +25–30m **7980 ± 250**

Gif-3022. Kranak, +15m **8560 ± 250**

Gif-3023. Siorapaluk **8770 ± 120**

Shell from Siorapaluk (77° 48′ N, 70° 58′ W), +60m.

Gif-3212. Ivnartalik **7600 ± 400**

Shell from Ivnartalik (77° 50′ N, 71° W).

VOLCANOES

France

Massif Central

Gif-3590. Puy de Mey, 8 **1760 ± 90**

Paleosol III, Puy de Mey (45° 43′ N, 2° 56′ E). Coll and subm 1975 by R Brousse, Fac Sci, Orsay.

Gif-6229. Bois de Ceyssat **3490 ± 80**

Wood in paleosol under pyroclastic deposit, 1m thick, Bois de Ceyssat (45° 45′ N, 2° 59′ E). Coll and subm 1983 by R Brousse.

Gif-3589. Pont de Rivallet, 2 **6900 ± 500**

Paleosol under Tartaret flow, near Pont de Rivallet (45° 35′ N, 3° 03′ E). Coll and subm 1975 by R Maury, Fac Sci, Orsay.

Gif-6152. Puy de Cliziaux **7750 ± 90**

Wood in paleosol under black lapilli deposit, 40cm thick, at Puy de Cliziaux (45° 08′ N, 3° E), Chaîne des Puys. Coll and subm 1983 by R Brousse.

Gif-6231. Cheire de Mercoeur **8110 ± 90**

Charcoal at base of trachyandesitic ash level overlain by basaltic ash, Cheir de Mercoeur, Chaîne des Puys (45° 43′ N, 2° 56′ E), alt 870m. Coll and subm 1983 by R Brousse.

Gif-6228. Puy de Tenusset **8150 ± 380**

Wood, Puy de Tenusset, Chaîne des Puys (45° 52′ N, 2° 56′ E), alt 960m. Coll and subm 1983 by R Brousse.

Gif-6230. Puy du Pourcharet **8150 ± 90**

Charcoal in scoria level, Puy du Pourcharet, Chaîne des Puys (45° 43′ N, 2° 56′ E) alt 1060m. Coll and subm 1983 by R Brousse.

Gif-3638. Puy de Louchadière **8760 ± 170**

Charcoal in volcanic scoria levels, plain between Puy de Louchadière and Puy Chopine (45° 50′ N, 2° 56′ E), Chaîne des Puys. Coll and subm 1975 by H Pelletier, Fac Sci, Clermont-Ferrand. *Comment:* dates trachyandesitic eruption of Puy Chopine.

Gif-5133. Jaujac **15,000 ± 360**

Charcoal under ash from Jaujac volcano (44° 38′ N, 4° 15′ E), Vivarais.

Gif-5132. Monpezat **16,280 ± 420**

Charcoal under Monpezat basaltic flow, Château de Pourcheyrolles, Vivarais (44° 43′ N, 4° 22′ E). Coll and subm 1980 by R Brousse.

Gif-2640. Pont de Labeaume, Vals **11,770 ± 270**

Paleosol under Pont de Labeaume flow (44° 39′ N, 4° 16′ E), Ardèche. Coll and subm 1972 by R Maury and R Brousse.

Gif-2642. Egaules **≥35,000**

Wood under lava flow, Egaules (45° 50′ N, 2° 59′ E), Chaine des Puys. Coll and subm 1972 by R Brousse.

Gif-2643. Souilhols, 535 e **≥35,000**

Wood under scoria from Souilhols volcano (44° 40′ N, 4° 15′ E), Ardèche. Coll and subm 1972 by R Maury and R Brousse.

Olby series

Two lava flows with reversed remanent magnetism were discovered 1967 at Laschamp and Olby (45° 44′ N, 2° 51′ E), in Chaîne des Puys, by N Bonhommet and J Balkine. This event was thought to have occurred between 20,000 and 8000 yr ago (Bonhommet & Zahringer, 1969). New ^{14}C, TL, and K-Ar dates at "Les Plats, Olby" indicate much greater age values (Gillot *et al,* 1979).

Gif-4007. Olby 1 **26,800 ± 800**

Residual organic fraction after extraction of humic acids from soil under Olby lava flow. Coll 1977 by J Labeyrie. *Comment:* insufficient humic acids dating.

Gif-4563. Olby 2 **≥28,500**

Humic fraction, extracted at pH 9.87 from 2nd soil sample, coll 1978 at same loc as Gif-4007.

Gif-4564. Olby 3 **≥33,200**

Humic fraction, extracted at pH 11.5–12, from same soil as Gif-4563.

Gif-4565. Olby 4 **≥36,200**

Residual fraction, after extraction of humic fraction, from same soil as Gif-4563.

General Comment: ^{14}C age of Olby organic layer is ≥36,000 yr: it agrees with TL and K-Ar ages obtained for lava flow, which are 36,000 ± 4000 and 42,000 ± 5000, respectively.

Italy

Vesuvius series

Samples dated to establish eruptive history of Somma-Vesuvius volcanic complex from study of pyroclastic sequences of Monte Somma (40° 49′ N, 14° 26′ E) in order to evaluate volcanic risks in Naples region (Delibrias *et al,* 1979). Coll and subm 1977–79 by D Paola, CNR, Pisa, R Santacroce and G Marinelli, Univ Pisa.

Gif-5266. Cava "La Marca", PFSV 308 **470 ± 60**

Charcoal in paleosol, lying on ash.

Gif-5265. Cava "La Marca", PFSV 306 **1550 ± 60**

Paleosol, under ash and paleosol Gif-5266; sequence above historic pumice level of AD 472.

Gif-5268. Cava unova tra Pollena e Cercola, PFSV 315 **330 ± 60**

Charcoal in pumice supposed to be Pompei level. *Comment:* date does not confirm hypothesis.

Gif-4203. Cava Lagno Amendolare, I **1030 ± 90**

Wood under nuée ardente deposit. Coll and subm by G Marinelli.

Gif-4205. Cava Lagno Amendolare, PFSV 86 **1750 ± 90**

Charcoal in nuée ardente deposit, 1m thick, above pumice supposedly corresponding to Pompei eruption, AD 79. *Comment:* date supports hypothesis.

Gif-4206. Lagno di Pollena, PFSV 83 **1600 ± 60**

Carbonized tree trunk in nuée ardente deposit, above pumice level of Pompei.

Gif-4250. Cava Lagno Amendolare, PFSV 86 bis **1590 ± 60**

Carbonized wood in nuée ardente deposit above Pompei level.

Gif-4483. Lagno di Pollena, PFSV 101 **1280 ± 50**

Wood in lahar above nuée ardente deposit.

Gif-5098. Irpina, 3 **1890 ± 60**

Carbonized wood in unit dated to Pompei level (40° 45′ N, 14° 27′ E). Coll and subm by G Camus, Fac Sci, Clermont-Ferrand.

Gif-5097. Ottaviano, 2 **1900 ± 70**

Carbonized wood in soil from sequence above pumice level of Avellino (40° 51′ N, 14° 29′ E). Coll and subm by G Camus.

Gif-4484. Cava Primavera, PFSV 105 **1800 ± 60**

Wood in lahar between nuée ardente deposit and Pompei level.

Gif-4377. Cava Primavera, PFSV 104 **1810 ± 50**

Carbonized wood in pumice of Pompei level, quarry 2.

Gif-5264. Cava Primavera, PFSV 300 **3530 ± 70**

Paleosol on ashy layer between pumices of Pompei and Avellino dated by Gif-4517 (below). Coll and subm by R Santacroce.

Gif-5096. Ottaviano, 1 **3170 ± 70**

Carbonized wood in soil above pumice of Avellino. Coll and subm 1979 by G Camus.

Gif-4486. Terzigno, PFSV 156 **3600 ± 80**

Paleosol underlying pumice.

Gif-4517. Astroni, PFSV 210 **3760 ± 70**

Paleosol under Avellino pumice.

Gif-5267. Cava Loop, PFSV 314 **2750 ± 200**

Paleosol in pumice supposedly Pompei or Avellino level. *Comment:* date does not confirm hypothesis.

Gif-4485. Santa Teresella, PFSV 115 **5530 ± 80**

Paleosol underlying pumice of Astroni.

Gif-5262. Cava Lagno Amendolare, PFSV 295 **6870 ± 130**

Paleosol under nuée ardente deposit. *Comment:* unrelated to Pompei event, as expected.

Gif-4378. Case Traianello, PFSV 112 **7910 ± 100**

Upper part of paleosol overlying pumice of Agnano and underlying "Pomici Gemelli."

Gif-4379. Case Traianello, PFSV 113 **8470 ± 100**

Lower part of same paleosol as Gif-4378.

Gif-5099. Avellino, 4 **8110 ± 100**

Carbonized wood in unit under Avellino pumice (40° 49′ N, 14° 47′ E). Coll and subm 1979 by G Camus.

Gif-4251. Cava Lagno Amendolare, PFSV 89 **8830 ± 70**

Paleosol, same strat position as paleosol Gif-4378. Humic acids from same sample were dated, 8650 ± 130. *Comment:* these paleosols do not seem contaminated and thus give significant ages.

Gif-4376. Cava Lagno Amendolare, PFSV 111 **9760 ± 300**

Paleosol underlain by pumice of Agnano.

Gif-4488. Cava Primavera, PFSV 110 **11,400 ± 130**

Paleosol between two pumices dated at Cava Amendolare by Gif-4376 and -4375.

Gif-4487. Cava Primavera, PFSV 109 **14,120 ± 160**

Paleosol between two pyroclastic units above pumice of Amendolare dated by Gif-4375.

Gif-4375. Cava Lagno Amendolare, PFSV 106 **17,050 ± 140**

Paleosol on pyroclastic unit "Pomici di base" overlying lava from Monte Somma.

General Comment: Pompei level, well dated, has been important datum to establish stratigraphy of recent eruptions of Vesuvius.

Etna series

Samples from Etna (37° 42′ N, 15° 02′ E). Coll and subm 1972–1974 by G Kieffer, Inst Geog, Clermont-Ferrand, to date some important eruptions of last eruptive sequence (Kieffer, 1979, 1985).

Gif-3070. Etna, 74 II **1810 ± 90**

Carbonized wood in pumiceous ash, W side of Etna, alt 1980m. *Comment:* dates very important eruption.

Gif-3071. Etna, 74 III **1760 ± 90**

Tree trunk in ash, NE side of Etna, alt 1980m. *Comment:* dates very important eruption.

Gif-2775. Etna, 73 2 **1320 ± 90**

Wood in fine ash, overlying lapilli layer, S side of Etna (37° 42′ N, 15° 01′ E), alt 1600m. *Comment:* corresponds to explosive episode.

Gif-2776. Etna, 73 V **3230 ± 110**

Carbonized tree trunk in fine ash, overlying brown-colored pumice, on S side of Etna, alt 1600m. *Comment:* corresponds to explosive episode.

Gif-2777. Etna, 73 VI **6100 ± 140**

Carbonized wood in brown pumice overlying thin yellow ash on ancient lava flows, S side of Etna. *Comment:* Gif-2775, -2776, -2777 are superimposed and correspond to three explosive episodes.

Gif-3428. Etna, 74 V **2840 ± 110**

Carbonized wood under andesitic ash, some m thick, Zafferrana-Rifugio Sapienza Rd (37° 41′ N, 2° 36′ E), alt 1600m.

Gif-2448. Etna, 72 2 **1840 ± 90**

Branches of *Pinus laricio* in reworked pumice deposit on caldera lip, SW side of Etna, alt 1750m.

Gif-2778. Etna, 73 IX **4280 ± 110**

Carbonized wood in fine ash NW side of Etna, alt 1800m. *Comment:* corresponds to explosive episode.

Gif-3427. Etna 74 IV **5460 ± 130**

Wood in ash, at bottom of cliff of "Olmo," near Torre Archirafi, 2m above msl. *Comment:* dates beginning of last stage of formation of Valle del Bove.

Gif-3429. Etna 74 VI **8140 ± 190**

Carbonized wood under andesitic ash, Cassone-Monte Pomociaro wood (37° 41′ N, 2° 36′ E), alt 1400m. *Comment:* dates one of oldest explosive eruptions of last sequence of acid eruptions of Etna.

Gif-4618. Etna, 78 I **14,180 ± 260**

Carbonized tree trunk under pyroclastic flow, NE Biancavilla, alt +590m. Coll and subm 1978 by G Kieffer.

Gif-3069. Etna, 74 I **18,100 ± 400**

Soil under flow lava at base of W hillside of Etna.

Lipari Is. series

Samples from pyroclastic surge deposits of Monte Guardia, S Lipari Is. (38° 28′ N, 14° 58′ E). Deposits represent sequences III and IV of volcanic activity. Coll and subm 1980–81 by G Zuffa and R Mazzuoli, Univ Calabria, Consenza (Crisci *et al,* 1983).

Gif-5326. Lipari, sec VII, LR 61 **16,800 ± 200**

Organic horizon from upper ash-flow units.

Gif-5371. Lipari, sec VII, LR 60 **20,500 ± 200**

Organic horizon from upper ash-flow units.

Gif-5591. Lipari, sec I, LR 88 **20,300 ± 700**

Organic horizon, poor in organic carbon, from upper ash-flow units. *Comment:* undersized sample.

Gif–5328. Lipari, sec I, LR 66 **22,600 ± 300**

Carbonaceous earth, sec I, overlying andesitic unit designed as "Key bed," overlain by surge deposits of Monte Guardia.

Gif-5587. Lipari, sec I, LR 84 **22,480 ± 1100**

Organic horizon, poor in organic carbon, underlying "key bed."

Gif-5375. Lipari, sec I, LR 68 **23,500 ± 900**

Organic horizon, underlying Gif-5587.

Gif-5327. Lipari, sec XVIII, LR 64 **≥35,000**

Wood, in unit above deposits of Monte San Angelo eruption, at base of lower ash-flow units.

Lesser Antilles

Guadeloupe

La Soufrière series

Wood and charcoal dated to establish chronology for volcanism of La Soufrière. This study was made by Paterne (1980).

Gif-3014. Quarry of Pintade, Basse Terre I **≥35,000**

Charcoal in pumice (16° 00′ N, 61° 44′ W). Coll and subm 1973 by M Feuillard, St Claude, Guadeloupe.

Gif-3015. Quarry of Pintade, Basse Terre 2 **14,950 ± 200**

Charcoal in pumice. Coll and subm 1973 by M Feuillard. *Comment:* aberrant date can only be explained by sampling error.

Gif-3031. Quarry of Pintade, Basse Terre 3 **≥35,000**

Charcoal in pumice. Coll and subm by M Feuillard.

Gif-4729. Quarry Danois, GB 42 **≥38,500**

Charcoal in rose-colored pumice flow of Pintade. Coll by J Dagain and subm 1979 by D Westercamp, BRGM, Orléans.

Gif-4732. Rivière du Pérou, GB 45 **≥38,500**

Charcoal in lahar of phreatic origin.

Gif-4725. Rivière du Galion, GB 38 **≥38,500**

Carbonized wood in yellowish lahar (16° 24′ N, 61° 41′ W). Coll by J Dagain and subm 1979 by D Westercamp.

Gif-4343. Ravine Chaude, GB 6 **≥37,000**

Wood in paleosol, under gray clay unit, lying on cinerite deposit (16° 01′ N, 61° 40′ W), alt 700m. Coll and subm 1977 by D Westercamp.

Gif-4344. Ravine Chaude, GB 8 **≥37,000**

Carbonaceous soil under cinerite layer.

Gif-4703. Ravine Chaude, GB 7 **≥38,500**

Charcoal, 1.8m under Gif-4344. Coll and subm 1977 by D Westercamp.

Gif-4707. Mouth of Grand Carbet Riv, GB 17 ≥30,000

Humic acid from carbonaceous remains in flow of white and gray pumice with gray ash. Coll and subm 1978 by D Westercamp.

Gif-4709. Mouth of Grand Carbet Riv, GB 21 ≥38,500

Charcoal in gray ash (16° 01′ N, 61° 34′ W). Coll and subm 1978 by D Westercamp.

Gif-4708. Mouth of Grand Carbet Riv, GB 20 24,300 ± 900

Charcoal fragments in nuée ardente deposit of fine gray ash with lapilli, 1m above Gif-4709. Coll and subm 1978 by D Westercamp.

Gif-3032. Mouth of Grand Carbet Riv 21,340 ± 400

Charcoal from ash layer, 0.6m thick, lying on pumice and underlying nuée ardente deposit, 7m thick. Coll and subm 1973 by M Feuillard.

Gif-3016. Anse à la Fontaine, Mouth of Grand Carbet Riv 25,500 ± 500

Charcoal fragments in nuée ardente lying on pumice deposit. Coll and subm 1973 by M Feuillard.

Gif-4346. Rivière du Grand Carbet 29,800 ± 800

Charcoal in nuée ardente deposit of Saint-Vincent type underlying Gif-3016 and -3032. Coll and subm 1977 by D Westercamp.

Gif-4715. Rivière du Grand Carbet, GB 27 23,800 ± 500

Charcoal in deposit of hot lahar originating in nuée ardente of porphyric andesite, alt 120m. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-4721. Rivière Grande Anse, GB 34 23,200 ± 600

Wood in reworked fm with abundant light porphyric pumice (15° 59′ N, 61° 39′ W), alt 60m. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-4717. Rivière du Grand Carbet, GB 30 21,730 ± 550

Fine charcoal fragments in soil of ashy nuée ardente deposit of porphyric andesite, on right bank of Rivière du Grand Carbet (16° 02′ N, 61° 36′ W), alt 240m. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-4718. Rivière du Grand Carbet, GB 31 23,450 ± 600

Wood in lahar of phreatic origin, under nuée ardente deposit containing charcoal dated by Gif-4717. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-4714. Rivière du Grand Carbet, niv 4 24,200 ± 600

Charcoal fragments in nuée ardente deposit of dark gray porphyric andesite, 5m thick, alt 105m. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-4347. Rivière du Grand Carbet, niv 2 **17,800 ± 400**

Charcoal fragments in deposit of nuée ardente composed of dark gray andesite, above nuée ardente deposit of Saint Vincent type dated by Gif-4714. Coll and subm 1977 by D Westercamp.

Gif-4719. Morne Dongo, GB 32 **13,800 ± 260**

Carbonaceous soils alternating with coarse ash units of variable grain size (16° 02′ N, 61° 37′ W), alt 290m. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-4720. Morne Dongo, GB 33 **14,500 ± 200**

Yellowish-brown clay under Gif-4719.

Gif-4345. Rivière du Galion, 7 **12,700 ± 230**

Wood in volcanic-sedimentary sequence with vitreous pyroclastic rocks, 4m thick (16° 21′ N, 61° 39′ W), alt 670m. Coll and subm by D Westercamp.

Gif-4706. Rivière du Galion, 5, GB II **13,640 ± 250**

Wood in lahar of phreatic eruption. Coll and subm 1978 by D Westercamp.

Gif-4724. Rivière du Galion, GB 37 **8500 ± 100**

Wood in lahar of phreatic origin (16° 00′ N, 61° 42′ W), alt 100m. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-4723. Rivière du Galion, GB 36 **7700 ± 140**

Wood in lahar with dark gray andesite blocks, alt 90m. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-4713. Morne Dolé, GB 25 **4600 ± 80**

Carbonized wood in the upper part of the nuée ardente sequence containing lapilli of bicolored andesite (16° 00′ N, 61° 40′ W), alt 908m. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-4712. Morne Dolé, GB 24 **4400 ± 110**

Carbonized wood in yellowish-brown clay overlying Gif-4713.

Gif-4730. Rivière Grande Anse, GB43 **3600 ± 60**

Wood in lahar of phreatic origin (16° 30′ N, 61° 39′ W), alt 500m. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-4700. Rivière Grande Anse, GB 2 **3500 ± 90**

Fragments of wood in lahar composed of reworked pyroclastic deposits (16° 00′ N, 61° 39′ W), alt 640m. Coll and subm 1978 by D Westercamp.

Gif-3035. Rivière du Galion, Morin site **3450 ± 100**

Wood from lower part of sequence of superimposed lahars, 50m thick, alt 210m. Coll and subm 1973 by M Feuillard.

Gif-4342. Morne Savon, Matouba **3200 ± 100**

Carbonized wood in nuée ardente deposit of pale violet andesite, 1m thick (16° 20′ N, 61° 42′ W), alt 518m. Coll and subm 1977 by D Westercamp.

Gif-4710. Rivière aux Herbes, GB 22 **3200 ± 100**

Wood from upper part of sequence of superimposed lahars, with and without wood (16° N, 61° 43′ W), alt 180m. Coll and subm 1978 by J Dagain.

Gif-4716. Rivière du Grand Carbet, GB 28 **2850 ± 70**

Wood from lahar of phreatic origin (16° 02′ N, 61° 36′ W), alt 230m. Coll and subm 1978 by J Dagain and D Westercamp.

Gif-3034. Morne Dolé **2800 ± 100**

Wood in lahar of reworked nuée ardente deposit, alt 340m. Coll and subm 1973 by M Feuillard.

Gif-4731. Rivière du Galion, GB 44 **2700 ± 80**

Wood in lahar of phreatic origin, alt 310m. Coll and subm 1979 by J Dagain and D Westercamp.

Gif-4705. Rivière aux Herbes, GB 10 **2550 ± 70**

Wood in lahar with abundant light andesite blocks. Coll and subm 1978 by D Westercamp.

Gif-4702. Ravine Chaude, GB 5 **1700 ± 100**

Wood in lahar from phreatic eruption (16° 02′ N, 61° 40′ W). Coll and subm 1978 by D Westercamp.

Gif-4734. Valkanaers, near Gourbeyre, GB 50 **1370 ± 100**

Peat, alt 300m.

Gif-4735. Rivière du Galion, GB 47 A **680 ± 60**

Wood from level with carbonized tree trunks in reworked pumice and black cinders, alt 570m. Coll and subm 1979 by J Dagain and D Westercamp.

Gif-4736. Rivière du Galion, GB 47 B **690 ± 90**

Similar to Gif-4735. Coll and subm 1979 by M Paterne.

Gif-4737. Rivière du Galion, GB 48 **650 ± 50**

Similar to Gif-4735. Coll and subm 1979 by M Paterne.

Gif-4738. Savane à Mulets, GB 49 **450 ± 60**

Carbonized wood in pumice overlying violet nuée ardente deposit, Gif-4704 (16° 02′ N, 61° 40′ W), alt 1050m. Coll and subm 1979 by J Dagain and D Westercamp.

Gif-4704. Ravine de la Matyles, GB 9 **460 ± 90**

Wood in lahar from phreatic eruption, under Gif-4738 (16° 02′ N, 61° 39′ W), alt 1130m. Coll and subm 1978 by D Westercamp.

Gif-4733. Trois Rivières, GB 46 **200 ± 50**

Charcoal in clay, lying on andesite flows of Trois Rivières (16° 58′ N, 61° 38′ W), alt 300m. Coll and subm 1979 by J Dagain and D Westercamp.

Gif-3033. Savane à Mulets **200 ± 80**

Wood in non-indurated pumice, 1m thick, overlying volcanic sand, alt 1130m. Coll and subm 1973 by M Feuillard.

Gif-4722. Rivière Grande Anse, GB 35 **≤120**

Wood in rock fall (16° 25′ N, 61° 39′ W), alt 490m. Coll and subm 1978 by J Dagain and D Westercamp.

Martinique

Montagne Pelée series

Samples dated to establish chronology of volcanic eruptions of Montagne Pelée.

Gif-4752. Junction of Rivières Capot and Daniel, MPB 72 **≥40,000**

Carbonized tree trunks in gray ash underlying pyroclastic deposit overlain by nuée ardente (14° 16′ N, 61° 07′ W), alt 320m.

Gif-4753. Junction of Rivières Capot and Daniel, MPB 73 **22,100 ± 600**

Carbonized wood in nuée ardente deposit, under Gif-4752.

Gif-4760. Rivière Providence, MPB 90 **≥40,000**

Carbonized wood in weathered nuée ardente deposit (14° 47′ N, 61° 07′ W), alt 330m. Coll and subm 1979 by D Westercamp.

Gif-4761. Ravine Abd el Kader, MPB 91 **26,500 ± 600**

Carbonized wood from lower part of pyroclastic flow unit with weathered vitreous bicolored cinders (14° 48′ N, 61° 07′ W), alt 380m. Coll and subm 1979 by D Westercamp.

Gif-4765. Rivière La Falaise, MPB 95 **21,100 ± 580**

Carbonized large pieces of wood in ashy nuée ardente deposit. (14° 49′ N, 61° 08′ W), alt 290m. Coll and subm 1979 by D Westercamp.

Gif-4764. Rivière La Falaise, MPB 94 12,400 ± 140

Carbonized wood in weathered blackish pumice and scoria (14° 49′ N, 61° 08′ W), alt 300m. Coll and subm 1979 by D Westercamp.

Gif-4759. Road from Fond Labour to Morne Degras, MPB 79 11,500 ± 200

Abundant carbonized wood in nuée ardente deposit (14° 48′ N, 61° 06′ W), alt 170m. Coll and subm 1977 by D Westercamp.

Gif-4767. Ravine from Trou Congo to Vivies, MPB 97 10,280 ± 180

Carbonized wood in white pumice flow unit (14° 49′ N, 61° 06′ W), alt 120m. Coll and subm 1979 by D Westercamp.

Gif-4782. Rivière des Pères, MPB 32 6630 ± 130

Carbonized wood in pumice flow deposit (14° 16′ N, 61° 10′ W), alt 190m. Coll and subm 1973 by D Westercamp.

Gif-4768. Rivière La Falaise, MPB 98 5070 ± 110

Carbonized wood from lower part of black scoria flow, 4m thick, overlain by important nuée ardente deposit, Merapi type (14° 49′ N, 61° 08′ W), alt 440m. Coll and subm 1979 by D Westercamp.

Gif-4751. Rivière Marie Luce, MPB 71 4780 ± 80

Wood in lahar (14° 46′ N, 61° 07′ W), alt 355m. Coll and subm 1977 by D Westercamp.

Gif-4763. Rivière La Falaise, MPB 93 4710 ± 70

Carbonized wood in nuée ardente deposit with abundant blocks (14° 49′ N, 61° 08′ W), alt 350m. Coll and subm 1979 by D Westercamp.

Gif-4780. Quarry of Morne Ponce, MPB 22 4620 ± 70

Carbonized wood in pumice flow deposit (14° 45′ N, 61° 11′ W), alt 5m. Coll and subm 1973 by D Westercamp.

Gif-4775. Road from Pointe La Mare to De La Chartreuse 4530 ± 110

Carbonized wood in nuée ardente deposit (14° 47′ N, 61° 13′ W), alt 5m. Coll and subm 1973 by D Westercamp.

Gif-4756. Rivière La Falaise, MPB 76 4040 ± 110

Carbonized wood in pumice flow unit, under recent plinean deposits (14° 50′ N, 61° 07′ W), alt 190m. Coll by L Stieltjes and subm 1977 by D Westercamp.

Gif-4757. E Basse Pointe, MPB 77 3960 ± 70

Carbonized wood in pumice flow unit (14° 52′ N, 61° 07′ W), alt 2m. Coll by L Stieltjes and subm 1977 by D Westercamp.

Gif-4769. Rivière La Falaise, MPB 99 **3660 ± 70**

Charcoal in pumice breccia with volcanic bombs, lying on bicolored breccia (14° 49′ N, 61° 08′ W), alt 450m. Coll and subm 1979 by D Westercamp.

Gif-4766. Ajoupa Bouillon, MPB 96 **2300 ± 60**

Wood in lahar (14° 49′ N, 61° 07′ W), alt 210m. Coll and subm 1979 by D Westercamp.

Gif-4754. Road from Morne Capot to Fond Labour, MPB 74 **2250 ± 60**

Charcoal in fine nuée ardente deposit (14° 49′ N, 61° 06′ W), alt 180m. Coll by L Stieltjes and subm 1977 by D Westercamp.

Gif-4762. Rivière Capot, MPB 92 **2160 ± 90**

Wood in lahar (14° 48′ N, 61° 07′ W), alt 210m. Coll and subm 1973 by D Westercamp.

Gif-4774. Route de la Grande Savane, MPB 8 **2020 ± 60**

Carbonized tree trunks (14° 47′ N, 61° 13′ W), alt 50m. Coll and subm 1973 by D Westercamp.

Gif-4781. Rivière Sèche, MPB 23 **1720 ± 60**

Carbonized wood in pumice flow deposit overlain by recent deposits (14° 46′ N, 61° 11′ W), alt 100m. Coll and subm 1973 by D Westercamp.

Gif-4755. Savanne Pascal, MPB 75 **1700 ± 90**

Carbonized wood in pumice flow unit overlying nuée ardente deposit (14° 49′ N, 61° 07′ W). Coll by L Stieltjes and subm 1977 by D Westercamp.

Gif-4773. Ravine de Fond Canonville, MPB 2 **1670 ± 90**

Carbonized wood in pumice flow deposit, (14° 47′ N, 61° 12′ W), alt 150m. Coll and subm 1973 by D Westercamp.

Gif-4779. Rivière du Pêcheur, MPB 21 **640 ± 60**

Carbonized tree trunks in coarse breccia (14° 48′ N, 61° 13′ W), alt 40m. Coll and subm 1973 by D. Westercamp.

Gif-4750. Rivière Cloche, MPB 70 **620 ± 90**

Wood in peaty clay. Coll and subm 1977 by D Westercamp.

Gif-4758. Quarry of Fond Canonville, MPB 78 **≤80**

Carbonized wood in pumice flow unit (14° 47′ N, 61° 12′ W), alt 10m. Coll and subm 1977 by D Westercamp.

General Comment: these results and those obtained from Guadeloupe show some periods of strong volcanic activity common to both islands.

Gif-2965. Montagne Pelée, MR 182 **1650 ± 100**

Carbonized wood in cinders, Montagne Pelée (14° 47′ N, 61° 11′ W). Coll and subm 1973 by F Colmet Daage, ORSTOM, Fort de France, Martinique.

Gif-3257. Montagne Pelée, MR 190 **2820 ± 100**

Wood in ashy breccia, 1.5 to 3m thick, Montagne Pelée. Coll and subm 1973 by F Colmet Daage.

La Réunion Islands

La Reunion Is. series

Samples coll 1979 by L Stieltjes, BRGM, Saint Denis, to date end of activity of Piton des Neiges.

Gif-4865. Piton des Neiges, RU 40 **24,500 ± 420**

Charcoal in pyroclastic deposit overlying basaltic lava flow, Piton des Neiges, Forêt de Bebour (21° 07′ S, 55° 35′ E).

Gif-4866. Piton des Neiges, RU 116 **26,700 ± 550**

Paleosol in pyroclastic deposit overlying basaltic lava flow, Piton des Neiges, Forêt de Bebour (21° 07′ S, 55° 35′ E).

Gif-4870. Piton des Neiges, RU 167 **21,900 ± 300**

Charcoal in pyroclastic deposit overlying basaltic lava flow, Piton des Neiges, Plateau de Belouve (21° 04′ S, 55° 35′ E).

Gif-4867. Piton des Neiges, RU 43 **30,500 + 850 − 760**

Carbonaceous matter in pyroclastic deposit lying on basaltic lava flow, Piton des Neiges, Plateau de Belouve (21° 06′ S, 55° 34′ E).

Gif-4869. Piton des Neiges, RU 119 **30,700 + 900 − 700**

Charcoal in pyroclastic deposit lying on lava flow, Piton des Neiges, Plateau de Belouve, dated 70,000 BP by K-Ar method (pers commun).

Gif-4868. Piton des Neiges, RU 118 **≥40,000**

Charcoal in pyroclastic deposit lying on lava flow, Piton des Neiges, Plateau de Belouve (21° 06′ S, 55° 34′ E). *Comment:* possibly Gif-4867 and -4869 are slightly contaminated and there is only one pyroclastic deposit older than 40,000 yr.

Gif-4357. Piton des Neiges, RU 77-1 **≥35,000**

Wood under pyroclastic flow unit on W side of Cirque de Mafite, Piton des Neiges (21° 05′ S, 55° 30′ E). Coll and subm 1977 by G Kieffer.

Gif-5432. Hauts de Saint-André **≥37,000**

Charcoal in tuff lying on andosol that overlies lava flow, Hauts de Saint-André (20° 58′ S, 55° 36′ E).

Gif-5433. Hauts de Trois Bassins **31,700 ± 650**

Charcoal in yellow cinerite layer overlying last lava flows of Piton des Neiges, Hauts de Trois Bassins (21° 06′ S, 55° 21′ E).

Gif-5559. Hauts de Saint Paul, RU 507 **≥42,000**

Charcoal in clayey unit underlying gray ash and scoria deposit, 10m thick, on flank of Piton des Neiges, Hauts de Saint Paul (21° 02′ S, 55° 21′ E).

MARINE SEDIMENTS

The following marine sediment samples come from:

1) Cores KW 31, KR 30, coll 1972 in Niger Delta, during Walda cruise aboard *R/V Jean Charcot* and subm by J C Duplessy, CFR, CNRS, Gif-sur-Yvette.
2) Cores MD 73004, MD 73025 coll 1973 in Indian Ocean during Osiris I cruise aboard *R/V Marion Dufresne* and subm by J C Duplessy.
3) Cores CH 73139 c coll 1973 in N Atlantic Ocean during Faega I cruise of *R/V Jean Charcot.*
4) Cores MD 77191, MD 77203 coll 1977 in N Indian Ocean during Osiris III expedition aboard *R/V Marion Dufresne* and subm by J C Duplessy.
5) Core MG 6237 coll 1978 during Marcongo 8 expedition aboard *R/V Le Mizery* and subm by P Giresse, Univ Perpignan.

These cores were analyzed mainly for oxygen isotopic ratios of foraminiferae (Duplessy *et al,* 1981), micropaleology, and sedimentology (Pastouret *et al,* 1978; Giresse *et al,* 1982). Dated levels correspond to characteristic points of isotopic curves. According to core, organic matter (OM) or carbonate fraction ≤44μ ($Ca\ CO^3$) has been dated. These data are presented in Table 1.

Mediterrannean Sea

Messina abyssal plain series

Organic matter of marine sediments of cores from Messina abyssal plain. Samples subm 1974 by M Melguen, CONEXO, Plouzané, Finistère.

Gif-3397. Core KS 05, 23–25cm **7930 ± 570**

Sapropelic level from core KS 05 (38° 35′ N, 17° 52′ E), water depth 3482m.

Gif-3398. Core KS 05, 869–871cm **≥25,000**

Gif-3399. Core KS 06, 1315–1317cm **9100 ± 680**

Sapropelic level from core KS 06 (36° 69′ N, 18° 31′ E), water depth 3975m.

TABLE 1

Gif Marine Sediment Samples

Gif no.	Core no.	Lat, Long	Water depth (m)	Level (cm)	Age (BP)	Dated fraction
−4005	CH 73139 c	54° 38′ N, 16° 21′ W	2209	7–13	1970 ± 200	$CaCO^3$
−4323	CH 73139 c	54° 38′ N, 16° 21′ W	2209	46–50	5170 ± 260	$CaCO^3$
−4006	CH 73139 c	54° 38′ N, 16° 21′ W	2209	77–85	8280 ± 350	$CaCO^3$
−5150	CH 73139 c	54° 38′ N, 16° 21′ W	2209	100–102.5	8960 ± 400	$CaCO^3$
−4491	CH 73139 c	54° 38′ N, 16° 21′ W	2209	112–120	11,600 ± 480	$CaCO^3$
−5152	CH 73139 c	54° 38′ N, 16° 21′ W	2209	135–137	11,680 ± 540	$CaCO^3$
−4252	CH 73139 c	54° 38′ N, 16° 21′ W	2209	140–144	11,490 ± 480	$CaCO^3$
−5135	CH 73139 c	54° 38′ N, 16° 21′ W	2209	145–147	12,880 ± 700	$CaCO^3$
−5169	CH 73139 c	54° 38′ N, 16° 21′ W	2209	152–155	13,600 ± 670	$CaCO^3$
−4380	CH 73139 c	54° 38′ N, 16° 21′ W	2209	157.5–160.5	14,800 ± 770	$CaCO^3$
−4253	CH 73139 c	54° 38′ N, 16° 21′ W	2209	180–184	16,480 ± 900	$CaCO^3$
−4254	CH 73139 c	54° 38′ N, 16° 21′ W	2209	220–224	22,630 ± 2100	$CaCO^3$
−3950	KW 31	03° 31′ N, 05° 34′ W	1181	0–6	2660 ± 250	OM
−3951	KW 31	03° 31′ N, 05° 34′ W	1181	27–35	3670 ± 300	OM
−3949	KW 31	03° 31′ N, 05° 34′ W	1181	120–125	6750 ± 410	OM
−3959	KW 31	03° 31′ N, 05° 34′ W	1181	312–316	10,900 ± 650	OM
−3813	KW 31	03° 31′ N, 05° 34′ W	1181	397–400	11,200 ± 650	OM
−3752	KW 31	03° 31′ N, 05° 34′ W	1181	705–708	11,500 ± 650	OM
−3815	KW 31	03° 31′ N, 05° 34′ W	1181	817–820	13,600 ± 600	OM
−3816	KW 31	03° 31′ N, 05° 34′ W	1181	877–880	$16{,}100\ ^{+1300}_{-1100}$	OM
−3930	KW 31	03° 31′ N, 05° 34′ W	1181	1192–1195	$24{,}600\ ^{+2400}_{-1800}$	OM
−4106	KW 31	03° 31′ N, 05° 34′ W	1181	1297–1300	≥24,900	OM
−3952	KW 31	03° 31′ N, 05° 34′ W	1181	1407–1410	≥26,000	OM
−3957	KR 30	03° 31′ N, 05° 34′ W	1181	3–8	2950 ± 250	OM
−3309	MD 73004	04° 58′ S, 61° 40′ E	3930	35–40	8300 ± 350	$CaCO^3$
−3310	MD 73004	04° 58′ S, 61° 40′ E	3930	65–70	13,500 ± 600	$CaCO^3$
−4534	MG 237	5° 12′ S, 11° 20′ E	1000	140–150	8380 ± 150	OM
−5197	MG 237	5° 12′ S, 11° 20′ E	1000	210–220	10,350 ± 300	OM
−4535	MG 237	5° 12′ S, 11° 20′ E	1000	290–300	10,290 ± 180	OM
−4456	MG 237	5° 12′ S, 11° 20′ E	1000	350–360	11,230 ± 200	OM
−5198	MG 237	5° 12′ S, 11° 20′ E	1000	390–400	12,690 ± 300	OM
−4457	MG 237	5° 12′ S, 11° 20′ E	1000	470–480	13,870 ± 250	OM
−4536	MG 237	5° 12′ S, 11° 20′ E	1000	590–600	15,850 ± 410	OM
−4434	MD 73025	43° 49′ S, 51° 19′ E	3284	35–39	6690 ± 330	$CaCO^3$
−4435	MD 73025	43° 49′ S, 51° 19′ E	3284	76–80	8000 ± 370	$CaCO^3$
−4436	MD 73025	43° 49′ S, 51° 19′ E	3284	152–159	8700 ± 400	$CaCO^3$
−4430	MD 73025	43° 49′ S, 51° 19′ E	3284	182–186	9650 ± 440	$CaCO^3$
−4431	MD 73025	43° 49′ S, 51° 19′ E	3284	256–260	11,190 ± 520	$CaCO^3$
−4329	MD 73025	43° 49′ S, 51° 19′ E	3284	276–280	12,620 ± 550	$CaCO^3$
−4437	MD 73025	43° 49′ S, 51° 19′ E	3284	324–329	17,200 ± 1000	$CaCO^3$
−4438	MD 73025	43° 49′ S, 51° 19′ E	3284	355–359	19,000 ± 1200	$CaCO^3$
−4439	MD 73025	43° 49′ S, 51° 19′ E	3284	416–420	24,000 ± 2400	$CaCO^3$
−4935	MD 77191	7° 30′ N, 76° 43° E	1254	0–2	2650 ± 230	OM
−4891	MD 77191	7° 30′ N, 76° 43° E	1254	58–60	3300 ± 240	OM
−4892	MD 77191	7° 30′ N, 76° 43° E	1254	144–146	3500 ± 250	OM
−4893	MD 77191	7° 30′ N, 76° 43° E	1254	254–257	5400 ± 290	OM
−4894	MD 77191	7° 30′ N, 76° 43° E	1254	403–405	8160 ± 380	OM
−4895	MD 77191	7° 30′ N, 76° 43° E	1254	475–478	9560 ± 440	OM
−4896	MD 77191	7° 30′ N, 76° 43° E	1254	502–505	10,580 ± 480	OM
−4945	MD 77191	7° 30′ N, 76° 43° E	1254	536–540	11,370 ± 520	OM
−4937	MD 77191	7° 30′ N, 76° 43° E	1254	596–600	12,130 ± 570	OM
−4946	MD 77191	7° 30′ N, 76° 43° E	1254	641–645	13,800 ± 680	OM
−4899	MD 77191	7° 30′ N, 76° 43° E	1254	702–705	18,100 ± 500	OM
−5754	MD 77203	20° 41′ N, 59° 34′ E	2442	15–19	7920 ± 370	$CaCO^3$
−5755	MD 77203	20° 41′ N, 59° 34′ E	2442	77–79	11,070 ± 370	$CaCO^3$
−5756	MD 77203	20° 41′ N, 59° 34′ E	2442	143–145	14,800 ± 260	$CaCO^3$
−5858	MD 77203	20° 41′ N, 59° 34′ E	2442	204–206	17,050 ± 400	$CaCO^3$
−5757	MD 77203	20° 41′ N, 59° 34′ E	2442	243–245	22,400 ± 500	$CaCO^3$
−5758	MD 77203	20° 41′ N, 59° 34′ E	2442	313–315	24,500 ± 270	$CaCO^3$
−5759	MD 77203	20° 41′ N, 59° 34′ E	2442	348–350	25,500 ± 450	$CaCO^3$
−5760	MD 77203	20° 41′ N, 59° 34′ E	2442	400–403	26,800 ± 1000	$CaCO^3$
−5860	MD 77203	20° 41′ N, 59° 34′ E	2442	503–506	29,200 ± 1000	$CaCO^3$
−5861	MD 77203	20° 41′ N, 59° 34′ E	2442	603–605	31,200 ± 900	$CaCO^3$

Gif-3400. Core KS 07, 31–33cm **8700 ± 680**

Sapropelic level from core KS 07 (35° 40′ N, 17° 13′ E), water depth 3915m.

Gif-3401. Core KS 07, 39–40cm **9600 ± 1200**

Sapropelic level.

Venezuela

Dmerara plain series

Organic fraction of marine sediments cores coll 1973 during Orgon II cruise on board *R/V Jean Charcot.* Subm 1978 by J Moyes, Univ Bordeaux.

Gif-4543. Core KS 02 **9600 ± 440**

Carbonate fraction (≥60μ) from level 92.5 to 97.5cm of core KS 02 (10° 28′ N, 59° 30′ 59° 30′ W), water depth 1260m. *Comment:* sample dated because of abundance of Pteropods in sediment at this level.

Gif-4544. Core KS 03 **≥30,000**

Carbonate fraction (≥60μ) from level 380 to 390cm of core KS 03 (10° 02′ N, 57° 32′ W), water depth 3410m. *Comment:* sample subm to date disappearance of *Pulleniatina obliloquilaculata* sp.

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INSTITUT ROYAL DU PATRIMOINE ARTISTIQUE RADIOCARBON DATES XI

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This list contains the results of ^{14}C determinations obtained at the laboratory in 1984. Our laboratory measures ^{14}C activity in the form of methane with a proportional counter built by Heidelberg University and an electronic unit built by Berthold, Benelux Analytical Instruments. The sample counting time is 4000 minutes with printouts at 100 minute intervals. Sample error is reported as one standard deviation. $\delta^{13}C$ for mortar is measured by the University of Lyon Laboratory, $\delta^{13}C$ was not measured or estimated for other samples.

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GEOLOGIC SAMPLES

Belgium

Dunes series

Samples from coastal plain in W Vlaanderen. Coll 1983 and subm Nov 1983 by R De Ceunynck, Univ Gent, Belgium.

IRPA-579. De Panne D01 **590 ± 50**

Soil at 180cm depth (51° 05′ 45″ N, 2° 36′ 18″ E).

IRPA-580. De Panne D05 **1470 ± 50**

Soil at 485 cm depth (51° 05′ 44″ N, 2° 36′ 45″ E).

IRPA-581. De Panne DP/KV-51/C-14A **1630 ± 60**

Top of peat at 555cm depth (51° 05′ 47″ N, 2° 35′ 37″ E).

IRPA-582. De Panne DP/KV-51/C-14B **2080 ± 60**

Basal peat at 575cm depth (51° 05′ 47″ N, 2° 35′ 37″ E).

IRPA-585. Koksijde WWK1VB7/C-14B **470 ± 50**

Top of peat at 95cm depth (51° 06′ 57″ N, 2° 39′ 37″ E).

IRPA-587. Koksijde WWKVB7/C-14A1 **790 ± 50**

Base of peat at 115cm depth (51° 06′ 57″ N, 2° 39′ 37″ E).

IRPA-588. Adinkerke AG10 top **4040 ± 70**

Peat at 170cm depth (51° 03′ 36″ N, 2° 33′ 48″ E).

IRPA-589. Adinkerke AG10 base **4300 ± 70**

Peat at 180cm depth (51° 03′ 36″ N, 2° 33′ 48″ E).

IRPA-590. Adinkerke **4270 ± 70**

Wood found under base of peat at 187cm depth (51° 03′ 36″ N, 2° 33′ 48″ E).

IRPA-624. Klemskerke-De Haan KB1 **1370 ± 50**

Soil with peat at 80cm depth (51° 15′ 04″ N, 3° 00′ 05″ E). Possible contamination by roots.

General Comment (R DeC): dates agree with previous results and with relative archaeol chronology; dates used to elaborate stratigraphy of coastal dunes.

Mark series

The following results complete previously pub series (R, 1981, v 23, p 345–346; R, 1983, v 25, p 869) of samples from alluvial plain of Mark R in Brabant and Hainaut. Coll and subm 1983–1984 by W Huybrechts, Geol Inst, Free Univ Brussels.

IRPA-553. Herne B81/6/5 **8890 ± 90**

Middle of peat, 622 to 625cm below surface (50° 43′ N, 4° 01′ E).

IRPA-555. Herne B81/6/9 **870 ± 50**

Top of peat (50° 43′ N, 4° 01′ E), possibly contaminated by younger roots.

IRPA-569. Herne B81/6/8(1) **3080 ± 60**

Top of peat, 115 to 125cm below surface (50° 43′ N, 4° 01′ E).

IRPA-570. Herne B81/6/8(2) **6050 ± 80**

Base of peat at 230cm below surface (50° 43′ N, 4° 01′ E).

IRPA-571. Marcq B81/6/17(A) **10,370 ± 120**
(B) **9490 ± 130**

Peat with pieces of wood at 425cm depth (50° 41′ N, 4° 00′ E). Sample divided in two parts; hard layer, A, and sandy peat, B. Sandy peat is diluted (75.5% sample).

IRPA-572. Marcq B81/6/18(1) **1640 ± 60**

Top of peat, 55 to 60cm below surface (50° 41′ N, 4° 00′ E).

IRPA-573. Marcq B81/6/18(2) **2740 ± 60**

Base of peat, 270 to 275cm below surface (50° 41′ N, 4° 00′ E).

IRPA-619. Piepels **12,140 ± 140**

Peat, 740.5 to 742.5cm below surface (50° 45′ 11″ N, 3° 59′ 17″ E).

IRPA-643. Marcq B84/4/28(1) **10,880 ± 120**

Base of peat, 406 to 414cm below surface (50° 40′N, 3° 59′ E).

IRPA-644. Marcq B84/4/28(2) **1130 ± 50**

Wood at 170cm depth (50° 40′ N, 3° 59′ E).

Western coastal plain of Belgium series

The following results complete previously pub series (R, 1984, v 25, p 385–387) of peat and wood from several levels of core in W Vlaanderen. Dated to study evolution of so-called surface peat (Baeteman *et al*, 1979; Baeteman, 1981). Coll and subm 1983 by C Baeteman, Geol Service Belgium.

IRPA-515. Drie Grachten 6 **6500 ± 90**

Peat from 824 to 830cm at Merkem (50° 57′ 45″ N, 2° 49′ 22″ E), diluted (74.4% sample).

IRPA-520. Drie Grachten 7 **7030 ± 80**

Peat from 1070 to 1080cm at Merkem (50° 57′ 45″ N, 2° 49′ 22″ E).

General Comment (CB): both samples coll from same boring, namely from base of 2nd and 3rd intercalated peat layer at viz-4.35m and -6.85m (absolute level). Dates fit well into whole series from different peat layers of this boring (IRPA-521, -529, -524, -530, -531).

IRPA-521. Drie Grachten 8 **1750 ± 50**

Clayey peat from 288 to 292cm at Merkem (50° 57′ 45″ N, 2° 49′ 22″ E). *Comment* (CB): dates top of uppermost intercalated peat layer at +1.03m (absolute level). Site is loc far inland, nearly at S border of coastal plain. Date confirms that in these inland areas end of peat growth occurred much later than in more coastal parts. This is youngest known date of top of peat (which obviously is not eroded or disturbed) in area and coincides well with IRPA-537: 1870 ± 50 BP, also from top of same peat layer in more inland area.

IRPA-518. Spermalie 2-4 **4860 ± 70**

Wood from base of top peat, 340 to 350cm below surface (51° 07′ 50″ N, 2° 51′ 15″ E).

IRPA-560. Wolvenest 4 **4970 ± 70**

Peat from base of first peat layer, 349 to 353cm below surface at Ramskapelle (51° 06′ 40″ N, 2° 46′ 45″ E).

IRPA-562. Violon **5160 ± 70**

Base of peat, 370 to 375cm below surface at Ramskapelle (51° 06′ 40″ N, 2° 46′ 45″ E).

General Comment (CB): results represent series of dates of base of uppermost intercalated peat layer at depth 0.29 and 0.50m (absolute level). Loci

are rather far from each other, although they are all in seaward part of coastal plain. Ages coincide very well, confirming that beginning of this peat growth was at ca 4900 BP.

IRPA-519. Spermalie 2-5 **5650 ± 70**

Peat from top of base peat, 415 to 420cm below surface (57° 07′ 50″ N, 2° 51′ 15″ E).

IRPA-566. Allaartshoeve **8250 ± 100**

Peat from top of base peat, 1460 to 1467cm below surface at Wulpen (51° 06′ 05″ N, 2° 43′ 40″ E).

General Comment (CB): dates basal peat of initial Holocene marine influence at, respectively, 11 and 1m depth (absolute level) at two loci in vicinity of Nieuwpoort. Samples indicate totally different Holocene sequence due to level of pre-Holocene surface. Dates correspond with expected ages in accordance with depth although 8250 ± 95 BP is oldest known date of basal peat in W coastal plain of Belgium.

IRPA-557. Wolleboom **3360 ± 60**

Peat from base of basal peat, 700 to 703cm below surface at Reninge (50° 58′ 43″ N, 2° 47′ 25″ E). *Comment* (CB): date confirms that peat originated from eroded part of top of uppermost peat layer. This result can be compared with IRPA-539, -540, and -560 from similar situations.

IRPA-558. Wolvenest 1 **6160 ± 80**

Wood from top of second peat layer, 563cm below surface at Ramskapelle (51° 06′ 40″ N, 2° 46′ 45″ E).

IRPA-559. Wolvenest 2 **6200 ± 80**

Peat from top of second peat layer, 563 to 567cm below surface at Ramskapelle (51° 06′ 40″ N, 2° 46′ 45″ E).

IRPA-561. Wolvenest 3 **6420 ± 80**

Peat from base of second peat layer, 573 to 577cm below surface at Ramskapelle (51° 06′ 40″ N, 2° 46′ 45″ E).

General Comment (CB): samples date top and base of intercalated peat layer at depth 2.63 to 2.77m (absolute level). IRPA-558 represents date of wood fragment formed at top of layer and fully agrees with ^{14}C age of top of peat, itself. This series agrees well with few dates on second regional intercalated peat layer at ca 2.5m depth (Hv-8795:6340 ± 110 BP, Hv-8796:6425 ± 70 BP; Hv-8799:6015 ± 65 BP, Baeteman, 1981).

IRPA-564. Moerhof **4830 ± 70**

Base of peat, 225 to 239cm below surface at Veurne (51° 03′ 57″ N, 2° 37′ 05″ E). *Comment* (CB): base of peat layer was sampled in area of de Buitenmoeren (just E of de Moeren). Greatest part of peat layer was excavated. Date should demonstrate if peat layer is to be correlated with uppermost regional peat layer (surface peat) and whether or not it started to grow

much later than in rest of coastal plain, as it occurs at higher level (+0.90m). Age agrees very well with all other dates of base of peat layer (Baeteman, 1981; Baeteman *et al,* 1979; IRPA-518, -560, -562) and also with sample from vicinity in Bulskamp, IRPA-388: 4480 ± 240 BP, and its palynology (Baeteman & Verbruggen, 1980).

IRPA-565. Mechelhof **2870 ± 60**

Peat from 988 to 994cm below surface at Leffinge (51° 10′ 05″ N, 2° 53′ E). *Comment* (CB): peat was coll at 4.86m depth (absolute level) at base of continuous tidal flat (mud and mixed flat) sequence, 10m thick. From lithologic sequence it was not very clear whether peat is to be correlated with basal peat occurring at about same depth in surrounding area or if it is reworked peat block. Date confirms that peat originated from eroded part of top of uppermost intercalated peat layer and can be compared with IRPA-539 and -540 from similar situations.

Scotland

Cairngorms Estate series

This series from Cairngorms completes previously pub lists (R, 1976, v 18, p 158; R, 1977, v 19, p 385-387; R, 1978, v 20, p 197-198; R, 1981, v 23, p 347). Coll 1974-1981 and subm Dec 1983 by AD Dubois, Univ Antwerpen, Belgium.

IRPA-591. Site 2A **5460 ± 70**

Wood (*Pinus*) (57° 08′ 51″ N, 3° 38′ 42″ E); alt +595m.

IRPA-592. Site 22-A-A **1780 ± 60**

Wood (*Pinus*) (57° 08′ 13″ N, 3° 41′ 11″ E); alt +530m.

IRPA-593. Site 7-1 (G1) **6870 ± 80**

Roots from wood (*Pinus*) (57° 07′ 58″ N, 3° 40′ 17″ E); alt +640 m.

IRPA-594. Site 20-C **7350 ± 90**

Roots from wood (*Pinus*) (57° 07′ 16″ N, 3° 41′ 11″ E); alt +790m.

IRPA-595. Site 6-bis **4760 ± 90**

Roots from wood (*Pinus*) (57° 07′ 29″ N, 3° 40′ 33″ E); alt +690m.

IRPA-596. Site 22-C **3310 ± 60**

Wood (*Pinus*) (57° 08′ 13″ N, 3° 41′ 11″ E); alt +530m.

IRPA-597. Site 17-B **4080 ± 60**

Roots from wood (*Pinus*) (57° 08′ 48″ N, 3° 38′ 38″ E); alt +615m.

IRPA-599. Site 22-B-B **4130 ± 70**

Roots from wood (*Pinus*) (57° 08′ 13″ N, 3° 41′ 11″ E); alt +530m.

IRPA-600. Site 2 **5900 ± 90**

Wood (*Pinus*) (57° 08′ 51″ N, 3° 38′ 42″ E); alt +595m.

IRPA-598. Barns of Barnack A **3440 ± 60**

Roots from wood (*Pinus*) (57° 07′ 49″ N, 3° 34′ 05″ E); alt +710m.

IRPA-601. Barns of Barnack C **6660 ± 80**

Roots from wood (*Pinus*) (57° 07′ 49″ N, 3° 34′ 05″ E); alt +710m.

IRPA-603. Barns of Barnack D **6760 ± 80**

Roots from wood (*Pinus*) (57° 07′ 50″ N, 3° 33′ 57″ E); alt +695m.

IRPA-602. Barns of Barnack E **4660 ± 60**

Roots from wood (*Pinus*) (57° 07′ 50″ N, 3° 33′ 57″ E); alt +695m.

IRPA-604. Coire Odhar Site F **6750 ± 80**

Roots from wood (*Pinus*) (57° 08′ 54″ N, 3° 34′ 23″ E); alt +700m.

Africa

Morocco series

Organic material and calcareous crust from Morocco coll 1978–1983 and subm 1984 by L Mathieu, Fac Agronom Gembloux, Belgium. Dates are used in morphol and pedol study in which soils and calcareous crusts are assoc (Bock & Mathieu, 1982).

IRPA-628. Khenifra 11 **6110 ± 80**

Organic material (32° 59′ N, 5° 27′ E). Humic acids extraction. Rharbien age expected.

IRPA-629. Bab el Arbaa 18 **2720 ± 70**

Organic material (34° 01′ N, 4° 06′ E). Humic acids extraction. Diluted: 69% sample. Rharbien age expected.

IRPA-630. Bab Bon Idri 10 **2420 ± 70**

Organic material (34° 08′ N, 4° 05′ E). Humic acids extraction. Diluted: 67.5% sample. Rharbien age expected.

IRPA-631. Berkine 20 **6580 ± 110**

Organic material (3° 39′ N, 4° 03′ E). Humic acids extraction. Diluted: 61.7% sample. Rharbien age expected.

IRPA-632. Khenifra 2 **1730 ± 50**

Organic material (32° 59′ N, 5° 27′ E). Humic acids extraction. Rharbien age expected.

IRPA-638. Col Rose des Vents **17,190 ± 230**

Calcareous crust (33° 31′ N, 4° 30′ E). Pretreated with HCl 37% until 50% weight loss. Tensiftien age expected.

IRPA-639. Mitek **24,650 ± 530**

Calcareous crust (34° 04′ N, 3° 56′ E). Pretreated with HCl 37% until 50% weight loss. Tensiftien age expected.

IRPA-640. Gueldamane **12,220 ± 140**

Calcareous crust (34° 02′ N, 3° 56′ E). Pretreated with HCl 37% until 50% weight loss. Tensiftien age expected.

IRPA-641. Jeouna **16,530 ± 210**

Calcareous crust (34° 12′ N, 3° 58′ E). Pretreated with HCl 37% until 50% weight loss. Tensiftien age expected.

IRPA-642. Jebel Almar **20,680 ± 330**

Calcareous crust (34° 01′ N, 3° 54′ E). Pretreated with HCl 37% until 50% weight loss. Tensiftien age expected.

IRPA-637. Iles du Cap Vert **32,900 ± 330**

Calcareous crust from Ile de Maio (15° 10′ N, 23° 31′ E) coll Oct 1980 and subm Oct 1984 by L Mathieu. Pretreated with HCl 37% until 50% weight loss. Tensiftien age expected.

Portugal

IRPA-635. Praia do Foz Site 1 **4040 ± 220**

Charcoal from Sines-Samougeria. Coll July 1984 by R De Ceunynck and subm Sept 1984 by A Gautier, Univ Gent, Belgium. From same site are dates: UM-1332: 520 BP and BETA-2909: 780 BP. Dilution: 19.7% sample.

IRPA-636. Praia do Morgavel Site 7 **19,780 ± 300**

Peat from Sines-Morgavel. Coll July 1984 by R De Ceunynck and subm Sept 1984 by A Gautier, Univ Gent, Belgium. Date is younger than Hv-2391: 39,940 BP and Hv-2392: 42,240 BP.

ARCHAEOLOGIC SAMPLES

Belgium

Aven Ackers series

Samples from Mesolithic site in Verrebroeck, Antwerpen (51° 30′ N, 4° 11′ 30″ E). Coll and subm 1983–1984 by R Van Hove.

IRPA-576. VeAZ83/I/G **5510 ± 100**

Podzol from soil layer accumulation (B2 horizon). *Comment* (RVH): archaeologically, date is interesting since podzolisation is younger than Mesolithic settlement on whole site. Dilution: 63.7% sample.

IRPA-577. VeAZ81/III/W **12,120 ± 140**

Sample from peat layer underlying young Pleistocene cover sand. *Comment* (RVH): assigned to late Bölling or Alleröd period. Date is *terminus post quem* for overlying Mesolithic settlement.

IRPA-607. VeAZ81/III/C (A) **4600 ± 70**
(B) **4930 ± 70**

Podzol. (A) is soluble fraction in NaOH 1%; (B) is residue. *Comment* (RVH): dates organic sand layer (peaty material) which grew in and on late Pleistocene sand; thus, it is youngest layer before alluviation. According to palynology, result refers to older level.

IRPA-633. VeAZ83/III **8890 ± 100**

Nuts from pit excavated in late Pleistocene cover sand; stratigraphically younger than IRPA-577. Sample dates Mesolithic settlement.

IRPA-578. Evergem **2490 ± 60**

Nuts from Evergem, O Vlaanderen (51° 06′ N, 3° 42′ E). Coll Sept 1983 by J Van Moerkerke and subm Sept 1983 by C Verbruggen, Univ Gent, Belgium. Date agrees with archaeol data.

Sint Martens-Latem series

Samples from Sint Martens-Latem, O Vlaanderen (51° 01′ 30″ N, 3° 37′ 20″ E). Coll Nov 1983 and subm Feb 1984 by F Vermeulen, Univ Gent, Belgium.

IRPA-609. LS83-M13 **3440 ± 60**

Soil from 150cm depth. *Comment* (FV): sample from humic layer assoc with remains of Late Bronze or Early Iron age.

IRPA-610. LS83-M14 **2050 ± 60**

Soil from Roman pit, at 130cm depth. *Comment* (FV): archaeologic date: ca AD 50.

IRPA-611. Gavere AJ83-M3 **2150 ± 50**

Wood from Roman well in Gavere, O Vlaanderen (50° 55″ N, 3° 39′ 30″ E), at 220cm depth. Coll Aug 1983 and subm Feb 1984 by F Vermeulen. *Comment* (FV): archaeologic date: 1st century AD.

IRPA-583. Lokeren **410 ± 50**

Wood from well in Lokeren, O Vlaanderen (51° 06′ N, 4° 01′ E), at 100cm depth. Coll and subm 1983 by A Verstraeten. Middle Age date expected.

IRPA-584. Sugny 83SU6 **1400 ± 60**

Charcoal from fire layer covered by walls of stone fortification occupied after AD 1075, in Sugny, Namur (49° 50′ N, 4° 54′ E). Coll and subm Nov 1983 by A Matthys, Natl Service Excavations, Belgium. *Comment* (AM): result agrees with archaeol data potsherds and tiles from Carolingian period found in other layer. More dates are needed to confirm this date.

IRPA-586. Donk 82D0592 **1780 ± 60**

Charcoal from 70 to 90cm depth, Limburg (50° 56′ N, 5° 07′ 30″ E). Coll Aug 1982 and subm April 1984 by L Van Impe, Natl Service Excavations, Belgium. La Tène age expected.

IRPA-605. Zwin **550 ± 50**

Wood from boat in Knokke, W Vlaanderen (51° 21′ 45″ N, 3° 21′ E). Coll Sept 1983 and subm Jan 1984 by S Wartel, Inst Royal Sci Nat, Belgium.

IRPA-608. Fagnolles **660 ± 50**

Wood (oak) from timber of bridge of Fagnolles Castle, Namur (50° 07′ 15″ N, 4° 34′ 01″ E), at 250 to 300cm depth. Coll Aug 1983 and subm Feb 1984 by L Lowagie. Date agrees with archaeol data.

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ILLINOIS STATE GEOLOGICAL SURVEY RADIOCARBON DATES VIII

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This article reports on archaeologic samples processed from February 1974 through May 1980 at the Illinois State Geological Survey (ISGS) Radiocarbon Dating Laboratory.

The benzene liquid scintillation technique was used following laboratory procedures reported by Coleman (1973, 1974). All ages were calculated on the basis of a ^{14}C half-life of 5568 yr, using the NBS oxalic acid standard as reference. Errors (1σ) reported account only for uncertainties in activity measurements of the sample, standard, and backgrounds. Assignment of modern and minimum ages is based on the 3σ criteria. If the difference in activity between the sample and the standard is less than three times the standard deviation of that difference, the age is reported as modern and the activity is reported as percent of modern. Samples having net activities less than 3σ are reported as minimum ages with the minimum age based on the net activity $+2\sigma$. Corrections for isotopic fractionation have been included for samples dated since December 1979.

ARCHAEOLOGIC SAMPLES

United States

Illinois

Crab Orchard site series

Charcoal from Jackson Co, in Shawnee Hills of S Illinois. Assoc with potsherds, chert flakes, and large quantities of sandstone. Coll 1973 by Walter Brieschke and William Gremin; subm by M J McNerney, S Illinois Univ Mus.

ISGS-245. 24B3-100 **1920 ± 80**

From 15km SW of Carbondale (37° 36′ 50″ N, 89° 17′ 32″ W) from fill of Feature 19, 87cm below surface.

ISGS-246. 24B3-111 **1900 ± 80**

From 10km SW of Carbondale (37° 39′ 00″ N, 89° 15′ 50″ W), from fill of Feature 5.

General Comment (MJM): Features 19 and 5 were apparently cooking or roasting facilities and contained Crab Orchard fabricmarked, and Sugar Hill cordmarked potsherds (McNerney, 1975).

ISGS-251. Loy site, F-181b **1970 ± 80**

Carbonized wood and nutshell from Greene Co, 18km S of Greenfield (39° 14′ 00″ N, 90° 12′ 02″ W). Separated from soil and coll at 15cm level of Middle Woodland and refuse pit. Coll 1971 and subm by K B Farnsworth,

Univ Michigan. *Comment* (KBF): date falls very close to previous Loy site dates (ISGS-171: 1970 ± 75 BP and ISGS-181: 2010 ± 90 BP, R, 1975, v 17, p 168), reinforcing conclusion that Loy site was of short-term, perhaps seasonal, occupation.

Helton Mound series

Wood charcoal from Greene Co, 10.5km S of Eldred (39° 11′ 20″ N, 90° 32′ 40″ W), from burned log that was part of crematory containing 6 individuals. Coll 1973 by Ann Magennis; subm by Jane Buikstra, Northwestern Univ.

ISGS-257. 22-4A **1020 ± 80**

ISGS-258. 22-4B **1130 ± 80**

General Comment (JB): dates are relatively recent for pottery vessel found above crematory, typed as "early bluff" and assoc with early portion of Late Woodland period in this region. Dates are important to define Late Woodland in this region.

Cahokia site series

Wood charcoal and charred organic material from Madison Co, between Collinsville and E St Louis (38° 39′ 39″ N, 90° 04′ 05″ W). Coll 1971 by R J Salzer; subm by D W Lathrap.

ISGS-276. DWL-13 **860 ± 80**

From 63cm below present surface in garbage layer in fill of house basin.

ISGS-280. Merrell Tract-14 **1050 ± 80**

ISGS-281. Merrell Tract-15 **1080 ± 80**

ISGS-283. Merrell Tract-16 **1220 ± 80**

From concentration of organic material on floor of old house (Feature 319).

General Comments (RJS): date on ISGS-276 is concordant with Fairmount phase house; ISGS-281 and -283, however, seem too old. (DWL): ISGS-280, -281, and -283 agree perfectly with ISGS-163: 1170 ± 80 BP, R, 1974, v 16, p 115, which dates identical pottery and architecture on Powell Tract. Cluster of three dates, ISGS-138, -140, and -141: 950 ± 80 BP, 1000 ± 80 BP, 780 ± 150 BP, respectively, R, 1974, v 16, p 115 indicate that Fairmount phase had terminated by 1000 BP. Thus, date of ISGS-276 is too young for Fairmount phase, but may indicate later episode in refilling of Fairmount phase house pit.

Titus site series

Carbonized wood and nutshell from Greene Co, 7.2km NE of Hardin (39° 11′ 24″ N, 90° 32′ 44″ W). Coll 1973 by S R Noble; subm by J A Brown, Northwestern Univ.

ISGS-290. Titus #2 **7990 ± 80**

From prehistoric pit in Horizon 3, 4.63m below surface.

ISGS-300. Titus #3 **8070 ± 100**

From upper 10cm level in prehistoric pit, ca 4.4m below surface.

ISGS-317. Titus #1 **9170 ± 110**

From log underlying Horizon 3 in sterile soil, 3.93 to 4.3m below surface.

General Comment (JAB): ISGS-290 and -300 are sufficiently close in age for same horizon. ISGS-317 is older than overlying occupation (Horizon 3) by unexpected amount (ca 1000 yr), but is compatible with its stratigraphic position.

Koster site series

Carbonized wood and nutshell from Greene Co, 8km NE of Hardin (39° 12′ 30″ N, 90° 33′ 00″ W). Coll 1970 to 1974 by G L Houart and R B McMillan; subm by C A Bebrich and J A Brown, Northwestern Univ.

ISGS-329. KOSN #90 **3950 ± 80**

From Feature 286a, Horizon 4, 0.1 to 0.5m below primary ref datum.

ISGS-414. KOSN #555 **5820 ± 80**

From Feature 1740a, Horizon 7A, 2.74 to 3.04m below primary ref datum.

ISGS-338. KOSN #610 **7020 ± 120**

From Horizon 8C, upper component, Sq 362, Level 11, 4.16 to 4.24m below datum.

ISGS-303. KOSN #700, #701 **7670 ± 110**

From Feature 2010a in Horizon 8F, 4.84 to 4.92m below datum.

ISGS-316. KOSN #702 **7800 ± 160**

From Feature 2007b in Horizon 9A, 5.10 to 5.11m below datum.

ISGS-336. KOSN #75 **8220 ± 80**

From Feature 262b, c, Horizon 9D, 5.94 to 6.03m below datum.

ISGS-337. KOSN #81 **8130 ± 80**

From Feature 288c, Horizon 10B, 6.71 to 7.01m below datum.

ISGS-292. KOSN #705 **8440 ± 80**

From Feature 2025a in Horizon 11, 7.11 to 7.19m below datum.

ISGS-328. KOSN #709 **8730 ± 90**

From Feature 2062a, b, Horizon 12, 7.55 to 7.65m below datum.

ISGS-415. KOSN #717 **12,320 ± 80**

From dewatering well shaft #2, ca 10m below datum and 3m below Horizon 12 in sterile sand.

General Comment (JAB): highly satisfactory set of dates agree with depositional sequence for Early, Middle, and Late Archaic occupations at Koster. ISGS-337 is anomalously young (Butzer, 1977, p 32), but lies within proper range. Sequence of these and other Koster dates is illustrated graphically in Brown and Vierra (1983, p 180).

Pabst site series

Wood charcoal from De Witt Co, 8km ENE of Clinton (40° 10′ 16″ N, 88° 50′ 07″ W). Coll 1975 and subm by R B Lewis, Univ Illinois.

ISGS-376. F1-75 **3860 ± 80**

From Middle/Late Archaic refuse pit.

ISGS-377. F2-75 **4300 ± 80**

From A horizon of intra-Holocene soil overlain by Middle/Late Archaic midden.

General Comment (RBL): dates provide estimate for beginning of Late Archaic midden deposits at Pabst site. Chronology established by these two dates is consistent with that inferred from comparison of tool forms in strata to similar tool forms from other dated archaeologic contexts.

Reed Walker site series

Wood charcoal from Coles Co, 9.5km S of Charleston (39° 23′ 46″ N, 88° 10′ 02″ W). Coll 1973 and 1974 and subm by R J Barth, Univ Illinois.

ISGS-404. RB-1 **520 ± 80**

From fire pit assoc with shell-tempered pottery, chipping debris, and bone. *Comment* (RJB): date is first for Vincennes culture in Embarras R Valley, and extends span of Vincennes culture by ca 300 yr.

ISGS-406. RB-2 **1210 ± 80**

From fire pit in floor of semi-subterranean pit house. *Comment* (RJB): date is first for Lamotte culture in Embarras Valley, and probably falls close to beginning of Lamotte occupation of site.

Fingerhut site series

Charcoal from St Clair Co, 6.4km SW of Collinsville (38° 39′ 23″ N, 90° 05′ 23″ W). Coll 1962 by Jon Winston and C J Bareis; subm by C J Bareis.

ISGS-418. R 6 **1200 ± 140**

From fill of Burial 20.

ISGS-419. R 1 & R 3 **930 ± 150**

From fill of bell-shaped refuse pit, F-1.

General Comment (CJB): ISGS-418 is inconsistent with temporal range of

Late Woodland ceramics at Fingerhut site. ISGS-419 is slightly younger than expected but may well represent later occupation at site.

ISGS-420. Weitzer site #11 **2150 ± 150**

Wood charcoal from Greene Co, 11.5km NNE of Eldred (39° 21′ 52″ N, 90° 35′ 13″ W), from basal 2cm of fill in Feature 1051 E. Coll 1973 by T Simon and J P Nicholas; subm by J A Brown. *Comment* (JAB): date is younger than expected but consistent with stratigraphic loc of sample beneath Late Woodland occupation at this site.

Birch Creek series

Mastodon(?) tusk from Greene Co, 5.3km ENE of Roodhouse (39° 30′ 15″ N, 90° 16′ 30″ W), embedded in sand at edge of creek. Coll 1976 by Joyce and James Kesinger; subm by Merle Leman and Patrick Sugent, N Greene Jr High School, Roodhouse, Illinois.

ISGS-428 A. Apatite fraction **9820 ± 150**

ISGS-428 B. Organic fraction **11,040 ± 110**

General Comment (DDC): disagreement of dates indicates that sample was contaminated; we do not know which date, if any, is correct.

Kohler site series

Wood charcoal from Alexander Co, 1km SSE of Millcreek (37° 20′ N, 89° 15″ W), from charcoal concentration at depth 70 to 90cm below surface. Coll 1976 and subm by W D Ganzer, Pulaski/Alexander Co Soil and Water Conservation Dist, Mounds, Illinois.

ISGS-434. MCC-1-4, 70–80cm depth **570 ± 80**

ISGS-440. MCC-1-5, 85–90cm depth **610 ± 90**

General Comment (WDG): dates correspond to late-middle period of occupation.

Becker Borrow pit (CT-95) series

Charred wood from Clinton Co, 4km NE of Breese (38° 37′ N, 89° 29′ W). Coll 1974 by Jorge Marcos and Sue Russel; subm by C J Bareis and A W Wilson.

ISGS-398. CJB-2 **1160 ± 80**

From fill of Feature 92. *Comment* (AWW): date fits very well with assoc materials and other dates on similar materials.

ISGS-399. CJB-1 **2500 ± 80**

From fill in depression in floor of Feature 87. *Comment* (AWW): date does not fit with Late Woodland ceramics from fill of this feature.

ISGS-456. R-121 **1460 ± 80**

From pit Feature 70, assoc with early Late Woodland vessels.

ISGS-457. R-122 **1580 ± 100**

From loess clay fill of Feature 70. *Comment* (AWW): Feature 70 is oval pit with concave walls and flat floor with post mold. Pit is superimposed by Mississippian wall trenches. Similar features elsewhere have been dated in range, 1550 to 1350 BP.

ISGS-469. R-123 **970 ± 80**

From floor of Feature 175. *Comment* (AWW): date confirms interpretation of structure as being transitional Late Woodland to Mississipian.

ISGS-464. R-129 **850 ± 80**

From remainder of wall post of structural Feature 180. *Comment* (AWW): date helps to substantiate hypothesis of multiple Mississippian structural modes (wall trench and post mold) at this site.

ISGS-470. R-126 **810 ± 80**

From floor of Feature 179. *Comment* (AWW): sample was immediately N of Structure F-180 (ISGS-464). Contemporaneity of dates on these structures further confirms hypothesis of multiple Mississippian construction modes at site.

Judson College site series

Charcoal from Kane Co, inside N city limit of Elgin, W side of Fox R (42° 03′ 30″ N, 88° 17′ 30″ W). Coll 1977 by Allan Holder, subm by E S Cassells, Judson Coll, Elgin, Illinois.

ISGS-473. K-47/Feature 0 **330 ± 80**

From top of two large dolomite rocks that formed base of hearth (Feature 0). *Comment* (ESC): date indicates historic/proto-historic utilization much younger than some assoc projectile points would indicate. However, on basis of a few small triangular and notched projectile points found in this site, late occupation, as indicated by date, is not unreasonable.

ISGS-474. K-47/Feature P **310 ± 80**

From bottom of basin-shaped hearth, Feature P. *Comment* (ESC): date agrees with ISGS-473. Younger than expected dates may represent end of occupation at site.

ISGS-522. K-47/Feature F **2020 ± 80**

From poorly-defined pit assoc with bone fragments and chipped stone tools. *Comment* (ESC): date agrees with typologic evidence and helps establish Late Archaic-Early Woodland occupation at site.

ISGS-481. Castellan Site NIU-110 **1340 ± 80**

Charcoal from Lee Co, 3km W of Dixon (41° 49′ 24″ N, 89° 32′ 42″ W), from mound fill assoc with Late Woodland pottery and stone tools. Coll 1976 and subm by J W Springer. *Comment* (JWS): date is very close to dates from comparable sites in Wisconsin.

Medusa Mound Group series

Human bone from Lee Co, 5km NE of Dixon (41° 54′ N, 89° 28′ W), from burial at 30cm depth in homogeneous clay mound fill. Coll 1977 by NIU field school; subm by J W Springer.

ISGS-484A. B_1MV, apatite fraction **970 ± 100**

ISGS-484B. B_1MV, total organic fraction **1130 ± 80**

General Comment (JWS): although there are no diagnostic artifacts, character of mounds suggests Late Woodland date. Dates are compatible with Late Woodland affiliation.

NIU-89 series

Human vertebrae from Ogle Co, 4.5km of Oregon, Illinois (42° 00′ 10″ N, 89° 22′ 30″ W), from grave in sand and gravel knoll. Coll 1976 by Philip Volkman; subm by J W Springer.

ISGS-487A. Apatite fraction **1340 ± 120**

ISGS-487B. Total organic fraction **640 ± 80**

General Comment (JWS): assoc artifacts are of Late Woodland stage. Either date is possibly correct, although 1340 BP is more likely.

Cameron Road site series

Charcoal from Warren Co, 8km W of Galesburg (44° 55′ 51″ N, 90° 30′ 51″ W). Coll 1978 by T East; subm by M R Beckes and J E King, Dickson Mound Mus, Lewistown, Illinois.

ISGS-539. Lot 496 **97.97 ± .73% modern**

From Feature 8, 0 to 16cm from surface.

ISGS-540. Lot 267 **200 ± 80**

From Feature 7, 0 to 16cm from ground surface.

ISGS-591. Southend site, Mt-89 **680 ± 80**

Wood charcoal from Moultrie Co, 4.4km NE of Findley (39° 31′ 40″ N, 88° 42′ 00″ W), from lowest natural stratigraphic level of Feature 3. Coll 1978 by C R Moffat; subm by T J Riley, Univ Illinois. *Comment* (TJR): date is consistent with our estimated time of occupation of Mt-89 deduced from ceramic cross-dating with Cahokia area.

ISGS-592. Doctor's Island site **710 ± 80**

Wood charcoal from Moultrie Co, 4.5km NE of Findley (39° 32′ 15″ N, 88° 42′ 05″ W), from lower half of large Mississippian refuse pit. Coll 1978 by C R Moffat and J Yingst; subm by T J Riley. *Comment* (TJR): along with ISGS-591, date provides time range of Middle Mississippian occupation of Upper Kaskaskia area. Date also indicates that this occupation may have

begun earlier and lasted longer than previously supposed (Gardner, 1969).

ISGS-606. Parking Lot site, SY-62 **560 ± 120**

Wood charcoal from Shelby Co, 6km N of Findley (39° 34′ 36″ N, 88° 45′ 02″ W), from 15 to 20cm below surface in yellowish brown silty-clay stratum. Coll 1978 by C R Moffat; subm by T J Riley. *Comment* (TJR): date largely overlaps dates previously obtained for Mississippian component at Jasper Newman site (Gardner, 1969), suggesting possible contemporaneity between Jasper Newman site and SY-62.

The American Bottoms, Illinois (fig 1)

Range site (11-S-47) series

Carbonized or uncarbonized wood from St Clair Co, 0.5km E of Dupo (38° 30′ 59″ N, 90° 12′ 02″ W). Coll 1977 to 1980 by Doug Jackson *et al;* subm by C J Bareis.

ISGS-569. C-18 **950 ± 80**

From floor of burned Stirling phase wall trench structure, Feature 16.

ISGS-570. C-192-1 **870 ± 80**

From open pit, Feature 17, within and assoc with burned Stirling phase wall trench structure, Feature 16.

ISGS-577. C-728 **910 ± 80**

From fill unit with Stirling phase pit, Feature 297.

ISGS-595. C-119 **790 ± 80**

From fill unit within Range phase pit, Feature 106.

ISGS-596. C-747 **860 ± 130**

From burned post, Feature 40, within and assoc with burned Stirling phase structure, Feature 16.

ISGS-619. C-2520 **1160 ± 80**

From Patrick phase, keyhole-shaped structure, Feature 902, superimposed by later Patrick phase, keyhole-shaped structure, Feature 906.

ISGS-620. C-2512 **990 ± 80**

From Range phase pit, Feature 925.

ISGS-623. C-1901 **880 ± 90**

From fill unit in Range phase structure, Feature 775.

ISGS-626. C-2522 **1110 ± 90**

From Patrick phase keyhole-shaped structure, superimposed by later Patrick phase, keyhole-shaped structure, Feature 906.

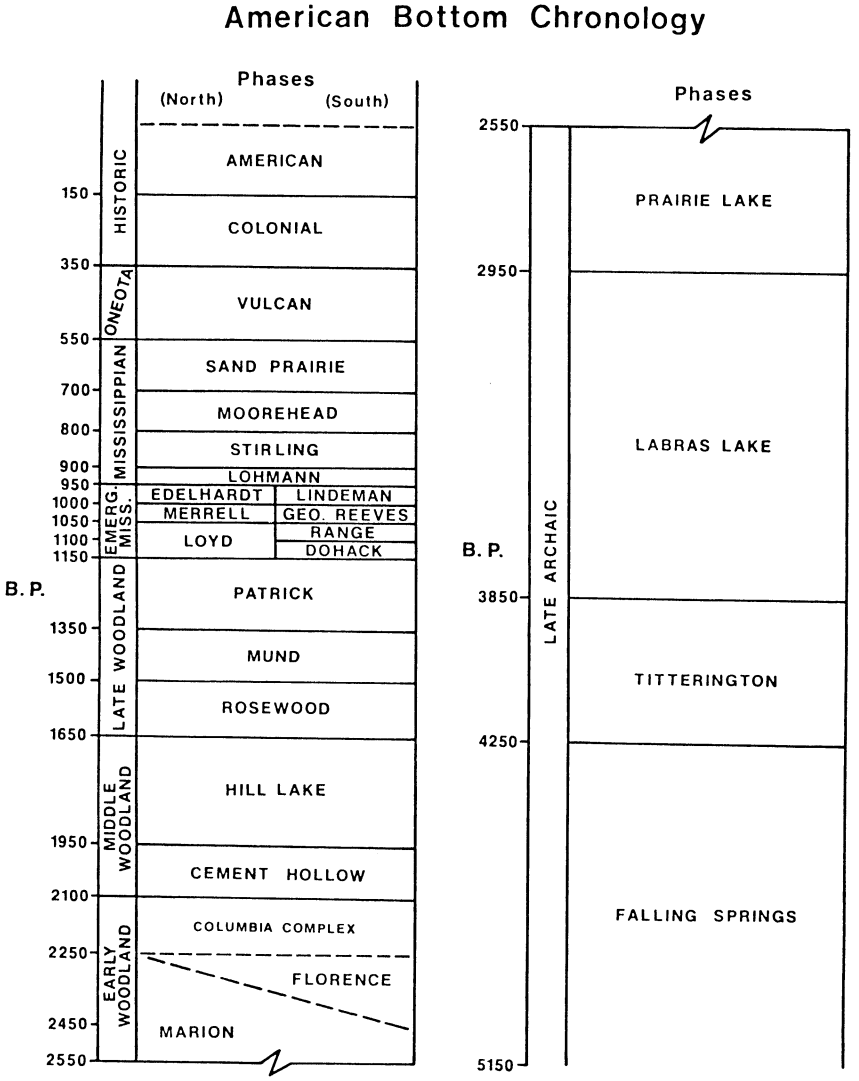

Fig 1. American Bottom chronology

ISGS-627. C-1897 **880 ± 90**

From fill of Range phase pit, Feature 786.

ISGS-642. C-2521 **1070 ± 100**

From fill of Patrick phase keyhole-shaped structure, Feature 902.

ISGS-646A. C-119 **810 ± 80**

Repeat run of ISGS-595; sample was leached by acid and base.

ISGS-646B. C-119 **810 ± 80**

Repeat run of ISGS-595; sample was pretreated in same manner as ISGS-595 (*ie,* acid leach only).

ISGS-651. C-130 **1250 ± 130**

From base of fill, just above floor of Range phase structure, Feature 113, in same community as Feature 106 (ISGS-595).

ISGS-776. C-687 **1170 ± 80**

From fill unit within Range phase rectangular pit, Feature 295, in same community as ISGS-595 and -651.

ISGS-810. C-3177 **1010 ± 80**

From fill of Lindeman phase pit, Feature 501.

ISGS-811. C-3426 **1040 ± 80**

From floor of Range phase burned structure, Feature 1256.

ISGS-824. C-3183 **970 ± 80**

From floor of Lindeman phase burned structure, Feature 1179.

ISGS-825. FL-1503 **890 ± 80**

From fill of Stirling phase structure, Feature 171.

ISGS-853. C-7060 **1510 ± 80**

From fill of Patrick phase pit, Feature 4484.

ISGS-893. C-7464 **1080 ± 80**

ISGS-901. C-7463 **1100 ± 70**

From fill of Patrick phase burned keyhole-shaped structure, Feature 5230.

ISGS-905. C-6668 **1090 ± 70**

From fill of Range phase burned structure, Feature 3625.

ISGS-913. C-6480 **960 ± 70**

ISGS-914. C-6504 **990 ± 70**

From fill of Dohack phase burned structure, Feature 3273.

ISGS-954. C-7836 **990 ± 100**

From SW edge of Mississippian (Sand Prairie phase ?) burial pit, Feature 1477. Sample consisted of uncarbonized cedar fragments.

ISGS-962. C-7023 **1120 ± 80**

From fill of Mississippian burial pit, Feature 4415. Sample was uncarbonized cedar log.

ISGS-1011. C-7820, 21, and 23 **2870 ± 200**

From fill of Prairie Lake phase, Feature 5723.

ISGS-1012. C-4776 **1430 ± 70**

From Patrick phase hearth, Feature 1584.

ISGS-1019. C-4802 **220 ± 70**

From portion of carbonized log in Patrick phase, Feature 1618.

ISGS-1021. C-4805 **99.39 ± 0.54 % modern** $\delta^{13}C = -27.7‰$

From portion of carbonized log in Patrick phase hearth, Feature 1582.

General Comment (FAI-270 Staff): wherever possible, samples were taken from sizable logs from primary context; mixed contexts were avoided. Samples were selected from outer rings of logs. Dates exhibit usual range of variability assoc with large series of dates from single loc. Extreme variability of dates from Emergent Mississippian (Range & Dohack phases) contexts is consistent with variability noted at other Emergent Mississippian sites in area.

Carbon Monoxide sites (11-Mo-593) series

Samples from Monroe Co, 4.3km NW of Columbia (38° 28′ 20″ N, 90° 13′ 42″ W). Coll 1977 to 1979 by Caven Clark and Becky Schaefer; subm by L M Smith and C J Bareis.

ISGS-571. C-1008 **2910 ± 80**

Wood from geomorphologic context 13.4m below surface in Cahokia alluvium of Hill Lake Meander scar.

ISGS-572. C-1009 **4390 ± 90**

Wood from geomorphologic context 15.85m below surface in coarse sand.

ISGS-573. C-985 **110.6 ± 0.8% modern**

Wood from geomorphologic context 3.35m below surface in alluvial sequence of Hill Lake Meander Scar channel fill.

ISGS-631. 79-178. 18G, A, B, & C **2120 ± 100** $\delta^{13}C = -24.8‰$

Nutshell and wood charcoal from fill of Columbia complex shallow basin pit, Feature 19.

ISGS-633. C-974, 976, 980 & 978 **1960 ± 110** $\delta^{13}C = -24.8‰$

Wood charcoal from fill of Columbia complex shallow basin pit, Feature 4.

General Comment (FAI-270 Staff): five samples from Carbon Monoxide site are from geomorphologic context or from Early Woodland, Columbia complex occupation of site. ISGS-572 is from context deposited while Hill Lake Meander was active channel of Mississippi R prior to its cutoff. ISGS-571 is from context deposited after Hill Lake Meander was cut off. ISGS-573 is from recent deposits in Hill Lake Meander scar.

Julien site (11-S-63) series

Carbonized wood from St Clair Co, within Cahokia (38° 33′ 22″ N, 90° 09′ 07″ W). Coll 1979 by Joyce William *et al*; subm by C J Bareis.

ISGS-579. CS #107 (79-890) **600 ± 80**

From burned roof or wall members on floor of Sand Prairie phase wall trench structure, Feature 91.

ISGS-581. CS #30 (79-183) **590 ± 80**

From burned roof or wall members on floor of Sand Prairie phase wall trench structure, Feature 82.

ISGS-586. CS #65 (79-414) **830 ± 110**

From floor of Moorehead or Sand Prairie phase wall trench structure, Feature 85.

ISGS-587. CS #42 (79-199) **710 ± 80**

From floor of Moorehead phase wall trench structure, Feature 3.

ISGS-589. CS #1 (79-59) **630 ± 80**

From floor of Sand Prairie phase wall trench structure, Feature 2.

ISGS-758. C-1283 **990 ± 80** $\delta^{13}C = -27.0‰$

From fill of burned Sand Prairie phase structure, Feature 2.

ISGS-760. C-1535 **560 ± 80** $\delta^{13}C = -26.1‰$

From burned Sand Prairie phase structure, Feature 91.

General Comment (FAI-270 Staff): ISGS-586 dates earlier than expected for either Moorehead or Sand Prairie phases. This might be contamination problem since sample was small and found just below base of plowed zone. Although ISGS-758 dates earlier than expected for Sand Prairie phase, context was unambiguous and colln methods standard.

Missouri Pacific #2 site (11-S-46) series

Carbonized wood from St Clair Co, SE edge of Dupo (38° 30′ 34″ N, 90° 12′ 24″ W). Samples from fill of Prairie Lake phase pits. Coll 1978 by John Ducan, Mary Mruzik, and Jane Bouchard; subm by C J Bareis.

ISGS-588. C-340 & 342, Feature 53 **2800 ± 80**

ISGS-599. C-361, 368 & 369, Feature 42 **2540 ± 80**

ISGS-601. C-309 & 310, Feature 122 **2860 ± 80**

ISGS-605. C-304, Feature 122 **2760 ± 80**

Truck #7 site (11-Mo-200) series

Carbonized wood and nutshell from Monroe Co, 2km NW of Columbia (38° 28′ 51″ N, 90° 13′ 29″ W). Coll 1978 to 1979 by Helen Deluga, Sharon Taube, and Becky Schaefer; subm by C J Bareis.

ISGS-600. C-1104 **1860 ± 80**

From fill of Hill Lake phase pit, Feature 14.

ISGS-703. Fl 195-207 **1720 ± 80** $\delta^{13}C = -25.6‰$

From fill of Hill Lake phase pit, Feature 18.

ISGS–634. C-1112 **1790 ± 80** $\delta^{13}C = -25.5‰$

From burned internal post within Hill Lake phase post structure, Feature 1.

ISGS-636. C-1683 **1510 ± 80** $\delta^{13}C = -25.5‰$

From burned internal post within Hill Lake phase post structure, Feature 1.

Carbon Dioxide site (11-Mo-594) series

Carbonized wood and nutshell from Monroe Co, 2km NW of Columbia (38° 28′ 36″ N, 90° 13′ 36″ W). Coll 1978 by Don Reinhold *et al*; subm by C J Bareis.

ISGS-603. C-482 **1700 ± 80**

From fill of Rosewood phase pit, Feature 21.

ISGS-689. Fl 871-874 **1630 ± 80** $\delta^{13}C = -24.8‰$

From fill of Rosewood phase pit, Feature 36.

ISGS-683. C-489 **880 ± 80** $\delta^{13}C = -25.4‰$

From burned area near floor of Lohmann phase wall trench structure.

ISGS-699. Fl 46 52, 387 & 395 **970 ± 80** $\delta^{13}C = -25.5‰$

From fill of Fairmount phase pit, Feature 17.

Florence Street site (11-S-458) series

Carbonized wood from St Clair Co, within city limit of Cahokia (38° 33′ 28″ N, 90° 08′ 57″ W). Coll 1979 by Joyce William *et al*; subm by C J Bareis.

ISGS-616. C-2458 & C-2460 **2400 ± 80**
$\delta^{13}C = -24.6‰$

From burned area in Florence phase activity area, Feature 72, buried under silty sand, ca 65cm thick.

ISGS-632. C-2467, 2473, & 2476 **2130 ± 110**
$\delta^{13}C = -25.4‰$

From reduced and oxidized zone in Florence phase, Feature 95.

ISGS-775. FL-1782 **2290 ± 80**
$\delta^{13}C = -26.2‰$

From silty sand in burned zone of Florence phase activity area, Feature 72.

General Comment (FAI-270 Staff): dates were used to establish expected range of 2450 to 2250 BP for Florence phase.

Go Kart North site (11-Mo-552N) series

Carbonized wood and nutshell from Monroe Co, 2.5km NW of Columbia (38° 29′ 04″ N, 90° 13′ 13″ W). Coll 1978 to 1979 by Helen Deluga *et al*; sub by C J Bareis.

ISGS-628. C-1912 **4020 ± 100**

ISGS-629. C-1913 **4060 ± 100**

ISGS-630. C-1915 **4110 ± 100**

From fill of Titterington phase pit, Feature 61.

ISGS-693. Fl 389, 450 & 451 **4100 ± 130**
$\delta^{13}C = -25.0‰$

From fill of Titterington phase pit, Feature 70.

ISGS-695. C-1925 **4060 ± 80**
$\delta^{13}C = -25.5‰$

From fill of Titterington phase pit, Feature 89.

ISGS-697. Fl 79-140, 163 & 173 **4130 ± 80**
$\delta^{13}C = -25.6‰$

From fill of Titterington phase pit, Feature 32.

ISGS-698. Fl 233, 260 & 275 **4100 ± 80**
$\delta^{13}C = -25.6‰$

From fill of Titterington phase pit, Feature 13.

General Comment (FAI-270 Staff): Late Archaic Titterington phase component of Go Kart N site incorporated 209 pit features arranged in linear pattern along bank of Hill Lake Meander scar. Tight clustering of dates supports conclusion that site was intensive, short-term, multi-family occupation.

George Reeves site (11-S-650) series

Carbonized wood from St Clair Co, 1km SE of Dupo (38° 28′ 08″ N, 90° 12′ 31″ W). Coll 1979 to 1980 by Chuck Bentz *et al*; subm by C J Bareis.

ISGS-635. C-2640 **810 ± 80**
$\delta^{13}C = -25.1‰$
From support post of Lohmann phase structure, Feature 19.

ISGS-685. C-2629 **950 ± 130**
$\delta^{13}C = -25.0‰$
From fill of Lohmann phase pit, Feature 17.

ISGS-694. C-3780 **950 ± 80**
$\delta^{13}C = -25.8‰$
From support post of Lohmann phase structure, Feature 157.

ISGS-687. C-3813 **3710 ± 120**
$\delta^{13}C = -25.0‰$
From fill of Titterington phase pit, Feature 25.

ISGS-884. 80-194 & 204 **1510 ± 70**
$\delta^{13}C = -25.8‰$
From Mund phase pit, Feature 310.

ISGS-892. 80-274, 272 **1480 ± 70**
$\delta^{13}C = -26.2‰$
From Mund phase pit, Feature 300.

ISGS-885. 80-236 **1620 ± 70**
$\delta^{13}C = -25.5‰$
From Mund phase pit, Feature 319.

General Comment. (FAI-270 Staff): two Mund phase dates, 1510 BP and 1480 BP, suggest contemporaneity of two separate clusters of Mund phase pit features at site. Two Lohmann phase dates of 950 BP suggest contemporaneity of two other separate feature clusters at site.

BBB Motor site (11-Ms-595) series

Wood charcoal from Madison Co, 1.2km W of Collinsville (38° 40′ 28″ N, 90° 01′ 13″ W). Coll 1979 to 1980 by T Emerson and C Witty; subm by C J Bareis.

ISGS-637. C-4463 & C-4465 **750 ± 80**
$\delta^{13}C = -25.5‰$

From Stirling phase pit, Feature 38.

ISGS-705. C-4510 **880 ± 120**
$\delta^{13}C = -25.9‰$

From Zone E of Stirling phase pit, Feature 125.

ISGS-708. C-4503 **930 ± 80**
$\delta^{13}C = -25.1‰$

From Zone D of Stirling phase, Feature 125.

ISGS-787. C-4473 **1040 ± 80**
$\delta^{13}C = -26.9‰$

From W half of Edelhardt phase pit, Feature 65.

ISGS-788. C-4551 **930 ± 80**
$\delta^{13}C = -27.0‰$

From NE half of Edelhardt phase pit, Feature 266.

ISGS-801. C-4544 **950 ± 80**
$\delta^{13}C = -26.5‰$

From SW half of Edelhardt phase pit, Feature 21.

ISGS-802. C-4489 **1060 ± 80**
$\delta^{13}C = -26.1‰$

From S half of Edelhardt phase pit, Feature 97.

General Comment (FAI-270 Staff): Edelhardt phase dates represent single occupation community of relatively short duration. Stirling phase dates represent area spatially isolated from earlier Edelhardt phase occupation of site. Feature 38 contained lower portion of Keller figurine, while Feature 125 was assoc with structure that contained upper portion of Keller figurine.

Prairie Lake Meander Scar series

Organic debris from St Clair Co, 1.35km NE of Dupo (38° 31′ 48″ N, 90° 11′ 45″ W), from Cahokia alluvium of Prairie Lake Meander scar. Coll 1978 by John Mathes Engineering Co; subm by L M Smith.

ISGS-638. S-6, S-22 **6550 ± 80**
$\delta^{13}C = -25.5‰$

From lower channel fill at depth 16.5m below surface.

ISGS-644. S-4, S-19 **9850 ± 300**

From lower channel fill at depth 14.4m below surface.

General Comment (FAI-270 Staff): depth from surface of ISGS-638 suggests that channel was abandoned short time before deposition of sampled sedi-

ments. Expected date was 4500 BP; expected range of dates for ISGS-644 sample was 5500 to 3000 BP. Sample must have been contaminated during retrieval.

Mund site (11-S-435) series

Carbonized wood and nutshells from St Clair Co, 1km S of Dupo (38° 29′ 14″ N, 90° 12′ 54″ W). Coll 1979 and 1980 by Gereth Lewis *et al*; subm by C J Bareis.

ISGS-643. C-2552, 2557 & 2558 **1380 ± 80**
$\delta^{13}C = -24.4‰$

From pit fill of Mund phase pit, Feature 85.

ISGS-645. C-2253 & C-2262 **2070 ± 110**

From fill of Cement Hollow phase trash pit, Feature 18.

ISGS-700. C-3619 C **3130 ± 80**
$\delta^{13}C = -27.0‰$

ISGS-701. C-3619 D **3240 ± 80**
$\delta^{13}C = -25.9‰$

ISGS-702. C-3619 A **3400 ± 80**
$\delta^{13}C = -28.0‰$

Uncarbonized wood from Hill Lake Meander Channel fill, 9.1 to 10.7m below surface.

ISGS-711. C-3569 **2180 ± 90**
$\delta^{13}C = -23.8‰$

From buried soil horizon 10 to 15cm above Marion phase feature.

ISGS-847. C-2996 **1270 ± 80**
$\delta^{13}C = -25.4‰$

From excavation unit in alluvial fan, 1.75m below surface.

ISGS-865. C-2906 & 2908 **1470 ± 80**
$\delta^{13}C = -24.8‰$

From pit fill of Mund phase pit, Feature 123.

ISGS-866. C-2281 & 2282 **2080 ± 80**
$\delta^{13}C = -26.0‰$

From pit fill of Cement Hollow phase, Feature 9.

General Comment (FAI-270 Staff): samples dating abandonment of Hill Lake Meander scar (ISGS-700 to −702) were assoc with moist, dark gray, sandy silt channel fill that rested immediately above bedrock bench at bottom of E cut bank of abandoned channel. Dates are specific for channel abandonment. Expected range was 3800 to 3200 BP. Marion phase occupation at site could not be directly sampled although ISGS-711 was obtained

from burned layer stratigraphically positioned 10 to 15cm above Marion phase feature. Date, 2180 BP agrees with expected range of 2550 to 2250 BP for Marion phase. Two dates for ISGS-645 and −866 were used to establish expected range of 2100 to 1950 BP for Cement Hollow phase. ISGS-847 is from erosional gully in Cement Hollow alluvial fan which truncated Mund phase occupational surface. Presence of this gully indicates that alluvial fan was still active several centuries after end of Mund phase occupation.

Alpha #1 site (11-S-632) series

Carbonized wood from St Clair Co, 6.8km NW of Belleville (38° 33′ 11″ N, 90° 04′ 38″ W). Coll 1978 by Mark Mehrer *et al*; subm by C J Bareis.

ISGS-663. C-937 **1580 ± 80** $\delta^{13}C = -25.6‰$

From fill of S half of Rosewood phase pit, Feature 39.

ISGS-709. C-920 **1830 ± 90** $\delta^{13}C = -26.7‰$

From fill of NE half of Rosewood phase pit, Feature 33.

ISGS-710. C-914 **1710 ± 80** $\delta^{13}C = -27.6‰$

From fill of N half of Rosewood phase pit, Feature 10.

ISGS-713. C-912 **150 ± 80** $\delta^{13}C = -26.4‰$

From fill of W half of Rosewood phase pit, Feature 25.

ISGS-715. C-938 & 939 **1390 ± 80** $\delta^{13}C = -26.2‰$

From fill of E half of Rosewood phase pit, Feature 45.

Dohack site (11-S-642) series

Carbonized wood and nutshell from St Clair Co, 5km S of Dupo (30° 29′ 00″ N, 90° 12′ 50″ W). Coll 1979 and 1980 by Becky Schaefer; subm by C J Bareis.

ISGS-664. C-2768 **830 ± 80** $\delta^{13}C = -24.9‰$

From burned lens in Dohack phase pit, Feature 81.

ISGS-665. C-2784 **970 ± 80** $\delta^{13}C = -26.1‰$

From fill of Dohack phase pit, Feature 55.

940 ± 100

ISGS-691. C-2782 $\delta^{13}C = -25.0‰$

From fill of Dohack phase pit, Feature 55.

1130 ± 80

ISGS-696. Fl 2259 $\delta^{13}C = -24.4‰$

From fill of Patrick phase pit, Feature 51.

1230 ± 80

ISGS-704. C-4979 $\delta^{13}C = -26.4‰$

From fill of Patrick phase pit, Feature 171.

1100 ± 80

ISGS-706. C-5275 $\delta^{13}C = -26.0‰$

From fill of Patrick phase pit, Feature 183.

General Comment (FAI-270 Staff): Dohack site is type site for Dohack phase. Four samples (ISGS-664, −665, −678, and −691) presently provide only known ^{14}C dates from Dohack phase context.

Leingang site (11-Mo-722) series

Carbonized wood from Monroe Co, 3.2km S of Dupo (38° 28′ 52″ N, 90° 12′ 55″ W). Coll 1979 by Robert Young *et al*; subm by C J Bareis.

1580 ± 80

ISGS-668. C-2598 $\delta^{13}C = -25.1‰$

From fill of Rosewood phase pit, Feature 1.

1480 ± 80

ISGS-734. C-3051 & C-3054 $\delta^{13}C = -25.5‰$

From fill of W half of Rosewood phase pit, Feature 96.

1670 ± 80

ISGS-771. C-3038 & C-3039 $\delta^{13}C = -26.0‰$

From N and S halves of Rosewood phase pit, Feature 6.

5290 ± 90

ISGS-769. C-3052 & C-3053 $\delta^{13}C = -25.3‰$

From fill of E half of Late Archaic pit, Feature 58.

General Comment (FAI-270 Staff): date, 5290 BP for ISGS-769 from Late Archaic pit feature implies Falling Springs phase affiliation. Although earliest expected date for Falling Springs phase is 5150 BP, diagnostic materi-

ISGS-670. C-2615 **1390 ± 80**
$\delta^{13}C = -25.3‰$

From fill of NE half of Rosewood phase pit, Feature 14.

ISGS-735. C-2613 & C-2618 **1390 ± 100**
$\delta^{13}C = -25.2‰$

From E half of Rosewood phase pit, Feature 7.

General Comment (FAI-270 Staff): two dates of 1390 BP are considered late for Rosewood phase, which has expected range of 1650 to 1500 BP. Diagnostic artifacts from site firmly establish site as Rosewood phase occupation.

Rosewood site (11-S-639) series

Carbonized wood from St Clair Co, 2.5km N of Belleville (38° 32′ 31″ N, 89° 59′ 21″ W). Coll 1978 and 1979 by G Prentice *et al*; subm by C J Bareis.

ISGS-728. C-4 **1530 ± 80**
$\delta^{13}C = -25.2‰$

From fill of W half of Rosewood phase pit, Feature 87.

ISGS-743. C-7 **1630 ± 80**
$\delta^{13}C = -25.6‰$

From fill of SW half of Rosewood phase pit, Feature 121.

ISGS-754. C-3 **1670 ± 80**
$\delta^{13}C = -26.3‰$

From fill of S half of Rosewood phase pit, Feature 62.

General Comment (FAI-270 Staff): Rosewood site is type site for Rosewood phase. Dates for ISGS-728, −743, and −754 were used to establish expected range of 1650 to 1500 BP for Rosewood phase.

McLean site (11-S-640) series

Carbonized wood from St Clair Co, 2.2km S of Centreville (38° 32′ 55″ N, 90° 10′ 14″ W). Coll 1979 by G Lewis and R Appel; subm by C J Bareis.

ISGS-730. C-4032 **4360 ± 120**
$\delta^{13}C = -26.3‰$

From fill of N half of Falling Springs phase pit, Feature 28.

ISGS-736. C-4040 **4600 ± 80**
$\delta^{13}C = -25.6‰$

From fill of N and S halves of Falling Springs phase pit, Feature 82.

Holdener site (11-S-685) series

Carbonized wood from St Clair Co, 1.5km ESE of Edgemont (38° 35′ 31″ N, 90° 02′ 25″ W). Coll 1980 by W L Wittry; subm by C J Bareis.

ISGS-731. C-5737 **850 ± 80**
$\delta^{13}C = -25.9‰$
From fill of pit, Feature 11.

ISGS-836. C-5780 **1230 ± 80**
$\delta^{13}C = -26.1‰$
From fill of pit, Feature 64.

ISGS-837. C-5837 **1310 ± 80**
$\delta^{13}C = -25.6‰$
From fill of Feature 89.

ISGS-846. C-5829, C-5836, & C-5838 **1300 ± 80**
$\delta^{13}C = -26.1‰$
From fill of Feature 49.

Turner site (11-S-50) series

Carbonized wood from St Clair Co (38° 34′ 57″ N, 90° 06′ 03″ W). Coll 1979 and 1980 by R Ord and J Duncan; subm by C J Bareis.

ISGS-732. C-3993 **1050 ± 80**
$\delta^{13}C = -26.1‰$
From fill of Stirling phase hearth, Feature 83.

ISGS-733. C-4953 **1060 ± 80**
$\delta^{13}C = -25.0‰$
From burned fill along SE basin wall of Stirling phase, Feature 5.

Columbia Quarry site (11-S-629) series

Carbonized wood from St Clair Co, 1km E of Dupo (38° 31′ 05″ N, 90° 10′ 55″ W). Coll 1979 and 1981 by R T William; subm by C J Bareis.

ISGS-739. C-3706 **1560 ± 90**
$\delta^{13}C = -26.2‰$
From fill of Mund phase pit, Feature 24.

ISGS-741. C-3657 & C-3660 **1570 ± 80**
$\delta^{13}C = -26.5‰$
From fill of Mund phase pit, Feature 12.

ISGS-745. C-3712 & C-3713 **1570 ± 80**
$\delta^{13}C = -26.6‰$
From fill of NE half of Mund phase pit, Feature 31.

ISGS-755. C-3708 & C-3709 **1660 ± 80**
$\delta^{13}C = -26.2‰$
From fill of Mund phase pit, Feature 27.

1440 ± 90

ISGS-756. C-3670 & C-3686 $\delta^{13}C = -26.6‰$

From fill of NE and SE halves of Mund phase pit, Feature 2.

1330 ± 70

ISGS-889. #1 $\delta^{13}C = -27.4‰$

From fill of Patrick phase feature.

General Comment (FAI-270 Staff): 5 Mund phase dates represent 5 different Mund phase pit clusters. Patrick phase date is from area of site separate from area of Mund phase occupation.

Hofstetter site (11-S-693) series

Carbonized wood from St Clair Co, 3km SW of Centreville (38° 32′ 34″ N, 90° 08′ 37″ W). Coll 1980 and 1981 by Walt Babich and Mark Essary; subm by Allan Westover; Illinois State Univ, Normal.

890 ± 70

ISGS-887. #1 $\delta^{13}C = -25.2‰$

From tree post remnant, 30cm below present surface on floor of Emergent Mississippian Structure 4.

1090 ± 90

ISGS-908. #2 $\delta^{13}C = -25.8‰$

From Emergent Mississippian Structure 2, 21cm below surface.

1610 ± 90

ISGS-921. #3 $\delta^{13}C = -25.0‰$

From fill of Late Woodland Feature 7, with concentration between 20 to 30cm below surface.

Mund House site (11-S-695) series

Carbonized wood and nutshell from St Clair Co, 2km S of Dupo (38° 29′ 30″ N, 90° 12′ 45″ W). Coll 1981 by Roger Williamson and Mike Morelock; subm by C J Bareis.

730 ± 90

ISGS-925. 80-126 $\delta^{13}C = -26.0‰$

From fill within large Sand Prairie phase structure, Feature 27.

5360 ± 100

ISGS-926. 80-66B $\delta^{13}C = -25.3‰$

From float sample of fill of Falling Springs phase pit, Feature 22.

East St Louis Stone Quarry site (11-S-468) series

Carbonized wood from St Clair Co, NE edge of N Dupo (38° 32′ 17″ N, 90° 11′ 03″ W). Coll 1980 by Robert Ord; subm by C J Bareis.

ISGS-902. **790 ± 70**

From Moorehead or Sand Prairie phase structure, Feature 3, in area separate from cemetery area.

ISGS-944. C-5973 **910 ± 90**
$\delta^{13}C = -25.9‰$

From beneath group of sherds near cranium in S portion of Sand Prairie phase grave, Feature 57.

ISGS-946. C-5975 **760 ± 90**
$\delta^{13}C = -25.3‰$

From SW corner of Sand Prairie phase grave, Feature 75, near extended skeleton's cranium.

General Comment (FAI-270 Staff): cemetery is attributed to Sand Prairie phase which has expected range of 700 to 550 BP. Early dates of 910 and 760 BP may reflect dating of carbonized wood from earlier component elsewhere in site area (wood is adventitious inclusion in features).

Joan Carrie site (11-Mo-663) series

Carbonized wood from Monroe Co, at NW edge of Columbia (38° 27′ 30″ N, 90° 13′ 15″ W). Coll 1978 by Susan Jelly and Steve Forman; subm by L A Conrad, Western Illinois Univ, Macomb.

ISGS-984. L-320 **940 ± 70**
$\delta^{13}C = -27.0‰$

ISGS-986. L-472 & 473 **1000 ± 70**
$\delta^{13}C = -26.1‰$

From bottom of pit feature which contains Dohack phase ceramics.

General Comment (LAC): both dates seem too young for Dohack phase assoc of samples. Compelling strat evidence and anomalous dates for other sites indicate that expected date of 1150 to 1200 yr BP is more likely.

Fish Lake site (11-Mo-608) series

Carbonized wood from Monroe Co, 8km NW of Columbia (38° 28′ 35″ N, 90° 14′ 51″ W). Coll 1982 by Roger Williamson *et al*; subm by C J Bareis.

ISGS-1044. C-7627 **1390 ± 70**
$\delta^{13}C = -25.7‰$

From Patrick phase pit, Feature 126, in burned zone near base of refuse pit, 65cm deep.

ISGS-1046. C-7871 **1030 ± 100**
$\delta^{13}C = -25.5‰$

From floor of Patrick phase keyhole-shaped structure, Feature 116.

ISGS-1047. C-7526 **1170 ± 100**
$\delta^{13}C = -25.5‰$

From fill of Patrick phase keyhole-shaped structure, Feature 9.

ISGS-1060. C-7880 **1170 ± 110**
$\delta^{13}C = -26.7‰$

From fill of Patrick phase pit, Feature 80.

ISGS-1062. C-7602 **1360 ± 130**
$\delta^{13}C = -26.4‰$

From pit fill of Patrick phase pit, Feature 123.

Other Sites

ISGS-712. Alpha #7 (11-Mo-638) C-963 **420 ± 80**
$\delta^{13}C = -26.0‰$

Carbonized wood from St Clair Co, 3km SE of Centreville (38° 35′ 37″ N, 90° 04′ 37″ W), from fill of W half of Rosewood phase pit, Feature 4. Coll 1978 by F Finney; subm by C J Bareis.

ISGS-719. Alpha #3 (11-S-634) C-945 **1290 ± 80**
$\delta^{13}C = -25.8‰$

Carbonized wood from St Clair Co, 6.5km NW of Belleville (38° 33′ 10″ N, 90° 04′ 36″ W), from soil matrix fill of Patrick phase pit, Feature 6. Coll 1978 by Doug Jackson; subm by C J Bareis.

ISGS-938. Tep site (11-Mo-154), L-451 & 452 **5150 ± 100**
$\delta^{13}C = -25.6‰$

Carbonized nutshell and wood from Monroe Co, at NW edge of Columbia (38° 27′ 30″ N, 90° 13′ 15″ W), from fill of Feature 21, in cluster of Marion phase features characterized by Kramer points, but no Marion ceramics. Coll 1978 by Susan Gardner; subm by L A Conrad. *Comment* (LAC): two Brannon sidenotched points recovered from plowed surface of site seem to support likelihood that this date accurately reflects age of Feature 21, which antedates Marion occupation. Unfortunately, this assoc is too tentative to be useful.

Indiana

Prairie Creek site series

Wood from Daviess Co, 5km N of Washington (38° 42′ 51″ N, 87° 10′ 16″ W), from ca 0.6m depth in Stratum 7, assoc with artifacts. Coll 1973 and subm by Curtis Tomak, Indiana Univ at Bloomington.

ISGS-269. #C-7 **2540 ± 80**

ISGS-270. #B-7 **3540 ± 90**

General Comment (CT): dates are much younger than expected. Disagreement between these two samples from same stratum, presence of extinct

animals, and complicated nature of stream deposits together indicate that Stratum 7 is mixed deposit in this area of site.

Texas

ISGS-593. Lewisville 41DN72 **26,610 ± 310**

Charred material from Denton Co (33° 04′ 05″ N, 96° 59′ 23″ W), from hearth covered by river deposits, assoc with artifacts. Coll 1979 by Dennis Stamford; subm by D L Johnson. *Comment* (DLJ): date, like other Lewisville dates, is inconsistent with Clovis point, which has narrow chronologic limits, between 11,000 to 11,500 BP. This date and others can be explained if part of Lewisville charcoal was derived from Cretaceous lignite that outcrops upstream from hearth.

Other Localities

Philippines

Mustang Cave series

Shell from Cagayan Prov, 1km E of Agugadan (17° 43′ N, 121° 50′ E). Coll and subm by Barbara Thiel, Univ Illinois.

ISGS-496. BT-1 **11,450 ± 170**

From near base of cultural levels, 125cm below surface, assoc with flake tools and animal bones.

ISGS-497. BT-2 **10,750 ± 150**

From base of pottery-bearing levels, 75cm below surface.

ISGS-495. Arku Cave **2460 ± 80**

Charcoal from Cagayan Prov, 2km SE of Agugadan (17° 42′ N, 121° 50′ E), from 77cm below surface assoc with human bone and pottery. Coll 1976 and subm by Barbara Thiel.

Mexico

Chalcatzingo-Morelos series

Charcoal from Morelos, 1.6km SE of Village of Chalcatzingo (18° 40′ 47″ N, 99° 46′ 00″ W), from Tetla excavations. Coll 1974 and subm by D C Grove, Univ Illinois.

ISGS-508. Tetla-1 **700 ± 80**

From house floor.

ISGS-509. Tetla-2 **600 ± 80**

From stratigraphic Level IV, 30 to 50cm depth, oven or kiln.

General Comment (DCG): first dates for early post classic period in this region of Mexico; they confirm estimated age for early post-classic in central Mexico.

Italy

ISGS-554. Morgantina, Sicily **2430 ± 80**

Charcoal from Enna prov, 6km NE of Aidone (37° 25′ 50″ N, 02° 01′ 37″ E), from hollow in lower floor of Archaic Habitation 1. Coll 1969 and subm by H L Allan, Univ Illinois.

Honduras

Copan series

Charcoal, 3km from village of Copan (14° 51′ 11″ N, 89° 09′ 07″ W), from fill under Valhalla platform floor near N end of "the cut" at ruins of Copan. Coll 1979 by R Smither and M Baker; subm by R Smither, Argonne Natl Lab.

ISGS-576. CO-1 **1620 ± 80**

ISGS-625. CO-2 **1430 ± 100**
$\delta^{13}C = -25.4‰$

Tanzania

Nasera Rockshelter series

Bone fragments from Serengeti Plains, 26.5km N of Olduvai Gorge (02° 44′ 30″ S, 35° 19′ 08″ E). Coll 1975 by Andrew Kilonzo; subm by M J Mehlman, Univ Illinois.

ISGS-438A. MJM-4, apatite **2060 ± 100**

ISGS-438B. MJM-4, organic **2180 ± 200**

From silty tuffaceous sands in strat Unit 3A, assoc with faunal remains, stone artifacts, and several Late Stone age potsherds. *Comment* (MJM): agrees with other dates with Ahira-Ware assocs at Serenera, Tanzania (Bower, 1973) and in Nakuru/Naivasha basin of Kenya.

ISGS-444A. MJM-5, apatite **5400 ± 150**

ISGS-444B. MJM-5, organic **4720 ± 150**

From very silty tuffaceous sands in Unit 3AA, assoc with several Late Stone age potsherds attributable to Kansyore Ware. *Comment* (MJM): both dates seem too old for Kansyore sherds at Nasera (Soper & Golden, 1969). Disagreement between two fractions indicates that neither may be reliable.

ISGS-427A. MJM-3, apatite **8100 ± 120**

ISGS-427C. MJM-3, apatite **8060 ± 100**

ISGS-427B. MJM-3, organic **7100 ± 80**

ISGS-427D. MJM-3, organic **7160 ± 100**

From strat Unit 3B. *Comment* (MJM): not unreasonable to believe that this horizon of artifacts encompasses 1000 yr or more. Dates, 7000 to 8000 BP are consistent with earlier dates for other microlith-rich assemblages in Tanzania at Kisese II (Inskeep, 1962; Deacon, 1966) and in Uganda at Munyama Cave (VanNoten, 1971).

ISGS-449A. MJM-11, apatite **22,460 ± 500**

ISGS-449B. MJM-11, organic **14,780 ± 250**

From strat Unit 4, assoc with faunal remains and stone artifacts of Late Stone age type. *Comment* (MJM): disagreement between two fractions indicates that one or both fractions have undergone postdepositional contamination. Aspartic acid age of 18,000 yr was obtained for bone from this horizon by J L Bada (pers commun).

ISGS-445A. MJM-6, apatite **21,700 ± 600**

ISGS-445B. MJM-6, organic **21,600 ± 400**

From strat Unit 5A. Comment (MJM): dates are not unreasonable for early Late Stone age assemblage in E Africa. Further, dates are consistent with ISGS-425A: 22,350 ± 380 BP and ISGS-425B: 22,910 ± 400 BP, which date underlying Level 6 containing assemblage transitional from Middle to Late Stone age.

ISGS-425A. MJM-1, apatite **22,350 ± 380**

ISGS-425B. MJM-1, organic **22,910 ± 400**

From strat Unit 6, assoc with faunal remains and artifacts of late Middle Stone age (transitional?). *Comment* (MJM): dates are consistent with expectations based on nature of archaeol occurrence (Deacon, 1966), but 5000 to 10,000 yr younger than might have been expected on basis of strat correlation (Leakey *et al*, 1972). It is suggested that ISGS-425 be provisionally accepted as min age for Ndutu sediments.

Mumba Rockshelter series

Samples from Mbulu Dist, 4.3km WSW of Mangola Chini Guard Post (Barrazani) (03° 32′ 18″ S, 35° 17′ 48″ E). Coll 1977 by Faustin John; subm by M J Mehlman.

ISGS-498. MJM-20 **31,070 ± 500**

Snail shell from red-gray silty sand unit, 280 to 290cm below datum. *Comment* (MJM): date is assoc not only with interesting lithic assemblage but also with beginning of snail midden deposits at Mumba shelter.

ISGS-499. MJM-21 **36,900 ± 800**

Snail shell from yellow-white coarse-sand beach "lag" deposit, 270 to 280cm below datum. *Comment* (MJM): snail shell incorporated in this beach sand must have been reworked from earlier strata.

ISGS-565. MJM-25 **1780 ± 80**

Charcoal from reddish-gray sandy silt, 40 to 55cm below surface, assoc with Late Stone age accumulation. *Comment* (MJM): although age appears rather recent for accompanying archaeol assemblage, date is believed to be correct because charcoal sample was definitely *in situ.*

ISGS-566. MJM-43 **26,960 ± 760**

Ostrich eggshell from reddish sandy silt, 170 to 180cm below surface. *Comment* (MJM): this date, together with ISGS-498: 31,070 ± 500 BP and ISGS-499: 36,900 ± 800 BP indicates that beach deposit at Mumba (Bed IV) is ca 28,000 BP, in agreement with data from Ngorongoro Crater (Hay, 1968) and Lake Manyara in N Tanzania.

Ecuador

Elmuerto Rockshelter series

Carbonized wood from Guayas, 1.5km WSW of El Morro, 5.5km E of Playas (02° 38′ S, 80° 20′ W). Coll 1975 and subm by C D Spath, Univ Illinois.

ISGS-472. Em b-4 **5220 ± 80**

From uppermost level with large quantities of shells from mangrove environment.

ISGS-471. Em b-9 **7180 ± 80**

From lowest level with shells from mangrove environment.

General Comment (CDS): dates bracket aceramic mangrove-oriented deposition at site. Open sites of this type have been assigned to Jambeli culture (500 BC to AD 500) (Estrada, Meggers, & Evans, 1964), but their locations relative to ancient distribution of mangrove vegetation suggest both earlier and longer period of specialization in these resources. Dates support this interpretation.

Valdivia series

Charcoal from Morona, on S side of mouth of Valdivia R, at San Pedro (02° 30′ S, 77° 15′ W), from aceramic levels at base of excavation in Valdivia Midden. Coll 1971 by Henning Bischof; subm by D W Lathrap, Univ Illinois.

ISGS-274. DWL-11 **4580 ± 80**

ISGS-275. DWL-12 **4700 ± 80**

General Comment (HB): extension of 1971 excavation was made in January, 1975. A few San Pedro sherds were found in several layers that had not yielded sherds in 1971. Consequently, thickness of supposedly preceramic deposit, as shown in pub profile (Bischof, 1973), was significantly reduced. There are still no sherds from Level 20, which is dated by these samples, so technically, this level still could be called aceramic. In view of very low,

though constant, density of sherds in San Pedro levels, now extended to include Level 19, it is also possible that absence of sherds in Level 20 is fortuitous.

Pastaza site series

Charcoal from Morona-Santiago, near Husanga in valley of Rio Pastaza R (02° 30′ S, 77° 15′ W). Coll 1969 by P I Porras; subm by D W Lathrap.

ISGS-384. #463 **600 ± 80**

From 10 to 20cm level of Cut 10.

ISGS-385. #444 **4160 ± 80**

From 70 to 80cm level of Cut 10.

General Comment (DWL): date of upper level (ISGS-384) is consistent with pottery, which exhibits features (such as corrugation) that are widespread in protohistoric and historic time in upper Amazon. Date of lower zone (ISGS-385) agrees well with stylistic dating of Pastaza phase ceramics. Both dates agree with alignment between Valdivia VI on Ecuador Coast and Pastaza phase, as now known. Complexity of Pastaza pottery supports contention concerning ultimate origins of Valdivia culture and alignments between Amazon Basin and upper Amazon (Lathrap, 1970, 1971).

Real Alto series

Wood charcoal from Guayas (02° 23′ 40″ S, 80° 42′ 27″ W). Coll 1975 and subm by D L Lathrap.

ISGS-439. #3438 **4110 ± 80**

ISGS-446. #1269 **4270 ± 80**

ISGS-452. #3450 **4700 ± 300**

Samples from within small Valdivia II mound.

ISGS-467. #2431 **4140 ± 190**

From 70 to 80cm below surface, 10cm above first appearance of Valdivia II ceramics in Unit C-5 of Tr C.

ISGS-466. #1178 **4390 ± 80**

From 70 to 80cm below surface, assoc with appearance of Valdivia II ceramics in Unit C-15 of Tr C.

ISGS-468. #3569 **4760 ± 120**

From 80 to 90cm below surface, assoc with first appearance of Valdivia ceramics.

ISGS-448. #2778 **5620 ± 250**

From 90 to 100cm below surface, assoc with aceramic level underlying earliest Valdivia 1.5 to 2 occupation in N Unit C-1 of Tr C.

General Comment (DWL): ISGS-439, -446, and -452 relate to sequence of deliberate mound construction at W side of inner plaza of Real Alto. ISGS-467, -466, and -448 relate to continuous strat profile of Tr C in NW corner of rectangular Valdivia community (Lathrap, Marcas, & Zeidler, 1977). All seven dates are compatible with their mutual strat relationships and with all other acceptable dates of Valdivia culture.

ISGS-478A. Split 1, Perinao site **4510 ± 100**

ISGS-478B. Split 2, Perinao site **4460 ± 100**

Wood charcoal from Balzar, Guayas, 5km N of Colimes (01° 30′ 00″ S, 80° 00′ 00″ W), from bottom of oven pit 7.95m below surface. Coll 1977 by J G Marcas; subm by D W Lathrap. *Comment* (DWL): dates suggest that rate of alluvial deposition in inner flood plain of Daule R was relatively slow up to 5000 BP and increased rapidly from that time on. Acceleration of alluvial deposition was possibly result of intensification of farming along upper Daule ca 5000 BP.

Peru

Upper Amazon series

Carbonized palm nuts and charcoal from Loreto prov, NE of Pucallpa, on bank of Rio Calleria R (07° 50′ S, 74° 15′ W to 07° 55′ S, 74° 20′ W). Coll 1973 by R A Braun; subm by D W Lathrap.

ISGS-272. Contamanilla site, L-10 **670 ± 120**

From excavation Unit #5 at depth 50 to 60cm in direct assoc with ceramic remains.

ISGS-273. Piyuya site PIY-1, L-9 **500 ± 80**

From midden 19cm below surface.

General Comment (RAB): dates suggest that during early phase of domination of Central Ucayali by Tupian speakers, represented by Caimito complex, one refuge area for people they displaced (descendants of Panoan speakers assoc with Cumancaya complex) was backwoods area drained by right-bank tributaries of Ucayali. Furthermore, ceramic remains of CAL-7 and PIU-1 unequivocally represent direct antecedent to Remo, described for 17th and 19th centuries as comprising as many as 3000 people at headwaters of Rio Callaria (Steward, 1948). Presence of rare Caimito trade (?) sherds at these two sites are consistent with these dates.

Chavin de Huanter series

Wood charcoal from Ancash (09° 25′ S, 77° 30′ W). Coll 1976 by Richard Burger; subm by D W Lathrap.

ISGS-486. #1162 **2770 ± 80**

From lower level of fill within circular structure later buried by Urabarriu period platform.

ISGS-493. #1159 **2900 ± 150**

From fill of earliest platform construction at Chavin de Huanter site.

ISGS-510. #468 **2190 ± 210**

From depth 180cm in yellow to brown clay on top of platform of cobbles.

ISGS-506. #455 **2520 ± 100**

From depth 300 to 310cm in layer of brown soil above floor of lowest Janabarriu construction assoc with abundant Janabarriu ceramics.

ISGS–507. #472 **2400 ± 100**

From depth 350 to 365cm within stratum of clay and disintegrated gravel in direct assoc with Chakinani ceramics.

General Comment (RB): dates span three phase ceramic sequence defined for early ceremonial center and its assoc settlement. ISGS-486, -493, and -510 belong to Urabarriu phase, whereas ISGS-507 and -506 fall in Chakinani and Janabarriu phases, respectively. Judging from these dates and similar series of samples tested at Univ California-Riverside, Chavin temple appears to have begun ca 2800 BP and lasted for ca 6 centuries.

ISGS-545. Qata Casallaqta site **370 ± 80**

Charcoal from ca 3km S of center of Cuzco (13° 32′ S, 71° 59′ W), from floor of Rm 03, Pit II, in direct assoc with floor of Inca structure. Coll 1973 by D E Arnold; subm by D W Lathrap.

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ILLINOIS STATE GEOLOGICAL SURVEY RADIOCARBON DATES IX

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The following list contains samples of geologic interest that were processed from June 1980 through March 1983 at the Illinois State Geological Survey (ISGS) Radiocarbon Dating Laboratory. The benzene liquid scintillation technique was used following laboratory procedures previously reported by Coleman (1973, 1974).

All ages were calculated on the basis of a ^{14}C half-life of 5568 yr, using the NBS oxalic acid standard as reference. Errors (1σ) reported account only for uncertainties in activity measurements of the sample, standard, and backgrounds. Assignment of modern and minimum ages is based on the 3σ criteria. Barry W Fisher assisted in sample preparation.

Lake Michigan Shoreline, Greater Chicago Area

Illinois

Lake Michigan N Shore Channel, Bowmanville series

Samples from Cook Co, within city limit of Chicago (41° 58′ to 42° 04′ N, 87° 41′ W). Coll 1910 to 1914 by F C Baker (1920); subm by A K Hansel and Charles Collinson, ISGS.

ISGS-961. Station 9, P96, 244 to 279cm depth **4550 ± 70** $\delta^{13}C = -4.6‰$

Shell from coarse sand layer.

ISGS-928. Station 9, P58, 279 to 292cm depth **5580 ± 70** $\delta^{13}C = -27.0‰$

Wood from peaty zone.

ISGS-953. Station 27, P66 **5420 ± 70** $\delta^{13}C = -26.7‰$

Wood from silt zone, 6.7m thick.

ISGS-959. Station 16, P75 & P148 **4690 ± 90** $\delta^{13}C = -3.9‰$

Shell from gravel and sand layer overlain and underlain by silt.

General Comment (AKH): dates indicate that Bowmanville deposits are middle Holocene and record postglacial Nipissing transgression rather than low water phase of Lake Chicago as postulated by Baker.

Lake Michigan N Shore Channel, Stations 33 and 37 series

Samples from Cook Co, within city limit of Chicago (41° 58′ to 42° 04′ N, 87° 41′ W). Coll 1910 to 1914 by F C Baker; subm by A K Hansel and Charles Collinson.

8590 ± 140

ISGS-927. Station 37, P64, 70 to 278cm depth $\delta^{13}C = -24.5‰$

Pine cones from silt zone interstratified with sand.

10,570 ± 180

ISGS-950. Station 33, P62, 305 to 307cm depth $\delta^{13}C = -25.7‰$

Wood from silt layer.

11,010 ± 130

ISGS-984. Station 33, P60 $\delta^{13}C = 27.7‰$

Wood from sand layer, 0.3cm thick.

General Comment (AKH): range of dates and stratigraphy indicate that deposition at this locality probably was alluvial and that lake level was below 184m (Toleston and Main Algonquin) level between 11,000 and 8600 BP.

Lake Michigan, N Shore Channel, lakeshore series

Samples from Cook Co, within city limit of Chicago (41° 58′ to 42° 04′ N, 87° 41′ W). Coll 1910 to 1914 by F C Baker; subm by A K Hansel and Charles Collinson.

10,180 ± 180

ISGS-943. Station 62, P63 $\delta^{13}C = -26.1‰$

Wood from sand layer.

11,370 ± 150

ISGS-957. Station 63, P47 $\delta^{13}C = -26.5‰$

Wood from sand layer.

General Comment (AKH): location of these samples with respect to former shorelines is uncertain.

Rose Hill spit series

Samples from Cook Co, within city limit of Chicago (40° 03′ 55″ N, 87° 40′ 33″ W). From sand pile dredged from pit in Rosehill Cemetery. Coll 1982 by L R Follmer and A K Hansel; subm by A K Hansel.

11,610 ± 70

ISGS-985. AKH-2-82 $\delta^{13}C = -26.8‰$

Driftwood from distal part of Rose Hill spit.

11,000 ± 80

ISGS-1097. AKH-1-82 $\delta^{13}C = -26.3‰$

Driftwood from distal part of Rose Hill spit.

General Comment (AKH): dates indicate that Rose Hill spit, extension of Calumet shoreline (189m alt) of Lake Chicago, is post-Two Creeks in age.

6280 ± 70

ISGS-960. Palos Hills $\delta^{13}C = -28.0‰$

Peat from Cook Co, at W edge of Palos Hills City limits (41° 41′ 37″ N, 87° 50′ 20″ W) from peat layer ca 46cm thick overlying clay. Coll 1971 by

A K Hansel; subm by Charles Collinson and A K Hansel. *Comment* (AKH): peat deposition in outlet channel documents low water phase between Calumet and Nipissing phases of Great Lakes.

ISGS-970. Ogden ditch, P88 **4640 ± 80**
$\delta^{13}C = -1.6‰$

Shell from Cook Co, 2.4km N and 0.8km W of Chicago Midway Airport (41° 47′ 57″ N, 87° 46′ 20″ W), from silt zone containing *Unios* in upper part. Coll 1910 to 1914 by F C Baker; subm by A K Hansel and Charles Collinson. *Comment* (AKH): date is consistent with ISGS-959, -961 on pelecypod shells from N Shore Channel and documents Nipissing phase of Great Lakes.

ISGS-987. NE Park, Evanston **4670 ± 180**
$\delta^{13}C = -30.1‰$

Buried soil from Cook Co, within city limit of Evanston (42° 03′ 55″ N, 87° 40′ 33″ W), from silt and fine sand zone. Coll 1982 and subm by A K Hansel. *Comment* (AKH): date limits Nipissing transgression to alt of 183m to after 4970 ± 180 BP.

Waukegan Marsh series

Peat and muck from Lake Co, within city limit of Waukegan (42° 23′ 06″ N, 87° 51′ 11″ W), from organic silt zone. Coll 1982 L R Follmer; subm by A K Hansel.

ISGS-1007. AKH-4-82 **3730 ± 80**
$\delta^{13}C = -28.2‰$

From 1.3 to 1.4m below surface.

ISGS-997. AKH-5-82 **9090 ± 210**
$\delta^{13}C = -28.7‰$

From 1.8 to 1.99m below surface.

General Comment (AKH): older date limits onset of accumulation of organic sediment in depression on Glenwood Lake Chicago plain. Younger date may be erroneous because site is overlain by fill and roadbed.

Wisconsin

ISGS-999. AKH-6-82, Barnes Creek **5420 ± 150**
$\delta^{13}C = -28.2‰$

Wood from Kenosha Co, 3.3km S of Kenosha (42° 31′ 52″ N, 87° 48, 50″ W), from organic clayey silt zone. Coll 1982 by A K Hansel and Charles Collinson; subm by A K Hansel. *Comment* (AKH): date is max for nearshore sand body at Barnes Creek.

St Francis power plant series

Samples from Milwaukee Co, S of power plant, within city limit of St Francis, along Lake Michigan shoreline (42° 58′ 02″ N, 87° 50′ 48″ W). Coll 1982 and subm by A K Hansel.

37,800 ± 1100

ISGS-1023. AKH-8 $\delta^{13}C = -29.6‰$

Carbonized wood from top of sand and gravel sequence under 4m of Wadsworth till.

>42,000

ISGS-1025. AKH-7 $\delta^{13}C = -28.9‰$

Wood peat from base of Haeger till.

>50,000

ISGS-1106. AKH-9 $\delta^{13}C = -29.3‰$

Compressed peat clast redeposited on present beach.

General Comment (DMM): dates on wood and peat in Wadsworth and Haeger Till are too old for stratigraphic units and samples were evidently redeposited during ice advances that deposited these tills. Peat clast evidently ripped from below present level of Lake Michigan by waves. It probably represents interstadial dated by Gephart, Managham, and Larson (1983) at ca 40,000 BP or greater.

Illinois

DuPage Mammoth site series, NIU-123

Lake clay and mastodon bone from DuPage Co, 1.7km S of W Chicago (41° 50′ 52″ N, 88° 11′ 42″ W). Coll 1977 and subm by J W Springer, N Illinois Univ, DeKalb, Illinois.

ISGS-465. JWS-1 **15,240 ± 120**

Lake clay with peat from base of glacial kettle, assoc with mastodon bones. *Comment* (JWS): date is incompatible with previously accepted age of underlying W Chicago till and outwash of ca 14,500 BP (Frye & Willman, 1973). We prefer younger date from same site, ISGS-485: 13,130 ± 350 BP (Springer & Flemal, 1981).

ISGS-485. JWS-2 **13,130 ± 350**

Mastodon bone from waterlogged blue clay accumulated in bottom of glacial lake. *Comment* (JWS): date is compatible with previously accepted age of underlying W Chicago till and outwash of ca 14,500 BP.

NIU-28 series

Wood and mastodon bone from LaSalle Co, 5.25km SW of Somonauk (41° 36′ 48″ N, 88° 44′ 42″ W). Coll 1976 by Richard Lange; subm by J W Springer.

ISGS-482. 28-C **12,410 ± 130**

Wood from olive-gray clay containing bones. *Comment* (JWS): sample comes from same depth as mastodon bones. Date suggests that accumulation of clay began as much as 1400 yr before mastodon was buried.

ISGS-483. 28-B **11,080 ± 350**

Wood from fine gravel layer. *Comment* (JWS): date agrees with ISGS-489 (on mastodon bone). Fine gravel in which sample occurred is often found immediately surrounding mastodon bones. Sample should provide good date for bones themselves.

ISGS-489A. 28-C. Apatite fraction **10,890 ± 210**

ISGS-489B. 28-C. Total organic fraction **10,990 ± 110**

Mastodon bone with olive-gray clay. *Comment* (JWS): dates are in excellent agreement with ISGS-483 and each other.

Park Page Dam series

Wood from Winnebago Co, NW edge of Rockford (42° 18′ 30″ N, 89° 10′ W). From boring RD-24, at contact of water-lain silt and overlying gravel. Coll 1979 by Ron Pearson; subm by R C Anderson, Augustana Coll, Rock Island, Illinois.

ISGS-647. RCA-1 **>39,000**
$\delta^{13}C = -25.7‰$

ISGS-720. RCA-1 (Repeat run) **>50,000**
$\delta^{13}C = -25.7‰$

General Comment (RCA): sample was recovered from top of laminated silt that probably represents ponding of water in front of advancing Altonian ice. These lacustrine sediments were then covered by glacio-fluvial sand and gravel deposited as ice drew nearer. Eventually Winnebago Till was deposited at time of max ice advance. Both dates lead to similar conclusion that till is Illinoian or even older.

Athens N Quarry series

Samples from Menard Co, ca 6.5km NNE of Athens (40° 00′ 50″ N, 89° 42′ 16″ W). Coll 1980 and 1981 by L R Follmer and W H Johnson; subm by L R Follmer, ISGS.

ISGS-684. 6.35 to 6.53m **41,770 ± 1100**
$\delta^{13}C = -29.0‰$

Washed organic debris from degraded Ab soil in Berry Clay, 6.35 to 6.53m below surface.

ISGS-688. **35,560 ± 900**
$\delta^{13}C = -28.8‰$

Base soluble fraction of ISGS-684.

ISGS-870. 230N-1 **35,750 ± 620**
$\delta^{13}C = -28.4‰$

Organic silt from Ab horizon of leached soil.

37,000 ± 1200

ISGS-883. 230N-2 $\delta^{13}C = -26.9‰$

Organic silt from Ab zone of lower Altonian soil, 5.75 to 5.78m below surface.

General Comment (LRF): ISGS-684 dates organic debris in A horizon of Sangamon Soil developed in accretionary deposits (Berry Clay) of early Wisconsinan age. This horizon is top of upward growing soil and is abruptly separated from overlying Roxana Silt. ISGS-688 dates total humic acids extracted from ISGS-684 and indicates that amount of alluvial contamination into Sangamon through Roxana is low. These results suggest that beginning of main body of Roxana loess is ca 45,000 BP or slightly older (Follmer, 1983). ISGS-870 and -883 date A horizons of unnamed soils in alternating sequence of A and Bg horizons which overlie non-stratified Roxana Silt and underlie Farmdale Soil profile described by Follmer *et al* (1979). These two horizons appear to represent stratigraphic split of horizon dated 38,920 ± 1100 BP (ISGS-654: R, 1981, v 23, p 364) exposed in previous quarry exposure.

33,000 ± 1000

ISGS-673. C-502 + 89, 34.5 $\delta^{13}C = -25.0‰$

Wood from Sangamon Co, 1km E of Springfield (39° 47′ 10″ N, 89° 34′ 40″ W), from dark gray clay in Altonian alluvium, 10.5m below surface. Coll 1979 and subm by L R Follmer. *Comment* (LRF): date is estimate of beginning of aggradation in Sugar Creek near confluence with Sangamon R.

(98.5 ± 0.4)% modern

ISGS-676. Consolidation Coal-Burning Star, H-1 $\delta^{13}C = -25.3‰$

Wood from Perry Co, 12km WSW of Pinckneyville (38° 02′ 15″ N, 89° 30′ 00″ W), from wood-rich layer in alluvium, 3.05 to 3.96m below surface. Coll 1979 by Stan Harris, subm by L R Follmer and Stan Harris, Dept Geol, S Illinois Univ, Carbondale.

ISGS Test Site DAA-19 series

Organic silt and clay from Coles Co, 4km S of Ashmore (39° 29′ 17″ N, 88° 01′ 20″ W). Coll 1980 by P C Reed and W J Morse; subm by P C Reed, ISGS.

32,620 ± 650

ISGS-681. 36.6m $\delta^{13}C = -28.1‰$

From organic zone incorporated in clay and silt, 36.6m below surface.

25,170 ± 150

ISGS-686. 33.5m $\delta^{13}C = -27.8‰$

From same organic zone as ISGS-681, 33.5m below surface.

General Comment (PCR): ISGS-686 yields Farmdalian age, whereas ISGS-681 yields age which correlates favorably with Plano Silt dates in N Illinois.

Dates suggest that reliable geochronol data can be obtained using mud rotary drill cuttings.

Greenway school series

Combined organic fragments and silt (<10μm fraction) from Ogle Co, 3.2km NW of Esmond (42° 03′ 22″ N, 88° 57′ 39″ W), from lacustrine silt with small wood fragments, 7.5 to 7.7m below surface. Coll 1980 by L R Follmer and R J Krumm; subm by L R Follmer.

ISGS-722. LRF-80-0-2&3 **>41,000**
$\delta^{13}C = -27.7‰$

ISGS-724. LRF-80-0-4&5 **>41,000**
$\delta^{13}C = -13.1‰$

Split of ISGS-722.

General Comment (LRF): ISGS-722 and -724 represent field replicates from four cores. Previous sampling at same site yielded age of 23,750 ± 950 BP (I-2784, William & Frye, 1970), which was suspected to be in error. Samples are from stratified zone under Esmond Till, thought to be oldest Woodfordian (late-Wisconsinan) till in Illinois. Subsequent studies showed that Sangamon Soil occurs on Esmond in locations which are rarely preserved. Esmond correlates to youngest Illinoian (Radnor) till in Central Illinois.

ISGS-723. TA-3, S-7 **20,870 ± 130**
$\delta^{13}C = -27.2‰$

Organic rich silt with wood chips from Macon Co, 2.7km NW of Macon (39° 44′ 01″ N, 89° 01′ 02″ W), from top of organic zone, 20.7m below surface. Coll 1980 and subm by W J Morse, ISGS. *Comment* (WJM): date confirms that paleosol is Robein Silt of Farmdalian age. Location at margin of Shelbyville moraine helps date max Wisconsinan ice advance.

ISGS-727. TA-6, S-9 **21,250 ± 170**
$\delta^{13}C = -29.3‰$

Brown to reddish brown organic silt from Macon Co, 1.2km NE of Elwin (39° 47′ 10″ N, 88° 58′ 59″ W), from upper part of organic silt, 26.8 to 27.8m below surface. Coll 1980 and subm by W J Morse. *Comment* (WJM): helps date max Wisconsinan ice advance and agrees with other dates near margin of Shelbyville moraine.

Pittsburg Basin series

Peaty gyttja from Fayette Co, 10km SW of Vandalia (38° 54′ 15″ N, 89° 11′ 10″ W). Coll 1979 by H E Wright, L R Follmer and John King; subm by John King, Univ Minnesota.

ISGS-738. PBS-79D #1 **32,590 ± 930**
$\delta^{13}C = -24.8‰$

From lake sediment core, 263 to 265cm interval.

ISGS-748. PBS-79D #2 **39,800 ± 1200**
$\delta^{13}C = -25.5‰$

From lake sediment core, 269 to 271cm interval.

ISGS-746. PBS-79D #3 **>42,000**
$\delta^{13}C = -27.4‰$

From lake sediment core, 275 to 277cm interval.

ISGS-750. PBS-79D #4 **40,030 ± 990**
$\delta^{13}C = -26.8‰$

From lake sediment core, 281 to 283cm interval.

ISGS-742. PBS-79D #5 **41,110 ± 810**
$\delta^{13}C = -28.3‰$

From lake sediment core, 289 to 291cm interval.

Oak Crest Subdivision series

Muck and peat from Winnebago Co, 8km SW of Calendonia (42° 20′ 02″ N, 88° 59′ 11″ W). Coll 1980 and 1982 by R C Berg and L R Follmer; subm by R C Berg, ISGS.

ISGS-749. Site 1, RCB-WB-6 **33,220 ± 710**
$\delta^{13}C = -28.4‰$

From organic silt zone, 1.98 to 2.29m interval in open-bucket auger.

ISGS-744. Site 1, RCB-WB-18 & 19 **47,400 ± 2400**
$\delta^{13}C = -28.1‰$

From 2.89 to 3.05m interval in muck zone.

ISGS-1039. Site 2, RCB-1 **24,830 ± 350**
$\delta^{13}C = -29.6‰$

From 1.02 to 1.14m interval in sand interbedded clay zone.

ISGS-1073. Site 2, RCB-2 **37,900 ± 1300**
$\delta^{13}C = -28.0‰$

From peat zone, 1.55 to 1.63m interval.

ISGS-1069. Site 2, RCB-3 **43,800 ± 2700**
$\delta^{13}C = -29.0‰$

From fibrous peat zone, 1.85 to 1.98m interval.

ISGS-1045. Site 2, RCB-4 **43,100 ± 1100**
$\delta^{13}C = -29.1‰$

From very fibrous peat zone, 2.54 to 2.64m interval.

General Comment (RCB): ISGS-749 agrees well with date of upper limit of Plano Silt member of the Winnebago Fm, GrN-4408: 32,600 ± 520 (Willman & Frye, 1970). ISGS-744 provides lower limit of Plano Silt member.

ISGS-1039, -1073, -1069, and -1045 establish higher limit for bog sequence. These four dates document pine to spruce transition shown in pollen analysis and establish upper time limit for underlying Argyle Till member.

1940 ± 80

ISGS-757. Camp Sagawau $\delta^{13}C = -25.4‰$

Decomposed woody materials from Cook Co, 5km E of Lemont (41° 41′ 14″ N, 87° 52′ 45″ W), from sandy and silty fluvial or lacustrine deposit, ca 3m below surface. Coll 1980 by W G Dixon and Ralph Trornton; subm by W G Dixon, ISGS. *Comment* (WGD): exposures in stream bed were considered to be Lemont Drift, and strata in which decomposed wood was contained were of younger but indeterminate age. This sample is probably root from Late Holocene tree. *In situ* woody material appears to be decomposed log which had been compressed by weight of overlying sediments.

>38,000

ISGS-765. Mahomet NE Bridge $\delta^{13}C = -25.9‰$

Wood from Champaign Co, 0.8km E of Mahomet (40° 11′ 04″ N, 88° 23′ 28″ W), from 1.5m below top of Piatt till. Coll 1980 by L R Follmer, W H Johnson, and W J Morse; subm by W J Morse. *Comment* (WJM): Piatt till is already known to be younger than Farmdalian. Date of >38,000 does not further define age of unit.

17,690 ± 270

ISGS-767. Sunnycrest Drainage Ditch $\delta^{13}C = -26.6‰$

Twigs and root fragments from Champaign Co, 3.6km SE from downtown Urbana (40° 05′ 50″ N, 88° 10′ 10″ W), from 2.05 to 2.15 m below top of Richland Loess. Coll 1980 and subm by W H Johnson. *Comment* (WHJ): date is min for deglaciation from Urbana Moraine and for Batestown Till member of Wedron Fm. This is oldest date from sediment overlying Wedron Fm in Illinois.

47,400 ± 1500

ISGS-772. Nimitz Quarry Section $\delta^{13}C = -25.9‰$

Wood from Winnebago Co, 4km ENE of Loves Park (42° 19′ 48″ N, 89° 00′ 07″ W), from organic zone, 8.5 to 9.5m below surface. Coll 1980 by R C Berg, L R Follmer, and J P Kempton; subm by R C Berg. *Comment* (RCB): date is younger than stratigraphic evidence and nearby ^{14}C dates had suggested.

>48,000

ISGS-778. B W project $\delta^{13}C = -30.3‰$

Organic silt with wood fragments from Winnebago Co, 3km WNW of Rockton (42° 27′ 38″ N, 89° 06′ 22″ W), from dark gray leached organic silt zone, 45.9 to 46.1m below surface. Coll 1980 and subm by R C Berg. *Comment* (RCB): date verifies suspected Early Altonian or pre-Wisconsinan age for bulk of Rock Bedrock valley fill.

20,670 ± 280

ISGS-828. Clinton power station, #1 $\delta^{13}C = -30.2‰$

Moss from DeWitt Co, 8km E of Clinton (40° 10′ 09″ N, 88° 50′ 20″ W), from moss bed, 1 to 2cm thick, 10cm below Wedron till in Morton loess. Coll 1981 and subm by J E King.

5680 ± 80

ISGS-829. Mussel Beach, MB-50 $\delta^{13}C = -8.8‰$

Mussel shells from Rock Island Co, 7km SW of Rock Island (41° 28′ 04″ N, 90° 38′ 27″ W), from top of buried sandy loam beach ridge assoc with Indian artifacts. Coll 1981 by M L Barnhardt and P F Person; subm by M L Barnhardt, Illinois State Univ, Normal, Illinois. *Comment* (MLB): these mussel shells are found at contact between underlying beach sand and sediments deposited during various slough and backwater periods. With ISGS-842, it helps establish rate of deposition in area.

3670 ± 80

ISGS-842. Beach Ridge $\delta^{13}C = -25.0‰$

Organic rich soil from Rock Island Co, 8km SW of Rock Island (41° 27′ 40″ N, 90° 38′ 45″ W), from base of abandoned beach ridge, 1.5m below surface. Coll 1981 by M L Barnhardt and P F Peason; subm by M L Barnhardt. *Comment* (MLB): date agrees with ISGS-829, from beach ridge farther from river in same area.

Wedron Section series

Wood from LaSalle Co, 0.6km S of Wedron (41° 25′ 52″ N, 88° 46′ 50″ W). Coll 1981 by L R Follmer and W H Johnson; subm by L R Follmer.

24,900 ± 200

ISGS-862. W_9-E-1 $\delta^{13}C = -26.2‰$

From sandy alluvium, 3 to 3.5m below surface.

24,370 ± 310

ISGS-863. W_9-D-1 $\delta^{13}C = -26.1‰$

From pink brown lacustrine clay, ca 10m below surface.

General Comment (LRF): ISGS-862 is from top of valley fill sequence underlying stratified pinkish clay (Peddicord Fm) which cuts into St Peter Sandstone. ISGS-863 is from base of Peddicord Fm overlying normal Farmdale Soil (A/Bg/c). Dates agree well with previous dates on wood from Peddicord at this site and with date from top of Farmdale Soil in other places. Peddicord Fm is now interpreted to represent slack water lake formed at end of Farmdalian during onset of Woodfordian (late Wisconsinan) glaciation.

McKee Farm series

Carbonaceous silt from McDonough Co, 6km N of Macomb (40° 30′ 43″ N, 90° 40′ 27″ W). Coll 1979 by J E King and W H Johnson; subm by W H Johnson, Dept Geol, Univ Illinois.

ISGS-1041. MF-1 **25,260 ± 280**
$\delta^{13}C = -28.0‰$

From Robein Silt at depth 2.63 to 2.68m. *Comment* (WHJ): date is from near top of carbonaceous sequence of deposits; it marks approx position where large increase in spruce occurs in sediment.

ISGS-1042. MF-B **37,800 ± 2100**
$\delta^{13}C = -29.0‰$

From Robein/Roxana at depth 3.13 to 3.2m. *Comment* (WHJ): date is from middle to lower part of carbonaceous sequence of deposits and is 0.4m above position of ISGS-975. Both dates are the same. Origin of discrepancy is not clear.

ISGS-975. MF-A **37,700 ± 1400**
$\delta^{13}C = -29.0‰$

From Robein Silt at depth 3.55 to 3.65m. *Comment* (WHJ): date is from base of carbonaceous sequence of deposits; it marks approx position where spruce pollen begins to occur in sediment.

Sangamon Sewer Site series

Wood from Champaign Co, 3.1km NE of Mahomet (40° 12′ 58″ N, 88° 22′ 42″ W). Coll 1982 by W H Johnson and D I Casavant; subm by W H Johnson.

ISGS-1074. #15 **11,550 ± 130**
$\delta^{13}C = -29.8‰$

From sandy silt ca 3.6m below ground surface. *Comment* (WHJ): date is on wood 0.5m above base of postglacial alluvium (Cahokia Alluvium) which occurs above erosion surface cut on glaciofluvial deposits of Henry Fm.

ISGS-1077. #10 **5080 ± 70**
$\delta^{13}C = -27.0‰$

From base of 2.5m sequence of overbank sediments in Cahokia Alluvium. *Comment* (WJH): date marks beginning of overbank sedimentation in abandoned channel cut in older Holocene alluvium.

Becker-Schumann Farm series

Wood charcoal from Calhoun Co, 5km NW of Kampsville (39° 19′ 56″ N, 90° 39′ 49″ W). Coll 1978 and subm by R T Styles.

ISGS-867. TRS-1 **1010 ± 100**
$\delta^{13}C = -26.2‰$

From near boundary of two main units of Holocene creek alluvium in lens of light gray silt.

ISGS-871. TRS-2 **510 ± 70**
$\delta^{13}C = -25.3‰$

From silty creek alluvium, ca 90cm below surface in creek bank.

General Comment (RTS): dates suggest extensive Late Holocene fluvial activity in small upland drainage in W Illinois. ISGS-867 reflects waning stage of Butzer's (1977) proposed upland erosion phase, which ranges from ca 1200 to 950 BP ISGS-871 indicates that fluvial activity continued into more recent time, at least on local level.

Hartwell Levee District series

Samples from Greene Co, 2.7 to 7.7km SW of Hillview (39° 23′ 26″ N, 90° 33′ to 34′ W). Coll 1981 by E R Hajic and D S Leigh; subm by E R Hajic, Geomorphol Lab, Northwestern Univ, Evanston, Illinois.

ISGS-900. HLC-38C, D **13,010 ± 140**
$\delta^{13}C = -26.3‰$

Wood conifer from dark, unleached, laminated slackwater silt and clayey silt below N-most remnant of Deer Plain terrace clays. *Comment* (ERH): date is max for Deer Plain terrace and assoc lacustrine clay in lower Illinois R valley. Date agrees with ISGS-894 (13,390 ± 190 BP, Hajic, 1983) and ISGS-875 (13,360 ± 100 BP, Wiant, Hajic & Styles, 1983) from same or related lithologic unit, same stratigraphic position, and similar botanical components.

ISGS-903. HLC-42 A&B **3650 ± 70**
$\delta^{13}C = -27.5‰$

Wood and charcoal from base of dark gray, unleached clayey silt. *Comment* (ERH): date is max for end of paleochannel infilling episode (Hajic, 1983).

ISGS-930. HLC-11 A&B **5700 ± 140**
$\delta^{13}C = -26.0‰$

From base of thick sequence of channel-filling dark gray, unleached, clayey silts and top portion of underlying black unleached fine to medium sand. *Comment* (ERH): date is min for start of paleochannel infilling primarily with slackwater deposits. Lithologic unit from which this sample was coll constitutes bulk Holocene Valley fill (Hajic, 1983).

Nutwood Levee District series

Uncarbonized wood (spruce and cedar) from Jersey Co, 3.9 to 5.5km E of Hardin (39° 09′ N, 90° 33′ to 34′ W). Coll 1981 and subm by E R Hajic.

ISGS-894. 12.84 to 13.20m **13,390 ± 190**
$\delta^{13}C = -26.7‰$

From dark gray, unleached, laminated slackwater silt and sand silt beneath Deer Plain terrace and assoc lacustrine clays and alluvial fan silts along E margin of Illinois R Valley. *Comment* (ERH): date is min for initiation of Valley-wide lacustrine environment in lower Illinois R Valley (Hajic, 1983).

ISGS-911. 3.65 to 4.80m **12,000 ± 100**
$\delta^{13}C = -27.6‰$

From slightly sandier zone near upper part of unoxidized, unleached, laminated slackwater silt and clay unit believed to be within eroded remnant of Keach Scholl terrace. *Comment* (ERH): max age for Keach Scholl terrace and min age for Deer Plain terrace in lower Illinois R Valley (Hajic, 1983).

Indiana

ISGS-424. Harrodsburg Crevice **25,050 ± 660**

Apatite fraction of bone from Monroe Co, 14km S of Bloomington (39° 02′ 30″ N, 86° 32′ 30″ W), from crevice-type cave deposit. Coll 1974 by P J Munson; subm by P W Parmalee, Univ Tennessee. *Comment* (PWP): preliminary analyses of faunal materials from Harrodsburg Crevice suggest locale served as both habitation and denning site.

Adams Mill series

Samples from Carroll Co, 2km NE of Cutler (40° 29′ 02″ N, 86° 30′ 12″ W). Coll 1979 and 1981 and subm by N K Bleuer, Indiana Geol Survey.

ISGS-677. NKB-79-1 **22,950 ± 160**
$\delta^{13}C = -24.8‰$

Wood from till assoc with deformed basal pods of woody debris, 7m below surface.

ISGS-952. NKB-81-2 **22,350 ± 120**
$\delta^{13}C = -24.4‰$

Wood chips from organic silt zone, ca 30cm thick.

ISGS-977. NKB-81-1 **21,980 ± 160**
$\delta^{13}C = -29.4‰$

Muck from atop Adams Mill Beds.

General Comment (NKB): all three dates seem somewhat older than expected for this location.

13-15-6 series

Organic silt from Parke Co, 5.5km SE of Bellmore (39° 00′ 44″ N, 87° 00′ 41″ W), from silt assoc with fibrous organic debris. Coll 1979 and subm by N K Bleuer.

ISGS-679. 4.26 to 4.41m **24,240 ± 270**
$\delta^{13}C = -18.7‰$

ISGS-707. 3.96 to 4.11m **23,540 ± 540**
$\delta^{13}C = -28.9‰$

General Comment (NKB): dates are assumed to antedate ice advance by considerable length of time.

ISGS-682. 13-15-17 **23,480 ± 100**
$\delta^{13}C = -26.6‰$

Organic silt from Parke Co, 7km ESE of Rockville (39° 45′ 10″ N, 87° 08′ 04″ W), from silty muck and organic silt, grading to clayey black mineral soil at base, 4.41 to 5.18m below surface. Coll 1979 and subm by N K Bleuer. *Comment* (NKB): date is assumed to antedate actual ice advance.

ISGS-690. Green Castle Quarry **20,080 ± 100**
$\delta^{13}C = -24.4‰$

Woody debris from Putnam Co, 1.5km W of Green Castle (39° 37′ 47″ N, 86° 53′ 00″ W), from top mat layer of silt zone. Coll 1979 and subm by N K Bleuer. *Comment* (NKB): date indicates that overlying till is not direct correlation (in time or event) of Wayne's Center Grove Till of Johnson Co.

ISGS-717. Ambia Teays Test #1 **25,450 ± 480**
$\delta^{13}C = -28.3‰$

Organic silt from Benton Co, 1.5km E of Ambia (40° 29′ 12″ N, 87° 29′ 27″ W), from silt to silty clay zone, slightly organic stained in top part, 23.8 to 27.4m below surface. Coll 1979 and subm by N K Bleuer. *Comment* (NKB): assumed to date Wisconsinan Fairgrange advance at that place. It is not out of line with dates in Illinois at that lat, but is much older than basal Trafalgar dates in central and NE Indiana.

ISGS-880. Liverpool Section **11,290 ± 80**
$\delta^{13}C = -26.9‰$

Wood fragments from peat from Lake Co, 1km E of Liverpool (41° 32′ 50″ N, 87° 16′ 26″ W), from peat bed in cross-bedded and laminated sand. Coll 1981 by Perry Zack and A T Smith; subm by R B Votaw, Indiana Univ NW, Gary, Indiana. *Comment* (RBV): site is in Calumet stage shoreline sands and provides date for near Two-Creekan age materials in Indiana.

ISGS-941. Alcoa production well **>31,000**
$\delta^{13}C = -26.4‰$

Organic silt from Tippecanoe Co, SE edge of Lafayette (40° 24′ 03″ N, 86° 51′ 59″ W), from soft blue clay layer, 36.27m below surface. Coll 1981 by Peerless-Midwest Co Drillers; subm by N K Bleuer. *Comment* (NKB): date suggests that some or all of primary gravel package in S Lafayette may be pre-Wisconsinan.

ISGS-942. Kokomo USGS-D-7 **41,600 ± 2200**
$\delta^{13}C = -29.5‰$

Organic silt from Howard Co, 4.5km NW of Kokomo (40° 33′ 05″ N, 86° 14′ 34″ W), from 16.76 to 17.37m in auger hole D-7B. Coll 1981 by B Compahni and R Autio; subm by N K Bleuer. *Comment* (NKB): date establishes sequence of three overlying tills as Wisconsinan in age, and suggests indirectly that lower till can be correlated (lithologically) to lowest till at Adams Mill locality, which overlies 20,000 BP material. Dated unit is

assumed to be truncated and to indicate long record of mid-Wisconsin accumulation.

Pyle Site series

Samples from Adams Co, 6km ENE of Berne (40° 40′ 32″ N, 84° 53′ 19″ W), from sediment core. Coll 1980 by L C Shane and H E Wright; subm by L C Shane, Limnol Research Center, Univ Minnesota.

ISGS-1052. 190 to 193cm depth **9240 ± 80**
$\delta^{13}C = -26.2‰$

Only wood sample from this series; others are gyttya.

ISGS-1066. 257.5 to 260cm **10,170 ± 70**
$\delta^{13}C = -31.9‰$

ISGS-1076. 313 to 315cm **9080 ± 180**
$\delta^{13}C = -31.0‰$

ISGS-1068. 350 to 355cm **11,930 ± 90**
$\delta^{13}C = -26.4‰$

ISGS-1055. 440 to 445cm **13,510 ± 160**
$\delta^{13}C = -29.2‰$

General Comment (LCS): five dates from Pyle site, NE Indiana, date major changes in late-glacial pollen record of region. Series was designed to confirm chronology of other nearby sites and to focus specifically on recurrence of spruce pollen dating to ca 11,000 BP. Four of five dates agree very well with other research. ISGS-1076 is out of sequence by ca 2000 yr.

ISGS-1054. American Aggregates **>50,000**
$\delta^{13}C = -26.9‰$

Wood from Wayne Co, 27km ENE of Richmond (39° 50′ 30″ N, 84° 49′ 23″ W), from organic silt bed, 15 to 30cm thick, exposed on NW side of cut along abandoned railroad right-of-way. Coll 1982 and subm by B B Miller, Dept Geol, Kent State Univ, Kent, Ohio. *Comment* (BBM): date for this wood from unit 6 of American Aggregates pit agrees with earlier attempts to date this organic silt bed (Gooding, 1975) and suggests that mollusks from unit 6 are probably older than those recovered from unit 1 at Bantas Fork, dated by ISGS-726: 44,800 ± 1700 (Goldthwait *et al,* 1981).

ISGS-1067. Wildcat Creek Body Shop, Blue Bank **21,660 ± 240**
$\delta^{13}C = -26.5‰$

Wood from Tippecanoe Co, 3km E of Hwy 52 bypass, Lafayette (40° 25′ 56″ N, 86° 49′ 20″ W), from sheared sand-clay layer. Coll 1982 by N K Bleuer and R Pavey; subm by N K Bleuer. *Comment* (NKB): date corroborates units above as Wisconsinan; gives younger advance date for area than Adams Mill series.

>50,000

ISGS-1070. Green Creek Section A $\delta^{13}C = -26.9‰$

Wood from Parke Co, 12.8km N of Rockville (39° 54′ 55″ N, 87° 14′ 20″ W), from base of till. Coll 1982 and subm by N K Bleuer. *Comment* (NKB): date indicates that till unit above is Illinoian or older.

Russellville Quarry series

Samples from Putnam Co, 0.8km SSW of Russellville (39° 50′ 44″ N, 86° 59′ 14″ W). Coll 1982 and subm by N K Bleuer.

22,360 ± 580

ISGS-1071. 82/R-lower $\delta^{13}C = -25.5‰$

Wood from lower portion of organic silt.

22,400 ± 210

ISGS-1075. 82/R-upper $\delta^{13}C = -25.1‰$

Silt from top of transported organic zone.

General Comment (NKB): ISGS-1071 is slightly older than would have been assumed. ISGS-1075 suggests that upper organic zones may be repeated as part of long basal thrust sheets.

3970 ± 100

ISGS-1072. Lower Durkeys Run $\delta^{13}C - 28.9‰$

Wood from Tippecanoe Co, in SW of Lafayette (40° 24′ 08″ N, 86° 54′ 15″ W), from muck, marl channel fill. Coll 1982 by N K Bleuer and R Pavey; subm by N K Bleuer. *Comment* (NKB): date is obviously post-Wisconsinan and shows sediments to be inset alluvial fill.

Ohio

44,800 ± 1700

ISGS-726. Bantas Fork #1 $\delta^{13}C = -28.0‰$

Organic silt from Preble Co, 4.8km E of Eaton (39° 45′ 12″ N, 84° 35′ 05″ W), from interstadial deposit immediately below till in which sidney weathering profile developed. Coll 1980 and subm by D P Stewart, Dept Geol, Miami Univ, Ohio. *Comment* (DPS): date confirms correlation of unit with New Paris Interstade and supports middle Wisconsinan age for Fairhaven till above it.

20,210 ± 260

ISGS-761. Doty's Highbank $\delta^{13}C - 25.8‰$

Wood (red spruce) from Butler Co, 4km N of Oxford (39° 33′ 05″ N, 84° 43′ 56″ W), from stump zone, overlain and underlain by till unit. Coll 1980 and subm by D P Stewart. *Comment* (DPS): date corrects age of stump zone at Doty's Highbank. It also confirms correlation of Fayette till below and Shelbyville till above.

ISGS-764. Gregory Creek #5 **19,350 ± 130** $\delta^{13}C = -25.4‰$

Wood (red spruce) from Butler Co, 3.5km SE of Lesourdsville (39° 24′ 30″ N, 84° 25′ 20″ W), from glacial till, 145cm from base of till unit and interstadial deposit below. Coll 1979 by K M Newdale; subm by D P Stewart. *Comment* (KMN): date confirms correlation of till with upper Shelbyville till of region and suggests that this till is younger than lower Shelbyville exposed to W.

ISGS-922. E Branch Chagrin R Gravel Pit **9360 ± 100** $\delta^{13}C = -27.6‰$

Wood from Geauga Co, 0.75km S of Lake Geauga (41° 33′ 45″ N, 81° 18′ 30″ W), from lens of slit surrounded by gravel and exposed in face of gravel pit, 2.5m below terrace surface. Coll 1981 and subm by S M Totten, Hanover Coll, Hanover, Indiana. *Comment* (SMT): date is ca 4000 yr younger than expected. Either E Branch Chagrin R terrace is younger than believed, or leaching has resulted in sample contamination. Passage of spruce cones in deposit suggests wood is older than data indicates.

Brown's Run series

Wood from Butler Co, 6.65km SW of Germantown (39° 34′ 30″ N, 84° 26′ 00″ W). Coll 1982 by D P Stewart and B B Miller; subm by B B Miller.

ISGS-1053. 82-9b **20,590 ± 190** $\delta^{13}C = -25.5‰$

From organic silt lens ca 22.6m below top of cut bank on S side of Brown's Run.

ISGS-1057. 82-9c **20,480 ± 340** $\delta^{13}C = -26.9‰$

From organic silt layer, ca 30cm thick, ca 3.5cm above silt lens in underlying sand and gravel (ISGS-1053).

General Comment (BBM): dates agree with one another and appear to support field interpretation which suggested that organic lens from which ISGS-1053 was taken may have been squeezed into enclosing sand and gravel unit. ISGS-1053 agrees well with ISGS-761: 20,210 ± 260 BP, from stump zone at Doty's Highbank (Goldthwait *et al,* 1981).

New Mexico

ISGS-762. Pintado Section, NM-192 **240 ± 80** $\delta^{13}C = -22.0‰$

Charcoal from Guadelupe Co, 8km SW of Santa Rosa (34° 25′ 36″ N, 104° 44′ 00″ W), from extensive hearth at interface between fine sand and silt units. Coll 1980 by A B Leonard and J C Frye; subm by A B Leonard and H D Glass, ISGS.

3390 ± 80

ISGS-770. Black R Crossing, NM-134 $\delta^{13}C = -7.7‰$

Mollusk shell from Eddy Co, 24km S of Carlsbad (32° 12′ 42″ N, 104° 13′ 18″ W), from terrace deposit, 6m thick. Coll 1977 by A B Leonard and J C Frye; subm by A B Leonard.

11,150 ± 130

ISGS-932. McMillan Dam S, NMF-203 $\delta^{13}C = -5.6‰$

Shell fragments of Unionid mussels from Eddy Co, 0.1km S of Lake McMillan Reservoir (32° 38′ 11″ N, 104° 20′ 42″ W), from river terrace W of Pecos R channel, ca 4m above channel sediments. Coll 1981 by J C Frye and A B Leonard; subm by A B Leonard and H D Glass.

950 ± 100

ISGS-998. Hagerman N Section, NMF-202A $\delta^{13}C = -23.7‰$

Organic debris from Chaves Co, 4.8km NNE of Hagerman (33° 08′ 24″ N, 104° 19′ 48″ W), from terrace sediments on Rio Felix. Coll 1981 by J C Frye and A B Leonard; subm by A B Leonard.

15,730 ± 240

ISGS-1002. Trujillo Ranch Section $\delta^{13}C = -7.8‰$

Gastropod shells from DeBaca Co, 9.7km SSW dam at Lake Sunner (34° 32′ 31″ N, 104° 25′ 26″ W), from dry lake sediments exposed by erosion. Coll 1981 by J C Frye and A B Leonard; subm by A B Leonard.

California

Proposed Little Cojo Bay LNG Site series

Marine shells from Santa Barbara Co (34° 27′ 03″ N, 120° 25′ 08″ W), from marine sands overlying marine abrasion platform of first emergent marine terrace exposed in seacliff. Coll 1980 by R H Patterson; subm by D L Johnson, Univ Illinois.

38,600 ± 500

ISGS-714. COJO-2 $\delta^{13}C = 0.2‰$

42,150 ± 750

ISGS-716. COJO-1 $\delta^{13}C = 0.4‰$

45,400 ± 1200

ISGS-718. Beach Fault Trench terrace #2 $\delta^{13}C = -23.4‰$

Charcoal from Santa Barbara Co, 19km W of Gaviota Beach and 2km E of Point Conception (34° 27′ 17″ N, 120° 24′ 37″ W), from Beach Fault terrace sediments comprised largely of continental alluvial fan deposits. Coll 1980 by D L Johnson and T K Rickwell; subm by D L Johnson.

ISGS-721. Running Spring, San Migule Island SMI-251b **22,510 ± 200**
$\delta^{13}C = -24.4‰$

Organic soil from Santa Barbara Co, 56km WSW of Santa Barbara (34° 02′ 44″ N, 122° 25′ 34″ W), from buried colluvial soil, 2.9m below surface. Coll 1978 by D L Johnson and M L Barnhardt; subm by D L Johnson. *Comment* (DLJ): date is consistent with its stratigraphic position. Samples coll ca 1.2m above this horizon dated 16,520 ± 150 BP and 15,630 ± 460 BP, respectively (ISGS-518, -525: R, 1981, v 23, p 377). Both samples indicate that episodes of fire occurred during full glacial time, and that *Mammuthus exilis* was then present on island.

ISGS-725. Canada Verde uppermost buried soil SRI-16 **650 ± 70**
$\delta^{13}C = -26.2‰$

Soil from Santa Barbara Co, ca 60km WSW of Santa Barbara (34° 00′ 28″ N, 120° 06′ 04″ W), from uppermost buried soil in alluvial fill of Canada Verde assoc with shell midden material. Coll 1978 and subm by D L Johnson. *Comment* (DLJ): date is mean residence time for organic carbon in uppermost buried soil. Date shows that end of alluviation and onset of stream entrenchment began in very late Holocene, possibly during early historic period.

ISGS-768. La Vista #3 **9960 ± 200**
$\delta^{13}C = -26.9‰$

Organic material from Ventura Co, 3km SW of Ojai (34° 25′ 28″ N, 119° 16′ 10″ W), from interface between buried soil and overlying alluvium. Coll 1978 by D L Johnson and Mike Clark; subm by D L Johnson. *Comment* (DLJ): date marks time of burial of Oakview terrace paleosol at this site, and also marks time of faulting of terrace upon which cities of Oakview and, in part, Ojai are built.

ISGS-774. Fossil Forest, SMI **270 ± 80**
$\delta^{13}C = 22.8‰$

Organic material from Santa Barbara Co, midway between San Miguel Hill and Green Mt, San Miguel I., Santa Barbara (34° 02′ 16″ N, 120° 22′ 30″ W), from interiors of exhumed calcified plants (rhizoconcretions) in fossil forest exposed in wind-eroded eolianite dune. Coll 1976 by D L Johnson and D Muhs; subm by D L Johnson. *Comment* (DLJ): sample was expected either to be between 18,000 and 30,000 BP or to be modern. Young age fits neither assumption, but indicates that either (1) organic interiors of rhizoconcretions have been contaminated with plant roots growing into them from above, or (2) that some of rhizoconcretions are not old and may have formed around modern roots growing downward into eolianite.

ISGS-799. Oakview Terrace #2 **36,600 ± 1100**
$\delta^{13}C = -24.9‰$

Charcoal from Ventura Co, ca 0.25 km S of Oakview (34° 23′ 24″, 119° 18′ 02″ W), from fine-grained river alluvium, 8.3m below Oakview terrace

surface. Coll 1980 by D J Johnson and R K Rockwell; subm by D L Johnson. *Comment* (DLJ): date confirms 39,360 ± 2610 BP, previously determined by Univ of Washington for initial sedimentation of Oakview terrace. It is also concordant with younger date, ISGS-768: 9960 ± 200 BP, on alluvium which overlies Oakview surface at La Vista #3.

Upper Sauces Canyon Fire area series

Charcoal from Santa Barbara Co, 50km SSW of Santa Barbara (34° 00′ 31″ N, 119° 52′ 00″ W). Coll 1981 by M Glassow and D L Johnson; subm by D L Johnson.

ISGS-876. SCI-16, Fire Area B **12,760 ± 180**
$\delta^{13}C = -24.9‰$

From 90cm below surface in alluvium.

ISGS-877. SCI-15, Fire Area A **13,110 ± 120**
$\delta^{13}C = -22.0‰$

From contact of residual soil developed in weathered bedrock and overlying alluvium in upper Sauces Canyon.

Lower Sauces Canyon fossil logs series

Fossil wood from Santa Barbara Co, 50km SW of Santa Barbara (34° 00′ 42″ N, 119° 52′ 30″ W), from floor of lower Canada de Los Sauces in alluvium. Coll 1981 by M Glassow and D L Johnson; subm by D L Johnson.

ISGS-878. SCI-18 **12,920 ± 140**
$\delta^{13}C = -26.7‰$

ISGS-879. SCI-19 **13,380 ± 80**
$\delta^{13}C = -26.7‰$

ISGS-907. SCI-20 **13,310 ± 100**
$\delta^{13}C = -23.5‰$

ISGS-910. SCI-21 **13,340 ± 110**
$\delta^{13}C = -24.2‰$

ISGS-915. SCI-23 **12,630 ± 100**
$\delta^{13}C = -24.2‰$

ISGS-919. SCI-30 **12,870 ± 140**
$\delta^{13}C = -25.4‰$

Missouri

Brynjulfson Cave #1 series

Extinct beaver bone from Boone Co, 19km S of Columbia (38° 51′ 07″ N, 92° 16′ 50″ W), from ca 12m length of cave fill. Coll 1962 by M G Mehl; subm by P W Parmalee, Univ Tennessee, Knoxville.

ISGS-267A. Bone apatite **21,570 ± 510**

ISGS-267B. Bone collagen **>29,800**

General Comment (PWP): collagen date (ISGS-267B) of >29,800 BP is consistent with two dates (ISGS-204A: >27,000 BP and ISGS-204B: 34,600 ± 2100 BP, R, 1975, v 17, p 172) obtained from extinct peccary from same cave. Degree of bone fossilization of these two species was similar and they may have been contemporaneous.

Utah

Bald Mountain bog series

Charcoal fragments from Summit Co, 44km E of Kansas (40° 42′ 40″ N, 110° 54′ 15″ W). Coll 1980 by M L Barnhardt and P F Person; subm by M L Barnhardt.

4320 ± 120

ISGS-759. BMF-70 $\delta^{13}C = -25.1‰$

From charcoal layer, 70cm below surface, on top of organic soil zone.

5050 ± 130

ISGS-763. BMF-83 $\delta^{13}C = -23.5‰$

From charcoal layer, 83cm below surface at base of buried soil horizon.

General Comment (MLB): dates help establish rates of alpine meadow fm. ISGS-759 provides basal date for development of avalanche boulder tongues and other talus features utilized in alpine glacial chronology for area, whereas ISGS-763 dates beginning of depositional phase which may correlate with increased avalanche and talus activity assoc with post-Altithermal cooling.

Bald Mountain W Meadow series

Charcoal flasks from Summit Co, 43km E of Kansas (40° 41′ 30″ N, 110° 55′ 10″ W). Coll 1981 by M L Barnhardt and P F Person; subm by M L Barnhardt.

6320 ± 150

ISGS-906. BMW-3-70 $\delta^{13}C = -24.5‰$

From buried soil, 60 to 83cm below surface.

4320 ± 90

ISGS-924. BMW-2-29 $\delta^{13}C = -24.3‰$

From base of colluvial unit overlying ground moraine, ca 29cm below surface.

Wisconsin

ISGS-1050. Waukesha Lime pit **3500 ± 70**
$\delta^{13}C = -19.4‰$

Organic clay from Waukesha Co, 1km N of Waukesha (88° 12′ 44″ N, 43° 01′ 54″ W), from Beta horizon of buried soil in drumlin. Coll 1982 by L R Follmer and A K Hansel; subm by L R Follmer. *Comment* (LRF): this material was thought to be either dead or modern. Results indicate that dated material was contaminated.

ISGS-1061. Kewaunee South **11,700 ± 100**
$\delta^{13}C = -27.8‰$

Wood from Kewaunee Co, S edge of Kewaunee (44° 26′ 50″ N, 87° 30′ 10″ W), from top of buried black organic layer ranging from 5 to 13cm thick. Coll 1981 and subm by A F Schneider, Univ Wisconsin - Parkside, Kenosha, Wisconsin. *Comment* (AFS): date confirms organic layer as Two Creek Forest Bed and overlying red till as Two River till.

ISGS-1058. Two River South sand pit **11,910 ± 120**
$\delta^{13}C = -27.4‰$

Wood from Manitowoc Co, N edge of Two Rivers (44° 09′ 58″ N, 87° 33′ 30″ W), from red clayey till (Two River till). Coll 1968 by Paul Stoelting; subm by A F Schneider. *Comment* (AFS): date confirms post Two Creeks (Greatlakean) age of Two Rivers till at its type locality which has not previously been dated.

Michigan

ISGS-948. Glenn Shores **>48,000**
$\delta^{13}C = -27.0‰$

Wood from Allegan Co, 2km SW of Glenn (42° 30.5′ N, 86° 15′ W), from gravel underlain and overlain by clay till. Coll 1981 and subm by Greg Gephart, Dept Geol, Michigan State Univ.

Alaska

ISGS-968. McBride Glacier Section **7430 ± 70**
$\delta^{13}C = -26.0‰$

Wood (spruce) from Glacier Bay National Park, 75km NNW of Gustavus (52° 02′ 24″ N, 136° 08′ 00″ W), from root of tree stump in breccia with thin soil. Coll 1981 and subm by R D Powell, Dept Geol, N Illinois Univ, DeKalb, Illinois. *Comment* (RDP): date agrees with other dates of Hypsithermal positions (McKenzie, 1976; Goldthwait, 1963, 1966). Farthest N date in Muir Inlet to be documented.

Venezuela

Old Beach Ridge Complex series

Conch shells from Nueva Esparta (10° 58′ to 59′ N, 64° 02′ to 03′ W). Coll 1978 to 1979 and subm by C S Alexander, Dept Geog, Univ Illinois.

ISGS-556. 3 Margarita **510 ± 70**

From 6km WSW of La Guardia, from base of coquina pedestal, ca 0.5m below surface.

ISGS-564. 2 Margarita **35,550 ± 660**

From 2km SW of La Guardia, from beach ridge gravel ca 2m below surface.

ISGS-611. M-1979-1 **32,840 ± 550**

From 0.5km SW of La Guardia, from fine sand-silt-clay deposit ca 0.3m below Coquina layer.

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[RADIOCARBON, VOL 28, NO. 1, 1986, P 134–140]

KÖLN RADIOCARBON DATES III

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The present list contains ^{14}C dates from archaeologic samples attributed to the European Mesolithic period from the typology of associated finds, especially microliths. Of these samples, 14 are from Germany and 6 from France.

Because of the older ages, natural preservation of ^{14}C samples *in situ* is generally poorer for the Mesolithic period than for younger periods. There are also higher risks of contamination and stratigraphic disturbance, eg, by bioturbation (Rolfsen, 1979, fig 2). Poorly conserved samples, especially those stored in museums, often have been treated with carbon-containing preservatives, sometimes without proper notes on quality or quantity of preservative agents used. Therefore, the number of successful ^{14}C dates from older periods is quite low. This problem was realized some time ago, and, on the initiative of JC Vogel, Pretoria, and H de Lumley, Marseille, a group devoted to dating Mesolithic and Paleolithic ^{14}C samples was launched in 1977 at the 10th Congress of INQUA at Birmingham.

For the Mesolithic period, there may be difficulties assigning archaeologic dates to samples. Microliths can occur both in Mesolithic and Neolithic layers. With few finds it might be difficult to distinguish Mesolithic from Neolithic layers, though. Taute (1973/74b, fig 8, 8–14, p 92) demonstrated seven types of microliths occurring both in well-established Mesolithic and Early Neolithic sites in southern Germany and Austria. Extensive investigations were made by researchers on discordant ^{14}C dates (Vaughan, ms; Olson, ms; *cf* also Evin, 1983) which include Mesolithic dates. A compilation of possible sources of discordant ^{14}C dates was published by Münnich (1958, 1961). We have included some obviously discordant ^{14}C dates into the present list, even if the reasons for the errors have not, as yet, been established, following suggestions given, eg, by Milojčić (1958, p 413; 1961, p 451) and Nader (1981).

Sample processing and dating procedures remain unchanged since our previous date list (Freundlich, Schwabedissen & Wendt, 1980).

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Germany

Sarching series

Samples from several Mesolithic settlement "compounds" (Wohnanlage), near Sarching, Kr Regensburg, Bavaria (12° 15′ N, 49° 1′ E). Sites

overlay aeolian sands covering lower terrace of Danube R (Schönweiss & Werner, 1974a, b). Coll and subm by W Schönweiss, Coburg.

KN-2517. Sarching 5.27 **2210 ± 50**

Fragments of wood charcoal from fireplace at ca 70cm below surface N of circular darkened spot in "Anlage 5", Sq 27. Assoc finds (Schönweiss & Werner, 1974 a, b, fig 14–18) correspond to shapes characteristic of Early Mesolithic periods, Beuronien A and B (Taute, 1973/74a; 1975). *Comment:* date does not agree with expected age. Sample material was apparently introduced from upper layers.

KN-2518. Sarching 5.20 **4230 ± 45**

Wood charcoal fragments from fireplace ca 70cm below surface in Sq 20 of "Anlage 5." *Comment:* same as KN-2517.

KN-2519. Sarching 8 **8890 ± 70**

Bone fragments from fireplace ca 70cm below surface in sand dune, belonging to one of several sites yielding many finds, in "Anlage 8, Atzenhof" (Schönweiss & Werner, 1974a). Assoc stone artifacts can possibly be attributed to Late Paleolithic (Schönweiss & Werner, 1974a, fig 3, 1–3) or Mesolithic periods, Beuronien A or B (Schönweiss & Werner, 1974a, fig 11 and 12), or Beuronien C (Schönweiss & Werner, 1974a, fig 4, 1–15). *Comment:* compared to dates from uppermost three levels, Beuronien B (Schicht 10) of Jägerhaushöhle/Kr Tuttlingen, Baden-Württemberg (B-946, 8840 ± 70) (Taute, 1980, p 18–19) and hitherto oldest Beuronien C date of Felsdach rock shelter, Inzigkofen/Kr Sigmaringen, Baden-Württemberg (B-935, 8720 ± 120), *cf* Taute (1980, p 18–19), this sample may well originate from Early Mesolithic period, Beuronien B.

Teverener Heide series

Wood charcoal from Mesolithic context on Teverener Heide/Scherpenseeler Denne near Teveren/Kr Heinsberg, Nordrhein-Westfalen (6° 6′ N, 50° 56′ E), excavated 1975/76 and subm by S K Arora, Rheinisches Landesmus, Bonn, Außenstelle Braunkohle, Lich-Steinstrass, Niederzier (Arora, 1978).

KN-2261. Teverener Heide 120-6-1 **8920 ± 80**

Wood charcoal from pit, 50cm below surface, surrounded by light, fine sand, assoc with artifacts belonging to Teverener Gruppe (latest early Atlantic period of West German Mesolithic Stufe IV, after Arora, 1976).

KN-2662. Teverener Heide 120-10-1 **8910 ± 80**

Wood charcoal from same layer as KN-2261. *Comment:* dates appear too old compared to dates from same period in Holland (Arora, 1976, note 80):

a) de Leien, Friesland prov, GrN-1567, 7700 ± 70 and GrN-685, 7150 ± 140 (Vogel & Waterbolk, 1963, p 176);

b) Duurswoude I, Friesland prov, GrN-1567, 7700 ± 70 (Vogel & Waterbolk, 1963, p 169);
c) Hatert, Gelderland prov, GrN-1607, 7670 ± 110 (Vogel & Waterbolk, 1963, p 174);
d) Oirschot V, Nordbrabant prov, GrN-1659, 8030 ± 50 and 6230 ± 60 (Vogel & Waterbolk, 1963, p 174).

KN-2899. Teverener Heide 213 **7510 ± 170**

Evenly distributed wood charcoal particles from layer 10 to 20cm depth, ca 50cm below surface, in sand dune. Assoc finds belong to Hambacher Gruppe (Stufe II of West German Mesolithic chronology, *cf* Arora, 1976) ranging from late Pre-boreal through early Boreal periods.

KN-2900. Teverener Heide 214 **7520 ± 240**

Wood charcoal from same layer as KN-2899.

KN-2901. Teverener Heide 172 **7490 ± 80**

Wood charcoal from same layer as KN-2899.

General Comment: ^{14}C dates do not correspond to archaeol assessment; dates for Hambacher Gruppe, archaeol assigned to late Pre-boreal through early Boreal periods, tend to suggest transitional Boreal/Atlantic period, instead. Hambacher dates also contradict Teverener Heide samples, which should be younger according to palynol results, although their ^{14}C dates come out older (*cf* KN-2261, -2262). Possibly, superficial sample layer was contaminated by younger materials.

KN-2999. Gustorf 8 **5420 ± 180**

Bone (*Bos primigenius*) from humic loam sediment found in former erosional creek ca 20cm below surface. Same site, Gustorf, Grevenbroich township, Kr Neuss, Nordrhein-Westfalen (6° 6′ N, 50° 56′ E) yielded numerous flint artifacts belonging to Hambacher Gruppe (Stufe II of West German Mesolithic chronology, *cf* Arora, 1976). Sample coll 1974 by S K Arora, Rheinisches Landesmus, Bonn. *Comment:* ^{14}C date is considerably too young; expected age was similar to KN-2899 to -2901. We learned only after analysis was finished that this bone sample had been preserved by impregnation in synthetic glue dispersion (polyvinyl acetate). Tentative correction for glue contaminant (all-synthetic material from petrochemicals) would render even younger date.

KN-I.329. Sedelsberg **4580 ± 60**

Wood charcoal from Mesolithic dune site, Sedelsberg (Flur 9, Flurstück 388/46), Scharrel/Oldenburg, Kr Cloppenburg, Niedersachsen (7° 44′ N, 53° 3′ E). Sample comes from bleached soil horizon, 50 to 80cm thick, with scattered charcoal particles and covered by 20 to 30cm heather-bearing type humic soil. Basal layer consists of bleached dune sand, partly layered by iron-hardened sand (bog-iron ore). Assoc artifacts include microliths, either trapezoid or with one oblique and one transverse truncation ("Trapezspitzen"), as flaked from regular blades classified as Late

Mesolithic (6th and 5th millennia BC), *cf* Steffens (1963b, fig 1). Sample coll and subm by H G Steffens, Staatliches Mus Naturkunde u Vorgeschichte, Oldenburg i O. *Comment:* ^{14}C date is much too young. Sample was either contaminated by younger materials or introduced from upper layers.

KN-I.683. Minstedt **8540 ± 60**

Charred hazelnut shells (*Corylus*) from Hinck's Weide III excavation on dune site, Minstedt, on banks of Oste R near Bremervörde/Kr Rotenburg/Wümme, Niedersachsen (9° 7′ N, 53° 26′ E). Two samples coll 1958 from excavation areas A and B by F W Franke, Bremervörde, and subm for H Schwabedissen. Samples date accompanying simple-shaped microliths, such as pieces with one transverse and one oblique truncation (Viereckspitzen), as well as right- (or blunt-) angular triangles, and micro-burins (Kerbreste), and two core-axes from area A (Franke, 1978, fig 3–6). These finds represent Early Mesolithic estimated to be "spät-Duvenseezeitlich" (see Comment, H Schwabedissen in Franke, 1978, p 239). *Comment:* date seems appropriate. Due to evidently low carbon content, both samples were combined for processing.

KN-2034. Grosse Ofnet-Höhle **7720 ± 80**

Bone fragments (remains of human skull) from one of two skull burial sites in Grosse Ofnet-Höhle cave on rim of Nördlinger Ries plain near Nördlingen/Kr Nördlingen, Bavaria (10° 28′ N, 48° 10′ E). Excavated 1908, by R R Schmidt and subm 1974 by G Glowatzki, Univ Bern, Switzerland. *Comment:* ^{14}C date suggests skull was buried between Early and Late Mesolithic periods, confirming attribution to Mesolithic period, based on archaeol reasons. Amino-acid racemization analysis (Bada, 1972; Bada & Schröder, 1975; Protsch, 1976) yielded considerably older date: 13,100 (!) ± 100 BP (UCLA-1783; Glowatzki & Protsch, 1973). This date has been legitimately criticized by Naber (1974). Two geometric microliths (one nearly equilateral triangle, one bluntly-angled isosceles triangle) assoc respectively with Skull 24 of Burial I and Skull 1 of Burial II (Schmidt, 1912), uniquely belong to Mesolithic period and can be dated archaeol later than 10,000 BP. Obviously limited value of amino-acid racemization dates is also demonstrated by extremely old date for Schellnecker Wänd, Mesolithic grave, near Neuessing, upper Altmühl R valley (Naber, 1973; Gerhardt & Naber, 1983; Gieseler, 1977): UCLA-1869, 18,200 ± 200 BP (Glowatzki & Protsch, 1974).

Taubried series

Chalky mud and silty gyttja loam sediment with relatively high carbon content, from Taubried II site, Bad Buchau/Kr Biberach, Baden-Württemberg (9° 37′ N, 48° 5′ E). Coll 1980 by F Herzig, subm by H Schlichtherle, Landesdenkmalamt Baden-Württemberg. Both samples come from two profile columns at ca 20cm from each other. They could be attributed to Boreal age by palynol and were linked stratigraphically to layer of hazelnuts (*Corylus*) which contained microliths of Early Mesolithic stage, Beuronien A/B (H Schlichtherle, pers commun). Find layer was imbedded in gyttja

loam sediment overlain by peat datable to Neolithic period (Schlichtherle, 1981, p 34).

KN-3071. Taubried II, col c, TaRC 2 **9370 ± 80**

Gyttja sediment sample underlying hazelnut (*Corylus*) layer, ca 70 to 75cm below surface.

KN-3072. Taubried II, col b, TaRC 6 **9300 ± 80**

Gyttja sediment sample from hazelnut layer, ca 70cm below surface.

General Comment: comparable date from Jägerhaushöhle cave on upper Danube R (Taute, 1980, p 18–19), cultural layer 13 (Beuronien A layer), B-948: 9600 ± 100, and cultural layer 10 (uppermost of three layers of Beuronien B type), B-946: 8840 ± 70.

France

Gramari series

Wood charcoal from Gramari site, Méthamis, Vaucluse (44° 01′ N, 5° 14′ E). Coll and subm 1967 by M Paccard, Velleron/Vaucluse. Site is open-air sta with extended Sauveterrian strat (Paccard, 1971).

KN-I.386. Gramari 3A, Layer 1 **8730 ± 60**

Wood charcoal from Level 3A, Layer 1; same as layer dated at Gif lab (Delibrias, Guillier & Labeyrie, 1971, p 219), Gif-262: 3420 ± 200, Gif-752: 7740 ± 190. *Comment:* Gif dates seem too young (Paccard, 1971, p 83). In their chronologic table, Livache and Paccard (1980, p 143) obviously place our Köln date in wrong position.

KN-I.387. Gramari 3B, Layer 2 **8830 ± 70**

Wood charcoal from Level 3B, Layer 2; to be compared to Gif date from same level, Layer 1 and 2, Gif-753: 8000 ± 190 (Delibrias, Guillier & Labeyrie, 1971, p 219; Paccard, 1971, p 83).

KN-I.389. Gramari 5 **9110 ± 150**

Wood charcoal from Level 5; *cf* Gif date from same level, Gif-755: 10,070 ± 230 (Paccard, 1971, p 83; Delibrias, Guillier & Labeyrie, 1971, p 219).

KN-I.390. Gramari 7 **9310 ± 60**

Wood charcoal from Level 7.

General Comment: Köln dates correspond to expected age and fit chronologic sequence.

KN-I.058. La Baume de Montclus **7670 ± 60**

Wood charcoal from La Baume de Montclus rock shelter, Montclus, Gard (44° 16′ N, 4° 26′ E). Coll and subm 1960 by M Escalon de Fonton, CNRS, Marseille. Sample coll ca 3m below surface. Layer 22A/Zone 5/AB

(Escalon de Fonton, 1966a, p 158, fig 66). Contents of layer are characteristic of Sauveterrian, *Sauveterrian-final* or middle Montclusian, according to Rozoy (1978). Some earlier Köln dates were revised (Freundlich, Schwabedissen & Wendt, 1980, p 68; Rozoy, 1978, p 285). Escalon de Fonton (1966b, p 50) quoted unrevised date, KN-58: 8130 ± 240. *Comment:* date agrees with Lyon dates from same layer, Ly-307: 7770 ± 410, wood charcoal, and Ly-308: 7750 ± 340, 1.5g collagen from 190g bone material (Delibrias, Guillier & Labeyrie, 1971, p 62; Delibrias *et al,* 1976, p 514).

KN-I.157. Abri des Boeufs **7060 ± 160**

Wood charcoal, Layer 2, Abri des Boeufs, 60cm depth, Roquefavour-la Plantade, Ventabren, Bouche-du-Rhône (43° 31′ N, 5° 18′ E). Coll 1950 and subm by M Escalon de Fonton, CNRS, Marseille. Assoc finds consisted of Early Mesolithic period (Montadian), *cf* Escalon de Fonton (1956, p 34–40). *Comment:* date is too young, *cf* other dates of final Montadian, Fos-sur-Mer, Le Mourre Poussiou, Bouche-du-Rhône, Ly-706: 8980 ± 200 (Evin, Marien & Pachiaudi, 1975, p 22) and La Baume Longue, Ponteau, Martigues, MC-591: 9780 ± 200; *cf* Escalon de Fonton (1976, p 1371).

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UNIVERSITY OF LUND RADIOCARBON DATES XVIII

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INTRODUCTION

Most of the ^{14}C measurements reported here were made between October 1983 and October 1984. Equipment, measurement, and treatment of samples are as reported previously (R, 1968, v 10, p 36–37; 1976, v 18, p 290; 1980, v 22, p 1045).

Age calculations are based on a contemporary value equal to 95‰ of the activity of NBS oxalic acid standard (No. 4990A) and on the conventional half-life for ^{14}C of 5568 yr. Results are reported in years before 1950 (years BP). Errors quoted with the dates are based on counting statistics alone and are equivalent to ± 1 standard deviation ($\pm\sigma$).

Corrections for deviations from $\delta^{13}C = -25.0‰$ in the PDB scale are applied for all samples; also for marine shells. The apparent age for marine material due to the reservoir effect must be subtracted from our dates on such samples.

The remark "undersized; diluted," in *Comments* means the sample did not produce enough CO_2 to fill the counter to normal pressure and "dead" CO_2 from anthracite was introduced to make up the pressure. "‰ sample" indicates amount of CO_2 derived from the sample present in the diluted counting gas; the rest is "dead" CO_2. Organic carbon content reported for bone samples is calculated from yield of CO_2 by combustion of gelatine remaining after treatment. Organic carbon lost during treatment is not included in calculated percentage.

The description of each sample is based on information provided by the submitter.

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GEOLOGIC SAMPLES

Sweden

Eastern Småland series

Sediment and coarse organic matter (>0.25mm) from lakes Bergakyllen (57° 11′ N, 16° 08′ E), Skvarran (57° 12′ N, 16° 09′ E), Stensjön (57° 12′ N, 16° 17′ E), and Bastgöl (57° 13′ N, 16° 19′ E), Kalmar län, E Småland. Coll March 1983 and subm by N-O Svensson, Dept Quaternary Geol, Univ Lund. Dated as part of study of Late Weichselian and Early Holocene shore displacement in E Småland. Depths refer to sediment surface. Samples

were taken with Russian-type corer, diam 10cm. All samples pretreated with HCl. Lu-2172 received additional treatment with NaOH and soluble fraction was dated separately.

Bergakyllen

Lu-2171. Bergakyllen 1 — **10,620 ± 130**; $\delta^{13}C = -28.1‰$

Coarse organic matter, mainly water moss, depth 675cm, just above isolation level. *Comment:* sample undersized; diluted; 52‰ sample. (3 1-day counts.)

Lu-2172. Bergakyllen 4, insoluble — **11,360 ± 100**; $\delta^{13}C = -26.1‰$

Insoluble fraction of muddy clay, <0.3mm, depth 675cm.

Lu-2172A. Bergakyllen 4, soluble — **11,260 ± 100**; $\delta^{13}C = -26.4‰$

Acid-precipitated part of NaOH-soluble fraction, depth 675cm.

Lu-2173. Bergakyllen 2 — **10,460 ± 90**; $\delta^{13}C = -27.0‰$

Clay gyttja, depth 665cm.

Lu-2174. Bergakyllen 3 — **9710 ± 90**; $\delta^{13}C = -26.5‰$

Clay gyttja, depth 645cm.

Skvarran

Lu-2175. Skvarran 1 — **11,610 ± 100**; $\delta^{13}C = -21.1‰$

Clay gyttja, depth 438cm, just above isolation level.

Lu-2176. Skvarran 2 — **10,920 ± 100**; $\delta^{13}C = -23.0‰$

Clay gyttja, depth 426cm, ca 15cm above isolation level.

Lu-2177. Skvarran 4 — **10,150 ± 90**; $\delta^{13}C = -22.6‰$

Clay gyttja, depth 409cm, ca 30cm above isolation level.

Stensjön

Lu-2178. Stensjön 1 — **10,720 ± 100**; $\delta^{13}C = -24.0‰$

Clay gyttja, depth 437cm, just above isolation level.

9850 ± 90

Lu-2179. Stensjön 2 $\delta^{13}C = -27.2‰$

Muddy clay, depth 433cm. *Comment:* no clear indication of carbonate in this sample.

Bastgöl

9840 ± 90

Lu-2180. Bastgöl 1 $\delta^{13}C = -24.1‰$

Clay gyttja, depth 387cm.

9610 ± 90

Lu-2181. Bastgöl 2 $\delta^{13}C = -25.3‰$

Fine detritus gyttja, depth 358cm, just below lower *Ancylus* transgression level. *Comment:* no clear indication of carbonate in this sample.

General Comment: acid treatment revealed carbonate in most samples.

>41,000

Lu-2210. Dösebacka 1983 $\delta^{13}C = -26.5‰$

Silt with 1.4‰ organic carbon content from lens-shaped deposit, 75cm thick, overlain by glaciofluvial material A4 (Hillefors, 1969, p 40–52) and underlain by till ("Mammoth level") at Dösebacka gravel pit (55° 37′ N, 13° 04′ E), 3km NNE of Kungälv, Bohuslän. Coll Aug 1983 and subm by Å Hillefors, Dept Phys Geog, Univ Göteborg. *Comment:* no pretreatment. (4 1-day counts.)

Central Halland Series I

Sediment, water moss, and mollusk and barnacle shells from lakes Valingesjön (57° 10′ 30″ N, 12° 23′ 45″ E), alt 30m, Kalvsjön (57° 05′ 30″ N, 12° 32′ 30″ E), alt 63m, Lillsjön (57° 05′ 20″ N, 12° 31′ 40″ E), alt 80m, and Grimsjön (57° 06′ 45″ N, 12° 28′ 30″ E), alt 56m, Central Halland. Coll Feb 1983 and Feb 1984 (Valingesjön) and subm by S Björck and G Digerfeldt, Dept Quaternary Geol, Univ Lund. Dating is part of study of Late Weichselian biostratigraphy, magnetostratigraphy, and relative sea-level changes at Swedish coast. Sediment samples were taken with Livingstone sampler, diam 10cm. Moss and mollusk and barnacle shells were washed from same level of several sediment cores from each sampling point. Depths refer to sediment surface. Chronozones are according to Mangerud *et al* (1974).

Valingesjön

Water depth 1.8m at sampling point.

13,150 ± 120

Lu-2343. Valingesjön 1, 1620 to 1760cm $\delta^{13}C = \pm 0.0‰$

Small shells and fragments (*Hiatella arctica, Mytilus edulis, Balanus balanus, Macoma calcarea,* and *Portlandia arctica*) from sandy, silty clay. Bølling chronozone. *Comment:* outer 12‰ removed by acid leaching. Sample undersized; diluted, 78‰ sample. (3 1-day counts.)

12,680 ± 110

Lu-2344. Valingesjön 2, 1445 to 1520cm $\delta^{13}C = -0.6‰$

Small shells and fragments (*Mytilus edulis, Balanus balanus, Hiatella arctica,* and *Portlandia arctica*) from silty clay. Bølling chronozone. *Comment:* outer 30‰ removed by acid leaching.

Kalvsjön

Water depth 3.3m at sampling point.

12,210 ± 320

Lu-2246. Kalvsjön, 231 to 233cm $\delta^{13}C = -30.9‰$

Water moss from sediment, transition Older Dryas/Allerød chronozone. *Comment:* no pretreatment; small sample; diluted; 15‰ sample. (6 1-day counts.) Burned at <650°C to avoid pyrolysis of carbonates that may be present in untreated samples.

11,070 ± 250

Lu-2247. Kalvsjön, 220 to 222cm $\delta^{13}C = -29.2‰$

Water moss from sediment, Allerød chronozone. *Comment:* no pretreatment; small sample; diluted; 18‰ sample. (5 1-day counts.) Burned at <650°C.

Lillsjön

Water depth 450cm at sampling point. All samples pretreated with HCl.

12,000 ± 100

Lu-2236. Lillsjön, 425 to 430cm $\delta^{13}C = -24.9‰$

Muddy clay. *Comment:* sample undersized; diluted; 73‰ sample. (3 1-day counts.)

11,880 ± 120

Lu-2238. Lillsjön, 416 to 421cm $\delta^{13}C = -25.1‰$

Clay gyttja. *Comment:* sample undersized; diluted; 86‰ sample.

10,930 ± 100

Lu-2237. Lillsjön, 406.5 to 411.5cm $\delta^{13}C = -25.8‰$

Clay gyttja.

Grimsjön

Water depth 330cm at sampling point.

12,490 ± 190

Lu-2245. Grimsjön, 233 to 237cm $\delta^{13}C = -31.7‰$

Water moss, probably Older Dryas/Bølling chronozone. *Comment:* no pretreatment; small sample; diluted; 40‰ sample. (3 1-day counts.) Burned at <600°C to avoid pyrolysis of carbonates that may be present in untreated samples.

9800 ± 230

Lu-2266. Halsjön 8 $\delta^{13}C = -27.7‰$

Water moss washed from sediment from Lake Halsjön (56° 14′ N, 15° 19′ E), central Blekinge. Sample from top of Layer 1 in Core I, ca 4.8m below mire surface, corresponding to Layer 2 in Core II (Björck, 1979, p 80–88; 1981, p 33). Coll Aug 1983 and subm by S Björck. Dated as complement to previous dates from Halsjön (R, 1980, v 22, p 1049). *Comment:* no pretreatment; sample undersized; diluted; 22‰ sample. (3 1-day counts.)

Vasasjön series

Peat and gyttja from ancient Vasasjön, ca 4km N of Sövestad, S Scania (55° 32.2′ N, 13° 48.3′ E). Coll 1983 and subm by M Hjelmroos, Dept Quaternary Geol, Univ Lund. Dated as part of study of local vegetational changes during last 6000 yr in Ystad area. For other dates from same site, see R, 1983, v 25, p 880 (Baldringe series). Depths given are below present surface.

3860 ± 60

Lu-2282. Vasasjön 1, 254 to 259cm $\delta^{13}C = -29.8‰$

Highly humified brushwood peat. *Fagus* pollen percentage decreasing. *Comment:* pretreated with HCl.

3640 ± 60

Lu-2283. Vasasjön 2, 338 to 343cm $\delta^{13}C = -29.4‰$

Moderately humified brushwood peat. Increase of *Fagus* and cereal pollen percentages. *Comment:* pretreated with HCl and NaOH; charred in nitrogen atmosphere before burning.

5270 ± 60

Lu-2284. Vasasjön 3, 469 to 471cm $\delta^{13}C = -32.2‰$

Gyttja. Decrease of *Ulmus* pollen percentage. *Comment:* pretreated with HCl.

Dags Mosse Series III

Peat from S part of mosse, SW of Lake Tåkern, Östergötland (58° 19.5′ N, 14° 42′ E). Coll May 1982 by H Göransson and T Persson; subm by H Göransson, Dept Quaternary Geol, Univ Lund. Dated as complement to Dags Mosse Series I and II (R, 1983, v 25, p 877–880; 1984, v 26, p 393–394). Depths refer to present bog surface. All samples pretreated with HCl and charred in nitrogen atmosphere before burning. Pollen zones according to Göransson (1977, p 36–43).

6840 ± 70

Lu-2336. Dags Mosse, 425 to 430cm $\delta^{13}C = -29.4‰$

Muddy *Phragmites* peat. *Tilia-Quercus-Ulmus* sub-zone of *Quercus-Pinus* pollen assemblage zone (Atlantic time).

6380 ± 70

Lu-2337. Dags Mosse, 400 to 405cm $\delta^{13}C = -28.7‰$

Muddy *Phragmites* peat. Same pollen sub-zone as Lu-2336, above.

6350 ± 70

Lu-2370. Dags Mosse, 380 to 385cm $\delta^{13}C = -29.8‰$

Radicel (*Thelypteris-Phragmites*) peat. Same pollen sub-zone as Lu-2336 and -2337.

6210 ± 70

Lu-2369. Dags Mosse, 360 to 365cm $\delta^{13}C = -29.1‰$

Radicel peat. Same pollen sub-zone as preceding samples.

5950 ± 70

Lu-2368. Dags Mosse, 340 to 345cm $\delta^{13}C = -28.7‰$

Radicel peat. Same pollen sub-zone as preceding samples.

5750 ± 70

Lu-2367. Dags Mosse, 320 to 325cm $\delta^{13}C = -27.7‰$

Radicel peat. Same pollen sub-zone as preceding samples.

5340 ± 60

Lu-2366. Dags Mosse, 300 to 305cm $\delta^{13}C = -28.4‰$

Radicel peat. Same pollen sub-zone as preceding samples.

3710 ± 60

Lu-2278. Dags Mosse, 280 to 287cm $\delta^{13}C = -27.8‰$

Sphagnum peat from very end of *Quercus-Tilia-Ulmus* sub-zone of *Quercus-Pinus* pollen assemblage zone.

3360 ± 60

Lu-2279. Dags Mosse, 266 to 274cm $\delta^{13}C = -27.9‰$

Sphagnum peat. Transition *Quercus-Tilia-Ulmus/ Quercus-Tilia* sub-zones.

3180 ± 50

Lu-2267. Dags Mosse, 244 to 247cm $\delta^{13}C = -27.3‰$

Sphagnum peat. Almost same pollen spectrum as for Lu-2279, above.

2830 ± 50

Lu-2268. Dags Mosse, 233.5 to 236.5cm $\delta^{13}C = -27.5‰$

Sphagnum peat. *Quercus-Tilia* sub-zone of *Quercus-Pinus* pollen assemblage zone.

2780 ± 50

Lu-2269. Dags Mosse, 223.5 to 226.5cm $\delta^{13}C = -27.1‰$

Sphagnum peat. Same pollen sub-zone as Lu-2268, above. Increasing pollen percentage of *Fraxinus; Carpinus* 0.5‰

2690 ± 50

Lu-2270. Dags Mosse, 218.5 to 221.5cm $\delta^{13}C = -26.5‰$

Sphagnum peat. Same pollen sub-zone as Lu-2268, above.

2380 ± 60

Lu-2271. Dags Mosse, 208.5 to 211.5cm $\delta^{13}C = -26.4‰$

Sphagnum peat. *Fraxinus* pollen 1.1‰.

2290 ± 50

Lu-2272. Dags Mosse, 203.5 to 206.5cm $\delta^{13}C = -25.9‰$

Sphagnum peat. Upper part of *Quercus-Tilia* sub-zone of *Quercus-Pinus* pollen assemblage zone. *Fraxinus* pollen 1.1‰.

2220 ± 50

Lu-2273. Dags Mosse, 198.5 to 201.5cm $\delta^{13}C = -26.2‰$

Sphagnum peat. Uppermost part of *Quercus-Pinus* pollen assemblage zone. Decrease of *Quercetum Mixtum* pollen percentage; *Picea* pollen increasing to 0.4‰.

2000 ± 50

Lu-2274. Dags Mosse, 193.5 to 196.5cm $\delta^{13}C = -26.5‰$

Sphagnum-Eriophorum vaginatum peat. Transition *Quercus-Pinus/Picea* pollen assemblage zone. Rational *Picea* limit. High percentage of *Plantago lanceolata* pollen.

1900 ± 50

Lu-2275. Dags Mosse, 188.5 to 191.5cm $\delta^{13}C = -26.7‰$

Sphagnum-Eriophorum vaginatum peat. Lowermost part of *Picea* pollen assemblage zone. *Picea* pollen percentage increasing to 2‰. *Carpinus* increasing to 1.6‰.

1670 ± 50

Lu-2276. Dags Mosse, 178.5 to 181.5cm $\delta^{13}C = -26.6‰$

Eriophorum vaginatum peat. Lower part of *Picea* pollen assemblage zone. *Picea* pollen 3.2‰; high percentages of *Plantago lanceolata* and cereal pollen.

1600 ± 50

Lu-2277. Dags Mosse, 175 to 177cm $\delta^{13}C = -27.2‰$

Eriophorum vaginatum peat. *Picea-Quercus* sub-zone of *Picea* pollen assemblage zone. Increase of *Rumex acetosella* pollen percentage; 1st find of *Secale* pollen.

1540 ± 45

Lu-2288. Dags Mosse, 171.5 to 178.5cm $\delta^{13}C = -27.6‰$

Sphagnum peat. *Picea* pollen assemblage zone.

1120 ± 45

Lu-2355. Dags Mosse, 164 to 171cm $\delta^{13}C = -27.5‰$

Sphagnum peat. *Picea* pollen assemblage zone.

1050 ± 70

Lu-2289. Dags Mosse, 156.5 to 163.5cm $\delta^{13}C = -27.5‰$

Sphagnum peat. Increase of *Betula* and decrease of *Pinus* pollen percentages. Two pollen grains of *Secale. Comment:* sample undersized; diluted; 47‰ sample.

1110 ± 45

Lu-2290. Dags Mosse, 146.5 to 153.5cm $\delta^{13}C = -27.0‰$

Sphagnum peat. Beginning decrease of *Alnus* pollen percentage.

990 ± 60

Lu-2291. Dags Mosse, 140 to 145cm $\delta^{13}C = -26.6‰$

Sphagnum peat. Continuing decrease of *Alnus* pollen percentage; max of *Picea* pollen (10.6‰). *Comment:* sample undersized; diluted; 62‰ sample.

980 ± 50

Lu-2292. Dags Mosse, 131.5 to 138.5cm $\delta^{13}C = -26.3‰$

Sphagnum peat. Absolute min in *Alnus* pollen curve. *Comment:* sample undersized; diluted; 77‰ sample.

990 ± 45

Lu-2293. Dags Mosse, 121.5 to 128.5cm $\delta^{13}C = -26.6‰$

Sphagnum peat. Increase of *Alnus* pollen percentage; max in pollen curves for *Betula* and *Tilia.*

820 ± 50

Lu-2294. Dags Mosse, 101.5 to 108.5cm $\delta^{13}C = -26.5‰$

Sphagnum peat. Beginning of Cannabaceae pollen curve. *Comment:* sample undersized; diluted; 83‰ sample.

720 ± 60

Lu-2295. Dags Mosse, 94 to 101.5cm $\delta^{13}C = -26.6‰$

Sphagnum peat. *Comment:* sample undersized; diluted; 56‰ sample.

880 ± 45

Lu-2356. Dags Mosse, 93 to 95cm $\delta^{13}C = -26.7‰$

Sphagnum peat. Upper part of *Picea-Quercus* sub-zone of *Picea* pollen assemblage zone.

Övre Örevattnet series

Sediment from Övre Örevattnet, 6.5km ESE of Hålanda, Västergötland (58° 02′ N, 12° 24′ E), alt 145m. Coll Feb 1983 by K Svedhage, Dept Geol, Univ Göteborg; subm by S Björck. Dated as part of study of Late

Weichselian shore displacement in Västergötland. Sediment core taken with Russian sampler. All samples except Lu-2360 and -2361 undersized; diluted. Amount of CO_2 from sample is given in *Comments* as "‰ sample." All samples pretreated with HCl. Depths refer to sediment surface.

11,940 ± 140
Lu-2264. Övre Örevattnet 2 $\delta^{13}C = -24.8‰$

Muddy clay, 327 to 332cm. Max in *Empetrum* pollen curve. *Comment:* 71‰ sample.

11,440 ± 150
Lu-2358. Övre Örevattnet 3 $\delta^{13}C = -25.4‰$

Muddy clay, 324 to 327cm. *Artemisia* pollen percentage increasing. *Comment:* 58‰ sample.

10,890 ± 130
Lu-2359. Övre Örevattnet 4 $\delta^{13}C = -25.9‰$

Clay gyttja, 317 to 320cm. Max in *Artemisia* pollen curve. *Comment:* 68‰ sample.

10,240 ± 110
Lu-2265. Övre Örevattnet 5 $\delta^{13}C = -24.7‰$

Clay gyttja, 310 to 313cm. *Empetrum* pollen percentage increasing. *Comment:* 76‰ sample.

9880 ± 100
Lu-2360. Övre Örevattnet 6 $\delta^{13}C = -26.4‰$

Gyttja, 305 to 308cm. Max in *Juniperus* pollen curve.

9230 ± 90
Lu-2361. Övre Örevattnet 7 $\delta^{13}C = -28.5‰$

Gyttja, 295 to 298cm. Beginning of continuous *Corylus* pollen curve (C°).

8550 ± 120
Lu-2362. Övre Örevattnet 8 $\delta^{13}C = -30.1‰$

Gyttja, 267 to 270cm. Beginning of continuous *Alnus* pollen curve (A°). *Comment:* 92‰ sample.

Store mosse series

Peat, Småland (57° 14′ 30″ N, 13° 56′ E). Coll 1982 and 1983 and subm by Göran Svensson, Dept Plant Ecol, Univ Lund. Results of study of recent vegetation at Store mosse pub by Svensson (1965). Dating is part of study of Holocene development of bog vegetation in area. Samples pooled from corresponding levels in 2 cores from each coring point taken with Russian sampler. Depths given below refer to bog surface. Degree of humification is given in scale from H1 (no humification) to H10 (almost completely humified). All samples pretreated with HCl and charred in nitrogen atmosphere before burning.

2340 ± 50

Lu-2308. Store mosse 1, 148 to 150cm $\delta^{13}C = -26.8‰$

Sphagnum peat, H 7, Coring Point 9:82. Sample taken 4cm above highly humified brushwood peat.

770 ± 45

Lu-2309. Store mosse 2, 165 to 168cm $\delta^{13}C = -26.7‰$

Sphagnum peat, H 3, Coring Point 7:82. Sample taken 4cm above transition *Carex-Sphagnum/Sphagnum* peat.

2310 ± 50

Lu-2310. Store mosse 3, 280 to 283cm $\delta^{13}C = -27.0‰$

Sphagnum peat, H 6, Coring Point 7:82. Sample taken 5cm above transition brushwood/*Sphagnum* peat.

3900 ± 60

Lu-2311. Store mosse 4, 340 to 343cm $\delta^{13}C = -27.1‰$

Sphagnum peat, H 7 to 8, Coring Point St 1.

1170 ± 45

Lu-2312. Store mosse 5, 179 to 183cm $\delta^{13}C = -26.2‰$

Sphagnum peat, H 4, Coring Point 5:82. Sample taken 1cm above highly humified peat layer.

1390 ± 45

Lu-2313. Store mosse 6, 205 to 208cm $\delta^{13}C = -27.8‰$

Sphagnum peat (*S cuspidatum*), H 5 to 6, Coring Point 5:82. Sample taken 22cm below highly humified peat layer.

2430 ± 50

Lu-2314. Store mosse 7, 280 to 283cm $\delta^{13}C = -26.9‰$

Sphagnum peat, H 4, Coring Point 5:82.

2800 ± 60

Lu-2315. Store mosse 8, 372 to 374cm $\delta^{13}C = -26.7‰$

Sphagnum peat, H 3 to 4, Coring Point 5:82. Sample taken 1cm above brushwood peat with abundant *Eriophorum vaginatum* fibers.

240 ± 45

Lu-2316. Store mosse 9, 108 to 114cm $\delta^{13}C = -26.8‰$

Sphagnum peat, H 2, Coring Point 24:82. Sample underlain by brushwood peat rich in *Eriophorum vaginatum* fibers.

810 ± 50

Lu-2317. Store mosse 10, 152 to 155cm $\delta^{13}C = -26.8‰$

Sphagnum peat (*S magellanicum*), H 3, Coring Point 22:82. Sample taken 1cm above highly humified peat layer with *Eriophorum vaginatum*. *Comment:* sample undersized; diluted; 85‰ sample.

1120 ± 45

Lu-2318. Store mosse 11, 175 to 178cm $\delta^{13}C = -26.1‰$

Sphagnum peat, H 7 to 8, Coring Point 18:82. Sample taken 1cm above very highly humified peat layer.

6830 ± 70

Lu-2319. Store mosse 12, 515 to 518cm $\delta^{13}C = -26.2‰$

Sphagnum peat, H 6, Coring Point Bj:83.

Southern Baltic series

Wood from 2 firmly rooted tree stumps from bottom of S Baltic Sea at water depth 13 to 14m, 3.5km N of Vitemölla (55° 43.9′ N, 14° 12.5′ E). Coll May 1983 by L Hansen and Malmö Sport Diving Club; subm by T Persson, Dept Quaternary Geol, Univ Lund. Peat samples for pollen analysis were taken beneath one stump (Lu-2341) and at 3 nearby points. For other dates from S Baltic, see R, 1982, v 24, p 197–198. Pretreated with HCl and NaOH.

9450 ± 90

Lu-2341. Southern Baltic 9 $\delta^{13}C = -27.0‰$

Wood from ca 40 thin outer tree rings of stump with 95 to 100 tree rings. Wood Sample No. 1, Proj Lövdalen.

9590 ± 90

Lu-2342. Southern Baltic 10 $\delta^{13}C = -26.6‰$

Wood from ca 25 tree rings of stump with 90 to 100 remaining tree rings. Outermost ca 20 rings were ill-preserved and were removed before wood was taken for dating. Wood Sample No. 2, Proj Lövdalen.

290 ± 70

Lu-2297. Flohus 1 $\delta^{13}C = -26.4‰$

Wood chips, bark fragments, and seeds from clayey sediment ca 3m below present surface, underlain by sandy gravel and overlain by sand, W of Västra Sönnarslöv, (56° 05′ N, 13° 05′ E), NW Scania, alt ca 50m. Coll May 1983 and subm by G Lemdahl, Dept Quaternary Geol, Univ Lund. Pretreated with HCl and NaOH. *Comment:* dated material apparently not in primary position. (1-day count.)

420 ± 45

Lu-2307. Holmby $\delta^{13}C = -25.8‰$

Large charcoal pieces (*Salix* or *Populus*) id by T Bartholin, from charcoal layer in aeolian sand in gravel pit 500m E of Holmby church, Scania (55° 44′ 55″ N, 13° 24′ 45″ E). Charcoal layer 120 to 128cm below present surface, 2 to 10cm above fossil ground surface, and underlain by aeolian sand. Coll Jan 1984 and subm by R Åhman, Dept Phys Geog, Univ Lund. Pretreated with HCl and NaOH.

Iceland

Icelandic Subfossil Marine Shell Series III

Marine bivalve and balanid shells from SW Iceland. Coll 1983 by O Ingolfsson; subm by C Hjort, Dept Quaternary Geol, Univ Lund. Dated as complement to Icelandic Subfossil Marine Shell Series I and II (R, 1983, v 25, p 882; 1984, v 26, p 398–399).

Lu-2338. Heynes 1 **11,430 ± 140**
$\delta^{13}C = +0.7‰$

Shells (*Hiatella arctica, Macoma calcarea, Balanus balanus*) from lowest part of silt layer, +2 to 3m, overlaying bedrock with glacial striation at Heynes, N shore of Hvalfjördur, SW Iceland (64° 18′ N, 22° 00′ W). *Comment:* outer 8‰ removed by acid leaching. Sample undersized; diluted; 65‰ sample.

Lu-2339. Gröf 2 **12,840 ± 110**
$\delta^{13}C = +0.1‰$

Large shall fragments (*Hiatella arctica*) from silt, ca +5m, overlain by delta sediment and till at Gröf, N shore of Hvalfjördur, SW Iceland (64° 20′ N, 21° 50′ W). *Comment:* outer 44‰ removed by acid leaching.

Lu-2340. Arkarlakur 1 **11,350 ± 100**
$\delta^{13}C = +0.7‰$

Shells and fragments (*Hiatella arctica, Mya truncata, Macoma calcarea*) from till, ca +3m, at Arkarlakur, Leiruvogur, N of Akrafjeld, SW Iceland (64° 22′ N, 21° 55′ W). *Comment:* outer 22‰ removed by acid leaching.

General Comment: corrections for deviations from $\delta^{13}C = -25‰$ PDB are applied. No corrections are made for reservoir age of living marine mollusks. Reservoir age for waters of Iceland pub by Håkansson (1983b).

Switzerland

Lu-2332. Blécheins **5830 ± 70**
$\delta^{13}C = -23.8‰$

Wood from outer ca 30 tree rings from piece of wood from glacial deposit S of Geneva (46° 07′ 01″ N, 6° 07′ 32″ E). Coll 1984 and subm by G Amberger, Service cantonal géol, Geneva. *Comment:* pretreated with HCl and NaOH.

Poland

Lu-2296. Suszek bog **11,810 ± 140**
$\delta^{13}C = -27.8‰$

Drift peat from basal layer in kettle basin, 12.7m below bog surface, overlain by gyttja and peat, E of Chojnice (53° 43′ N, 17° 46.5′ E). Coll Sept 1983 by G Miotk and B Adamczak; subm by M Adamczak, Biol Inst, Univ Toruń. *Comment:* no pretreatment; sample undersized; diluted; 69‰ sample.

Czechoslovakia

Bobrov series (II)

Peat and mud from calcitrophic spring mire, 2km NE of Bobrov village near Dolný Kubín, NE Czechoslovakia (49° 27′ N, 19° 34′ E). Coll Sept 1971 by E and K Rybníček; subm by E Rybníčková, Bot Inst, Czechoslovak Acad Sci, Brno. Dated as complement to Bobrov series (R, 1982, v 24, p 200–201). All samples pretreated with HCl. Depths refer to present bog surface. Pollen zones after Firbas (1949).

Lu-2219. Bobrov OK-1-B, 209 to 213cm **10,150 ± 90** $\delta^{13}C = -23.8‰$

Fen-mud with high content of clay and sand. End of Younger Dryas and beginning of Pre-boreal.

Lu-2220. Bobrov OK-1-B, 65 to 70cm **6450 ± 70** $\delta^{13}C = -28.2‰$

Fen-peat. Late part of Pollen Zone AT VII.

Lu-2221. Bobrov OK-1-B, 45cm **2650 ± 50** $\delta^{13}C = -26.9‰$

Fen-peat with small Ca content. Transition SB VIII/SA IX.

Lu-2222. Bobrov OK-1-B, 21 to 23cm **360 ± 45** $\delta^{13}C = -27.1‰$

Fen-peat. Beginning of Pollen Zone SA X. *Comment:* sample probably contaminated by recent roots or humic material.

Lu-2285. „Sivárňa" **11,340 ± 100** $\delta^{13}C = -27.5‰$

Peat with seeds of *Pinus cembra* from bog at „Sivárňa" near village Vyšné Ružbachy, Slovakia (49° 20′ N, 20° 36′ E), alt ca 600m. Coll Oct 1983 and subm by V Jankovska, Ústav experimentální fytotech, Československá akad věd, Brno. Important for study of late-glacial distribution of *Pinus cembra* and reconstruction of forestation of Carpathian Basins at end of glacial period. Pretreated with HCl.

Bulgaria

Lake Blatniza Series I

Sediment and mollusk shells from Lagoon-lake Blatniza (+4m), E shore of Black Sea, NE Bulgaria (43° 15′ 04″ N, 28° 23′ 02″ E). Coll Aug 1982 by E Bozilova, Biol Fac, Univ Sofia; subm by B Berglund. Dating is part of palaeoecol study belonging to IGCP Sub-proj 158B (Berglund, 1979). Depths refer to sediment surface.

4020 ± 60

Lu-2241. Lake Blatniza, 320 to 340 cm $\delta^{13}C = -24.8‰$

Detritus gyttja rich in shells of small mollusks. Sample aggregated from 3 core pieces, diam ca 2.5cm, from same level. *Comment:* mollusk shells and other carbonates, if present, were completely removed by HCl pretreatment.

4090 ± 60

Lu-2242. Lake Blatniza, 340 to 360cm $\delta^{13}C = -25.1‰$

Peaty gyttja with some small mollusk shells. Sample aggregated from 2 core pieces, diam ca 2.5cm, from same level. *Comment:* pretreated with HCl in same way as Lu-2241, above.

4580 ± 60

Lu-2243. Lake Blatniza, 260 to 280cm $\delta^{13}C = -1.2‰$

Small mollusk shells (mostly *Cardium edule*) separated from sandy peat (*Phragmites,* Cyperaceae, *Calystegia*) rich in shells. *Comment:* outer 30‰ of shells removed by acid leaching.

5300 ± 60

Lu-2244. Lake Blatniza, 480 to 500cm $\delta^{13}C = -25.7‰$

Clay gyttja with small mollusk shells. *Comment:* sample pretreated with HCl in same way as Lu-2241, above.

Tunisia

Bahiret El Biban series

Oolites from deposits near beach at Bahiret El Biban, Tunisia (33° 18′ N, 11° 07′ E). Coll Oct 1983 and subm by A Strasser, Dept Geol, Univ Geneva, Switzerland. Dated to determine if oolites were formed *in situ* or were reworked from older sediments. No pretreatment.

4760 ± 60

Lu-2280. Tunisia T 47 $\delta^{13}C = +3.4‰$

Oolites from shallow sub-tidal deposit, 150m from beach.

4750 ± 60

Lu-2281. Tunisia T 78 $\delta^{13}C = +4.2‰$

Oolites from ancient coastal dune, 120m from beach.

Canada

1820 ± 50

Lu-2335. Farrent Island $\delta^{13}C = -25.2‰$

Basal wood (*Thuja plicata* or *Chamaecyperis nootkatensis,* id by N Malmer) from sloping fen on Farrent I., 110km SSE of Prince Rupert, British Columbia (53° 22′ N, 129° 25′ W). Sample in contact with mineral soil at base of peat layer, depth 85cm, exposed by erosion and mainly consisting of

highly humified *Sphagnum* peat. Coll July 1983 and subm by N Malmer, Dept Plant Ecol, Univ Lund. Pretreated with HCl and NaOH.

ARCHAEOLOGIC SAMPLES

Sweden

Skateholm Series IV

Charcoal and sediment from settlement area (Ertebølle culture) at Skateholm, Tullstorp parish, S Scania (55° 23′ 10″ N, 13° 29′ E). Coll 1982 and 1983 by L Larsson, H Göransson, and T Persson; subm by L Larsson, Inst Archaeol, Univ Lund, and H Göransson. Dated as complement to Skateholm Series I, II, and III (R, 1982, v 24, p 205–206; 1983, v 25, p 887; 1984, v 26, p 405–406).

Lu-2229. Skateholm I, Anl 98 and 100 **5640 ± 60** $\delta^{13}C = -25.0‰$

Charcoal from Structures 98 and 100, assoc with flint implements. *Comment:* mild pretreatment with NaOH and HCl.

Lu-2347. Skateholm I, Grave 43 **6180 ± 70** $\delta^{13}C = -25.1‰$

Charcoal from Grave 43 (Larsson, 1983; 1984, p 13, fig 6). *Comment:* normal pretreatment with HCl and NaOH.

Lu-2349. Skateholm, P 1, insoluble **5760 ± 70** $\delta^{13}C = -27.2‰$

Gyttja from level 122.25 to 125.75cm in trench for pollen sampling, 38cm below base of transgression deposits (Järavallen). For information about earlier studies of deposits below Järavallen at Skateholm, see Nilsson (1935, p 453–455, Pl VI:22). *Comment:* pretreated with HCl and NaOH.

Lu-2349A. P 1, soluble **5500 ± 60** $\delta^{13}C = -27.2‰$

Acid-precipitated part of NaOH-soluble fraction from Lu-2349.

Lu-2350. Skateholm, P 2 **2960 ± 50** $\delta^{13}C = -29.0‰$

Peaty gyttja from level 84 to 87cm, overlain by transgression deposits, in trench for pollen sampling. *Comment:* pretreated with HCl and NaOH. Sample probably contaminated by recent root material.

Östra Vemmenhög series

Charcoal, wood, and bone from settlement area (Early/Middle Neolithic culture) at Ö Vemmenhög 7:20, Ö Vemmenhög parish, S Scania (55° 23′ 30″ N, 13° 29′ 20″ E). Coll Sept 1983 and subm by L Larsson. Excavation is part of Skateholm Proj (Larsson, 1983; 1984, p 7 fig 2, and p 36).

4940 ± 60

Lu-2346. Ö Vemmenhög 7:20, Sample A $\delta^{13}C = -24.2‰$

Charcoal (*Corylus avellana*) id by T Bartholin, from cultural layer. Assoc flint artifacts indicate Early Neolithic Period C or Middle Neolithic Period I. *Comment:* pretreated with HCl and NaOH.

4730 ± 70

Lu-2348. Ö Vemmenhög 7:20, Sample B $\delta^{13}C = -26.2‰$

Charcoal from cultural layer; same artifact assemblage as above. *Comment:* pretreated with HCl and NaOH. Sample undersized; diluted; 80‰ sample.

2930 ± 50

Lu-2351. Ö Vemmenhög 7:20, wood $\delta^{13}C = -27.3‰$

Wood from Structure A below cultural layer, assoc with funnel beaker indicating same archaeol period as for Sample A, above. *Comment:* no explanation for young age. Pretreated with HCl.

4240 ± 60

Lu-2352. Ö Vemmenhög 7:20, bone $\delta^{13}C = -22.2‰$

Collagen from ill-preserved cattle bone, id by L Jonsson, from cultural layer, Sqs x = 101, y = 107; x = 102, y = 108; x = 106, y = 107. Assoc with funnel beaker pottery indicating same archaeol period as for Sample A, above. *Comment:* organic carbon content: 1.6‰. Collagen extracted as described previously (R, 1976, v 18, p 290) with NaOH treatment. Sample undersized; diluted; 88‰ sample.

4360 ± 80

Lu-2345. Hylliekroken $\delta^{13}C = -20.0‰$

Collagen from ill-preserved human bone, id by N-G Gejvall, possibly from grave structure at Hylliekroken, S Scania (55° 35.5′ N, 12° 55′ E). Coll 1944; subm by L Larsson. Assoc with Late Mesolithic or perhaps Neolithic material (Kalling, 1944; Hjortsjö, 1945). *Comment:* organic carbon content: 1.6‰. Collagen extracted as described previously (R, 1976, v 18, p 290) without NaOH treatment. Sample undersized; diluted; 64‰ sample.

St Köpinge Series I

Charcoal from various sites in St Köpinge parish, S Scania. Archaeol study is part of interdisciplinary proj on dynamics of human influence on landscape in Ystad area. Preliminary excavation previously reported (Tesch 1979a, 1979b; Tesch, Widholm & Wihlborg, 1980). Coll 1973–1983 and subm by S Tesch, Inst Archaeol, Univ Lund. Charcoal id by T Bartholin, Dept Quaternary Geol, Univ Lund.

2780 ± 50

Lu-2232. Köpinge 58:1, A49, F99 $\delta^{13}C = -26.2‰$

Charcoal (*Quercus* sp) from fire pit (grave), Ancient Remain No. 38, at Köpinge 58:1 (55° 28′ N, 13° 59′ E). Coll 1973–1974. *Comment:* pretreated with HCl and NaOH.

2840 ± 50

Lu-2248. Köpinge 58:1, A19, F49 $\delta^{13}C = -27.3‰$

Charcoal from fire pit (grave) at same site as Lu-2232, above. Coll 1973–1974. *Comment:* mild pretreatment with NaOH and HCl.

2770 ± 50

Lu-2252. Köpinge 58:1, A44, F87 $\delta^{13}C = -26.5‰$

Charcoal (*Quercus* sp) from fire pit (grave) at same site as Lu-2232. Coll 1973–1974. *Comment:* pretreated with HCl and NaOH.

2690 ± 50

Lu-2257. Köpinge 58:1, A8, F9 $\delta^{13}C = -25.0‰$

Charcoal (*Fraxinus excelsior, Tilia* sp) from fire pit (grave) at same site as Lu-2232. Coll 1973–1974. *Comment:* mild pretreatment with NaOH and HCl.

2680 ± 50

Lu-2260. Köpinge 58:1, A9, F10 $\delta^{13}C = -25.8‰$

Charcoal (*Quercus* sp) from fire pit (grave) at same site as Lu-2232. Coll 1973–1974. *Comment:* pretreated with HCl and NaOH.

1630 ± 50

Lu-2234. Köpinge 64:1, A277 $\delta^{13}C = -25.2‰$

Charcoal (*Fraxinus excelsior, Quercus* sp, Pomoideae) from hearth with brittle-burned stones and soot, at Köpinge 64:1 (55° 26′ N, 13° 59′ E). Coll 1980. *Comment:* mild pretreatment with NaOH and HCl.

1790 ± 60

Lu-2250. Köpinge 15:22, A167 $\delta^{13}C = -25.6‰$

Charcoal from stem wood (*Quercus* sp) from post holes of Iron age house at Köpinge 15:22 (55° 26′ N, 13° 59′ E). Coll 1979. *Comment:* no pretreatment; sample undersized; diluted; 80‰ sample.

2450 ± 50

Lu-2249. Köpinge 19:85, A6 $\delta^{13}C = -26.4‰$

Charcoal (*Corylus avellana, Fraxinus excelsior*) from hearth with brittle-burned stones and soot at Köpinge 19:85 (55° 26′ N, 13° 59′ E). Coll 1981. *Comment:* pretreated with HCl and NaOH.

2600 ± 50

Lu-2259. Köpinge 19:85, A2 $\delta^{13}C = -27.6‰$

Charcoal (*Alnus* sp, *Fraxinus excelsior*) from hearth with brittle-burned stones and soot at same site as Lu-2249, above. Coll 1981. *Comment:* pretreated with HCl and NaOH.

2070 ± 50

Lu-2233. Köpinge, Väg 10, A64 $\delta^{13}C = -23.2‰$

Charcoal (*Acer* sp, *Corylus avellana*) from hearth with brittle-burned stones and soot at rd no. 10 near Köpinge (55° 28′ N, 13° 56′ E). Coll 1979. *Comment:* pretreated with HCl and NaOH.

1730 ± 50

Lu-2255. Kabusa, Väg 10, A1 $\delta^{13}C = -26.7‰$

Charcoal (*Tilia* sp, *Alnus* sp, *Corylus avellana*) from hearth with brittle-burned stones and soot at rd no. 10 near Kabusa (55° 26′ N, 13° 58′ E). Coll 1980. *Comment:* mild pretreatment with NaOH and HCl.

2740 ± 50

Lu-2231. L:a Köpinge 14:43, A192 $\delta^{13}C = -27.6‰$

Charcoal (*Alnus* sp) from base of hearth pit at L:a Köpinge 14:43 (55° 26′ N, 13° 56′ E). Coll 1979. *Comment:* pretreated with HCl and NaOH.

2670 ± 60

Lu-2256. L:a Köpinge 14:43, A484 $\delta^{13}C = -26.6‰$

Charcoal from stem wood (*Alnus* sp) from post hole at same site as Lu-2231, above. Coll 1979. *Comment:* mild pretreatment with NaOH and HCl. Sample undersized; diluted; 87‰ sample.

1650 ± 50

Lu-2235. L:a Köpinge 19:1, A550 $\delta^{13}C = -26.3‰$

Charcoal (*Betula* sp) from pit house at L:a Köpinge 19:1 (55° 26′ N, 13° 56′ E). Coll 1979. *Comment:* pretreated with HCl and NaOH.

2000 ± 50

Lu-2251. L:a Köpinge 6:20, A324, F50 $\delta^{13}C = -27.0‰$

Charcoal (*Quercus* sp) from hearth with brittle-burned stones and soot at L:a Köpinge 6:20 (55° 28′ N, 13° 59′ E). Coll 1975. *Comment:* pretreated with HCl and NaOH.

1600 ± 45

Lu-2258. Kabusafältet, P1, A2 $\delta^{13}C = -26.6‰$

Charcoal (*Quercus* sp, *Corylus avellana*) from hearth with brittle-burned stones and soot below >1m aeolian sand on Kabusa field (55° 25′ N, 14° 00′ E). Coll 1983. *Comment:* pretreated with HCl and NaOH.

Hagestad series

Charcoal from various sites in Hagestad area, Löderup parish, S Scania. Coll 1963–1966 and subm by M Strömberg, Inst Archaeol, Univ Lund. Dating is part of interdisciplinary proj in SE Scania centered around Hagestad (Strömberg, 1980, 1982, 1984). For other dates from Hagestad, see R, 1972, v 14, p 394–395; 1973, v 15, p 509; 1974, v 16, p 324; 1975, v 17, p 191–192; 1976, v 18, p 313.

2090 ± 50

Lu-2230. Hagestad 40:5, Sample 1:83 $\delta^{13}C = -24.9‰$

Charcoal from Hearth no. 1 on field with Middle Neolithic hut base and Late Neolithic graves at Hagestad 40:5 (55° 24′ N, 14° 09′ E). Assoc with flint and pottery indicating Middle Neolithic culture. *Comment:* pretreated with HCl and NaOH.

1180 ± 45

Lu-2261. Hagestad 24:1, Sample 2:83 $\delta^{13}C = -25.6‰$

Charcoal from W pit in Tr 1 at Hagestad 24:1 (55° 25′ N, 14° 09′ E). Assoc with slag, flint, and wattle and daub, indicating Late Iron age. *Comment:* pretreated with HCl and NaOH.

4070 ± 60

Lu-2262. Hagestad 22:8, Sample 3:83 $\delta^{13}C = -25.9‰$

Charcoal from test pit at Hagestad 22:8 (55° 24′ N, 14° 11′ E). Assoc with flint and pottery indicating Middle Neolithic culture. *Comment:* pretreated with HCl and NaOH.

1800 ± 50

Lu-2263. Hagestad 43:5A, Sample 4:83 $\delta^{13}C = -25.5‰$

Charcoal from cultural layer in Tr no. 1 at Hagestad 43:5A (55° 24′ N, 14° 08′ E). Assoc with flint and pottery indicating Middle Neolithic culture. *Comment:* mild pretreatment with NaOH and HCl. *General Comment:* Lu-2261 and -2262 agree with archaeol estimate based on assoc artifacts. Lu-2230 and -2263 unexpectedly late for unknown reason.

Gislöv series

Charcoal from settlement area at Gislöv 2, Ö Nöbbelöv parish, Scania 55° 30′ N, 14° 17′ E). Coll 1983–1984 and subm by M Strömberg. For other dates from Gislöv, see R, 1980, v 22, p 1062; 1982, v 24, p 207–208. All samples pretreated with HCl and NaOH.

1480 ± 50

Lu-2328. Gislöv 2, Sample 1:HT83 $\delta^{13}C = -25.8‰$

Charcoal from hearth, 1m below present ground surface. No artifacts in hearth but pottery and iron objects above it.

650 ± 45

Lu-2329. Gislöv 2, Sample 2:HT83 $\delta^{13}C = -25.7‰$

Charcoal from coal pit in upper cultural layer, Sq 18 (prelim no.). Assoc with pottery and iron objects indicating Early Medieval time. *Comment:* somewhat later than expected, but reasonable.

660 ± 45

Lu-2330. Gislöv 2, Sample 3:HT83 $\delta^{13}C = -26.1‰$

Charcoal from coal pit below hearth in upper cultural layer. Assoc with pottery and iron objects. Expected to be from same period as Lu-2329, above.

2050 ± 50

Lu-2331. Gislöv 2, Sample 1:VT84 $\delta^{13}C = -24.7‰$

Charcoal from Grave 1 (cremation). Assoc with pottery indicating Roman Iron age. *Comment:* somewhat earlier than expected.

Fotevik Series III

Wood and moss caulking and wood from poles, assoc with Late Viking age stone blocking in entrance to Foteviken Bay, SW Scania (55° 28′ N, 12° 56′ E). Coll May 1982 by Malmö Sjöfartsmus, Malmö; subm by C Ingelman-Sundberg and P Söderhielm, Malmö Sjöfartsmus. Repts pub previously (Ingelman-Sundberg & Söderhielm, 1982; Crumlin-Pedersen, 1984). For other dates from Fotevik, see R, 1983, v 25, p 888; 1984, v 26, p 408–409.

1110 ± 45

Lu-2240. Fotevik, F82.V4.2 $\delta^{13}C = -27.7‰$

Wood from Board 2, Wreck 4 (Crumlin-Pedersen, 1984, p 45–46; fig 41, p 47). *Comment:* pretreated with HCl and NaOH.

1060 ± 60

Lu-2320. Fotevik, F82.V1 $\delta^{13}C = -27.2‰$

Brown-moss caulking from scarf-joint of keel, Wreck 1 (Crumlin-Pedersen, 1984, p 28–40). *Comment:* only HCl pretreatment; sample undersized; diluted; 57‰ sample. Fibrous caulking material (sheep's wool) from same wreck dated at 1030 ± 45 BP (Lu-2213: R, 1984, v 26, p 409).

1080 ± 45

Lu-2321. Fotevik, F82.V2.1 $\delta^{13}C = -24.6‰$

Wood from Board 1, Wreck 2 (Crumlin-Pedersen, 1984, p 40–43; fig 36, p 43). *Comment:* pretreated with NaOH and HCl.

960 ± 45

Lu-2322. Fotevik, F82.V5.6 $\delta^{13}C = -27.5‰$

Oak wood from Boat Rib 6, Wreck 5 (Crumlin-Pedersen, 1984, p 46–49; fig 43–44, p 49). *Comment:* pretreated with HCl and NaOH.

1000 ± 45

Lu-2323. Fotevik, Pole ARN $\delta^{13}C = -30.2‰$

Wood from Pole ARN, X105751.300; Y13589.196. *Comment:* pretreated with HCl and NaOH.

1030 ± 45

Lu-2324. Fotevik, Pole AFE $\delta^{13}C = -28.7‰$

Wood from Pole AFE, F82.S50, X105480.083; Y13694.621. *Comment:* pretreated with HCl and NaOH.

950 ± 45

Lu-2325. Fotevik, Pole AHT $\delta^{13}C = -28.1‰$

Wood from Pole AHT, F82.S58, X105448.652; Y13694.803. *Comment:* pretreated with HCl and NaOH.

930 ± 45

Lu-2326. Fotevik, Pole AFS $\delta^{13}C = -26.2‰$

Wood from Pole AFS, F82.S30, X105448.652; Y13694.803 (Ingelman-Sundberg & Söderhielm, 1982, p 20, fig 16). *Comment:* pretreated with HCl and NaOH.

4420 ± 60

Lu-2327. Masmo $\delta^{13}C = -25.6‰$

Food remains from cooking vessels from site with Neolithic, Bronze age, and Iron age artifacts at Masmo, Södermanland (59° 14.5′ N, 17° 53′ E). Assoc with pottery and quartz artifacts indicating Neolithic or Pre-Roman Iron age. Coll April 1984 and subm by B Hulthén, Lab for Ceramic and Clay Mineralogy, Dept Quaternary Geol, Univ Lund. No pretreatment.

770 ± 45

Lu-2226. Åbyn, Byske $\delta^{13}C = -25.3‰$

Wood from dugout canoe (No. SM1268) from swamp N of Åbyn, Byske, Skellefteå, N Sweden (65° 03′ N, 20° 21′ E). Coll 1981 by workers during drainage of swamp; subm by P Gustafsson, Skellefteå Mus, Skellefteå. Assoc with small paddle ornamented with circles and points. *Comment:* pretreated with HCl and NaOH.

730 ± 45

Lu-2227. Västra Lillträsket, Nyland $\delta^{13}C = -24.2‰$

Wood from dugout canoe (No. SM6552) from shore of Lake Västra Lillträsket, Nyland, Skellefteå, N Sweden (64° 50′ N, 20° 45′ E). Coll 1949 by H Wagnstedt and E Westerlund; subm by P Gustafsson. *Comment:* sample delignified and residue washed repeatedly to remove traces of preservative as completely as possible. "Cellulose" charred in nitrogen atmosphere before burning.

8610 ± 90

Lu-2228. Skellefteå, *Alces alces* $\delta^{13}C = -21.6‰$

Collagen from bone (*Alces alces*) id by Rehndahl, Riksmus, Stockholm, from dark blue clay 2.4m below surface, town of Skellefteå, N Sweden (64° 45′ N, 20° 57′ E). Coll 1944 by T Ekblom and E Westerlund; subm by P Gustafsson. Diatom and pollen analysis indicate age of ca 7000 yr (Ekblom, 1946). *Comment:* organic carbon content: 3‰. Collagen extracted as described previously (R, 1976, v 18, p 290). Sample undersized; diluted; 67‰ sample. (3 1-day counts.)

Kyrkudden series (II)

Charcoal from excavation of medieval site at Kyrkudden, Hietaniemi parish, Norrbotten (66° 13′ N, 23° 43′ E). Coll 1979 and subm by T Wallerström, Norrbottens Mus, Luleå. For other dates from Kyrkudden, see R, 1984, v 26, p 404–405. No pretreatment; small samples.

530 ± 45

Lu-2286. Kyrkudden, F2055, F2043, F2268 $\delta^{13}C = -26.1‰$

Charcoal (*Pinus* sp) from cultural layer near blacksmith's workshop.

470 ± 45

Lu-2287. Kyrkudden, F2196, F2247, F2251 $\delta^{13}C = -25.5‰$

Charcoal (*Pinus* sp) from cultural layer, coll close to Lu-2286, above.

Ireland

2980 ± 60

Lu-2225. Carrowmore, Culleenamore 15A $\delta^{13}C = -25.7‰$

Charcoal Sample 1:82 from lower layer in outer kitchen midden (15A) at Settlement 15, Culleenamore, Co Sligo (54° 16′ N, 8° 36′ W). Coll 1982 and subm by G Burenhult, Inst Archaeol, Univ Stockholm. Results of excavations 1980 and 1981 at Settlement 15 previously pub (Österholm & Österholm, 1984). Samples coll 1980 above sand at base of midden (C14:18) and ca 1.5m above base (C14:6) dated at 4710 ± 100 BP (St-7624) and 3780 ± 60 BP (Lu-1759: R, 1981, v 23, p 401). Sample C14:30 coll 1981 in lower part of midden (Burenhult, 1984, p 344, fig 240) dated at 3970 ± 75 BP (Lu-1948: R, 1982, v 24, p 211). Dates from hearths in other parts of midden are 3060 ± 100 BP (Fra-60) and 3045 ± 100 BP (Fra-65) (Burenhult, 1984, p 131).

4250 ± 60

Lu-2239. Carrowkeel, 336 to 342cm $\delta^{13}C = -28.8‰$

Highly humified fen peat from bog in Treanscrabbagh Valley, N of Cairn B and WNW of Cairn C and D of Carrowkeel megalithic cemetery (Göransson, 1984, p 165–168), Bricklieve Mts, Co Sligo (54° 03′ N, 8° 23′ W). Coll Aug 1981 by H Göransson, M Thelaus, and M A Timoney; subm by H Göransson and G Burenhult. Pollen analysis by H Göransson (1984, p 184–185). For other dates from Carrowkeel, see R, 1983, v 25, p 889. Sample dates early part of forest regeneration phase (Göransson, 1984, p 188).

Carrowmore Strandhill series

Stratified sandy terrestrial submerged peat (Göransson, 1984, p 168–170) from deposit exposed during low tide ca 500m N of Strandhill, Knocknarea peninsula, ca 6km WNW of Carrowmore megalithic cemetery, Co Sligo (54° 16′ N, 8° 36′ W). Coll 1983 and subm by G Burenhult and H Göransson. Peat from same site coll 1981 dated at 5220 ± 60 BP (Lu-2021: R, 1983, v 25, p 890). Site described and results discussed by Burenhult (1984, p 38–42). Pretreated with HCl and NaOH.

5680 ± 60

Lu-2223. Carrowmore, Strandhill I:1983 $\delta^{13}C = -26.1‰$

Basal 4cm of peat layer, 9cm thick. Highly humified sandy-silty peat with rootlets of *Carex*.

5210 ± 60

Lu-2224. Carrowmore, Strandhill II:1983 $\delta^{13}C = -27.0‰$

Uppermost 5cm of peat layer, sample rich in *Phragmites* and *Carex* rootlets. Root epidermis of *Eriophorum* present. Initial decrease of *Ulmus* pollen percentage in pollen spectrum from top of peat. Pollen analysis by H Göransson (1984, p 186–187).

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NOTES AND COMMENTS

GLASSY MICROSPHERULES FROM BOMB COMBUSTION OF CHARCOAL

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Glassy microspherules, typically 200μm or less in diameter, are well documented from a variety of terrestrial and extraterrestrial sources (Baker, 1959, p 192–198; Glass, 1969; Rost, 1969; McKay, Greenwood & Morrison, 1970; Mueller & Hinsch, 1970; Cross, 1971; O'Keefe, 1980). To these we would add the formation of microspherules of similar habit when wood charcoal is burned in a combustion bomb (Barker, Burleigh & Meeks, 1969; Burleigh, 1973, 1974; Switsur, 1973; Switsur *et al*, 1974) as a first step in the chemical synthesis of samples for ^{14}C age measurement. The glassy material of these spherules originates from fusion at the high temperatures reached during the combustion, of traces of alkali-metal minerals in the charcoal and silica bodies (phytoliths) within its microstructure. Other materials commonly burned, such as bone collagen, do not yield microspherules. The age and source of the charcoal are immaterial, though different species (and perhaps other woody plant materials) may be more-or-less productive of spherules. Here we give a brief summary of the characteristics of these glassy microspherules, based on optical and scanning electron microscopy and energy-dispersive x-ray analysis.

Most of the microspherules from any one combustion range in size from 0.15 to 1.5mm (150–1500μm), are generally either brown or green, and may be either clear or opaque. Some are of mixed color with swirling patterns clearly visible in polished cross-section. Aggregates do occur, but most are individual spherules and close to true spheres in form. Many incorporate gas vesicles and, in one extreme instance, the glass formed only a thin envelope or cenosphere surrounding a single gas bubble. Some spherules incorporate mineral (quartz) grains, probably derived from the deposits from which the charcoal originated. Within some spherules are dendritic structures representing metallic inclusions derived from the molten combustion filament.

Chemically the microspherules fall into two broad groups having either high sodium (typically 23% Na_2O, 12% Al_2O_3, 53% SiO_2, 1.5% K_2O, 2.5% CaO, 8% Fe_2O_3) or high calcium content (typically 28% CaO, 11% Al_2O_3, 52% SiO_2, 2% K_2O, 7% Fe_2O_3). Their colors result mainly from the presence of iron oxides and other metallic ions in various states of reduction, and both groups may be either green or brown. Variations in composition occur within spherules from a single combustion and also within the different phases of a single spherule. The differences are attributable both to variations in composition of the minor constituents of the charcoal sample, and the rapidity of the fusion cycle in a typical combustion in which the spherules begin to solidify before uniform mixing of the glass and mineral species can take place. Measurements of softening temperatures showed

that the high-sodium spherules begin to soften at 800°C and the high-calcium spherules at temperatures in excess of 1000°C. The typical calcareous composition, if considered as a ternary system, Al_2O_3—SiO_2—CaO, falls within the anorthite region with a melting point of ca 1400°C (Muan & Osborn, 1965, p 95), and there are data to suggest that for a melt of this composition with a very low viscosity and a high fluidity of ca 1 poise, a temperature of 1600–1800°C would be in order (Bottinga & Weill, 1972). The consistently regular form of the spherules and their prominent convection flow lines suggest, however, that during the cycle of their formation much higher temperatures, possibly up to 2000°C or greater, may have been reached in the oxygen atmosphere (Bodsworth, 1963, p 134; Wheeler, 1958, p 39). This would allow great fluidity of the melt and rapid spherulization to occur.

From this observation, the general inference can be drawn that the property uniting all the very different processes, whether lunar, terrestrial, or artificial, by which microspherules are formed, is the tendency (given the constituents for the formation of a glass and temperatures well above its melting point) for rapid coalescence of discrete droplets under surface tension alone, in contrast with the formation of an amorphous mass that would be characteristic of slower processes, lower temperatures and less energetic conditions.

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[RADIOCARBON, VOL 28, NO. 1, 1986, P 167–169]

ANNOUNCEMENT OF A NEW COLLABORATIVE STUDY FOR INTERCALIBRATION OF ^{14}C DATING LABORATORIES

E M SCOTT*, M S BAXTER**, T C AITCHISON*,
D D HARKNESS†, and G T COOK**

ABSTRACT. A proposal for an international collaborative study to investigate and assess the existence of inter-laboratory variability is discussed. The proposed study would be conducted over two years and would investigate each stage of the dating process in turn.

INTRODUCTION

Approximately four years have now elapsed since the previous international collaborative study organized by the Glasgow ^{14}C laboratory, was reported (ISG, 1982, 1983). A total of 20 laboratories participated in that project, each analyzing an identical set of 8 samples from a floating dendrochronologic sequence, of age ca 5000 yr BP. The results proved interesting, hinting at the common existence of systematic biases amongst laboratories and of excess variability in results as measured against quoted errors. Unfortunately, the experimental design of the study did not allow us to identify the sources of observed bias and variability. Thus, having concluded that there were difficulties in interpreting and comparing results from more than one laboratory, the authors could only speculate on the likely causes, while urging that such an inter-laboratory exercise should be performed regularly.

The need for further work has become ever more pressing because of continued changes in ^{14}C dating experimentation. A new generation of accelerator laboratories has now been commissioned, and its first radiocarbon results have been published. In parallel, high precision and small sample counting laboratories have flourished. Thus, the diversity of laboratory techniques in existence makes it imperative that an objective monitoring, evaluation, and standardization operation be performed. In this note, then, we describe proposals for just such an operation to be organized jointly by the University of Glasgow and the Scottish Universities Research and Reactor Centre, and we invite participation in it. The aims of the study may be briefly summarized as follows.

First, we hope that, if the results again indicate a significant level of bias and variability amongst laboratories, we can make progress towards the breakdown and numerical assessment of the origins of such errors. In particular, the contributions to overall errors from three major sources (pretreatment, synthesis, and counting) will be assessed.

Secondly, the study will provide an important opportunity for cross-checking and verification of diverse laboratory operational procedures, including an assessment of each experimental approach.

Thirdly, the results will contribute to an understanding of the validity of routinely quoted errors; since there is no widely accepted prescription for error calculation, this aspect is particularly important. The introduction

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of duplicate samples at certain points in the study will assist in assessment of each laboratory's internal error structure.

Finally, the study will allow users of ^{14}C dates to assess and interpret measurements from more than one laboratory in an objective and scientific manner.

DESIGN OF THE STUDY

It is envisaged that the study will comprise three stages; stages 1 and 2 to be completed and a summary of the results reported before the commencement of stage 3. The hierarchical nature of the study will help identification of the components of any analytical variations. The study will be run "blind" by the participating laboratories, *ie,* each laboratory will be assigned a unique sample code thus ensuring, eg, that the duplicate samples will be unknown and that no subconscious biasing of results will occur. Results will be reported in a standard format particular attention being focussed on the quoted errors. A schematic plan of the study is shown in Figure 1, and summarized as follows:

The first stage of the study will relate to the ^{14}C counting process only (or as near to this as possible). Samples will require no or minimal pretreatment and synthesis. Sample material will most probably be benzene (for liquid scintillation laboratories) or laboratory-prepared carbonates (for gas counting and accelerator laboratories). Results from this stage will be used to identify the counting component in the overall variability in the results.

In the second stage, one further process will be introduced, namely sample synthesis. Quantities of homogenized, pretreated material will be

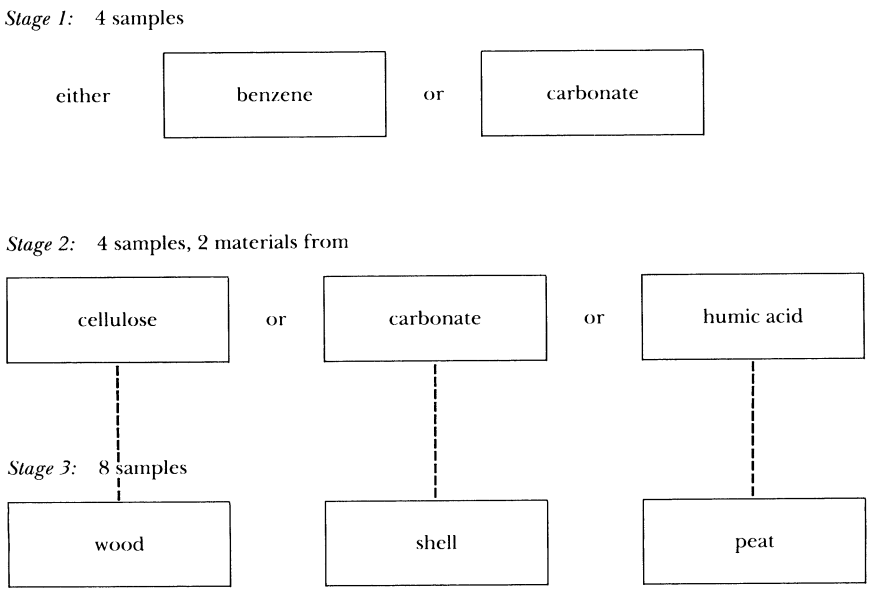

Fig 1. Schematic plan of study

supplied to laboratories which by this point, will have been asked to select 2 from 3 materials on offer, these to comprise carbonate (prepared from shell), cellulose (prepared from wood), and humic acid (extracted from peat). The choice of material in this stage will also determine the samples to be dated in the third and final stage. Results from this stage will demonstrate the level of performance for the synthesis and counting operations.

The final round of analyses will hopefully permit the investigation of the variation arising in the entire dating procedure of pretreatment, synthesis, and counting. Laboratories will be sent typical samples of a combination of either known-age wood, shell or peat; extractants from these materials having been previously dated in stage 2.

Thus, in total the study will involve assay, by each laboratory, of typically 16 samples, 4 in each of stages 1 and 2, and 8 in stage 3. It is hoped that this announcement will underline the need for such a comparative study which is, after all, of a type quite frequently performed in other analytical sciences, and will alert the ^{14}C community to this particular new study which it is hoped will commence in 1986. Through informal correspondence, there has already been a very positive general response to the project and it is expected already that a high percentage of all ^{14}C dating laboratories will take part. Assistance with funding for the project has already been sought, however, should the application be unsuccessful, it is hoped that a revised study would still go ahead. It is our hope that no laboratory that wishes to take part should be excluded. Hence, this invitation to participate. Any laboratory that has not already committed itself to the project but that wishes to do so should contact the first author (EMS) immediately.

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[RADIOCARBON, VOL 28, NO. 1, 1986, P 170–174]

RADIOCARBON DATING BLOOD RESIDUES ON PREHISTORIC STONE TOOLS[1]

D E NELSON*, T H LOY**, J S VOGEL* and J R SOUTHON*

ABSTRACT. We report here the first radiocarbon dating of blood residues on prehistoric stone tools. The residues found on two stone artifacts were subjected to various exploratory biochemical techniques to identify the species from which they were derived and to separate a suitable sample for dating by accelerator mass spectrometry. Although these techniques need much further development and detailed testing, the ages obtained in this first study were consistent with other data, indicating that the concept is viable. For the first time, the time of use of stone tools has been found directly, rather than by stratigraphic or other archaeologic inferential techniques.

INTRODUCTION

Trace amounts of plant and animal residues have been shown to persist on ancient stone tools for long periods of time. In particular, a butchering tool often retains residues of blood and tissue from its original use, and in most cases, the species of the animal that was butchered can be determined (Loy, 1983). Also, a number of artifacts have yielded identifiable residues of human blood (Loy, in press a, and unpub data), perhaps the results of manufacturing accidents made by the flint knappers. These findings indicate a wealth of new archaeologic information may be obtained from these residues (Loy & Nelson, in press).

We report here the first two successful ^{14}C dates for blood residues taken from stone tools. The first was made on ca 3mg of carbon extracted from an unusually large blood residue taken from an artifact of known age and archaeologic association. The result obtained was in very good agreement with the expected age. The second measurement was done to test the method on a much smaller amount of residue. The artifact from which this sample was obtained was found on the surface, and there was no method of independently dating it except by a general typologic comparison with other artifacts from the region. A carbon sample of only 50μg was removed from the tool and dated, yielding an age within the expected range. These first results prove the concept, and since tool residues of 50μg or greater may be common, the method may be broadly applicable once fully developed.

THE SAMPLES

The artifact chosen for the first study was a limestone spall-flake found during excavations of the Site IgSk-7 in northern British Columbia (Loy, 1984). One surface of this tool is covered with a large quantity of an organic residue which has been identified by isoelectric focusing (as discussed later) as the blood of snowshoe hare (*Lepus americanus*); the residue also contains feather barbules from a *Falconiforme* bird. It has been suggested that the blood was used as 'glue' for fletching arrows or darts (Loy, 1984). The site from which this artifact was recovered was originally dated several years ago

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[1] *Editor's note:* The late arrival of this manuscript determined its position at the end of this issue; the importance of its contents would have otherwise placed it in the first section.

using the traditional β-counting method. The uppermost cultural layer yielded an age of 580 ± 400 BP (SFU-97) measured on wood charcoal associated with a cooking hearth. Charcoal from a second hearth near the upper limit of the middle cultural unit was dated to 1060 ± 160 BP (SFU-98); the tool studied was found in the same pit ca 3cm above this second hearth. The lowest cultural unit was dated to 2830 ± 210 BP (SFU-150) on an isolated piece of wood charcoal near the upper limit of that lowest layer. (The samples above contained carbon in the amounts 0.2g, 0.8g, and 0.5g, respectively. These are very small for the SFU β-counting laboratory, and the uncertainties quoted reflect this.) These dates indicate that the stratigraphic sequence of the site was undisturbed, and that the age of the tool itself would be expected to be slightly younger than that of the associated hearth at 1060 ± 160 BP.

THE MEASUREMENTS

A first simple attempt to date the blood residue failed, yielding a modern age. We had removed a 50mg portion and treated it in the standard manner with dilute acid and base in an attempt to remove any carbonates and the mycohyphae and rootlets that were microscopically visible in the sample. Clearly, this treatment did not remove all these contaminants, and a much more selective sample preparation method was required. We decided to extract for analysis only the high molecular weight proteinaceous material that would be expected in a blood residue.

We removed 46mg of the remaining residue, added 1ml of physiologic saline, sonicated the solution for 45 minutes to disaggregate the sample, and gently stirred it on a nutating platform for 17 hours. A 1ml solution of 0.9M 3-[(3-cholamidopropyl)-dimethylammonio]-1-propanesulfonate was then added, and the solution stirred for another 72 hours. ("CHAPS" is a zwitterionic detergent which has been used to disaggregate blood residues; *cf* Hjelmeland, 1980). The solution was centrifuged at 2000G for 10 minutes and the supernatant filtered through a polycarbonate filter to remove all particles larger than 8μ. The resultant solution was placed in a Centricon-30 filter-concentrator (Amicon Canada, Ltd) and centrifuged at 2000G for 30 minutes. Ca 1ml of water was added, and the solution centrifuged again. This process was repeated four times to separate the large proteinaceous molecules (>30,000mw) from smaller contaminant molecules and from the CHAPS (mw 615). The high molecular weight material retentate in 1.5ml of solution was dark red-brown. All further measurements were made on this stock solution.

To identify the species of origin and, to an extent, the specific molecules isolated, we analyzed aliquots of the retentate and the filtrate by iso-electric focusing. These unknown samples, as well as control samples of animal blood (including the snowshoe hare), dried and aged human blood, commercial bovine hemoglobin, and commercial iso-electric point standard markers were applied to a 0.4mm polyacrylamide gel. Following the method described by Righetti (1983), this gel was prepared at 5%T, 3%C in the range from pH 3.2 to 9.1, and run at constant power (6W) to a final voltage of 1750V. The separated bands were then measured by densi-

tometry, and the isoelectric point (pI) of each peak was determined to an accuracy of ca 0.01pH by graphically scaling to those of the standards.

A simple "coefficient of similarity" was calculated against the blood pI values of known species. This coefficient is an index of the number of bands with identical pI values in common between separations of two samples; *ie*, it is the [number of matching values] divided by the [largest number of values]. The results for the retentate (top line, Table 1) strongly suggest that the sample is blood from a snowshoe hare; the coefficient of 0.72 is very high, and the pI values of the hemoglobin bands were an exact match with those of the control sample. The identities of the constituent molecules of the filtrate are as yet unknown, but they are clearly not strongly correlated with the control samples (line 2, Table 1).

For the ^{14}C measurements, an aliquot of the stock solution was pipetted into a quartz tube and gently evaporated to dryness. Ca 1g of wire-form CuO and 300 Torr of ultra-pure O_2 were added. The tube was then heated to ca 900°C to combust the material. Ca 1.8mg of carbon was obtained as CO_2. Half this CO_2 was catalytically converted to a graphite coating on Fe powder using the method of Vogel *et al* (1984) in apparatus developed specifically for sub-milligram samples. Ca 300μg of this graphite, together with the iron powder substrate, was pressed into a hole, 1.1mm in diameter, in an Al button, and placed in the ion source of our AMS equipment. The $^{14}C/^{13}C$ ratio for the unknown was obtained with respect to that of the ^{14}C standard NBS OX-1 by repeated sequential measurements of both. Details of the measurement methods and the equipment are given by Nelson *et al* (1984, in press).

The ^{14}C age obtained, as calculated using an assumed $\delta^{13}C$ value of -20%, was 1010 ± 90 yr BP (RIDDL–120). This result falls well within the general expected age range, and it correlates very well with the age of 1060 ± 160 BP independently obtained for the charcoal from the closely associated hearth.

The second artifact dated was a bifacially retouched knife manufac-

TABLE 1

The "similarity coefficients" comparing the isoelectric focusing data for the unknowns with those taken on known samples of human blood and on blood from a number of common northern British Columbia animals: moose (*Alces alces*), bison (*Bison bison*), caribou (*Rangifer tarandus*), black-tailed deer (*Odocoilus columbianus*) and snowshoe hare (*Lepus americanus*). The blood used for these comparative tests was all fresh blood that had been air-dried for at least three years as a thin smear on a microscope slide. The coefficients give an indication of the identity of the unknown, the value 1.0 indicating a perfect match. The last line in the table is an example in which the known human blood is compared with that of the other animals.

Sample	Human	Moose	Bison	Caribou	Deer	Hare	Identity
IgSk7:84							
-retentate	0.20	0.14	0.20	0.10	0.17	0.72	Hare
-filtrate	0.12	0.13	0.10	0.11	0.09	0.10	Unknown
IfSi1:6	0.36	0.23	0.20	0.30	0.21	0.11	Human, caribou*
Human	1.0	0.16	0.32	0.20	0.28	—	

* See text for other information confirming this designation

tured from chert. This tool was found along with 23 others as part of a cache in a northern British Columbia site (IfSi-1) that has since been destroyed by river erosion and highway construction. The residue on this tool had been tested previously to determine the species of origin. Isoelectric focusing run under the same conditions as described above indicated both human and caribou (*Rangifer tarandus*) blood (line 3, Table 1). This possibility was subsequently confirmed by a radio-immuno-assay that yielded evidence for *Cervidae* albumen (G Lowenstein, pers commun, 1985), and by a bead-linked, enzyme-linked immunosorbent assay that indicated the presence of human IgG (T H Loy, ms in preparation).

We removed a small sample that we thought would be more typical of the amount of residue to be expected on tools. This was done by applying ca 50μl of physiologic saline and 50μl of 13 mM CHAPS directly to the residue on the tool surface and then stirring, scraping, and soaking the material. The sample obtained was then processed as described above. The resultant solution was very weakly colored, and obviously contained only a little material. The entire sample was burned, yielding 50μg of carbon as CO_2. This sample was very small, even by AMS standards. All the CO_2 was converted to graphite and the age determinations were performed as described above. The background count rate for 50μg samples was determined from identical measurements on anthracite and found to be $\approx$2% of the rate for the modern standard. For this blood sample, all of the prepared graphite was consumed in the measurement, and ca 1% of all the ^{14}C atoms in the sample were detected.

The result was an age of 2180 $\pm$ 160 yr BP (RIDDL–121), calculated using an assumed $\delta^{13}C$ value of $-20‰$. As mentioned above, an independent date for this specific artifact was not possible, but the age found is in agreement with those for other artifacts of this type in northern British Columbia and the Yukon territories (Mitchell & Loy, 1981).

CONCLUSIONS

These two determinations show that blood residues on prehistoric stone tools can be successfully ^{14}C dated. However, much remains to be done before this method can be applied routinely.

First, while there is evidence that many artifacts retain traces of bioremnants (Loy, in press b), it has yet to be firmly demonstrated whether tools retaining sufficient quantities of uncontaminated carbon are commonplace or rare. To be dated, the residues must contain at least 50 to 100μg of carbon, since this amount approaches the useful lower limit for the AMS method. To put this in perspective, a smear of recent protein such as dried blood that is 1cm^2 and 10μm thick (see Loy, 1983, Figs 1 & 4) contains ca 500μg of carbon. Thus, a ^{14}C date may be possible if even a fraction of such a smear on an artifact persists uncontaminated. Our present information suggests that tool residues of sufficient size may be common, but detailed studies must now be undertaken to determine whether this is truly the case. However, we are uncertain if this information can be obtained from existing artifact collections. Since archaeologists normally begin their examination of stone tools by scrubbing them to remove the "dirt," the amount of residue remaining on these tools may thus be quite variable.

Next, we anticipate that a great deal of study will be required to determine the best methods for identifying and isolating the appropriate remnant bio-molecules for analysis. The techniques used here for separating the material to be dated were simple, exploratory techniques used to test the concept. They were very time consuming and not as selective as desirable. Ideally, only specifically identified molecules should be dated, and the purification techniques themselves must be carefully evaluated to ensure that contaminants are not inadvertently introduced during the preparation procedure. However, even the simple purification steps used in this study yielded excellent first results, and so we expect no unusually difficult problems in this respect.

The prospect of directly dating the time of use of a stone tool is exciting. Most archaeologic culture history is constructed from dates associated with cooking hearths or burned structures, and the artifacts are then related to the dates by stratigraphic or other inferential techniques. If, as our information suggests, bio-remnants on stone tools are found frequently and in sufficient quantity, then it will be possible for the first time to determine the temporal sequence of the development, use, and style of these artifacts by studying the objects themselves.

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Citations. A number of radiocarbon dates appear in publications without laboratory citation or refererence 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 ^{14}C 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.

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