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RADIOCARBON

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INSTRUCTIONS TO CONTRIBUTORS

Manuscripts of radiocarbon papers should follow the recommendations in *Suggestions to Authors,* 5th ed.* All copy (including the bibliography) must be typewritten in *double space.* Manuscripts for vol 22, no. 4 must be submitted in *duplicate* before May 1, 1980.

General or technical articles should follow the recommendations above and the editorial style of the *American Journal of Science.*

Descriptions of samples, in date lists, should follow as closely as possible the style shown in this volume. Each separate entry (date or series) in a date list should be considered an *abstract,* prepared in such a way that descriptive material is distinguished from geologic or archaeologic interpretation, but description and interpretation must be both brief and informative, emphasis placed on significant comments. Date lists should therefore not be preceded by abstracts, but abstracts of the more usual form should accompany all papers (eg, geochemical contributions) that are directed to specific problems.

Each description should include the following data, if possible in the order given:

1. Laboratory number, descriptive name (ordinarily that of the locality of collection), and the date expressed in years BP (before present, ie, before AD 1950). The standard error following the date should express, within limits of $\pm 1\sigma$, the laboratory's estimate of the accuracy of the radiocarbon measurement, *as judged on physicochemical (not geologic or archaeologic) grounds.*

2. Substance of which the sample is composed: if a plant or animal fossil, the scientific name if possible; otherwise the popular name, but not both. Also, where pertinent, the name of the person identifying the specimen.

3. Precise geographic location, *including latitude-longitude coordinates.*

4. Occurrence and stratigraphic position in precise terms; use of metric system exclusively. Stratigraphic sequences should *not* be included. However, references that contain them may be cited.

5. Reference to relevant publications. Citations within a description should be to author and year, with specific pages wherever appropriate. References to published date lists should cite the sample no., journal (R for Radiocarbon), years, vol, and specific page (eg, M-1832, R, 1968, v 10, p 97). Full bibliographic references are listed alphabetically at the end of the manuscript, in the form recommended in *Suggestions to Authors.*

6. Date of collection and name of collector.

7. Name of person submitting the sample to the laboratory, and name and address of institution or organization with which submitter is affiliated.

8. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted, as prescribed above. Interpretive material, summarizing the significance and implicity showing that the radiocarbon measurement was worth making, belongs here, as do technical matters, *eg,* chemical pretreatment, special laboratory difficulties, etc. Calendar estimates, reported in AD/BC may be included, citing the specific calibration curve used to obtain the estimate.

Illustrations should not be included unless absolutely essential. They should be original drawings, although photographic reproductions of line drawings are sometimes acceptable, and should accompany the manuscript in any case, if the two dimensions exceed 30cm and 23cm.

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* Suggestions to authors of the reports of the United States Geological Survey, 5th ed. Washington, DC, 1958 (Government Printing Office, $1.75).

NOTICE TO READERS

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 9th International Conference on Radiocarbon Dating, Los Angeles/La Jolla, 1976. 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 AD/BC, citing the specific calibration curve used to obtain the estimate.

Meaning 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.

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

Radiocarbon Measurements: Comprehensive Index, 1950-1965. This index, covering all published ^{14}C measurements through Volume 7 of

RADIOCARBON, and incorporating revisions made by all laboratories, has been published. It is available to all subscribers to RADIOCARBON at $10.00 US per copy.

Publication schedule. Beginning with Volume 15, RADIOCARBON has been published in three issues: Winter, Spring, and Summer. Volume 22 will include four issues. The deadline for v 22, no. 4 is May 1, 1980. Contributors who meet our deadlines will be given priority but publication is not guaranteed in the following issue.

List of laboratories. The comprehensive list of laboratories at the end of each volume now appears in the third number of each volume. For Volume 22, the list of laboratories will appear at the end of No. 4.

Index. All dates appear in index form at the end of the third number of each volume.

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EDITORIAL STATEMENT TO 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. The editors and readers agree that this expansion is broadening the scope of the Journal. For 1980, the editors announce the publication of the proceedings of the 10th International Radiocarbon Conference that was held at Bern and Heidelberg, August 19-26, 1979. Volume 22, Nos. 2 and 3, 1980 will contain these proceedings.

Subscribers will receive these issues at no extra cost; non-subscribers may order the special publication separately. The price has not yet been determined. Volume 22, 1980 will include four numbers.

The editors would like to acknowledge with gratitude the help of Harry V. Merrick, Department of Anthropology, Yale University, for his careful editing of archaeologic sections for Volume 21, No. 3, in the absence of Irving Rouse.

All correspondence, manuscripts and orders for the special issues should be sent to the Managing Editor, Radiocarbon, Box 2161, Yale Station, New Haven, Connecticut 06520.

The Editors

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Radiocarbon

1979

MEASUREMENT OF THE ^{14}C ACTIVITY OF THE ANU SUCROSE SECONDARY STANDARD BY MEANS OF THE PROPORTIONAL COUNTER TECHNIQUE

DUŠAN SRDOC,* BOGOMIL OBELIC,* NADA HORVATINCIC,* and ADELA SLIEPCEVIC**

ABSTRACT. A systematic crosschecking of the NBS oxalic acid standard, the ANU Sucrose secondary standard, and the RB oak tree rings grown in 1858 ± 5 and 1890 ± 5 has been performed using the proportional counter technique. Details on the counter gas (methane) purification are given. Corrections of count rates due to changes of barometric pressure and ambient temperature are applied and discussed. Results of measurements are presented and the ratios between mean activities of the NBS oxalic, ANU sucrose and RB oak samples are given.

INTRODUCTION

The prospect of vanishing stock of the NBS oxalic acid which has been used as the reference standard by many radiocarbon laboratories instigated a search for suitable secondary standards whose activity can be correlated with the activity of the NBS oxalic acid standard and/or the primary wood standard. The ANU Sucrose proposed by Polach and Krueger (1972) meets most of requirements for such a secondary standard: sucrose is chemically inert and relatively stable in comparison to inorganic compounds (carbonates); its molecular structure does not favor isotopic exchange in contact with atmospheric CO_2 during storage in dry form. Handling of samples is easy although combustion is not so straightforward; to compensate for tedious combustion the ANU sucrose gives, according to Polach and Krueger (1972), less spread in isotopic fractionation of the obtained CO_2. However, what makes the ANU sucrose a favorite and most attractive secondary standard is the fact that, thanks to efforts of Henry Polach and the Australian sugar and packaging industry, a large amount of high purity sucrose has been carefully stored, ready for free distribution to radiocarbon laboratories around the world. Since the amount of the NBS oxalic standard has become very limited in our laboratory, a decisions was made in 1977 to start the cross-calibration of the ANU sucrose secondary standard with the NBS oxalic acid standard.

Experimental

Our routine radiocarbon measuring system is based on combustion of the sample in a stream of purified oxygen, followed by trapping and purification of the CO_2 and subsequent conversion to CH_4 by hydrogenation via Ru catalyst. Methane is purified and counted in a propor-

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** Faculty of Veterinary Medicine, University of Zagreb, Yugoslavia.

tional counter in anticoincidence with a ring guard counter. The essential features of the system have been described elsewhere (Srdoč, Breyer, and Sliepcevic, 1971). However, several modifications in gas handling, gas purification, and electronics as well as in computer processing of data have been introduced, resulting in higher precision of measurements. Also, the background count has been reduced significantly, thus improving the figure of merit. Modifications and resulting improvements will now be described.

Gas purification technique

Our gas purification technique has been improved by applying vacuum distillation of the gas mixture obtained by the hydrogenation of CO_2. The gas mixture after hydrogenation consists of CH_4, water vapor, surplus of hydrogen, unreacted CO_2 and traces of impurities, mainly CO and higher hydrocarbons. The vacuum distillation proceeds as follows: the bottom of the reaction vessel (fig 1), containing the gas mixture after catalytic hydrogenation, is kept at liquid N_2 temperature. All gases except H_2 are thus condensed; H_2 is then pumped off for a short time; prolonged pumping would result in loss of CH_4 due to its relatively high vapor pressure at liquid N_2 temperature. Liquid N_2 is then replaced by dry ice+alcohol mixture. Water and heavy hydrocarbons are thus kept frozen and the rest of the gas mixture containing CH_4, traces of CO_2, and CO is condensed in a stainless steel container kept at liquid N_2 temperature (A in fig 2). Final distillation is performed by connecting container A with the CH_4 and traces of impurities kept at liquid N_2 temperature to the stainless steel container, B, filled with silicagel and also kept at liquid N_2 temperature. A slow distillation of CH_4 follows since the pressure of CH_4 above silicagel is much lower. Traces of CO_2, CO, C_2H_4, and C_nH_{2n+2} remain frozen at liquid N_2 temperature in the container A (fig 2). Their vapor pressure is so low at liquid N_2 temperature that they practically remain trapped in container A. The CH_4 obtained by the described vacuum distillation is practically free of any impurity which would exceed 10 to 100 ppm, as shown by gas chromatographic and mass spectrometric analyses. However, the gas multiplication factor, defined as the mean number of electrons formed in the single electron avalanche, is sensitive at high gas pressure even to such small amounts of impurities ranging from 10 to 100ppm when oxygen or any other electronegative gas is in question. Any change of the gas multiplication factor shifts the mean counting rate of the sample, causing an error in sample activity measurement. This was proved by measuring the counter resolution using the ^{55}Fe source. The counter resolution, expressed as the full width at half maximum (FWHM) of the measured spectrum, divided by the source energy, is a sensitive index of the counter performance, routinely used in nuclear spectroscopy. Broadening of spectrum and decreasing of gas multiplication were observed whenever methane was contaminated with air. The described vacuum distillation failed to restore the gas purity existing

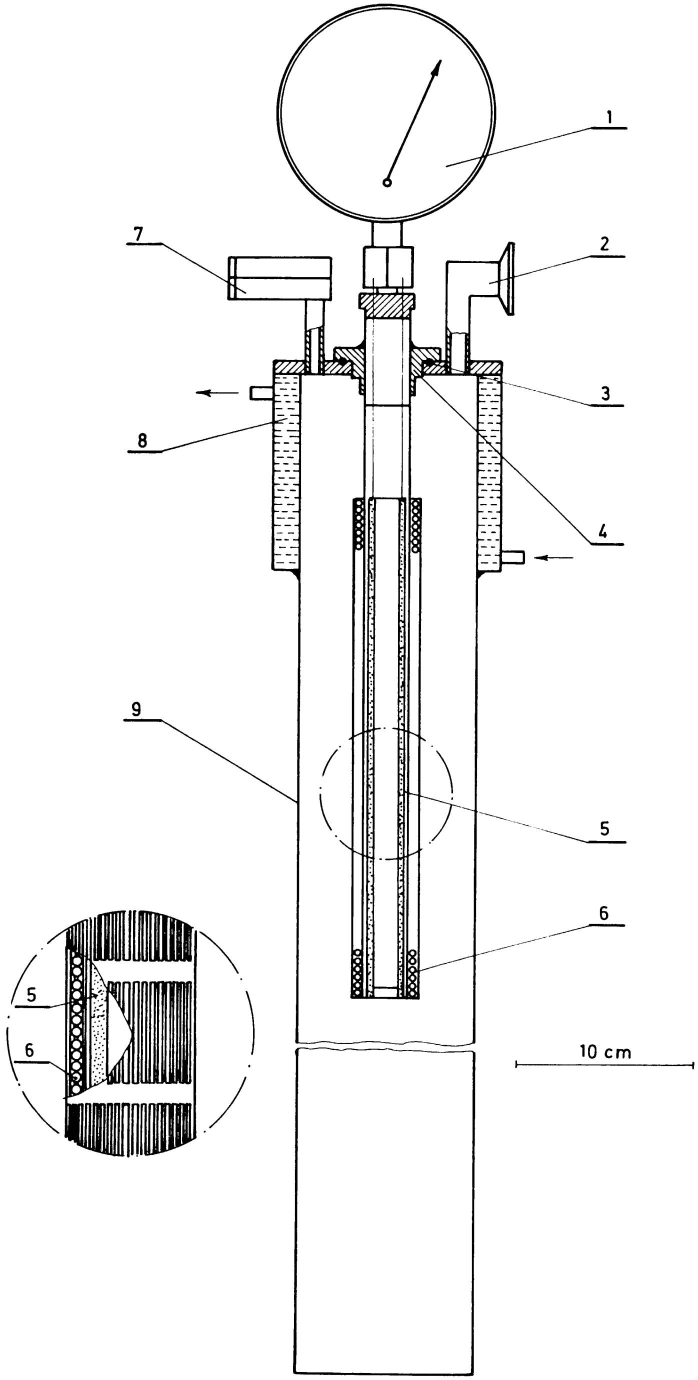

Fig 1. The methane convertor. 1—pressure gauge; 2—vacuum pump flange; 3—Viton O-ring; 4—catalyst holder; 5—heater; 6—catalyst; 7—H_2 and CO_2 inlet valve; 8—cooling coil; 9—stainless steel tank.

prior to contamination. Therefore, another step of gas purification follows the vacuum distillation. The next step of gas purification consists of passing methane through red hot copper turnings and a column filled with Anhydrone and Ascarite. No thermal decomposition of methane has been observed at the working temperatures of 650°C. Copper at elevated temperatures removes, effectively, any trace of oxygen. It remains bright after prolonged use, being constantly flushed with methane. Anhydrone and Ascarite remove water vapor and CO_2, respectively. High purity methane, thus obtained, has excellent counting properties; the resolution of the proportional counter filled up to 3 atm with purified gas is ≈16.5 percent for ^{55}Fe source.

Routine testing of gas purity is performed by measuring the counting rate in the middle of the initial steep part of the plateau curve. A 1 mCi ^{226}Ra source is carefully positioned in a fixed place close to the counter, providing a constant exposure rate. The counting rate at the chosen steep part of the plateau is extremely sensitive to gas contamination; this simple method replaces pulse height analysis which requires expensive electronics. Any gas sample that does not reach an empirically determined counting rate when exposed to the fixed dose rate at the selected voltage is subjected to the repeated purification.

Counting procedure and computer processing of data

Because of frequent disturbances in the power network as well as electronic failures, it was necessary to divide the measurement of sample activity into 20min intervals. Thus, long lasting measurements are not lost if a failure occurs. Besides, the statistical processing of data enables

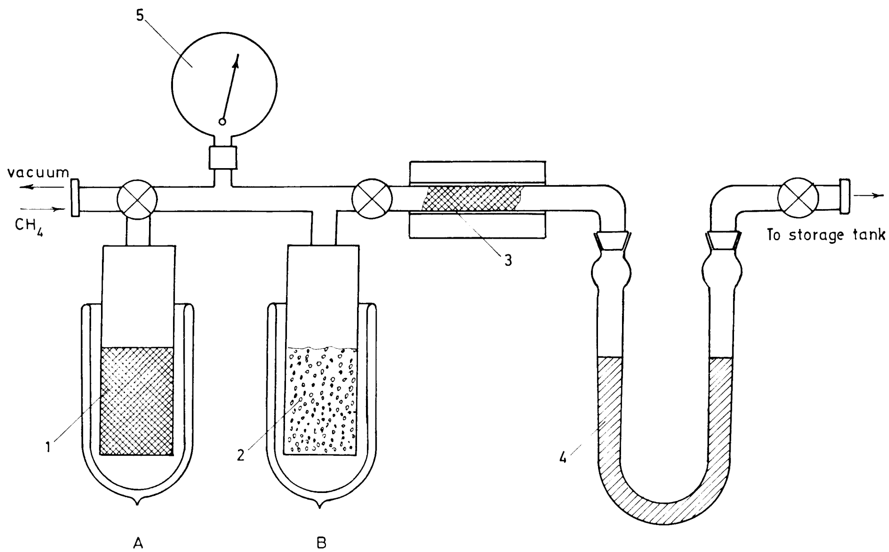

Fig 2. The methane purifier. 1—Cu turnings; 2—Silicagel; 3—Cu turnings; 4—Anhydrone-Ascarite filling; 5—pressure gauge.

the rejection of data that do not fit into statistical distribution (Chauvenet's criterion). Analysis of data printed on a strip chart revealed two effects that influenced the measurement: 1) the barometric effect, and 2) changing of the gas multiplication factor. A reciprocal correlation was found between the background count rate and the barometric pressure.

The mean coefficient $A = \overline{\Delta B}/\Delta P$ has been evaluated from experimental data. Averaged over a year, the mean coefficient, A, can be expressed as follows:

$$A = \frac{\overline{\Delta B}}{\Delta P} = \frac{\overline{B} - B}{\overline{P} - P} = -\ 0.0136\ \text{CPM/Torr} \qquad (1)$$

where $\overline{B}$ is the mean background counting rate at the mean yearly barometric pressure $\overline{P}$, which is equal to 748 Torr in our case. B and P correspond to sample background count and the mean barometric pressure during the measurement, respectively. The relative mean change of the background count rate is equal to –0.0024CPM per torr, at the present background count rate of 5.65CPM. Rearranging eq 1,

$$\overline{B} = B + A\Delta P \qquad (2)$$

is obtained.

The background count rate does not depend very much on small variations of gas pressure inside the counter. On the contrary, sample count rate depends on the total amount of gas in the counter; hence, eq 3 takes into account the difference between the filling temperature and the reference temperature (18°C) *and* the barometric effect:

$$S - \overline{B} = [S(P,T) - B(P)]\ T/T_r$$
$$S - \overline{B} = [S(P,T) - (\overline{B} - A\Delta P)]\ T/T_r \qquad (3)$$

S denotes the sample gross count rate reduced to the mean barometric pressure and the reference temperature. S(P,T) is the actual sample gross count rate at the barometric pressure, P, and temperature, T°K. T_r is the reference temperature, and T is the actual temperature at the moment of filling of the counter. Sample, standard, and background activities presented in section 3, have been calculated by using eq 3.

Although eq 3 helps correct the data, the correlation coefficient has been relatively low; this means that the standard deviation of the coefficient, $\overline{\Delta B}/\Delta P$, is large, and consequently, the correction for the change of barometric pressure is not perfect. Obviously, the barometric pressure is not the only parameter that influences the background counting rate.

The changing gas multiplication factor is caused by increasing contamination of the counter gas during the storage and counting period. The main source of gas contamination is outgassing of containers, gas lines and the counter, and air leakage or diffusion of air through gaskets, o-rings, et cetera. Deterioration of gas counting properties was also observed in the course of counting. Changing of the gas multiplication factor during gas storage has been suppressed by filling the gas containers with silicagel, which acted as a purifier probably absorbing polyatomic contaminants and accelerating elimination of free oxygen in the highly reducing atmosphere. Deterioration of gas during the counting cannot be completely eliminated. It could be diminished, though, by keeping the gas lines and the counter under the working pressure of methane all the time, strictly preventing exposure to air. The counting time should be comparable for background, standard, and sample measurement. A small correction of counting rate (0.06 percent per hour over 48^h) has been applied, based on the experimentally observed drop of counting rate for prolonged measurement, by extrapolating to the "standard" 48hr measurement. Computer processing of data greatly facilitates calculation of corrections, statistical evaluation of data, and final calculation of $\Delta^{14}C$, percent modern, and the age of a sample. Details of computer processing are presented elsewhere (Obelić and Planinić, 1975).

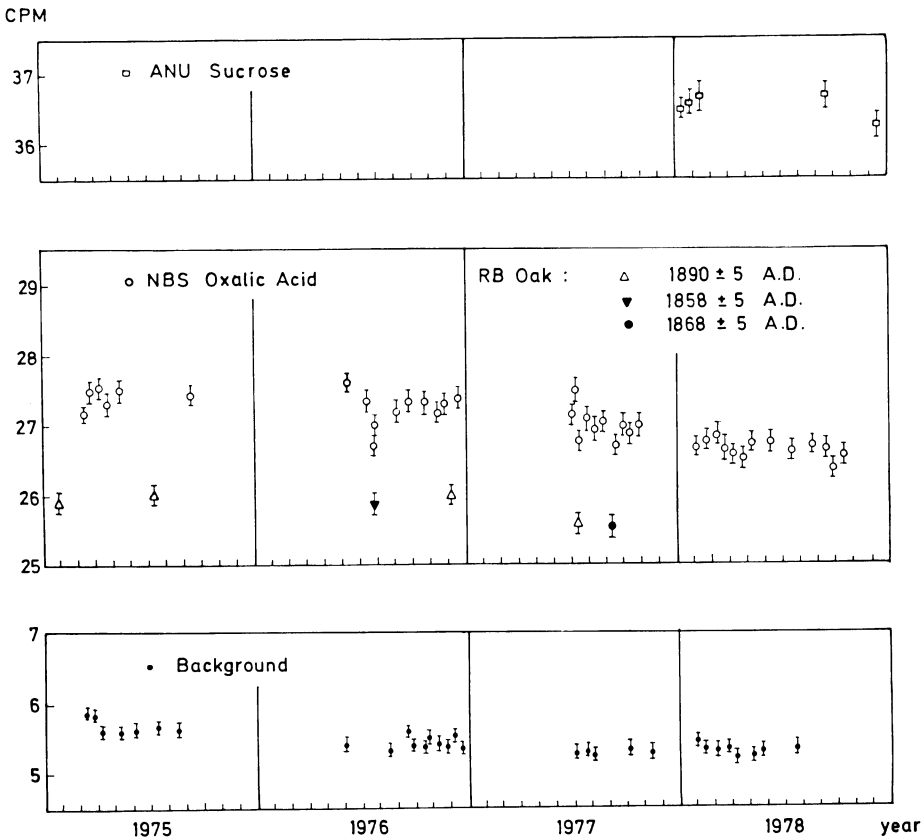

Fig 3. Measurement of activity of the NBS oxalic acid, the ANU sucrose, the RB oak tree rings, and the background.

RESULTS

Experimental data

The results of measurement of the NBS oxalic acid standard, ANU sucrose, RB oak tree rings grown in years 1858 and 1890, and the background count rate are presented in figure 3.

Counting rates of the NBS oxalic and the background varied slightly in the period 1975 to 1979 due to minor adjustments of electronic and gas gains. Therefore, measurements of standard and background activities are grouped and mean values calculated for each set of data. These values are used appropriately for measurements of samples in 1975 through 1978.

Wood samples were prepared from an oak tree grown on site, Rudjer Bošković Inst (45° 49′ N, 15° 59′ E) 180m above MSL, felled in 1973. Tree rings were counted at the Faculty of Forestry, Univ Zagreb. Ten tree rings corresponding to years 1858 ± 5, 1868 ± 5, and 1890 ± 5 were cut from a large wood disk. Wood samples were treated with 4 percent HCl and 4 percent NaOH as described (Srdoč, Breyer, and Sliepcevic, 1971, p 135).

Calculation of ratios

Using the weighted mean values from figure 3, the following ratios were obtained between the activity of various samples, corrected for isotopic fractionation:

$$\frac{\text{Net ANU Sucrose CPM}}{\text{Net NBS Oxalic acid} \times 0.95} = 1.5012 \pm 0.0032$$

The $\delta^{13}C$ ratios of NBS oxalic acid and the ANU sucrose samples prepared at our laboratory were measured by H Polach, ANU, Canberra, Australia and gave the following values:

NBS oxalic acid $\delta^{13}C$: -18.6 ± 0.4

ANU sucrose $\delta^{13}C$: -11.4 ± 0.4

The ratio between the ^{14}C activity of the oak wood tree rings grown nominally in 1858, 1868, and 1890, converted to year 1950 and the activity of the NBS oxalic also corrected for decay is presented in table 1. The activities are corrected for isotopic fractionation (Ox $\delta^{13}C = -19‰$, wood $\delta^{13}C = -24‰$). The mean ratio A_{wood}/A_{ox} shown in table 1 for samples of wood grown before industrial era (Suess effect) and nuclear weapon tests is 0.949 ± 0.004 which is in agreement with the accepted value, 0.95.

TABLE 1

$$\frac{A_{\text{wood (1858} \pm \text{5 yr)}}}{A_{\text{NBS oxalic}}} = 0.955 \pm 0.008$$

$$\frac{A_{\text{wood (1868} \pm \text{5 yr)}}}{A_{\text{NBS oxalic}}} = 0.944 \pm 0.004$$

$$\frac{A_{\text{wood (1890} \pm \text{5 yr)}}}{A_{\text{NBS oxalic}}} = 0.949 \pm 0.004$$

ACKNOWLEDGMENT

The authors wish to express their gratitude to Henry Polach for mass-spectrometric measurements and interest in our work. Thanks are due to Mrs E Hernaus for sample preparation.

REFERENCES

Polach, H A and Krueger, H A, 1972, Isotopic fractionation of NBS oxalic acid and ANU-sucrose radiocarbon dating standards: Internat conf on radiocarbon dating, 8th, Wellington, New Zealand, Proc, p H121.

Srdoč, D, Breyer, B, and Sliepčević, Adela, 1971, Ruder Bošković Institute radiocarbon measurements I: Radiocarbon, v 13, p 135-140.

Obelić, B and Planinić, J, 1977, Computer processing of ^{14}C and ^{3}H Data; statistical tests and corrections of data: Internat conf on low radioactivity measurements, High Tatras, Bratislava, Czechoslovakia, 1975, Proc, p 117.

Polach, H A, 1976, Arizona 1850 wood and ANU sucrose radiocarbon dating standards: Progress rept on international cross-calibration with NBS oxalic acid, *in* Berger, R and Suess, H, eds, Internat radiocarbon dating conf, 9th La Jolla, Proc: San Diego, California, in press.

[RADIOCARBON, VOL. 21, No. 3, P. 329-338]

ANU RADIOCARBON DATE LIST VII

H A POLACH, B G THOM,* and G M BOWMAN*

Compiled by Stella Wilkie

Radiocarbon Dating Research Laboratory, Australian National University, Canberra, Australia

Along SE coast of Australia a variety of Holocene barriers composed of siliceous sand and shell detritus occur within bedrock-confined embayments. On basis of morphostratigraphy 4 barrier types are recognized: prograded, stationary, receded and episodic transgressive dunes. Several subtypes are also distinguished. Composite bay barriers involving partial eolian reworking of a prograded barrier constitute most complex examples of Holocene depositional sequences on this coast. The present list is a preliminary attempt at defining the age structure of a group of such barriers (excepting receded type). Ages are reported in *conventional years* BP. Text references to ages and age ranges are *environmental effect corrected* ages BP* and yr* (as recommended by Stuiver and Polach, 1977), using 450 ± 35 yr as postulated by Gillespie and Polach (in press) in order to relate Australian oceanic environment shells to terrestrial environment wood. $\delta^{13}C$ errors, where based on measurement, are always ± 0.2‰ and are not shown in the text; when based on estimated values (*Est*) the error is given.

Samples were obtained by power-auger drilling, coll by B G Thom, Dept Biogeog and Geomorph, Australian National University and G M Bowman, Geography Dept, Sydney University, and subm by Dept Biogeog and Geomorph. Except where noted, cleaned shelly sand or shell sample was hydrolyzed with HCl under vacuum and released CO_2 recovered for further processing prior to ^{14}C analysis.

Reworking of mollusks and their redeposition at a later date in the sediment body in a dynamic nearshore or beach face environment have been considered by Bernard *et al* (1962) and Curray *et al* (1969). These workers have designated certain samples "anomalously old". However, in this list, consistency of pattern is prime guide to assessing reworking effect. In areas studied in detail (eg, Moruya, see fig 1), failure to find young dates below upper shoreface deposits limits the likelihood of all dates being reworked; all Holocene dates are assumed to date the period of deposition unless otherwise stated.

ACKNOWLEDGMENTS

We wish to acknowledge the significant contribution to the management of the laboratory made by J Golson who is Chairman of the ANU Radiocarbon Committee. Mass spectrometry was carried out by HAP at the University of Waikato, Dept of Chemistry, Hamilton, New Zealand, and we wish to thank A T Wilson for permission to do so. The excellent

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work of the laboratory's senior staff, John Head and John Gower, made this report possible.

Prograded Barriers

Moruya series

Located N of Moruya R, New South Wales (35° 53′ S, 150° 09′ E). Narrow drainage basins sculptured into folded Palaeozoic metasediments, which are locally capped by Tertiary basalts and fluvial gravels, are blocked by bay-head barrier which is composed of 40-50 beach ridges. Four ^{14}C dates on shell hash and organic muds were obtained from the transgressive facies. Eighteen ^{14}C dates on shell fragments were obtained from nearshore regressive unit, from which 5 age groups (4 relic, 1 modern) have been id (fig 1).

ANU-1117. $D^{14}C = -531.9 \pm 4.4‰$ **6100 ± 80**
$\delta^{13}C = +1.1‰$

Shell hash (1240 min count).

ANU-1118. $D^{14}C = -521.7 \pm 4.4‰$ **5920 ± 70**
$\delta^{13}C = +1.1‰$

Shell hash (1320 min count).

ANU-1197. $D^{14}C = -518.0 \pm 4.3‰$ **5860 ± 70**
$\delta^{13}C = +0.6‰$

Shell hash (1460 min count).

ANU-1119. $D^{14}C = -515.2 \pm 5.5‰$ **5820 ± 90**
$\delta^{13}C = +1.3‰$

Shell hash (760 min count).

ANU-1198. $D^{14}C = -515.9 \pm 4.3‰$ **5830 ± 70**
$\delta^{13}C = +1.2‰$

Shell hash (1480 min count).

ANU-1200. $D^{14}C = -542.8 \pm 4.6‰$ **6290 ± 80**
$\delta^{13}C = +0.6‰$

Shell hash (1180 min count).

ANU-1116. $D^{14}C = -458.8 \pm 4.5‰$ **4930 ± 70**
$\delta^{13}C = +1.2‰$

Shell hash (1300 min count).

ANU-1199. $D^{14}C = -471.1 \pm 5.0‰$ **5120 ± 80**
$\delta^{13}C = +1.1‰$

Shell hash (1100 min count).

ANU-1400. $D^{14}C = -489.9 \pm 5.4‰$ **5410 ± 90**
$\delta^{13}C = +1.1‰$

Shell hash (880 min count).

ANU-1138. $D^{14}C = -475.5 \pm 4.1‰$ **5180 ± 60**
$\delta^{13}C = +0.8‰$

Shell hash (1820 min count).

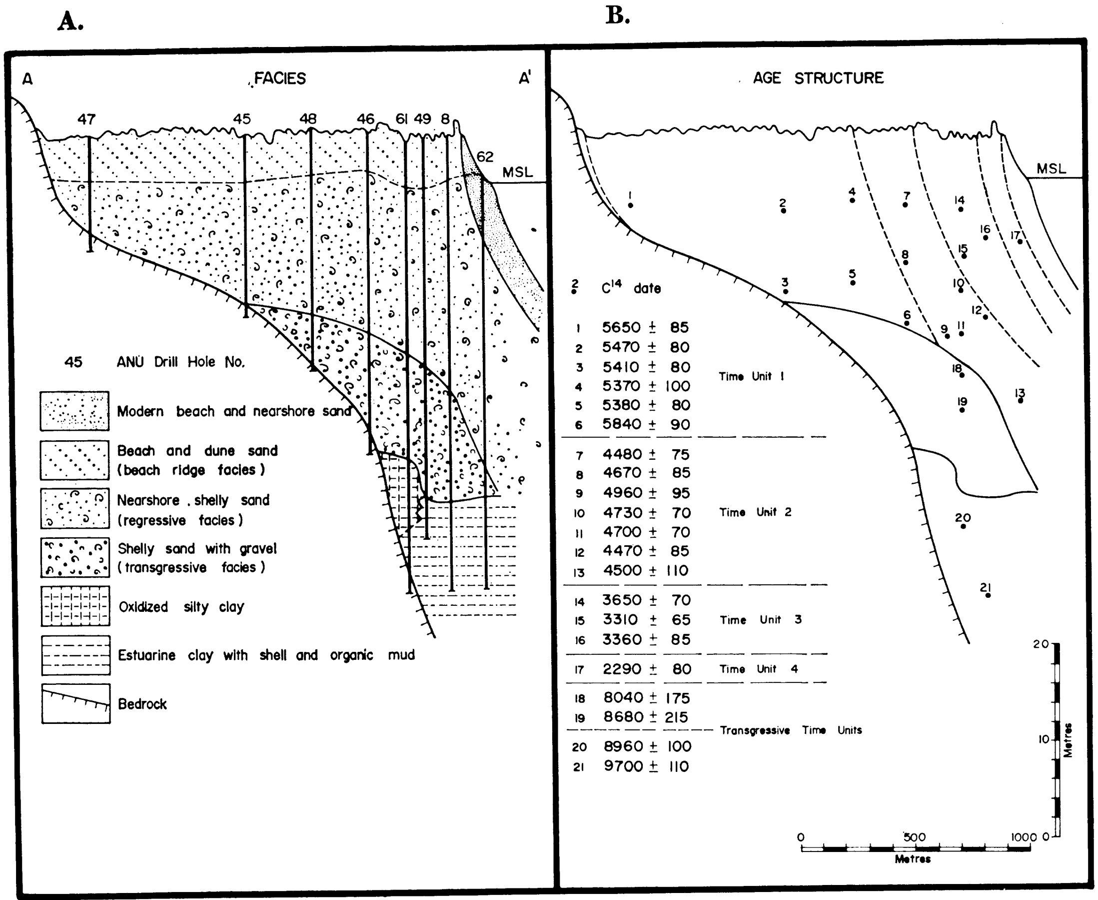

Fig. 1. Cross section of Moruya beach-ridge plain showing (A) facies and (B) ages structure. Time-lines are estimated on basis of ^{14}C dates from uppermost shelly sand samples. All dates listed in (B) are environmentally corrected ^{14}C ages BP* except organic matter dates, Nos. 20 & 21.

ANU-1139. **$D^{14}C = -473.2 \pm 4.0‰$** **5150 ± 60**
$\delta^{13}C = +1.1‰$

Shell hash (1960 min count).

ANU-1398. **$D^{14}C = -458.3 \pm 5.5‰$** **4920 ± 80**
Est $\delta^{13}C = +1.0 \pm 0.5‰$

Shell hash (900 min count).

ANU-1399. **$D^{14}C = -460.2 \pm 6.9‰$** **4950 ± 100**
$\delta^{13}C = +1.1‰$

Shell hash (680 min count).

ANU-1115. **$D^{14}C = -399.9 \pm 4.7‰$** **4100 ± 60**
$\delta^{13}C = +1.1‰$

Shell hash (1320 min count).

ANU-1137. **$D^{14}C = -374.0 \pm 4.3‰$** **3760 ± 60**
$\delta^{13}C = +1.0‰$

Shell hash (1920 min count).

ANU-1114. **$D^{14}C = -377.4 \pm 6.1‰$** **3810 ± 80**
$\delta^{13}C = +1.0‰$

Shell hash (1080 min count).

ANU-1397. **$D^{14}C = -289.4 \pm 6.1‰$** **2740 ± 70**
$\delta^{13}C = +0.7‰$

Shell hash (880 min count).

ANU-1140. **$D^{14}C = -652.4 \pm 7.4‰$** **8490 ± 170**
$\delta^{13}C = +0.4‰$

Shell hash. Dilution, 40% sample (1980 min count).

ANU-1141. **$D^{14}C = -678.9 \pm 8.1‰$** **9130 ± 210**
$\delta^{13}C = +0.9‰$

Shell hash. Dilution, 39% sample (2000 min count).

ANU-1133. **$D^{14}C = -672.1 \pm 4.0‰$** **8960 ± 100**
Est $\delta^{13}C = -24.0 \pm 2.0‰$

Organic mud, boiled in 2N HCl (1740 min count).

ANU-1132. **$D^{14}C = -700.8 \pm 3.9‰$** **9700 ± 110**
Est $\delta^{13}C = -24.0 \pm 2.0‰$

Organic mud, boiled in 2 N HCl (1720 min count).

ANU-1523. **$D^{14}C = -435.4 \pm 5.3‰$** **4590 ± 80**
$\delta^{13}C = +0.8‰$

Shell hash (1020 min count).

General Comment (BT): Holocene depositional history of Moruya embayment may be summarized as follows: 1) Between ca 10,000 and 8500 ^{14}C yr* ago a low-relief barrier stood 30 to 40m below present sea level and seaward of present shoreline. Estuarine sediments accumulated behind this transgressing barrier. Vertical and landward growth of barrier may have ceased between ca 8500 and 8000 ^{14}C yr*. 2) Rapid marine transgression from 8000 to 6000 ^{14}C yr* took sandy open-ocean shoreline to the head of the embayment, blocking off narrow drowned valleys in which estuarine shelly muds were rapidly accumulating. 3) From close to 6000 to ca 2500 ^{14}C yr* ago shoreline prograded by mechanism of multiple beach-ridge formation. Pattern of progradation was episodic. Four phases have been recognized. First resulted in deposition of more than half beach-ridge plain. This led to a marked change in environmental conditions in drowned valleys from estuarine to freshwater swamp. 4) Relative shoreline stability has characterized last 2500 ^{14}C yr* in embayment during which a complex hummocky foredune has formed.

Fens series

N of Port Stephens (32° 38′ S, 152° 12′ E), New South Wales. Embayment contains (Pleistocene) Inner and (Holocene) Outer Barriers. Both barriers composed of well-developed sets of beach ridges (Langford-Smith and Thom, 1969, pl III). An interbarrier depression 1 to 2km wide, occupied in part by diverted Lower Myall R, separates 2 barriers. Outer Barrier beach-ridge plain is 1km wide and contains 20 ridges. Dates are on Outer Barrier and interbarrier depression samples.

ANU-1665. $D^{14}C = -492.2 \pm 6.9‰$ **5440 ± 110**
Est $\delta^{13}C = +1.0 \pm 1.0‰$

Shell hash (1040 min count).

ANU-1527. $D^{14}C = -583.5 \pm 11.2‰$ **7040 ± 220**
$\delta^{13}C = +1.1‰$

Shell hash. Dilution, 27% sample (1520 min count).

ANU-1666. $D^{14}C = -499.4 \pm 6.2‰$ **5560 ± 100**
$\delta^{13}C = 0.0‰$

Shell hash (1040 min count).

ANU-1335. $D^{14}C = -528.2 \pm 30.1‰$ **6030 ± 530**
Est $\delta^{13}C = +1.0 \pm 1.0‰$

Shell hash. Dilution, 10% sample (1300 min count).

ANU-1336. $D^{14}C = -462.8 \pm 21.7‰$ **4990 ± 330**
$\delta^{13}C = +0.3‰$

Shell hash. Dilution, 14% sample (1500 min count).

ANU-1528. $D^{14}C = -463.3 \pm 6.4‰$ **5000 ± 100**
Est $\delta^{13}C = +1.0 \pm 1.0‰$

Shell hash (1000 min count).

ANU-1529. $D^{14}C = -595.4 \pm 9.8‰$ **7270 ± 200**
$\delta^{13}C = +1.0‰$

Shell hash. Dilution, 34% sample (1460 min count).

ANU-1531. $D^{14}C = -411.1 \pm 13.2‰$ **4250 ± 180**
$\delta^{13}C = +1.5‰$

Shell hash. Dilution, 25% sample (1440 min count).

ANU-1532. $D^{14}C = -403.7 \pm 5.4‰$ **4150 ± 70**
$\delta^{13}C = +1.6‰$

Shell hash (1040 min count).

ANU-1530. $D^{14}C = -532.0 \pm 5.0‰$ **6100 ± 90**
$\delta^{13}C = +1.5‰$

Shell hash (1000 min count).

General Comment (BT&GB): minimum ANU ^{14}C dates, and others (Thom *et al*, 1978) from nearshore facies show that most Outer Barrier progradation occurred during the period 5000 to 3300 ^{14}C yr BP*. Barrier appears to have ceased growing seaward since that period, or alternatively, has been eroded back to its present position removing later phases of progradation.

Age structure of 'backbarrier' or quiet-water interbarrier deposits suggests near vertical growth between 7000 and 5000 ^{14}C BP*. From mollusk composition a sandy partially enclosed bay is inferred which opened to S toward Port Stephens. Rich shelly facies rise close to present sea level in that direction. At site of section this unit dates 6800 to 6600 ^{14}C yr BP* at 13m below MSL (ANU-1527, -1529), but 4km to S, at −4m MSL a similar fauna dates 4990 ± 115 ^{14}C yr BP* (ANU-1665).

Following stages can be recognized in develop of Outer Barrier at Fens: 1) A low relief barrier that only partially enclosed a faunal-rich sandy bay was initiated within Fens embayment at least 7000 ^{14}C BP*, when sea level was ca 10 to 15m below its present position. 2) After sea level reached its present position, ca 6000 ^{14}C yr BP*, a narrow, low sand barrier probably formed a highly mobile open-ocean shoreline, subjected to periodic washover and eolian instability. Relevant date is ANU-1530 (5650 ± 95 ^{14}C yr BP*). 3) First phase of progradation occurred between 5000 and 4500 ^{14}C yr BP*. Critical dates for this event are ANU-1336 and GaK-1469, -1470 (see Thom *et al*, 1978) from within nearshore shelly facies and ANU-1528 on estuarine shells near contact with coarse beach sands. 4) Along seaward margin of Outer Barrier over last 3000 ^{14}C yr* or so a complex foredune has developed which is now undergoing extensive eolian erosion, esp at N end.

Wonboyn series

Embayment at Wonboyn on far S coast of NSW (37° 16′ S, 149° 57′ E) has extensive beach-ridge plain which is 1.6km wide and contains max of 60 beach ridges.

ANU-1396. $D^{14}C = -362.2 \pm 10.5‰$ **3610 ± 130**
$\delta^{13}C = +1.0‰$

Shell hash. Dilution, 38% sample (1080 min count).

ANU-1584. $D^{14}C = -315.9 \pm 7.9‰$ **3050 ± 90**
$\delta^{13}C = +1.4‰$

Shell hash (980 min count).

ANU-1585. $D^{14}C = -521.8 \pm 5.0‰$ **5930 ± 90**
$\delta^{13}C = +1.4‰$

Shell hash (1000 min count).

General Comment (BT&GB): sample ANU-1585 (5480 ± 95 yr BP*) coll from beneath inner edge of beach-ridge plain 1.4km from shoreline is consistent with ages from other sites of regressive shelly sands loc at rear of Outer Barriers. Wonboyn plain shows younger ages towards present shoreline with ANU-1396 (3160 ± 135 yr BP*) at 600m inland and ANU-1584 (2600 ± 100 yr BP*) at 500m.

Stationary Bay Barriers

Merimbula

On S coast New South Wales (36° 54′ S, 149° 54′ E). Although barrier possesses a few beach ridges, its narrow width (< 300m), wide back-barrier flat, and arrangement of facies, are typical of stationary bay barriers (Thom *et al*, 1978). In comparison with extensive beach-ridge plains, Merimbula barrier is relatively high, averaging 8 to 10m above MSL. Barrier consists of a thin wedge of near-shore shelly sand overlain by leached, well-sorted quartzose sands. However, shelly sands are not as clearly graded coarse to fine downward as in case of prograded barriers. A ^{14}C date of 5530 ± 85 ^{14}C yr BP* (ANU-1404) has been obtained from seaward side of barrier at depth of 7m below MSL.

ANU-1404. $D^{14}C = -525.0 \pm 4.5‰$ **5980 ± 80**
$\delta^{13}C = +1.4‰$

Shell hash (1380 min count). *Comment* (BT): stratigraphic pattern at Merimbula and other localities where stationary bay barriers have been drilled suggests 2 main phases of deposition. First commenced as transgressing Holocene sea entered embayments. Between ca 8000 and 7000 ^{14}C yr* ago transgressive barrier beach facies started to accumulate vertically as well as recede slowly inland. Behind beach washover processes initiated deposition of a relatively thick backbarrier sand facies (up to 20m). Second phase of barrier development occurred after sea level reached its present position (ca 6000 ^{14}C yr BP*). During this phase back-barrier deposition became a less active process as foredune ridges grew in height. Progradation, if it took place at all, occurred ca 5500 ^{14}C yr* ago. Thus, present shoreline position of stationary bay barriers dates from ca 5000 ^{14}C yr BP*.

Episodic Dune Barries

Eurunderee

At Eurunderee, near Myall Lakes (32° 29′ S, 152° 22′ E), Holocene Outer Barrier is composed of active sand blowouts and stabilized parabolic dunes. Elongate blowouts up to 1km in length penetrate N along troughs and up terminal walls of stabilized parabolic dunes (Thom, 1965, pl 1), most landward side of Outer Barrier overlies peats of interbarrier depression which date 3620 ± 130 ^{14}C yr BP (ANU-1673).

ANU-1673. D^{14}C = −362.8 ±6.3‰ **3620 ± 130**

Est δ^{13}C = −24.0 ±2.0‰

Organic soil, treated with hot HCl (980 min count). *Comment* (BT): episodic dune bay barriers contain either a predominantly eolian sequence both above and below sea level, or a transgressive-regressive marine sand sequence below sea level covered by mid- to late-Holocene dunes (eg, Bherwerre; Thom *et al*, 1978). In both cases, buried peats and soils, plus morphologic "nesting", attest to episodes of transgressive dunes (parabolic or long-walled types) followed by phases of vegetation stabilization of free-moving sand surfaces.

Composite Bay Barriers

Newcastle Bight series

Newcastle Bight, N coast of New South Wales (32° 48′ S, 151° 55′ E) is best studied example of a composite barrier. Morphologically barrier consists of a small area of beach-ridge plain exposed at E end and 3 long-walled transgressive ridges (2 stabilized plus seaward ridge, still mobile) which have overrun rest of barrier. 5 cross-sections have established gen stratigraphy (Ly, 1976) and show characteristic arrangement of sedimentary facies beneath barrier. Thom *et al* (1978, figs 8, 9) give morphologic map of area.

Inner Barrier surface lies buried by shelly transgressive sand sheet from which 4 dates have been obtained: 9520 + 1590 − 1330 ^{14}C yr BP* (ANU-1330), 8500 ± 145 ^{14}C yr BP* (ANU-1676), 8260 ± 295 ^{14}C BP* (ANU-1526) and 8100 ± 165 ^{14}C yr BP* (ANU-1677). Above this sheet is a wedge-shaped unit composed of near-shore shelly sand. Early mid-Holocene phase of progradation suggested by 6070 ± 125 ^{14}C yr BP* (ANU-1525). ANU-1675 (6770 ± 225 ^{14}C yr BP*) is also from this unit, but shell sample was probably reworked from older deposit. From within mobile dunes, an *in situ* tree stump was exhumed on deflated windward side and yielded age of 300 ± 70 ^{14}C yr BP (ANU-1331). There is no evidence of beach ridges amongst long-walled ridges, but landward stabilized long-walled ridge (Ridge I) has clearly overrun beach ridges to N and E. Ridge I also directly overlies either estuarine muds, containing a rich molluskan fauna (ANU-1332, 4310 ± 105 ^{14}C yr BP*), or backbarrier flat sands, on its landward side. Second vegetated long-walled ridge (Ridge II) more or less parallels shoreline and rests upon beach and nearshore sand facies. Seaward, active ridge front of mobile dune sheet (Ridge III) is burying old beach ridges at E end of barrier, transgressing swampy deflation surface of Ridge II. Figs 8 and 9, Thom *et al* (1978) show these features.

ANU-1330. D^{14}C = −710.9 ±51.5‰ **9970 +1580 −1320**

Est δ^{13}C = +1.0 ±1.0‰

Shell hash. Dilution, 6% sample (900 min count).

ANU-1526. $D^{14}C = -661.9 \pm 11.9‰$ **8710 ± 290**
$\delta^{13}C = +1.8‰$

Shell hash. Dilution, 28% sample (1220 min count).

ANU-1525. $D^{14}C = -556.0 \pm 6.8‰$ **6520 ± 120**
$\delta^{13}C = +1.4‰$

Shell hash (1020 min count).

ANU-1332. $D^{14}C = -447.2 \pm 6.7‰$ **4760 ± 100**
$\delta^{13}C = +1.9‰$

Shell hash (1280 min count).

ANU-1675. $D^{14}C = -592.8 \pm 10.8‰$ **7220 ± 220**
$\delta^{13}C = +1.5‰$

Shell hash. Dilution, 34% sample (1020 min count).

ANU-1676. $D^{14}C = -671.8 \pm 5.6‰$ **8950 ± 140**
$\delta^{13}C = +1.1‰$

Shell hash (1040 min count).

ANU-1677. $D^{14}C = -655.1 \pm 6.7‰$ **8550 ± 160**
$\delta^{13}C = +1.1‰$

Shell hash (1040 min count).

ANU-1678. $D^{14}C = -702.1 \pm 4.3‰$ **9730 ± 120**
$\delta^{13}C = +0.5‰$

Shell hash (1020 min count).

ANU-1679. $D^{14}C = -970.1 \pm 6.8‰$ **28,180 ± 2100**
$\delta^{13}C = 0.0‰$

Shell hash. Dilution, 40% sample (1440 min count).

ANU-1331. $D^{14}C = -36.0 \pm 7.8‰$ **300 ± 70**
Est $\delta^{13}C = -24.0 \pm 2.0‰$

Wood (1020 min count).

General Comment (BT&GB): 1) Basal transgressive shelly sand facies at −40m overlies oxidised pre-Inner Barrier clay. Shells date 27,730 ± 2100 ^{14}C yr BP* (ANU-1679), which, if assumed to reflect true age of deposition, supports est of −41 ± 1m for the 28,000 yr BP* low sea level determined from Reef complex II on the Huon Peninsula (Bloom *et al*, 1974). 2) Non-calcareous sand 4m thick, here interpreted as a nearshore-beach sand leached during Last Glacial sea level min. 3) Slightly muddy sand, rich in estuarine or open bay mollusks, at −25 to −30m, could reflect backbarrier sedimentation 9000 to 10,000 ^{14}C yr* ago (ANU-1678). 4) Shelly sand facies, quite coarse and containing granules, assoc with last phase of marine transgression. Shells which date 8100 ± 165 ^{14}C yr BP* (ANU-1677) and 8500 ± 145 ^{14}C yr BP* (ANU-1676) could have been reworked upward from more seaward barrier as argued for Moruya. 5) Thick backbarrier sand wedge interfingering with 4). 6) Nearshore shelly sand facies which overlies 4) and coarsens upward into tabular beach sand unit. Nearshore shelly sand is associated with sedimentary regression which formed "core" of Outer Barrier at present sea level. 7) Barrier is surmounted by 3 massive, cross-bedded sand bodies up to 30m thick. Two vegetated dune ridges, I and II, possess different degrees of soil development indicating discrete phases of deposition, followed by currently active phase III which is at least 300 ^{14}C yr old (ANU-1331).

SUMMARY

Episodic history of Holocene barriers in NSW is suggestive of synchronous processes initiating phases of marine regression or beach-ridge progradation, vertical foredune accretion, foredune erosion and destruction, transgressive dune mobilization, and vegetative colonization. Termination of postglacial marine transgression ca 6000 ^{14}C yr BP* on this coast and subsequent attainment of beach-nearshore equilibrium may explain rapid transfer of sand from offshore to onshore. In comparison with other coastal barriers, which have been documented by ^{14}C dating (eg, Bernard *et al*, 1962, Galveston I.), bay barriers of SE Australia exhibit more diverse age structures in that they commenced and generally ceased progradation earlier than N Hemisphere counterparts, although rates of progradation were similar at times of max accretion (3 to 6m/yr; Thom *et al*, 1978). Subsequent episodes may be best explained by secular variations in storminess and wave climate in Tasman Sea. Extent to which these variations correlate with mid to late Holocene global changes in climate (and/or slight undocumented changes in sea level) remains unknown.

References

Bernard, H A, Le Blanc, R J, and Major, C F, 1962, Recent and Pleistocene geology of Southeast Texas, *in*: Rainwater, E H and Zingula, R P (eds), Geology of the Gulf Coast and Central Texas and guidebook of excursions: Houston, Houston Geol Soc, p 175-224.

Bloom, A L, Broecker, W S, Chappell, John, Matthews, R S, and Mesolella, K J, 1974, Quaternary sea level fluctuations on a tectonic coast: new Th^{230}/U^{234} dates from the Huon Peninsula, New Guinea: Quaternary Research, v 4, p 185-205.

Curray, J R, Emmel, F J, and Crampton, P J S, 1969, Holocene history of a strand plain, lagoonal coast, Nayarit, Mexico, *in*: Lagunas Costeras, un Simposio, Mexico, UNAM-UNESCO, p 61-100.

Gillespie, R and Polach, H A, 1977, The suitability of marine shells for radiocarbon dating of Australian prehistory, *in*: Internatl conf on radiocarbon dating 9th, Proc, Univ California, Los Angeles and San Diego, in press.

Langford-Smith, T and Thom, B G, 1969, Coastal morphology of New South Wales: Geol Soc Australia Jour, v 16, p 572-580.

Ly, C K, 1976, Depositional and mineralogical studies of Quaternary sedimentation in the Newcastle-Port Stephens area of New South Wales: unpub PhD thesis, Univ Newcastle, Newcastle, New South Wales, Australia.

Stuiver, M and Polach, H A, 1977, Reporting of ^{14}C data: a discussion: Radiocarbon, v 19, p 358-363.

Thom, B G, 1965, Late Quaternary coastal morphology of the Port Stephens-Myall Lakes area, NSW: Royal Soc New South Wales Jour, v 98, p 23-36.

Thom, B G, Polach, H A, and Bowman, G M, 1978, Holocene age structure of coastal sand barriers in New South Wales, Australia: Occ monos, Dept Geog, Fac Military Studies, Univ New South Wales, 86 p.

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BRITISH MUSEUM NATURAL RADIOCARBON MEASUREMENTS XI

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The following list consists of dates for archaeologic samples measured over the period from June 1974 to July 1976. The dates were obtained by liquid scintillation counting of benzene using a Model 3315 Packard Tri-carb Liquid Scintillation Spectrometer linked to a Hewlett Packard 2100A computer system for on-line processing of counting data (Hall & Hewson, 1977). The laboratory procedures used were essentially those outlined in previous lists (see, eg, BM-VIII, R, 1976, v 18, p 16).

Sample materials were pretreated with dilute acid and alkali as appropriate; only the collagen fraction of antler and bone was used for dating.

The dates are expressed in radiocarbon years relative to AD 1950 based on the Libby half-life for ^{14}C of 5570 yr, and are corrected for isotopic fractionation ($\delta^{13}C$ values are relative to PDB). No corrections have been made for natural ^{14}C variations. The modern reference standard is NBS oxalic acid. Errors quoted with the dates are based on counting statistics alone and are equivalent to $\pm$ 1 standard deviation ($\pm 1\sigma$).

Descriptions, comments and references to publications are based on information supplied by the persons who submitted the samples.

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SAMPLE DESCRIPTIONS

ARCHAEOLOGIC SAMPLES

A. British Isles

BM-221. Oakhanger, Selborne, Hampshire **7869 ± 104**
$\delta^{13}C = -25.0‰$

Charcoal (*Pinus sylvestris* L, id by G W Dimbleby) from Site V, Oakhanger warren, Selborne, Hampshire, England (51° 05′ N, 0° 55′ W, Natl Grid Ref SU 760350) assoc with Mesolithic industry and settlement site immediately underlying cultivated soil (Rankine, 1952; Rankine *et al*, 1960). Coll ca 1950 by W F Rankine. *Comment*: though poorly stratified, Oakhanger is important site which has yielded large assemblage of Mesolithic flint artifacts now in British Mus colln.

BM-402. Upton Pyne, Devonshire **3336 ± 53**
$\delta^{13}C = -24.7‰$

Charcoal (*Quercus* sp) from Barrow 248b, 1km N of Upton Pyne, Exeter, Devonshire, England (50° 45′ N, 3° 30′ W, Natl Grid Ref SX 914990). Sample was in Urn 4 inverted on old ground surface in central sand core of barrow (Pollard & Russell, 1970). Coll 1967 by Sheila Pollard, Devon Archaeol Soc; subm by Henrietta Miles, Dept Extra-Mural Studies, Univ Exeter. *Comment*: Urn 4 was assoc with urn (no. 3) of Trevisker series (ApSimon & Greenfield, 1972); both were slightly subsequent to primary series Collared Urn inverted in small cist in old ground surface, and approx contemporary with "Wessex biconical" Urn (no. 1) inverted over cremation of infant. Date is 150 to 200 yr earlier than expected (ApSimon, 1976), possibly due to use of large timbers for funeral pyre.

Picken's Hole, Somerset

Collagen from animal bone fragments from Picken's Hole cave and rock shelter site, Crook Peak, Compton Bishop, Mendip, Somerset, England (51° 15′ N, 5° 55′ W, Natl Grid Ref ST 396550). Coll 1963 and subm by E K Tratman, Univ Bristol Spelaeol Soc, and A M ApSimon, from layers in talus slope containing 2 distinct faunal assemblages; uppermost layer dated (3) contained human remains and stone artifacts (Tratman, 1964).

BM-654. Picken's Hole **34,265 +2600 −1950**

Ref M30, Layer 3, Sample 3A; hyaena, rhinoceros, mammoth layer containing teeth of *Homo* sp, *cf sapiens*; Upper Pleistocene deposit, expected date ca 23,000 to 40,000 BP.

BM-655A. Picken's Hole **26,650 +1700 −1400**

Ref M30, Layer 5, Sample 5(I); lower bone layer dominated by wolf and bear (*Ursus arctos* L) with reindeer, red deer and bovid; interstadial deposit, expected date older than 40,000 BP.

BM-655B. Picken's Hole **27,000 +1850 −1500**

$\delta^{13}C = -22.5‰$

Ref M30, Layer 5, Sample 5(I); check measurement on BM-655A using fresh sample.

General Comment (AMA & RB): dates are in reverse order relative to apparent stratigraphy and date of ca 27,000 BP for Layer 5 (BM-655A) is much later than expected from faunal and pedologic evidence indicating mild interstadial conditions; other dates from NW Europe indicate open periglacial conditions ca 27,000 BP. Check measurement BM-655B confirms result but sample from Layer 5 was chemically weathered and may have been contaminated; some samples from this layer contained no collagen. Stone artifacts from sub-layer below 3A indicate industry of terminal Middle Palaeolithic facies for which date not later than ca 35,000 BP would be expected. BM-654 agrees with this and with pattern of other available dates for mid last-glaciation (Devensian) interstadials.

BM-729. Cattedown Cave, Devonshire **15,125 ± 390**
$\delta^{13}C = -24.7‰$

Collagen from tibia of reindeer (*Rangifer tarandus* L) from Cattedown Cave, Plymouth, Devonshire, England (50° 20′ N, 4° 05′ W, Natl Grid Ref SX 490537). Tibia (ref CBR 15.6.74/3) was from assoc group of bones representing hind part of single skeleton from late Pleistocene fill. Coll 1974 by B Lewarne; subm by A J Sutcliffe, Dept Palaeontol, British Mus (Nat Hist) as part of program for dating late-glacial and post-glacial mammals in British Isles (R, 1976, v 18, p 30). *Comment* (AJS): date corresponds with time of glacial advance and low sea level inferred from field evidence (Sutcliffe & Lewarne, 1977); human skeletal remains of possible Pleistocene age were found in 1886 in cave filling ca 60m away in same Devonian limestone formation (Worth, 1887; 1888).

Pilsgate, Lincolnshire

Two charcoal samples from Bronze age cremation burial at Barnack Road, Pilsgate, Lincolnshire, England (52° 40′ N, 0° 25′ W, Natl Grid Ref TF 049069) assoc with Collared Urn and Food Vessel (Pryor, 1974). Coll 1971 and subm by F M M Pryor for Nene Valley Research Comm.

BM-868. Pilsgate **3522 ± 38**
$\delta^{13}C = -24.6‰$

BM-869. Pilsgate **3296 ± 50**
$\delta^{13}C = -22.5‰$

General Comment: dates generally agree with those previously established for British Bronze age ceramics; their span may well reflect variable composition of pyre material.

Stonehenge Avenue, Amesbury, Wiltshire

Two antlers of red deer (*Cervus elaphus* L) from separate excavations of Stonehenge Avenue, Stonehenge, Amesbury, Wiltshire, England (51° 10′ N, 1° 50′ W, Natl Grid Ref SU 122422). Sample 1 coll 1973 and subm by G Smith, Dept Environment; Sample 2 coll 1923 by W Hawley and subm 1974 by R J C Atkinson, Dept Archaeol, Univ College, Cardiff, from colln of Salisbury Mus.

BM-1079. Stonehenge Avenue **3020 ± 180**
$\delta^{13}C = -24.8‰$

Sample 1. Collagen from antler from lower layer of ditch 55C(5), E end of Avenue (Smith, 1973). *Comment*: *cf* date, 2750 ± 100 (I-3216) for antler and domestic animal bone from middle of Avenue (Atkinson *et al*, 1976).

BM-1164. Stonehenge Avenue **3678 ± 68**
$\delta^{13}C = -23.7‰$

Sample 2. Collagen from antler (Salisbury Mus ref no. 4765) at base of ditch, SW end of NW Avenue. *Comment* (RJCA): date agrees with that for another antler at base of SE ditch NE of Heel Stone, 3720 ± 100

(HAR-2013, unpub), but not with dates for middle and E end of Avenue, 2750 ± 100 (I-3216); 3020 ± 180 (BM-1079, above). It may be inferred that Avenue is of 2 periods of construction.

Gorsey Bigbury, Somerset

Charcoal (mainly *Quercus* sp) and domestic animal bone samples (ref T.186) from Class 1 henge monument at Gorsey Bigbury, Cheddar, Somerset, England (51° 20′ N, 2° 45′ W, Natl Grid Ref ST 485558). Coll 1931-1934 by S J Jones; subm 1973 by A M ApSimon, Dept Archaeol, Univ Southampton. Samples came from Beaker occupation layer in fill of ditch (Jones, 1938).

BM-1086. Gorsey Bigbury **3663 ± 61**
$\delta^{13}C = -26.5‰$

Charcoal, ref CH2.

BM-1087. Gorsey Bigbury **3602 ± 71**
$\delta^{13}C = -27.8‰$

Charcoal, ref CH7.

BM-1088. Gorsey Bigbury **3800 ± 74**
$\delta^{13}C = -26.5‰$

Charcoal, ref CH9.

BM-1089. Gorsey Bigbury **3782 ± 62**
$\delta^{13}C = -26.8‰$

Charcoal, ref CH13.

BM-1090. Gorsey Bigbury **3666 ± 117**
$\delta^{13}C = -17.1‰$

Collagen separated from animal bone (Sample 1).

BM-1091. Gorsey Bigbury **3606 ± 67**
$\delta^{13}C = -22.6‰$

Collagen separated from animal bone (Sample 2).

General Comment (AMA): dates as expected with very good agreement between bone and charcoal; assoc pottery is late Bell Beaker, *cf* Lanting & van der Waals (1972) "steps" 5 and 6, predicted date ca 3750 to 3500 BP. Range of dates is consistent with 60 to 100 yr occupation estimated on archaeol evidence. Henge was probably constructed ca 200 radiocarbon yr earlier (ApSimon *et al*, 1976).

BM-1097. Grime's Graves, Norfolk **3084 ± 44**
$\delta^{13}C = -25.0‰$

Charcoal from surface feature (Trench 10, Layer 5, Sample 26) adjacent to Neolithic flint mine shaft at Grime's Graves, Weeting, Thetford, Norfolk, England (52° 30′ N, 0° 40′ E, Natl Grid Ref TL 816898). Coll 1972 and subm by R J Mercer, Dept Environment. For other samples in this series, see R, 1976, v 18, p 32-33; see also Mercer (1976).

BM-1102. Hartmann globe **100.2 ± 0.6 % modern**
$\delta^{13}C = -23.9‰$

Wood (probably Ash, *Fraxinus* sp) drilled from sphere of Hartmann terrestrial globe from colln of Natl Maritime Mus, Greenwich, London, England (51° 30′ N, 0° 0′ E). Subm by A D Baynes-Cope, Research Lab, British Mus. *Comment* (ADB-C): globe is similar to that shown in Holbein's painting "The Ambassadors", AD 1533, and to other globes in Helsinki colln formed in late 19th century by Count Nordenskiold, founder of modern cartography. Measurement shows unequivocally that mount is modern, ca AD 1890, and further work has since shown that map is also modern and not remounted 16th century map as previously believed (Baynes-Cope, ms in preparation).

Clegyr Boia, Dyfed

Charcoal samples (mainly *Quercus* sp, *Corylus avellana,* and some *Betula alba,* id by H A Hyde) from Clegyr Boia, a hill-fort of Iron age type having previous Neolithic occupation and later Dark age (6th century AD) legendary assoc (Baring-Gould, 1903; Williams, 1952), on St David's peninsula, Dyfed (Pembrokeshire), Wales (51° 50′ N, 5° 20′ W, Natl Grid Ref SM 737251). Coll 1943 by Audrey Williams, Ancient Monuments Inspectorate and subm 1973 by W F Grimes on behalf of Natl Mus Wales, Cardiff, to date Neolithic occupation and later construction of hill-fort.

BM-1109. Clegyr Boia **2370 ± 29**
$\delta^{13}C = -26.3‰$

Sample ref CBa, b, c from Neolithic occupation (hut and midden). *Comment* (WFG): date is unacceptable; samples were stratigraphically earlier than Iron age defences and had unequivocal Neolithic assoc.

BM-1110. Clegyr Boia **1950 ± 116**
$\delta^{13}C = -20.4‰$

Sample ref CBd from area of burning contemporary with structure near entrance to hill-fort. *Comment* (WFG): sites of Clegyr Boia type are thought, based on unclear evidence, to range through prehistoric Iron age into Dark age and, to this extent, date is acceptable.

BM-1111. Pond Cairn, Mid-Glamorgan **3506 ± 51**
$\delta^{13}C = -25.4‰$

Charcoal (mainly gorse, *Ulex* sp, and *Quercus* sp, id by H A Hyde) from primary Middle Bronze age assoc (Fox, 1938; 1959) in Pond Cairn, Coity, Mid-Glamorgan, Wales (51° 30′ N, 3° 30′ W, Natl Grid Ref SS 915812). Coll 1937 by Sir Cyril Fox and subm 1973 by W F Grimes, to date Collared Urn accompanying primary burial. *Comment* (WFG): date is acceptable.

BM-1112. Ogmore-by-Sea, Mid-Glamorgan **4659 ± 52**
$\delta^{13}C = -25.4‰$

Charcoal from a Late Neolithic occupation layer in sand-dunes on S side of mouth of Ogmore R, Sutton, Ogmore-by-Sea (Pen-y-bont), Mid-

Glamorgan, Wales (51° 30′ N, 3° 40′ W, Natl Grid Ref SS 863756). Coll ca 1968 by D P Webley and subm 1973 by H N Savory, Natl Mus Wales, Cardiff, to date basal layer of occupation deposit assoc with Peterborough ware. *Comment* (HNS): date agrees with date of 4320 ± 80 (HAR-1140, unpub) for burnt hazel nuts (*Corylus* sp) from upper part of same layer assoc with Cord-impressed ware (Webley, 1976, p 35, note 44); both dates are slightly earlier than expected.

Nant Maden, Powys

Charcoal samples from Early Bronze age round cairn at Nant Maden, Cwm Cadlan, Penderyn, Powys, Wales (51° 45′ N, 3° 30′ W, Natl Grid Ref SN 971105). Coll ca 1961 by D P Webley and subm 1973 by H N Savory, to date primary and secondary structures within 3-period cairn.

BM-1113. Nant Maden **3518 ± 51**
$\delta^{13}C = -20.5‰$

Sample ref 3. Charcoal from surface of D-shaped enclosure forming primary (Beaker) structure of cairn.

BM-1114. Nant Maden **3475 ± 36**
$\delta^{13}C = -26.4‰$

Sample ref 4. Charcoal assoc with cremation deposit and sherds of Collared Urn inserted in wall of ruined D-shaped primary structure before secondary cairn built.
General Comment (HNS): dates are in right order and quite acceptable.

BM-1118. Twyn-y-Gaer, Gwent **2236 ± 38**
$\delta^{13}C = -25.4‰$

Charcoal (ref CS5) from last rebuilding of fence delimiting annexe of Twyn-y-Gaer hill-fort, Cwmyoy, Gwent, Wales (51° 55′ N, 3° 30′ W, Natl Grid Ref SO 294219). Coll ca 1970 by L A Probert and subm 1973 by H N Savory, to fix date of Period I of hill-fort (Probert, 1976).

BM-1119. Portsdown, Hampshire **3009 ± 57**
$\delta^{13}C = -22.6‰$

Collagen from post-cranial bones of human skeleton (ref 541/1972) from Southwick Hill crossroads, Portsdown, Portsmouth, Hampshire, England (50° 50′ N, 1° 05′ W, Natl Grid Ref SU 648066). Crouched burial of female of 15-17 yr in shallow grave, assoc with double-ended cup of "Vase-support" type (Piggott, 1938). Coll 1972 and subm by D J Rudkin, Portsmouth City Mus. *Comment*: although later than expected, result is comparable with dates for Wessex culture assemblages from Earls Barton, BM-680, 3169 ± 51; BM-681, 3214 ± 64; Hove, BM-682, 3189 ± 36, and Edmondsham, BM-708, 3069 ± 45 (R, 1976, v 18, p 26, 29).

Thatcham, Berkshire

Two wood samples (*Salix* sp) from Avenell's Cottages Sec, Thatcham, Berkshire, England (51° 20′ N, 1° 15′ W, Natl Grid Ref SU 526656). Samples were dated as part of Kennet Valley Research Committee program for interdisciplinary study of Mesolithic sites. Coll 1975 and subm by G H Cheetham, Dept Geog, Univ Reading.

BM-1135. Thatcham **8929 ± 71**
$\delta^{13}C = -25.5‰$

Sample TS/A from 1.7m depth in peat, 10cm above junction of peat and clay. Cellulose fraction only.

BM-1136. Thatcham **9223 ± 100**
$\delta^{13}C = -27.8‰$

Sample TS/B from 1.8m depth at junction of peat and clay. Whole wood; pretreated with acid and alkali.

General Comment: samples date depositional and palaeoecologic changes in region with important series of Mesolithic sites (Churchill, 1962; Froom, 1976; Wymer, 1962); terrestrial mollusks in deposits underlying samples show transitions conforming with scheme proposed by Kerney (1977) for zonation of late-glacial and postglacial deposits.

Graveney, Kent

Two wood samples (*Quercus* sp) from boat found during cutting of drainage dyke at Graveney Marsh, 1.6km NW Graveney, Kent, England (51° 20′ N, 1° 0′ E, Natl Grid Ref TR 065638). Coll 1970 and subm by J M Fletcher, Research Lab Archaeol, Univ Oxford.

BM-1137. Graveney **1178 ± 38**
$\delta^{13}C = -25.9‰$

Wood from timbers of boat (Strake S3D).

BM-1138. Graveney **1095 ± 37**
$\delta^{13}C = -25.3‰$

Wood from timbers of boat (Strake S3D).

General Comment (RB): when these dates are corrected for "growth allowance" of timber (yr between known felling date and rings analyzed) and for natural ^{14}C variations, and taken with other dates in series (R, 1976, v 18, p 24-25) date of AD 944 ± 30 for construction of boat is obtained (Burleigh, 1978; Fenwick, 1972; 1978; Fletcher *et al*, 1978).

BM-1148. Bratton Down, Devonshire **2832 ± 42**
$\delta^{13}C = -24.8‰$

Charcoal (ref BRD/46) from cremation burial in barrow at Bratton Down, Bratton Fleming, Devonshire, England (51° 10′ N, 3° 45′ W, Natl Grid Ref SS 662377) assoc with sherds of Trevisker Style IV vessel. Coll 1973 and subm by Henrietta Miles, Dept Extra-Mural Studies, Univ Exeter. *Comment* (HM): result gives 1st indication of dating of late Trevisker series pottery and suggests barrow building in region continued into 1st millennium BC.

Milfield, Northumberland

Two charcoal samples from ditch fill of henge monument at Milfield North, 0.5km N of Milfield village, Wooler, Northumberland, England (55° 35′ N, 2° 10′ W, Natl Grid Ref NT 934349). Coll 1975 and subm by A F Harding, Dept Archaeol, Univ Durham.

BM-1149. Milfield North **3774 ± 39**
$\delta^{13}C = -25.8‰$

Sample 6 from burnt layer in middle silt of ditch (ca 50cm above Sample 15, BM-1150), SW sec, beside S entrance.

BM-1150. Milfield North **3801 ± 62**
$\delta^{13}C = -24.7‰$

Sample 15 from primary silt of ditch, SW sec, beside S entrance.

General Comment (AFH): closeness of dates suggests rapid infilling of ditch; no firm cultural assoc with ditch fill but large grave-pit in ditch contained sherds similar in type to pottery known in SW Scotland as "Beaker-Food Vessel". Charcoal from a 2nd grave-pit containing an Early Bronze age globular vessel was dated to 3750 ± 80 (HAR-1199, unpub).

Breiddin, Powys

Four charcoal samples from occupation deposits at Breiddin hill-fort, Powys, Wales (52° 35′ N, 3° 0′ W, Natl Grid Ref SJ 292144). Coll 1975 and subm by C R Musson, Clywd-Powys Archaeol Trust. See R, 1976, v 18, p 34-35 for other dates in this series.

BM-1158. Breiddin **2151 ± 31**
$\delta^{13}C = -25.0‰$

Sample BO4A from occupation layer behind rampart.

BM-1159. Breiddin **2142 ± 31**
$\delta^{13}C = -24.3‰$

Sample BO4C from occupation deposit behind rampart.

BM-1160. Breiddin **2108 ± 31**
$\delta^{13}C = -25.4‰$

Sample BO4E from floor of roundhouse behind rampart.

BM-1161. Breiddin **2141 ± 28**
$\delta^{13}C = -25.6‰$

Sample BO4G from refuse outside roundhouse behind rampart.

General Comment (CRM): deposits had accumulated behind rampart with *terminus post quem* of 2220 ± 90 (QL-1080, unpub); stratigraphic sequence was BM-1160, -1161, -1158, -1159 (BM-1160 earliest) for which individual dates are not distinguishable.

B. Ecuador

Southern Sierra series

Charcoal samples from sites in Southern Sierra region of Ecuador (ca 3° S, 80° W). Coll 1972-1974 and subm by W Bray, Inst Archaeol, Univ

London, and Elizabeth Carmichael, Mus Mankind, London. Dates help determine relationship between early pottery sites in coastal and Sierra regions. See R, 1977, v 19, p 148-149 for other dates in this series.

BM-905. El Carmen (lower) **2446 ± 50**
$\delta^{13}C = -24.2‰$

Sample ref 8C4.

BM-906. Chaullabamba **2800 ± 48**
$\delta^{13}C = -25.3‰$

Sample ref 14 (Conejero).

BM-907. Chaullabamba **2964 ± 50**
$\delta^{13}C = -19.1‰$

Sample ref 14B14ii.

BM-908. Chaullabamba **2784 ± 50**
$\delta^{13}C = -23.0‰$

Sample ref 14B29.

BM-909. Cerro Narrio **904 ± 59**
$\delta^{13}C = -22.6‰$

Sample ref 12C1a.

BM-910. Cahuashin Chico **Modern**
$\delta^{13}C = -24.0‰$

Sample ref 7B.

BM-911. Las Juntas **1970 ± 46**
$\delta^{13}C = -24.7‰$

Sample ref 58, 20cm (5.9.75).

BM-912. Villa Jubones **3181 ± 53**
$\delta^{13}C = -21.5‰$

Sample ref 56, Unit 1, Level 9.

BM-914. Sumay Pamba **2348 ± 52**
$\delta^{13}C = -26.1‰$

Benigno Malo excavation.

General Comment (EC): dates so far obtained for sites between Cuenca basin and Jubones R accord well with archaeol evidence (Grijalva, 1975) and confirm anticipated relationship with Chorrera phase of coastal Ecuador. BM-899 (R, 1977, v 19, p 149) and BM-914 above, were from sites S of Jubones R with distinct sherd assemblages. BM-909 from much disturbed site of Cerro Narrio was assoc with coarse pottery from separate location than BM-896 (R, 1977, v 19, p 149).

C. Egypt

BM-1139. Lentils **2112 ± 48**
$\delta^{13}C = -20.4‰$

Lentil seeds (*Lens culinaris*) from colln of Dept Egyptian Antiquities, British Mus. Coll in Egypt (ca 25° N, 30° E) ca 1834 by J Sams; exact provenience unknown. Seeds were infested in antiquity by beetles of family *Bruchidae*; recent examination showed these were of previously unknown sp; sample was dated for this reason, as direct historical evidence was lacking (Burleigh & Southgate, 1975).

D. Ethiopia

BM-1153. Gobedra **2806 ± 53**
$\delta^{13}C = -21.1‰$

Collagen from comminuted bone fragments (ref GBD/B/2a) from Gobedra rock-shelter, Gobedra hill, 6km W of Axum, Tigre prov, Ethiopia (14° 10′ N, 38° 45′ E) assoc with final phase of local "Late Stone Age" microlithic industry. Coll 1974 and subm by D W Phillipson, British Inst in E Africa, Nairobi. *Comment*: date is as expected for final phase of pottery-assoc microlithic industry (Phillipson, 1977).

E. Greece

BM-1074. Kouros figure **3817 ± 140**
$\delta^{13}C = -13.3‰$

Wood (*Acacia* sp, possibly *A negevensis, A seyal* or *A tortilis,* id by M Y Stant, Royal Botanic Gardens, Kew) from battered kouros human figure of 1/3-1/2 life-size, reputedly found on Aegean island of Samos (37° 45′ N, 26° 50′ E) ca 1939. Subm by A W Johnston, Dept Classical Archaeol, Univ College London. *Comment* (AWJ): figure was expected to be either Greek original of ca 475 BC or modern copy; early date and wood id suggest Egyptian XII Dynasty origin with possible Greek re-working; conflict of stylistic and other evidence precludes more definite attribution (Johnston, 1975).

Servia

Charcoal samples from Neolithic and Early Bronze age levels at Servia, W Macedonia, Greece (40° 10′ N, 22° 0′ E). Coll 1972-1973 and subm by Cressida Ridley, British School Archaeol at Athens and R N L B Hubbard, Inst Archaeol, Univ London.

BM-1103. Servia **6880 ± 49**
$\delta^{13}C = -25.2‰$

Sample 8; middle phase of Middle Neolithic (Sesklo).

BM-1104. Servia **6747 ± 51**
$\delta^{13}C = -25.1‰$

Sample 9; middle phase of Middle Neolithic (Sesklo).

BM-1105. Servia **6706 ± 53**
$\delta^{13}C = -24.1‰$

Sample 13; earliest Late Neolithic (Larissa).

BM-1106. Servia **6690 ± 83**
$\delta^{13}C = -23.0‰$

Sample 21; early phase of Middle Neolithic (Sesklo).

BM-1107. Servia **6606 ± 55**
$\delta^{13}C = -24.7‰$

Sample 22; later phase of Late Neolithic (Larissa).

BM-1108. Servia **3694 ± 98**
$\delta^{13}C = -23.8‰$

Sample 23; Early Bronze Age II.

BM-1157. Servia-Varytimidhes **6905 ± 87**
$\delta^{13}C = -24.5‰$

Sample 121; from fill of pit sealed by late Early Neolithic courtyard level.

General Comment (RNLBH): dates for Middle Neolithic (BM-1103, -1104, -1106) are generally acceptable for Sesklo culture but do not conform with stratigraphy at Servia (Rhomiopoulou & Ridley, 1972; 1973; 1974). Because of complicated pattern of post-holes, some dated material may not have originated in levels from which it was recovered. Late Neolithic dates (BM-1105, -1107) are several hundred yr older than expected; dates for Early Neolithic (BM-1157) and Early Bronze age (BM-1108) are ca 500 and 900 yr younger than expected. More Middle and Late Neolithic samples from 1973 excavations will be dated in attempt to clarify these results.

F. Israel

Timna

Charcoal samples from smelting areas and furnaces in Timna Valley, Wadi Arabah, ca 30km N of Elat, Gulf of Aquaba, Israel (34° 55′ N, 29° 45′ E). Coll ca 1974 (except BM-1163, coll 1960) and subm by M F Barbetti, Res Lab Archaeol, Univ Oxford, and B Rothenberg, Dir, Arabah Expedition (Rothenberg, 1972).

BM-1115. Timna **2840 ± 51**
$\delta^{13}C = -23.8‰$

Timna-2, Area E, Pit B, Sample 590; Ramesside smelting area and camp, ca 13-12th century BC.

BM-1116. Timna **1945 ± 309**
$\delta^{13}C = -25.0‰$

Timna-39, sample from wall of Chalcolithic furnace of 4th millennium BC (Rothenberg *et al*, 1978).

BM-1117. Timna **2779 ± 55**
$\delta^{13}C = -13.8‰$

Timna-200, Sample 589; Nabataean melting furnace, 1st century AD.

BM-1162. Timna **2480 ± 35**
$\delta^{13}C = -24.6‰$

Timna-30, Area C5, Stratum I, Sample 632, inclusions in slag; 12th century BC or later.

BM-1163. Wadi Amram **1240 ± 36**
$\delta^{13}C = -24.1‰$

Site 33, Sample 630, inclusions in slag; surface find, coll 1960, from slag heap incorporating material of Early Iron age, ca 12th century BC, and early Arabic date.

General Comment: calibrated date for BM-1115, ca 1100 BC, is consistent with archaeol evidence. BM-1117 came from apparent Nabataean furnace assoc with pottery of 1st century AD but immediately overlying temple of 12th century BC with which calibrated date agrees; furnace may not be assoc with pottery or charcoal may be from lower level. BM-1116 is also apparently invalidated by misassoc. BM-1162 provides date for Stratum I at Site 30; BM-1163 dates late use of slag heap at Site 33.

G. Poland

BM-1128. Saspow **5046 ± 102**
$\delta^{13}C = -25.7‰$

Charcoal from hearth in chipping floor (No. 2/1970) in upper part of infilled shaft (No. 6) of flint mine at Saspow Site I, Olkusz Dist, 25km W of Cracow, Poland (50° 15′ N, 19° 45′ E). Coll 1970 and subm by J Lech, Inst Hist Material Culture, Warsaw. Sample assoc with pottery and flints belonging to late stage of Danubian culture (*cf* Lengyel III-V). *Comment*: date agrees with age expected (Lech, 1972; Dziedussycka-Machnikowa & Lech, 1976) and with date of 5250 ± 90 for Shaft 4 at Saspow (GrN-7052C, unpub). For review of dates for flint mines, see Burleigh, 1975.

H. Romania

BM-1124. Gornea **5871 ± 54**
$\delta^{13}C = -25.8‰$

Charcoal (Ref 1974/57) from Vinča A culture site at Gornea, 10km SE of Moldova Nova, Caras-Severin Dist, Romania (44° 40′ N, 21° 40′ E). Coll 1974 and subm by R N L B Hubbard and J G Nandris, Inst Archaeol, Univ London. Charcoal fragments from Trench 23, Sq 1, Pit 21, Spits 4-6, separated by froth flotation and macerated with H_2O_2 to remove modern contaminants. Sample measured to provide date for beginning of Vinča culture, ca 4400 BC, for which few dates exist, and to test effectiveness of pretreatment procedure. *Comment* (JGN): mean of available dates for "earliest Vinča" material from Hungary and Yugoslavia is ca 4400 BC, some 450 radiocarbon yr earlier than BM-1124, but these are not all identical archaeol assemblages and sites extend over 650km; date for Gornea provides single determination for early but not necessarily earliest Vinča material from another regional sequence (Lazarovici, 1977).

References

ApSimon, A M, 1976, A view of the early prehistory of Wales, *in* Boon, G C and Lewis, J M, eds, Welsh Antiquity: Cardiff, Natl Mus Wales, p 37-53.

ApSimon, A M and Greenfield, E, 1972, The excavation of Bronze age and Iron age settlements at Trevisker, St Eval, Cornwall: Prehist Soc Proc, v 38, p 302-381.

ApSimon, A M, Musgrave, J H, Sheldon, J, Tratman, E K, and van Wijngaarden-Bakker, L H, 1976, Gorsey Bigbury, Cheddar, Somerset—radiocarbon dating, human and animal bones, charcoals, and archaeological reassessment: Univ Bristol Spelaeol Soc Proc, v 14, p 155-183.

Atkinson, R J C, Vatcher, F, and Vatcher, L, 1976, Radiocarbon dates for the Stonehenge Avenue: Antiquity, v 50, p 239-240.

Baring-Gould, S, 1903, The exploration of Clegyr Boia: Archaeologia Cambrensis, v 3, p 1-11.

Burleigh, R, 1975, Radiocarbon dates for flint mines, *in* Internatl symposium on flint, 2d, Maastricht, Netherlands, 8-11 May, 1975: Maastricht, Nederlandse Geol. Vereniging (Staringia No. 3), p 89-91.

__________ 1978, Radiocarbon dating, *in*: Fenwick, V (ed), The Graveney boat: a tenth-century find from Kent (British Archaeol Repts, British series 53): Oxford, BAR, p 105-110.

Burleigh, R and Southgate, B J, 1975, Insect infestation of stored Egyptian lentils in antiquity: Jour Archaeol Sci, v 2, p 391-392.

Churchill, D M, 1962, The stratigraphy of the Mesolithic Sites III and V at Thatcham, Berkshire, England: Prehist Soc Proc, v 28, p 362-370.

Dzieduszycka-Machnikowa, A and Lech, J, 1976, Neolityczne zespoly pracowniane z kopalni krzemienia w Saspowie (The neolithic workshop assemblages from the flint mine of Saspow): Polski Badania Archeol, v 19, p 161-169.

Fenwick, V, 1972, The Graveney boat. A pre-Conquest discovery in Kent: Internatl Jour Naut Archaeol, v 1, p 119-129.

__________ (ed), 1978, The Graveney boat: a tenth-century find from Kent (British Archaeol Repts, British series 53): Oxford, BAR.

Fletcher, J, Tapper, M, and Walker, F, 1978, Tree-ring studies, *in* Fenwick, V, ed, The Graveney boat: a tenth-century find from Kent (British Archaeol Repts, British series 53): Oxford, BAR, p 111-124.

Fox, Sir Cyril, 1938, Two Bronze age cairns in South Wales—Simondston and Pond Cairns, Coity Higher Parish, Bridgend (Glamorgan): Archaeologia, v 87, p 129-180.

__________ 1959, Life and death in the Bronze age: London, Routledge & Kegan Paul.

Froom, F R, 1976, Wawcott III—A stratified Mesolithic succession (British Archaeol Repts, British series 27): Oxford, BAR, p 1-209.

Grijalva, M M, 1975, Las investigaciones arqueologicas en la Sierra Ecuatoriana: Revista de la Universidad Catolica, Quito, v 10 (Año III), p 135-169.

Hall, J A and Hewson, A, 1977, On-line computing and radiocarbon dating at the British Museum: Jour Archaeol Sci, v 4, p 89-94.

Johnston, A W, 1975, Greece and Egypt—a knotty problem: Antiquity, v 49, p 125-128.

Jones, S J, 1938, The excavation of Gorsey Bigbury: Univ Bristol Spelaeol Soc Proc, v 5, p 3-55.

Kerney, M P, 1977, A proposed zonation scheme for late-glacial and postglacial deposits using land mollusca: Jour Archaeol Sci, v 4, p 387-390.

Lanting, J N and van der Waals, J D, 1972, British beakers as seen from the Continent: Helinium, v 13, p 38-58.

Lazarovici, G, 1977, Gornea (Preistorie): Resita (Caiete Banatica 5).

Lech, J, 1972, Odkrycie kopalni krzemienia na stanowisku I w Saspowie, pow. Olkusz (The discovery of a flint mine on Site I at Saspow, Olkusz Dist): Sprawozdania Archeol, v 24, p 37-47.

Mercer, R J, 1976, Grime's Graves, Norfolk—an interim statement on conclusions drawn from the total excavation of a flint mine shaft and a substantial surface area in 1971-72, *in* Burgess, C and Miket, R, eds, Settlement and economy in the third and second millennia BC (British Archaeol Repts, British series 33): Oxford, BAR, p 101-111.

Phillipson, D W, 1977, The excavation of Gobedra rock-shelter, Axum—an early occurrence of cultivated finger millet in northern Ethiopia: Azania, v 12, p 53-82.

Piggott, S, 1938, The early Bronze age in Wessex: Prehist Soc Proc, v 4, p 52-106.

Pollard, S H M and Russell, P M G, 1970, Excavation of round barrow 248b, Upton Pyne, Exeter: Devon Archaeol Soc Proc, v 27, p 49-78.

Probert, L A, 1976, Twyn-y-Gaer hill-fort, Gwent—an interim assessment, *in* Boon, G C and Lewis, J M, eds, Welsh Antiquity: Cardiff, Natl Mus Wales, p 105-119.

Pryor, F, 1974, Two Bronze age burials near Pilsgate, Lincolnshire: Cambridge Antiquarian Soc Proc, v 65, p 1-12.

Rankine, W F, 1952, A Mesolithic chipping floor at The Warren, Oakhanger, Selborne, Hants: Prehist Soc Proc, v 18, p 21-35.
Rankine, W F, Rankine, W M and Dimbleby, G W, 1960, Further excavations at a Mesolithic site at Oakhanger, Selborne, Hants: Prehist Soc Proc, v 26, p 246-262.
Rhomiopoulou, K and Ridley, C, 1972, Prehistoric settlement of Servia (West Macedonia), excavations 1971: Athens Annals Archaeol, v 5, p 27-34.
———— 1973, Prehistoric settlement of Servia (West Macedonia), excavations 1972: Athens Annals Archaeol, v 6, p 419-426.
———— 1974, Prehistoric settlement of Servia (West Macedonia), excavations 1973: Athens Annals Archaeol, v 7, p 351-360.
Rothenberg, B, 1972, Timna—valley of the Biblical copper mines: London, Thames and Hudson.
Rothenberg, B, Tylecote, R F and Boydell, P J, 1978, Chalcolithic copper smelting (Archaeo-Metallurgy, IAMS Mono No. 1): London, Inst Archaeo-Metallurgical Studies.
Smith, G, 1973, Excavation of the Stonehenge Avenue at West Amesbury, Wiltshire: Wiltshire Archaeol Mag, v 68, p 42-56.
Sutcliffe, A J and Lewarne, B, 1977, An unsolved mystery—the age of the almost destroyed human remains from Cattedown Cave, Plymouth: Studies in Speleol, v 3, p 43-48.
Tratman, E K, 1964, Picken's Hole, Crook Peak, Somerset. A pleistocene site, preliminary note: Univ Bristol Spelaeol Soc Proc, v 10, p 112-115.
Webley, D P, 1976, How the west was won—prehistoric land-use in the Southern Marches, *in* Boon, G C and Lewis, J M, eds, Welsh Antiquity: Cardiff, Natl Mus Wales, p 19-35.
Williams, A, 1952, Clegyr Boia, St David's (Pemb): Excavation in 1943: Archaeol Cambrensis, v 102, p 20-47.
Worth, R N, 1887, On the occurrence of human remains in a bone cave at Cattedown: Devon Assoc Adv Sci Trans & Repts, v 19, p 419-437.
———— 1888, The Cattedown bone cave: Plymouth Inst Trans, v 10, p 10-38.
Wymer, J J, 1962, Excavations at the Maglemosian sites at Thatcham, Berkshire, England: Prehist Soc Proc, v 28, p 329-361.

[RADIOCARBON, VOL. 21, No. 3, P. 353-357]

FLORENCE RADIOCARBON DATES IV

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This list comprises age measurements carried out from May 1977 to July 1978. Nearly all the samples are of prehistoric and archaeologic interest. All samples are from Italian territory.

Pretreatment of samples, production of purest CO_2 and counting techniques have been described elsewhere (Azzi, 1972; Azzi *et al,* 1973; Azzi *et al,* 1974). Ages of samples are calculated using the conventional half-life of 5570 + 30 yr and refer to 1950. Errors are stated in terms of one standard deviation of counting statistics.

ACKNOWLEDGMENT

We thank submitters for providing financial support.

SAMPLE DESCRIPTIONS

I. PREHISTORIC AND HISTORIC SAMPLES

Italy

Grotte Verdi di Pradis series

Charcoal from Grotte Verdi di Pradis, Clauzetto Co, Pordenone prov, loc Gecchia in Prealps of Friuli on right side of Tagliamento R (46° 14′ 43″ N, 12° 53′ 14″ E), at + 520m. Coll 1970 and subm 1976 by G Bartolomei and B Sala, Ist Geol and Paleontol Umana Ferrara. Charcoals refer to 2 different caves; accompanying fauna comprises *Marmota marmota* and *Microtus* nivalis, indicating Alpine prairie. Rare human industry is ascribed to Evolved Epigravettian.

F-84. Grotte Verdi di Pradis IIA-2 **11,770 ± 260**

Charcoal from Sec II, Layer 2, Evolved Epigravettian industry.

F-85. Grotte Verdi di Pradis IV,1b **11,250 ± 310**

Charcoal from Sec IV, Layer 1b, Evolved Epigravettian industry.

F-86. Grotte Verdi di Pradis IV,1 **10,970 ± 290**

Charcoal from Sec IV, Layer 1, Evolved Epigravettian industry.

General Comment: dates agree with chronology of Evolved Epigravettian of Northern Italy at Riparo Tagliente, Verona (R-605α: 13,430 ± 180; R-605: 13,330 ± 160; R-604: 12,000 ± 400; R-371: 12,040 ± 170) (Alessio *et al,* 1970). From a paleoclimatic point of view, presence of Alpine prairie at height +520m indicates that reascension of woodland has not yet occurred along with persistence of conditions of tardiglacial aridity.

Altavilla series

Peat from sounding done near Altavilla, Vicenza prov, in alluvial soil of left branch of Pleistocenic Conoid of Agno torrent, which creeps into depression between Lessini mts and Berici hills (45° 31′ 4″ N, 11°

29′ 08″ E). Coll and subm 1976 by G Bartolomei and R Bartolomei, Ist Geol & Paleontol Umana Ferrara.

F-87. Altavilla, −2.10 to −2.20m **3570 ± 90**

F-88. Altavilla, −3.20 to −3.40m **12,240 ± 230**

Date confirms Pleistocene age for Conoid.

F-97. Porto Badisco **6465 ± 185**

Charcoal from basal fireplace of Porto Badisco Cave, 11Km S Otranto, Apulia (40° 04′ 30″ N, 18° 29′ 13″ E). Coll 1970 by G F Lo Porto, Sov Antichità Apulia and subm 1972 by P Graziosi, Ist Antropol, Firenze. First date of settlement important for abundance of industry and rock art related to Neolithic and Early Metal ages.

F-99. Fiesole **990 ± 50**

Wood from a Medieval bucket belonging to Mus Fiesole, Firenze, inventory no. 802. Place of discovery is unknown. Subm 1977 by R Francovich, Ist Archaeol Medioevale Siena. Date agrees with typology.

Dicomano series

Charcoal from core of archaeol layer in open site of Dicomano, Florence prov (43° 53′ 26″ N, 13° 04′ 26″ E). Coll and subm 1976 by L Sarti, Ist Antropol Siena. The analyzed level lies between 2 alluvial layers and contains pottery and lithic industry belonging to Middle Bronze age.

F-103. Dicomano 3 **3280 ± 80**

F-104. Dicomano 4 **3220 ± 80**

General Comment: dates agree with typologic estimate and with other dates as F-73: 2850 ± 80; F-74: 3270 ± 80 (Azzi *et al*, 1977).

Castelcivita series

Charred bones from different levels of Castelcivita Cave, Salerno (40° 29′ 41″ N, 15° 12′ 36″ E). Coll and subm by P Gambassini, Ist Antropol Siena.

F-105. Castelcivita 8 **31,950 ± 650**

Charred bones from Level 8 containing Proto-Aurignacian industry with marginal backed points and carinated endscrapers. Samples is just above Level 9, F-72: 32,930 ± 720 (Azzi *et al*, 1977).

F-106. Castelcivita 12 **>34,000**

Charred bones from Level 12 of Uluzzian age. It underlies F-71: 32,470 ± 650 (Azzi *et al*, 1977).

F-107. Castelcivita 14 **33,220 ± 780**

Charred bones from Level 14, lower part of Uluzzian layer; lithic industry is mainly made up of splintered pieces.

General Comment: good agreement with previous dates and with Early Upper Paleolithic. F-106 seems too old.

F-108. Serino **31,200 ± 650**

Charcoal from level with fireplace in open site near Sala di Serino, Salerno (40° 51′ 28″ N, 14° 51′ 38″ E). Coll and subm 1976 by A Ronchitelli, Ist Antropol Siena. Dated layer underlies volcanites and contains lithic industry of early phase of Upper Paleolithic, probably Aurignacian.

Grotta della Cala series

Charcoal from levels of Epigravettian age in Grotta della Cala, Salerno (40° 00′ 02″ N, 15° 22′ 52″ E). Coll 1974 and subm 1976 by F Martini, Ist Antropol Siena.

F-109. Grotta della Cala, F **10,390 ± 180**

Charcoal from Layer F, final Epigravettian industry.

F-110. Grotta della Cala, H (upper) **12,350 ± 250**

Charcoal from upper cuts of Layer H, final Epigravettian industry.

F-111. Grotta della Cala, H (lower) **12,020 ± 210**

Charcoal from lower cuts of Layer H, final Epigravettian industry. Date agrees with F-21: 12,030 ± 220 (Azzi *et al*, 1973).

F-112. Grotta della Cala, M **14,740 ± 850**

Charcoal from Layer M. Transition between evolved Epigravettian industry and Final Epigravettian age.

F-113. Grotta della Cala, N **16,320 ± 850**

Charcoal from different cuts of Layer N. Upper level of this layer contains Evolved Epigravettian industry of "transitional" phase to the Final Epigravettian age; lower level contains Evolved Epigravettian industry.

General Comment: dates agree with typologic estimate.

Stufles series

Charcoal from little Iron age house uncovered during building excavation in Stufles sec of Bressanone, Alto Adige (46° 43′ 12″ N, 13° 14′ 51″ E). Coll and subm 1977 by L Dal Ri, Sovrintendenza prov ai beni culturali Bolzano. Site is rich in pottery and bronze.

F-114. Stufles, Capanna FE **2320 ± 70**

Charcoal from truss lying on Wall 5.

F-115. Stufles B **2750 ± 70**

Charcoal from hut, Zone 1.

F-116. Stufles LF **2240 ± 80**

Charcoal from truss directed toward corner of Wall 1 and 5.

General Comment: hut reflects characteristics of Rethic house (from Rethic Alps, N Italy). Dates are slightly too old for F-115 and slightly too young for F-114 and F-116.

F-117. Lignitized wood **4370 ± 80**

Partially lignitized wood extracted from clayey matrix of ancient earth movement, presently stabilized, found at crossroad of Piancaldolese and Frassineta prov rds, Toscana (44° 11′ 00″ N, 13° 33′ 17″ E). Coll and subm 1977 by P Galletti, Prov Firenze. Purpose of this date is study of dynamics of earth movements related to formation of Chaotic complex near Apeninic ridge.

F-118. Adige **470 ± 40**

Wood from base of Adige R, loc Fontanella, Veneto (45° 22′ 00″ N, 11° 10′ 10″ E). Coll and subm 1978 by L Sorbini, Mus Civico Storia Nat, Verona. Sample belongs to trunks > 20m long and 2m diam exposed by recent erosion of Adige R.

Brezzo di Bedero series

Wooden wedges from old trusses of Collegiata S Vittore N of Brezzo di Bedero, Varese, on E bank Lago Maggiore (45° 58′ 49″ N, 16° 11′ 8″ E, at +403m). Coll and subm 1978 by F Ramponi, Architect, Milan.

F-119. Brezzo di Bedero **870 ± 40**

Wood from Truss 1.

F-120. Brezzo di Bedero **430 ± 40**

Wood from Truss 2.

F-121. Brezzo di Bedero **380 ± 40**

Wood from Truss 3.

F-122. Brezzo di Bedero **510 ± 40**

Wood from Truss 4.

F-123. Brezzo di Bedero **530 ± 40**

Wood from Truss 5.

F-124. Brezzo di Bedero **960 ± 40**

Wood from Truss 6.

F-125. Brezzo di Bedero **420 ± 40**

Wood from Truss 7.

F-126. Brezzo di Bedero **450 ± 40**

Wood from Truss 8.

F-127. Brezzo di Bedero **480 ± 40**

Wood from Truss 9.

F-128. Brezzo di Bedero **600 ± 40**

Wood from Truss 10.

General Comment: according to records of Roboaldo, Archbishop of Milan (AD 1137), only 2 sides and 3 fine apses of the Romanesque building rebuilt in 12th century on an older church, still remained in view. The old trusses were hidden by vaults built from end of 16th century onwards. Dates confirm that building material from the older church was used, which is previous to AD 1137, and that various modifications took place afterwards. Trusses are still well preserved.

F-129. S Francesco **370 ± 60**

Walled-up wood from 1st room of upper corridor on left side of S Francesco church, Faenza, Toscana (44° 17′ N, 12° 33′ E). Coll and subm 1978 by A Gai, Conserv Cherubini, Florence. Date is related to wider study concerning possible differences in acoustic behavior between antique and modern wood in musical instruments, especially violins.

REFERENCES

Alessio, M, Bella, F, Improta, S, Belluomini, G, Cortesi, C, Turi, B, 1970, University of Rome carbon-14 dates VIII: Radiocarbon, v 12, p 600.

Azzi, C M, 1972, Costruzione e messa a punto di un impianto per datazioni tramite C-14 con il metodo a gas: Riv Sci Preist, v 28, p 197-209.

Azzi, C M, Bigliocca, L, and Gulisano, F, 1977, Florence radiocarbon dates III, v 19, p 165-169.

Azzi, C M, Bigliocca, L, and Piovan, E, 1973, Florence radiocarbon dates I: Radiocarbon, v 15, p 479-487.

——— 1974, Florence radiocarbon dates II: Radiocarbon, v 16, p 10-14.

Gambassini, P, 1976, Grotta di Castelcivita, Notiziario Paleolitico Campania: Riv Sci Preist, v 31, p 294.

[RADIOCARBON, VOL. 21, NO. 3, P. 358-383]

HARWELL RADIOCARBON MEASUREMENTS III

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The dates in this list follow on, approximately chronologically, from Harwell II (R, 1977, v 19, p 400-423) and refer principally to measurements carried out in the period 1975-6. Laboratory techniques have remained essentially unchanged from earlier reports but a full description of the setting-up philosophy and operating procedure of the liquid scintillation counting systems has now been published separately (Otlet and Warchal, 1977).

As before, calculations are based on the Libby half-life of 5568 yr and 0.95 times the NBS oxalic acid standard as 'modern', (both values treated as constants) and AD 1950 as the reference year. All results are corrected for fractionation according to the given $\delta^{13}C$ (wrt PDB) values.

The policy of giving as $\pm 1\sigma$ standard error an estimate of the full replicate sample reproducibility of the laboratory process and not just counting statistics has been continued. Publication of the estimation procedure given at the 9th International Conference on Radiocarbon Dating (Otlet, 1976) is expected shortly.

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I. ARCHAEOLOGIC SAMPLES

A. British Isles

Roxton series

Samples from Ring Ditches at Roxton, Bedfordshire, England (52° 9′ 50″ N, 0° 19′ W, NGR: TL156536). Coll by P J Woodward & A Taylor; subm Jan 1975 by P J Woodward.

HAR-711. ROX73D/Q2/X/16 **1420 ± 70**
$\delta^{13}C = -26.3‰$

Charcoal. *Comment* (PJW): no other evidence of occupation date available but result agrees with stratigraphy of Ring Ditch siltings. Hearth from which sample was taken was cut into a silt layer (resulting from ploughing) containing 3rd century AD Roman pottery.

HAR-997. ROX74B/Q2/338 **3620 ± 80**

$\delta^{13}C = -25.2‰$

Charcoal, AML 744056, from central burial in Ring Ditch B. Cremation in 2 Collared Urns in small pit. *Comment* (PJW): result is satisfactory and agrees well with Bronze age Collared Urns of this type.

HAR-998. ROX74B/Q1/V/23 **7700 ± 170**

$\delta^{13}C = -25.5‰$

Charcoal, AML 744056, found sealed in Ring Ditch B which had been deliberately in-filled soon after construction. *Comments*: small sample accounts for larger than usual error term (PJW): date older than expected. Sample was sealed in primary fill of Ring Ditch which surrounded central burial, dated as HAR-997 qv, and was, therefore, expected to be nearer to, and slightly later than, HAR-997.

HAR-999. ROX74/CQ2/330 **3800 ± 130**

$\delta^{13}C = -25.3‰$

Charcoal, AML 744056, assoc with robbed primary burial urn of Early-Mid Bronze age date. *Comment* (PJW): agrees with probable date of burial urn and HAR-997 qv.

HAR-1000. ROX74/CQ2/339 **3600 ± 80**

$\delta^{13}C = -25.0‰$

Charcoal, AML 744056, sampled for possible assoc with either robbed primary or with secondary burial. *Comment* (PJW): date is satisfactory since intermediate date between HAR-999 and -1001 reinforces hypothesis that this charcoal is not linked entirely with either primary or secondary burials.

HAR-1001. ROX74C/K3/X1/21 **3130 ± 60**

$\delta^{13}C = -25.5‰$

Charcoal, AML 744056, found with mass of cremated bones and 2 bone toggles, presumably representing bagged burial. *Comment* (PJW): this secondary burial was in discrete concentration in central pit below HAR-1000 and -999, which gave earlier dates. Date, some 600 yr later, is satisfactory in that it shows date reversal in pit.

HAR-1002. ROX74C/Q3/X1/11 **3620 ± 80**

$\delta^{13}C = -24.6‰$

Charcoal, AML 744056, from *in situ* fire in larger pit. *Comment* (PJW): as with HAR-1000, intermediate date between robbed primary burial, HAR-999, and secondary burial, HAR-1001, is satisfactory. Sample came from cleaned-out hearth assoc with secondary burial but fill is probably mixture of carbon of secondary and primary dates.

HAR-1003. ROX74C/QI/VI/II9/109 **3200 ± 50**

$\delta^{13}C = -26.0‰$

Charcoal, AML 744056, with cremation in part of inverted urn near bottom of Ring Ditch C, cut into primary fill. *Comment* (PJW): result ties in well with others for Ring Ditches B and C and also with nature of Middle Bronze age urn in which charcoal was contained.

HAR-1004. ROX74C/Q2/V/II **1640 ± 80**
$\delta^{13}C = -26.0‰$

Charcoal, AML 744056, from hearth cut into top silting of Ring Ditch C. *Comment* (PJW): exactly parallel hearth was found on Ring Ditch D and dated to 1420 ± 70, HAR-711. From site evidence, 2 dates were expected to be very nearly the same or, at any rate, closer than 2 results suggest.

Forcegarth series

Samples from series of excavations at Forcegarth Pasture, Forest in Teesdale, Co Durham, England (Fairless & Coggins, 1974; 1978). Samples subm by K J Fairless, Dir Excavations, Middleton St George Coll Educ.

HAR-864. FORCEGAR **1810 ± 70**
$\delta^{13}C = -26.9‰$

Charcoal fragments from floor level of E room of central house at Forcegarth Pasture North (54° 39′ 5″ N, 2° 11′ 40″ W, NGR: NY 875285). Coll Aug 1974 by D Coggins; subm Nov 1974. *Comment* (KJF): result is not inconsistent with coarse Iron age pottery found at same level outside entrance of E room.

HAR-1447. NY875283 **1740 ± 90**
$\delta^{13}C = -26.0‰$

Charcoal from foundation trench of pre-stone period house at Forcegarth Pasture South (54° 38′ 55″ N, 2° 11′ 40″ W, NGR: NY875283). Coll Aug 1975 and subm Dec 1975. *Comment* (KJF): result is not inconsistent with Roman period pottery recovered from succeeding stone phase of house.

Somerset Levels series

Dates reported below refer to samples taken during 1974 and 1975. A short note introducing project with earlier results is given in Harwell II (R, 1977, v 19, p 415-416). Detailed information on archaeology of area and dendrochronol and palaeobot studies under way is reported in Somerset Levels Papers 1 to 5 (Coles *et al*, 1975; 1976; 1977; Coles, 1978; 1979). Unless otherwise stated, all samples coll and subm by J M Coles, Dept Archaeol, Cambridge.

HAR-943. SLP7411 **2980 ± 70**
$\delta^{13}C = -29.8‰$

Wood, AML 744091, from brushwood platform beneath 0.5m peat at Meare Lake, Shapwick (51° 9′ 30″ N, 3° 47′ 30″ W, NGR: ST444406). Platform overlain by wood structure of heavy upper timbers (HAR-683, 3290 ± 70, R, 1977, v 19, p 416). *Comment* (JMC): result suggests that heavy planking used for upper layer was already old when put into use. Date also helps relate Meare Lake structure to other prehistoric material in area (Coles, 1978, p 32, 41).

HAR-944. SLP7412 **2740 ± 70**
$\delta^{13}C = -28.6‰$

Wood, AML 744092, from timbers of dismantled structure at edge of fen, beneath 1 to 2m peat originally but only 0.2m in 1974 (Coles *et al*, 1975) at Withy Bed Copse, Shapwick (51° 8′ 50″ N, 2° 48′ 20″ W, NGR: ST435394). *Comment* (JMC): date provides useful reference for relating this prehistoric material to known wooden structure to N and E of this site.

HAR-945. SLP7413 (Tinney's 1.7:2.6) **3040 ± 70**
$\delta^{13}C = -29.3‰$

Wood, AML 744093, from brushwood of wooden trackway beneath 1m peat at Tinney's Ground, Shapwick (51° 8′ 15″ N, 2° 45′ 30″ W, NGR: ST469382). *Comment* (JMC): confirms projected interrupted wooden trackway (HAR-681, 3040 ± 70: R, 1977, v 19, p 416 and HAR-948, 3020 ± 70). Assists dendrochronol studies of area (Coles, 1978, p 73).

HAR-946. SLP7414 (Tinney's 1.6:2.3) **2950 ± 80**
$\delta^{13}C = -30.0‰$

Wood, AML 744094, from brushwood of wooden trackway beneath 1m peat at Tinney's Ground, Shapwick, (51° 8′ 15″ N, 2° 45′ 30″ W, NGR: ST469382). *Comment* (JMC): result indicates general contemporaneity of trackways close to one another, near suggested later Bronze age settlement. Different trackway from HAR-945 and -947 (qv).

HAR-947. SLP7415 (Tinney's 1.3:2.1) **2960 ± 70**
$\delta^{13}C = -29.4‰$

Wood, AML 744095, from brushwood of wooden trackway beneath 1m peat at Tinney's Ground (51° 8′ 15″ N, 2° 43′ 45″ W, NGR: ST 489382). *Comment* (JMC): as HAR-946.

HAR-948. SLP7416 (Tinney's 9.3:10.3) **3020 ± 70**
$\delta^{13}C = -28.1‰$

Wood from brushwood of wooden trackway beneath 1m peat at Tinney's Ground, Shapwick (51° 8′ 15″ N, 2° 43′ 45″ W, NGR: ST 470382). *Comment* (JMC): as HAR-945.

HAR-1159. SLP751 (SK W 26) **3330 ± 70**
$\delta^{13}C = -28.1‰$

Peat taken adjacent to Bronze age wooden pitchfork, sealed beneath original 0.5 m peat at Skinner's Wood, Shapwick (51° 9′ 40″ N, 2° 50′ W, NGR: ST416404). *Comment* (JMC): dates unique implement. Peat sequence here follows standard stratigraphy (Coles, 1978, p 114).

HAR-1219. SLP755 (CV 2 B42) **4460 ± 90**
$\delta^{13}C = -27.8‰$

Wood from brushwood track (one of joined pair) running N from Polden Hills, at Garvin's Track B, Sharpham (51° 8′ 25″ N, 2° 46′ 50″ W, NGR: ST453385). *Comment* (JMC): result must be compared with HAR-

682 (4380 ± 70: R, 1977, v 19, p 416) and HAR-1222. HAR-682 represents a single joined track S of HAR-1219 and -1222. All dates agree internally and also with peat stratigraphy (Coles, 1978, p 79).

HAR-1220. SLP752 **4160 ± 100**
$\delta^{13}C = -28.8‰$

Wood from wooden track made of multiple hurdles at Walton track, Walton Heath, Meare (51° 8′ 50″ N, 2° 46′ 45″ W, NGR: ST454393). *Comment* (JMC): date agrees with peat stratigraphy and with absolute level OD. Oldest known wooden hurdles surviving and must relate to reports of 'hurdling' with Neolithic barrows (Coles *et al*, 1977).

HAR-1221. SLP753 **3050 ± 70**
$\delta^{13}C = -29.0‰$

Wood from sparse remnants of wood track running towards Glastonbury Stileway, Meare (51° 9′ 35″ N, 2° 45′ 50″ W, NGR: ST465408). *Comment* (JMC): dates structure in archaeol new area; agrees with peat stratigraphy. Many prehistoric structures of late 2nd millennium are now known (Coles, 1978, p 92).

HAR-1222. SLP754 (GV2 A46) **4280 ± 70**
$\delta^{13}C = -28.5‰$

Wood from brushwood track, running N from Polden Hills at Garvin's Track 4, Sharpham (51° 8′ 25″ N, 2° 46′ 50″ W, NGR: ST 453385). *Comment* (JMC): as HAR-1219.

HAR-1383. SLP756 **4210 ± 90**
$\delta^{13}C = -28.6‰$

Wood from low level wood structure at Rowland's Track, Ashcott Heath, Meare (51° 8′ 40″ N, 2° 47′ 5″ W, NGR: ST44983896) *Comment* (JMC): dates hurdle trackway in previously unknown area of Levels (Coles *et al*, 1977). Date corresponds well with Walton Heath series and helps reinforce archaeol suggestion of exact contemporaneity of Rowland's Track and Walton Heath series.

HAR-1467. SLP757 Part A **4330 ± 90**
$\delta^{13}C = -29.3‰$

HAR-1468. SLP757 Part B **4250 ± 90**
$\delta^{13}C = -26.7‰$

Wood, coppiced hazel and alder, from newly discovered wooden structure in low level peat at Walton Heath II.2, Meare (51° 8′ 50″ N, 2° 46′ 45″ W, NGR: ST45363934). *Comments*: samples A and B dated separately. (JMC): results date earliest surviving hurdles, made of coppiced hazel, alder, and willow, known from Britain (Coles *et al*, 1977, p 10).

HAR-1470. SLP758 Part 1 **4250 ± 80**
$\delta^{13}C = -29.8‰$

HAR-1471. SLP758 Part 2 **4420 ± 90**
$\delta^{13}C = -26.2‰$

Wood, age 4-8 yr growth from lowest level wood beneath Walton Track structure at Walton 4.108, Meare (51° 8′ 50″ N, 2° 46′ 45″ W, NGR: ST45363934). *Comment* (JMC): dates commencement of wooden structure on Walton Heath (Coles *et al*, 1977). Good agreement with HAR-1220.

Sweet Track series

As part of dendrochronol studies included in Somerset Levels project, a number of samples from Neolithic Sweet Track were subm for dating. Each sample, covering 15 annual rings, was selected from 40-yr intervals of 314-yr floating tree-ring chronology established on 129 oak timbers from this track. Samples subm to date, as closely as possible, felling of timber and track's construction. Track runs S-N across Levels, probably from Polden Hills to Meare-Westhay I.; all samples are from Sweet Track R at Shapwick. For detailed discussion of Sweet track, see Coles & Orme (1976; 1979). For description of tree-ring studies and further discussion of date results, see Morgan (1976; 1979). (Note: results are arranged in order, according to tree-ring sequence, not numerically, according to lab ref no.).

HAR-1379. SLP759 **4550 ± 70**
$\delta^{13}C = -27.2‰$

Wood from annual rings 58 to 73 (earliest) of tree-ring sequence. Includes secs cut from 9 timbers. *Comment* (JMC): younger than expected; should antedate site's construction >300 yr.

HAR-1472. SLP7510 Part 1 **5070 ± 80**
$\delta^{13}C = -26.2‰$

Wood from annual rings 98 to 113; includes secs cut from 16 timbers. *Comments*: rootlets and insect infestation in original material. (JMC): corresponds well with site and date and expected date from tree-ring evidence.

HAR-1473. SLP7510 Part 2 **4940 ± 150**
$\delta^{13}C = -27.2‰$

Wood from annual rings 98 to 113. *Comment*: unreliable result determined from residue re-burn after zero result in acetylene preparation stage. (JMC): younger than expected.

HAR-1475. SLP7511 Part 1 **5020 ± 100**
$\delta^{13}C = -27.3‰$

HAR-1476. SLP7511 Part 2 **5110 ± 90**
$\delta^{13}C = -26.6‰$

Wood from annual rings 138 to 153; includes secs cut from 11 timbers. *Comment*: rootlets and insect contamination in original material. (JMC): consistent with site date and tree-ring series.

HAR-1477. SLP7512 Part 1 **3940 ± 90**
$\delta^{13}C = -27.0‰$

Wood from annual rings 178 to 193; includes secs cut from 12 timbers. *Comment*: rootlets and insect contamination in original material. (JMC): date rejected.

HAR-1478. SLP7512 Part 2 **4800 ± 90**
$\delta^{13}C = -26.4‰$

Wood from annual rings 178 to 193. *Comment* (JMC): slightly younger than expected.

HAR-1384. SLP7513 Part 1 **5030 ± 90**
$\delta^{13}C = -27.1‰$

HAR-1469. SLP7513 Part 2 **5110 ± 90**
$\delta^{13}C = -27.0‰$

Wood from annual rings 218 to 233; includes secs from 12 timbers. *Comment* (JMC): both results are consistent with site date and tree-ring series.

HAR-1479. SLP7514 Part 1 **4710 ± 100**
$\delta^{13}C = -27.2‰$

HAR-1480. SLP7514 Part 2 **4870 ± 80**
$\delta^{13}C = -26.6‰$

Wood from annual rings 258 to 273; includes secs cut from 9 timbers. *Comment*: rootlets and insect contamination in original material. (JMC): HAR-1479 is slightly younger than expected; HAR-1480 is consistent with site date and tree-ring series.

Pentre series

Samples taken from Bronze age composite mound at Pentre Farm, Pontardulais, West Glamorgan, Wales (51° 42′ 25″ N, 4° 1′ 45″ W, NGR: SN59150265). Samples coll July 1974 and subm Nov 1974 by A H Ward. See Ward (1975) for interim report on excavation and Ward (1978) for final report.

HAR-958. P14 **3470 ± 70**
$\delta^{13}C = -24.6‰$

Charcoal, AML 749316, recovered from pit cut into earth mound that also contained cremated bone. Pit was sealed beneath stones of cairn cap covering mound. *Comment* (AHW): result corresponds well with structural style of monument interpreted as early Bronze age ritual site.

HAR-959. P113 **1500 ± 70**
$\delta^{13}C = -26.7‰$

Charcoal, AML 749317, from large pit outside edge of mound. Three successive layers of burning in pit were apparent; sample was taken solely from upper layer. *Comment* (AHW): on this late Roman - early

Post-Roman date, feature cannot be assoc with barrow. Possible interpretation—temporary native camp of that period.

Poundbury series

Samples from a multi-phase settlement dating from late Neolithic to Post-Roman period at Poundbury, Dorchester, Dorset, England (50° 42′ N, 2° 30′ W, NGR: SY685911). For interim report on excavations, see Green (1974). Samples coll Aug 1971 by J Beavis, HAR-993, -994, and Sept 1973 by H G Pell, HAR-995, -996; subm Jan 1975 by C J S Green, Dorchester Excavations Comm.

HAR-993. CH.93 **3380 ± 90**
$\delta^{13}C = -25.3‰$

Charcoal, AML 749181, from fill of post-hole within area of Late Neolithic to Middle Bronze age occupation. *Comment* (CJSG): sample from 1 of several post-holes on W side of Middle Bronze age settlement area. Result would fall within early Middle Bronze age of this region, somewhat early for main Deverel-Rimbury settlement but compatible with earliest phase.

HAR-994. CH.100 **3030 ± 90**
$\delta^{13}C = -27.2‰$

Charcoal, AML 749182, from base fill of V-cut ditch demarcating S side of Middle Bronze age settlement. *Comment* (CJSG): sample immediately antedates filling-in of ditch and presumed abandonment of Deverel-Rimbury settlement. Result falls midway between determinations for similar settlements at Shearplace Hill, Dorset and Itford Hill, Sussex and is a useful addition to dates for these rare sites.

HAR-995. CH137 (a) **1880 ± 70**
$\delta^{13}C = -24.7‰$

Charcoal, AML 749183, from layer of burning and occupation debris in bottom of sunken-floored hut of early Saxon type. *Comment* (CJSG): both character of feature from which sample was derived and date relative to underlying late Roman cemetery suggest date range for this feature of early 5th to 8th centuries AD. Sample contamination or origin from old timber must be considered.

HAR-996. CH137 (b) **2400 ± 70**
$\delta^{13}C = -22.9‰$

Charcoal, AML 749184, from same context as HAR-995. *Comment* (CJSG): see HAR-995.

Brenig Valley series

Samples from some monuments in Early Bronze age cemetery and from other excavations in Brenig Valley, Clwyd, North Wales (53° 6′ N, 3° 31′ W, NGR: SH980570). Interim report on round barrows, ring cairn, and earlier Mesolithic occupation in Lynch *et al* (1974) and Lynch and Allen (1975).

HAR-1027. BG734542. BRENIG 45 (round barrow) **3620 ± 100**
$\delta^{13}C$ = −25.8‰

Soil from contents of small Collared urn containing infant earbones. Urn was buried in palisade trench surrounding barrow and must be either contemporary or later than barrow. *Comment* (FL): date agrees with building of barrow (see HAR-712, -657: 3620 ± 60, 3570 ± 100) but does not agree well with HAR-658 qv (3290 ± 70) which suggested palisade was later addition, ca 1340 BC. Stratigraphic judgements need reconsideration.

HAR-1133. B44PA323. BRENIG 44 (ring cairn) **3500 ± 80**
$\delta^{13}C$ = −25.3‰

Charcoal from lower fill of Pit A cut from old ground surface later than HAR-501 qv (R, 1977, v 19, p 411). *Comment* (FL): slightly later than expected in view of HAR-501 (3630 ± 100) but relevant sequence is correct.

HAR-1136. B44F5123. BRENIG 44 **2960 ± 70**
$\delta^{13}C$ = −26.0‰

Charcoal from burning on pared old ground surface, interior of ring. *Comment* (FL): date seems incorrect. Charcoal was covered by inner bank built before 1550 BC, see HAR-505 (R, 1977, v 19, p 412) and HAR-1133. Date seems too late in cemetery sequence as a whole.

HAR-1137. B44PA133. BRENIG 44 **3330 ± 70**
$\delta^{13}C$ = −24.8‰

Charcoal from Pit A, upper fill, possibly re-cut from Layer 3. *Comment* (FL): date, although not significantly different from HAR-1133 qv for lower fill of this pit, is in right sequence and helps confirm archaeol evidence for re-cut. Agrees well with HAR-504, (R, 1977, v 19, p 412) and HAR-1138 for other pits dug from this level.

HAR-1138. B44PB133. BRENIG 44 **3290 ± 80**
$\delta^{13}C$ = −25.4‰

Charcoal from Pit B, Layer 3 of internal activity. Slightly later than re-cutting of Pit A, archaeologically. *Comment* (FL): date is appropriate. In view of strat relationship to re-cutting of Pit A, slightly later date was expected, but sequence is correct.

HAR-1134. BR470E57. BRENIG 47 (round cairn) **4090 ± 70**
$\delta^{13}C$ = −25.5‰

Charcoal from old ground surface beneath stone skirt. *Comment* (FL): earlier than expected, but not inappropriate. Thought to be earliest monument in cemetery, but date ca 1800 BC was hazarded.

HAR-1135. BR45E9P1. BRENIG 53 **7300 ± 100**
$\delta^{13}C = -29.4‰$

Charcoal from lower parts of fire pit. *Comment* (FL): sample from pits assoc with Mesolithic flint work and suits that assemblage. Agrees well with HAR-656 (7650 ± 80) which dates unassoc pit on other side of valley.

HAR-1434. BG3100 **4780 ± 160**
$\delta^{13}C = -25.9‰$

Charcoal from posthole in corner of 1975 excavation on fringe of Mesolithic occupation area but also close to 2 Bronze age monuments (BG44 & BG45) (53° 6′ 25″ N, 3° 31′ W, NGR: SH982572). *Comment*: small sample accounts for larger than normal error term.

HAR-1435. BG480723 **330 ± 70**
$\delta^{13}C = -26.7‰$

Charcoal from small pit at Brenig Valley Post-Medieval site (53° 6′ 30″ N, 3° 30′ 25″ W, NGR: SH988575) sealed beneath stone wall foundation of ?16th century AD, Hafoty Welsh summer farm (Allen, 1974). *Comment* (DWHA): pit and its neighbours were contemporary with period of activity represented by wall that sealed it.

HAR-1436. BG5328 **5120 ± 100**
$\delta^{13}C = -27.9‰$

Charcoal from 1 of at least 8 hearths or fire-pits assoc with stakeholes and quantities of flint and chert, which formed basis of area of possible Mesolithic occupation in Brenig Valley (53° 6′ 25″ N, 30° 31′ W, NGR: SH982572).

Odell series

Site at Odell, Bedfordshire, England (52° 12′ 5″ N, 0° 35′ 45″ W, NGR: SP956568). Samples coll 1974 and 1975 and subm 1975 by B Dix. Full report on site is forthcoming in Bedfordshire Archaeol Jour 16.

HAR-1038. ODLSWT19 **1230 ± 70**
$\delta^{13}C = -27.5‰$

Wood, AML 750910, from timber well. Sample formed integral part of structure; it was 1 of 4 piles around which lining was constructed (Dix, 1975a,b). *Comment* (BD): date consistent with archaeol expectations.

HAR-1427. 74F123S7 **1240 ± 80**
$\delta^{13}C = -28.7‰$

Wood, AML 756482, id by C A Keepax as probably Hazel or Alder, from stake from outer lining of well and formerly driven into natural side of well pit (Dix, 1975b; 1979). *Comment* (BD): *cf* HAR-1428 and -1838, below, which are from same well structure. This slightly more recent measurement may represent replacement of stake in outer lining.

HAR-1428. 74F123WB **1390 ± 70**

$\delta^{13}C = -28.3‰$

Wood, AML 75648, id by C A Keepax, as Willow twigs of 1-yr growth, from part of wicker basket forming integral part of well structure and around which silts had accumulated (*cf* Medieval Archaeol, v. 21, 1977, p 204 and pl XV1A; Dix, 1975b, 1979). *Comment* (BD): date consistent with archaeol expectations.

HAR-1838. 74F123TA **1350 ± 70**

$\delta^{13}C = -26.4‰$

Wood, AML 756481, id as Oak, from plank, possibly re-used timber, that, with others, formed platform for access to well (Dix, 1975b; 1979). *Comment* (BD): date consistent with archaeol expectations.

Little Waltham series

Samples from Little Waltham, Essex, England, (51° 47′ 15″ N, 0° 28′ 45″ E, NGR: TL736129). Coll 1971 and subm 1974, 1975 by P J Drury, Chelmsford Excavations Comm (Drury, 1973).

HAR-1047. LWALTHAM **3360 ± 80**

$\delta^{13}C = -28.2‰$

Soil, AML 740542, consisting of organic material mixed with silt from lowest level of silt in former channel of R Chelmer (Old River Channel Layer 4). *Comment* (PJD): result seems reasonable, other evidence for date of this feature is scanty.

HAR-1081. C11-1 (a) **2560 ± 80**

$\delta^{13}C = -26.1‰$

Soil, AML 729551, from burnt debris in Iron age hut wall trench. *Comment* (PJD): too early, sample came from same context as HAR-1088 and -1120 qv. Presumably contaminated by residual material.

HAR-1082. C11-1 (b) **3340 ± 90**

$\delta^{13}C = -25.6‰$

Soil, AML 729550, from burnt debris in Iron age hut wall trench. *Comment* (PJD): as for HAR-1081.

HAR-1087. LW71251-1 **5120 ± 130**

$\delta^{13}C = -25.4‰$

Soil, AML 729554, from Neolithic hearth. *Comment* (PJD): date fits pottery from feature which is plain Neolithic.

HAR-1088. C11-3 **2160 ± 80**

$\delta^{13}C = -25.1‰$

Soil, AML 729552, from wall trench of Iron age circular hut probably destroyed by fire.

HAR-1120. C11-34E **2100 ± 70**
$\delta^{13}C = -25.1‰$

Charcoal, AML 759553, from wall trench of Iron age circular hut, probably destroyed by fire. *Comment* (PJD): result, with that of HAR-1088, above, suggests date in mid-3rd century BC for Iron age settlement. Accords well with archaeol evidence from site.

Fullers Hill series

Samples from excavations (Rogerson, 1976) at Fullers Hill, Great Yarmouth, Norfolk, England (52° 35′ 30″ N, 1° 42′ 45″ E, NGR: TG 52250796). Coll and subm Jan 1975 by A Rogerson, Norfolk Archaeol Unit.

HAR-1079. 1032.197 **890 ± 70**
$\delta^{13}C = -26.8‰$

Charcoal, AML 749530, probably bldg material, from surface of clay floor sealed below thick layer of charcoal, itself sealed by wind-blown sand. Excavation Phase IX.

HAR-1080. 1032.306 **1010 ± 70**
$\delta^{13}C = -25.1‰$

Charcoal, AML 749531, from layer of probable bldg material overlying clay and soil floor and sealed below layer of wind-blown sand Excavation Phase VI.

General Comment (AR): on general archaeol grounds, both dates seem ca 100 yr too early. This is perhaps to be expected of charcoal from large timbers. For HAR-1080, one coin, AD 1042-1066, occurred in phase but apart from this chronology is entirely floating and, although stratigraphy was very clear, pottery was only other aid to dating. Within 2 standard deviations, results fall within expected range.

Moel y Gaer series

Samples from Moel y Gaer (Guilbert, 1975a,b; 1976) Rhosesmor, Clwyd, North Wales (53° 12′ N, 3° 11′ W, NGR: SJ211690).

HAR-1122. M0470 **2210 ± 70**
$\delta^{13}C = -25.3‰$

Charcoal, id as mixture of *Corylus avellana* and *Crataegus* sp, both ca 10 yr old, found as isolated patch in core of Phase 2, timber-framed Rampart A. *Comment* (GG): at worst, sample provides *terminus post quem* for construction of this rampart, not structural timber *in situ*.

HAR-1125. M1838 **2430 ± 140**
$\delta^{13}C = -25.9‰$

Charcoal, id as *Quercus* sp, 10+ yr old, with *Corylus avellana,* ca 10 yr old, from posthole which held one side of door frame into stake-wall round house of Phase 2 settlement. Charcoal derived from post pipe, ca 0.20m diam, that was largely back-filled with stones. *Comment* (GG): not structural timber *in situ*.

HAR-1126. M0316 **2510 ± 100**
$\delta^{13}C = -25.6‰$

Charcoal, id as *Corylus avellana*, ca 10 yr old, from dark gray clay filling of posthole belonging to porch of post-ring round-house. *Comment* (GG): result is compatible with HAR-606 (2570 ± 70, R, 1977, v 19, p 414) derived from another round house that was thought, on archaeol grounds, to be broadly contemporary with this one.

HAR-1127. M1071 **2660 ± 70**
$\delta^{13}C = -24.8‰$

Charcoal, id as *Quercus* sp, 50 or more yr old. Sample from 1 of ring of 12 small pits, each comprehensively blocked with stones, together comprising anomalous structure of 6.4m diam. *Comment*: heavy rootlet contamination.

HAR-1293. M1423-25 **2350 ± 90**
$\delta^{13}C = -25.9‰$

Charcoal, id as mixture of *Corylus avellana, Fraxinus exelsior*, and *Populus* sp, all ca 10 yr old. Sample was mixture from 3 postholes of entrance porch of post-ring round house. *Comment* (GG): probably not structural timbers *in situ*.

HAR-1294. M1479 **2380 ± 70**
$\delta^{13}C = -25.5‰$

Charcoal, id as mixture of *Corylus avellana*, min 10 yr old and *Quercus* sp, 20 to 50 yr old. Sample derived from silt filling of post-removal-hole dug into top of posthole of large four-poster belonging to grid layout of Phase 2 settlement. *Comment*: heavy rootlet contamination.

HAR-1353. M1605/17 **2390 ± 80**
$\delta^{13}C = -25.0‰$

Charcoal, id as mixture of *Corylus avellana*, up to 20 yr old with Quercus sp ca 25 yr and *Fraxinus* ca 10 yr. Sample derived from silt filling of post pipes of 4 different postholes (M1605, M1607, M1611, and M1617) of single post-ring round house. *Comments*: charcoal contained gravel pieces and rootlet contamination. (GG): probably not structural timbers *in situ*.

Wighton series

Samples from excavation of D-shaped enclosure located 1974 (Lawson, 1976) at Whey Curd Farm, Wighton, Norfolk (52° 54′ 20″ N, 0° 53′ 55″ E, NGR: TF944384). Coll Sept 1974 and subm April 1975 by A J Lawson.

HAR-1142. 1113WGTA **1710 ± 70**
$\delta^{13}C = -20.0‰$

Human bone, AML 753036, from Skeleton 19, 1 of 5 from graves sealed by old ground surface beneath bank. *Comment* (AJL): result agrees with very meagre archaeol evidence.

HAR-1143. 1113WGTB **1900 ± 120**
$\delta^{13}C = -22.1‰$

Animal bone, AML 753037, from silting of small ditch sealed by enclosure bank *Comment* (AJL): pottery from same context could be late 1st century.

NVRC series

Samples from multiple round barrow (Donaldson, 1977) at Barnack Cambridgeshire, England (52° 39′ N, 0° 26′ 45″ E, NGR: TF050069). Coll Dec 1974 and subm April 1975 by P Donaldson.

HAR-1156. BGP1497 **3230 ± 100**
$\delta^{13}C = -20.8‰$

Bone, from secondary burial.

HAR-1158. BGP1496 **3800 ± 100**
$\delta^{13}C = -21.4‰$

Bone, from secondary burial.

HAR-1205. BGP1499 **3590 ± 80**
$\delta^{13}C = -21.6‰$

Bone, from secondary burial.

HAR-1207. BGP1501 **3400 ± 80**
$\delta^{13}C = -21.6‰$

Bone, from secondary burial.

HAR-1430. BGP1498 **3450 ± 70**
$\delta^{13}C = -22.4‰$

Bone, from secondary burial.

HAR-1612. BGP2442 **3290 ± 80**
$\delta^{13}C = -21.9‰$

Human bone, from secondary burial. *Comment*: replicate check measurement on HAR-1206.

HAR-1645. BGP1450 **3570 ± 80**
$\delta^{13}C = -24.8‰$

Charcoal, AML 757633, id by C Keepax as Oak from large timbers from beside primary inhumation. Coll Feb 1975 and subm May 1976.

HAR-1163. SP74F3 **3290 ± 130**
$\delta^{13}C = -26.5‰$

Charcoal, AML 751850, from small pit, containing human cremation, cut into gravel and sealed beneath build-up of marsh clay, at Site 2, Devil's Wood, Sproughton, Suffolk, England (52° 3′ 35″ N, 1° 7′ E, NGR: TM13364447). Coll April 1974 and subm April 1975 by E A Martin, Suffolk Archaeol Unit. *Comments*: small sample, needed topping up with inactive CO_2 to enable measurement. (EAM): pit lay in middle of late Neolithic/early Bronze age settlement site (rept forthcoming in East Anglian Archaeol).

HAR-1192. HC75F312 **2310 ± 70**
$\delta^{13}C = -26.1‰$

Charcoal, AML 753125, from oval pit containing many heavily burned river pebbles and pot sherds at Holm Castle, Windmill Hill, Tewkesbury, Gloucestershire, England (51° 59′ 10″ N, 2° 9′ 50″ W, NGR: SO887321). Pit was part of complex of prehistoric features exposed by removal of topsoil, Medieval occupation levels and 60 to 80cm clay. Coll April 1975 by R L Hall; subm May 1975 by A Hannan, Dir Excavations, Tewkesbury Borough Council. *Comment* (AH): conditions prevailing during uncovering of large area of prehistoric ditches and pits and fragmentary state of pottery recovered made radiocabon date important. Initial comparison with pottery fabrics in North Gloucestershire pointed to Late Neolithic-Mid-Bronze age. Result permits broader approach to material.

HAR-1198. CHN74 **5270 ± 110**
$\delta^{13}C = -25.3‰$

Charcoal, from upper filling of Neolithic shaft (Bradley *et al*, 1975/6) at Cannon Hill, Bray, Berkshire, England (51° 30′ 15″ N, 0° 42′ 20″ W, NGR: SU89647926). Coll 1974 and subm May 1975 by R F Weng, Maidenhead Archaeol & Hist Soc. *Comment* (RFW): assoc occupation debris contained Grimston/Lyles Hill Ware, unfired clay, bone fragments and both Neolithic and Mesolithic flints. Shaft tentatively interpreted as a well and is earliest directly dated example in Britain.

HAR-1199. S62 **3750 ± 80**
$\delta^{13}C = -26.2‰$

Charcoal from large, deep pit, in centre of henge at Milfield North Henge Monument, Northumberland (55° 36′ 30″ N, 2° 6′ 45″ W, NGR: NT934349). Coll April 1975 and subm May 1975 by A F Harding, Dept Archaeol, Univ Durham. *Comment* (AFH): presumably part of primary construction and perhaps contemporary with sherds of Beaker-Food Vessel from adjacent pit.

HAR-1201. BC75/3 **780 ± 70**
$\delta^{13}C = -26.2‰$

Wood, AML 751142, from base plate of possible Medieval waterfront (Hill *et al*, in press; Hobley & Schofield, 1977) at Baynards Castle (51° 28′ 30″ N, 0° 4′ 30″ W, NGR: TQ31888093). Coll and subm April 1975 by B Hobley, Chief Urban Achaeol, Mus London.

Northampton series

Samples from St Peter's St, Northampton (52° 13′ 55″ N, 0° 54′ 55″ W, NGR: SP750603). Interim report on this site appears in Williams (1975). Samples coll Jan and Feb 1974; subm June 1975 by J Williams, Northampton Development Corp.

HAR-1225. M1152854 **1190 ± 70**
$\delta^{13}C = -26.2‰$

Soil containing charcoal, AML 753363, from layer within fill of Grubenhaus Phase IV, late Saxon period. *Comment* (JW): date probably 50 to 100 yr early.

HAR-1244. M1153302 **1110 ± 80**
$\delta^{13}C = -22.3‰$

Bone, AML 753364, from gully, ca 1m wide by 0.60m deep, with sandy fill, cut into weathered ironstone bedrock.

HAR-1245. M1153303 **1300 ± 60**
$\delta^{13}C = -22.3‰$

Bone, AML 753365, from Phase III B, destruction of concrete mixers, possibly late Saxon period, sand and mortar spreads, varying from a few cm to 0.5cm, overlay mixers.

HAR-1246. M1153304 **1310 ± 90**
$\delta^{13}C = -22.3‰$

Bone, AML 753366, from destruction of concrete mixers. *Comment* (JW): from same level as HAR-1245, above.

Hereford series

HAR-1260. HE74A380 **870 ± 80**
$\delta^{13}C = -22.3‰$

Animal bone, AML 753183, from fill of small ditch apparently sealed by gravel rampart (Shoesmith, in press) at Bewell House site, Hereford, England (52° 3′ 30″ N, 2° 43′ W, NGR: SO507401). Coll June 1975 and subm July 1975 by R Shoesmith, City Hereford Archaeol Comm. *Comment* (RS): sample of ditch silt nearby was taken for archaeomagnetic dating.

HAR-1375. HE732F219/F270 **990 ± 70**
$\delta^{13}C = -26.4‰$

Accumulated sample, 2 parts combined, of charcoal, which should be pre-turf rampart from Berington St, Phase II, Hereford, England. Coll March 1973 and subm Sept 1975 by R Shoesmith.

HAR-1318. HS75HLJB **1540 ± 90**
$\delta^{13}C = -28.1‰$

Wood, AML 756454, 1 of series, from silt deposit in R Thames at OD height (Newlyn) at Hays Lane Junction Box, London, England (51° 30′ 20″ N, 0° 4′ 30″ W, NGR: TQ33018023). Coll April 1975 by A Graham; subm Oct 1975 by H Sheldon, Southwark Archaeol Excavation Comm. *Comment* (HS): date shows that R Thames was depositing clay at OD height in low area along S bank in late Roman or immediate Post-Roman period.

GP 74 series

Samples from Iron age settlement site at Guiting Manor Farm, Guiting Power, Gloucestershire, England (51° 55′ 20″ N, 1° 53′ 5″ W, NGR: SP089250). Coll Nov 1974 and subm Oct 1975 by A Saville, Cheltenham Art Gallery & Mus Service.

HAR-1320. C108 etc. **6780 ± 110**
$\delta^{13}C = -24.5‰$

Charcoal, AML 756458, from fill of 7 pits (refs F1, F6, F7, F10, F11, F14, F23) assoc with Iron age pottery.

HAR-1323. C110/114 **3780 ± 100**
$\delta^{13}C = -24.7‰$

Charcoal, AML 756459, from fill of 2 pits (refs F3 and F5) assoc with Iron age pottery. *Comment*: small sample.

General Comment (AS): measurements inconsistent with context of samples, extracted from fills of Iron age storage/rubbish pits assoc with "Iron Age B"-type ceramics. On ceramic evidence, settlement presumably falls in range 300 to 0 BC.

CC 75 series

Samples from Bronze age round barrow at Cow Common, Gloucestershire, England (51° 55′ 5″ N, 1° 48′ 10″ W, NGR: SP13502625). Coll Jan 1975 and subm Oct 1975 by A Saville.

HAR-1325. C19A **3430 ± 80**
$\delta^{13}C = -25.0‰$

Charcoal, AML 756456, from centre of F3, also F8A.

HAR-1326. C28A **3390 ± 80**
$\delta^{13}C = -24.6‰$

Charcoal, AML 756457, from centre of F3, also F8G.

General Comment (AS): samples were taken from burnt timbers overlying primary grave pit that contained unaccompanied cremation, at centre of ditchless round barrow. Results in 15th century BC fit Bronze age barrow well.

HAR-1339. W103/4 **1600 ± 80**
$\delta^{13}C = -27.7‰$

Wood (oak), AML 753163, underlying 4th century AD Roman City Wall (of Period 5) Gloucester (Site 46/74), England (51° 51′ 40″ N, 2° 12′ 30″ W, NGR: SO835183). Coll Aug 1974 by C M Heighway; subm July 1975 by Excavation Unit, Gloucester (Heighway, 1976). *Comment* (CMH): sample of 25 sapwood rings from end of 85-yr tree-ring sequence. It was cut from 2 wooden piles that came from same tree.

HAR-1411. B18A EAST **4560 ± 70**
$\delta^{13}C = -27.2‰$

Charcoal, AML 680534, 680535, 680536, 30cm from base of inner of 2 concentric ditches of Neolithic mortuary enclosure (Jackson, 1976) at

Aldwincle Neolithic site, Aldwincle, Northamptonshire, England (54° 24′ 40″ N, 0° 30′ 20″ W, NGR: SP996803). Coll 1968 by D Jackson and L Biek; subm Dec 1975 by H Keeley.

HAR-1420. RAD75/2/33 **3000 ± 90**

$\delta^{13}C = -26.2‰$

Charcoal, AML 756427, from Radwell ring ditch 2, Bedfordshire, England (52° 13′ 10″ N, 0° 30′ 55″ W, NGR: TL011588). Charcoal was mostly twiggy; many of very small fragments were unid. but *Prunus* sp and hawthorn type tentatively id by C A Keepax. Sample from basal silt above primary fill, but with concentration of Bronze age material. Coll July 1975; subm Nov 1975 by P J Woodward. *Comment* (PJW): date shows re-use of ring ditch in Middle Bronze age when earlier material was disturbed. Other parallels occur along R Ouse. Ring ditches at Roxton and Warren Farm, Milton Keynes had similarly dated clearance horizons.

St Magnus series

Samples from different dated waterfronts of R Thames at St Magnus, part of New Fresh Wharf site, Billingsgate, London (51° 30′ 40″ N, 0° 4′ 40″ W, NGR: TQ32948067) Coll Aug 1975 by J Schofield; subm Nov 1975 by G H Wilcox, Mus London (Schofield & Miller, 1976; Hobley & Schofield, 1977; Miller, Schofield *et al*, Excavations at New Fresh Wharf 1974-1978, in press).

HAR-1421. SM75213 **1630 ± 70**

$\delta^{13}C = -27.0‰$

Wood (oak, id by C Keepax), AML 756477, from Roman pile assoc with waterfront structure on Thames. *Comment* (GHW): pottery and analogies for structure suggest earlier date.

HAR-1422. SM75171 **1080 ± 80**

$\delta^{13}C = -28.2‰$

Wood (oak, id by C Keepax), AML 756476, from late Saxon vertical stake assoc with mid- to late Saxon waterfront. *Comment* (GHW): fits well with pottery and stratigraphic sequence.

Bell Hotel series

Samples from earliest post-Roman habitation levels on site of Roman forum at Gloucester (Hurst, 1972). Site excavated at 11-17 Southgate St, Gloucester, England (51° 49′ N, 2° 12′ 20″ W, NGR: SO832135). Coll 1968 and subm Nov 1975 by H Hurst.

HAR-1443. 85/68 II **1240 ± 70**

$\delta^{13}C = -29.9‰$

Wood, AML 753160, from alder tree stump. Periods 6/7 (tree cut down at start of, or very early in occupation sequence).

HAR-1444. 85/68 II **1160 ± 80**
$\delta^{13}C = -27.1‰$

Wood, AML 753160, from Wall M1, Period 7, earliest post-Roman bldg.

HAR-1446. 85/68 XXI **1300 ± 70**
$\delta^{13}C = -26.4‰$

Wood, AML 753160, from Timber A, W sec, from earliest habitation level.

HAR-1636. 85/68 II **1160 ± 70**
$\delta^{13}C = -29.7‰$

Replicate check measurement on HAR-1443.

General Coment (HH): earliest dating evidence for post-Roman occupation at centre of Gloucester.

HAR-1448. CW75II29 **3480 ± 80**
$\delta^{13}C = -25.8‰$

Charcoal, AML 756528, from beaker spread on edge and over 1st Mound (Coombs, 1976) at Mortimer's Barrow 275, Callis Wold, Humberside (53° 59′ 25″ N, 0° 4′ 45″ W, NGR: SE832559). Coll Aug 1975 and subm Dec 1975 by D G Coombs, Dept Archaeol, Univ Manchester. *Comment* (DGC): date seems rather late for beakers represented in horizon. European evidence would suggest date nearer 2000 BC.

Bridge-by-Pass series

Samples from Late Bronze age barrow (Macpherson-Grant, 1977) at Bridge-by-Pass, Kent, England (53° 14′ 30″ N, 1° 9′ 20″ W, NGR: TR 19315331). Coll Sept 1974 and subm Jan 1976 by N Macpherson-Grant, Isle Thanet Archaeol Unit.

HAR-1492. SAMPLE A **2880 ± 80**
$\delta^{13}C = -25.1‰$

Charcoal, ca 25% id as *Quercus* sp, AML 749840, from Barrow 2, Cremation 7. *Comment* (NCM-G): apparently younger than Sample B (HAR-1493); latter was secondary burial outside barrow itself.

HAR-1493. SAMPLE B **2970 ± 80**
$\delta^{13}C = -25.4‰$

Charcoal, AML 749850, from external Cremation 5. *Comment* (NCM-G): sample from external (extra-barrow) cremation assumed secondary to cremations within barrow.

General Comment (NCM-G): both dates fit fairly well with pottery styles, dating this barrow and both internal and external burials to Late Bronze age. This period is not yet clearly understood in East Kent.

B. EIRE

Ballygeardra series

Samples from horizontal mill site at Ballygeardra Townland, Co Killkenny (52° 28′ N, 7° 15′ W). Coll by M F Ryan; subm Dec 1974 by A T Lucas, Dir, Natl Mus Ireland.

HAR-1048. NMI-01 **1310 ± 70**
$\delta^{13}C = -26.9‰$

Wood, part of beam.

HAR-1049. NMI-02 **1330 ± 90**
$\delta^{13}C = -27.4‰$

Wood, part of chute.

HAR-1050. NMI-03 **1450 ± 60**
$\delta^{13}C = -28.0‰$

Wood, part of timber balk.

Knocknagranshy series

Samples from horizontal mill site (Lucas, 1969) at Knocknagranshy Townland, Co Limerick (52° 32′ N, 8° 40′ W). Coll May 1955 and subm Dec 1974 by A T Lucas.

HAR-1051. NMI-04 **1200 ± 70**
$\delta^{13}C = -26.2‰$

Wood, part of chute.

HAR-1052. NMI-05 **1110 ± 70**
$\delta^{13}C = -27.5‰$

Wood, part of large beam that supported fore end of chute.

HAR-1053. NMI-06 **1150 ± 50**
$\delta^{13}C = -26.7‰$

Wood from footbeam of mill investigated by A T Lucas, June 1973 at Knocknacroy Townland, Co Sligo (54° 4′ N, 8° 27′ W). Subm Dec 1974 by A T Lucas.

HAR-1054. NMI-07 **1200 ± 60**
$\delta^{13}C = -27.4‰$

Wood from chute of horizontal mill discovered in moory ground some years prior to 1872 (Wakeman, 1872-3) at Rossorry Townland, Co Fermanagh (54° 20′ N, 7° 38′ W). Subm Dec 1974 by A T Lucas.

HAR-1055. NMI-08 **1350 ± 70**
$\delta^{13}C = -27.0‰$

Wood from chute of horizontal mill at Toberaquill Townland, Co Westmeath (50° 35′ N, 7° 15′ W). Coll Dec 1965 by A B O'Riordain; subm Dec 1974 by A T Lucas.

HAR-1056. NMI-09 **880 ± 80**
$\delta^{13}C = -26.9‰$

Wood from foot beam of house built in stave-cum-plank technique in Medieval horizon at Christ Church Place, Dublin City (53° 20′ N, 6° 16′ W). Coll by A B O'Riordain; subm Dec 1974 by A T Lucas. *Comment* (ATL): result agrees with evidence from assoc coin finds.

HAR-1144. NMI-10 **1090 ± 70**
$\delta^{13}C = -25.7‰$

Wood from mortised beam of horizontal mill excavated by Natl Mus Ireland at Boherduff Townland, Co Galway (53° 11′ N, 3° 38′ W). Coll May 1956 and subm April 1975 by A T Lucas. *Comment* (ATL): mill appears to have been assoc with neighboring early church site.

Carnsore series

Samples from site at Saint Vogue's Church and Enclosure, Carnsore, Co Wexford (52° 10′ N, 6° 22′ W). Coll Aug 1975 and subm Nov 1975 by A Lynch, Dept Archaeol, Univ Coll, Cork.

HAR-1380. CS/1 **1290 ± 80**
$\delta^{13}C = -25.3‰$

Charcoal, combined Samples CS/1 and CS/2, from 3 adjacent post-holes of similar diam and depth, beneath layer of carbonized wood and burnt soil. Postholes possibly held corner supports of rectangular wooden bldg. *Comment* (AL): agrees well with archaeol evidence of Early Christian occupation phase.

HAR-1382. CS/3 **1390 ± 80**
$\delta^{13}C = -25.5‰$

Charcoal from trench, 1m depth, beneath layer of burnt soil in SE quad of Enclosure. *Comment* (AL): agrees with archaeol evidence suggesting Early Christian occupation phase.

C. Mozambique

Manekweni series

Seven samples taken to span bldg and occupation of stone-walled enclosure at Manekweni, Mozambique (20° 11′ 05″ S, 34° 50′ 42″ E). Architectural style is of Zimbabwe of Later Iron age of Rhodesia with which site is contemporary and closely related culturally and economically (Garlake, 1976a,b). Samples coll and subm July 1975 by P S Garlake.

HAR-1240. MU/ED120 **770 ± 90**
$\delta^{13}C = -25.8‰$

Wood from midden beneath Zimbabwe-type solid clay dwelling. Earliest evidence of occupation at site. *Comment*: small sample yield in lab process. For replicate sample, see HAR-1285.

HAR-1250. MUED 4872 **340 ± 70**
$\delta^{13}C = -24.9‰$

Wood from timber fabric of destroyed structure in upper level, late phase in site's occupation.

HAR-1252. MUE/0539 **590 ± 70**
$\delta^{13}C = -24.0‰$

Wood from sand beneath midden (same midden as HAR-1253 and -1254 qv).

HAR-1253. MUEA 0507 **500 ± 50**

$\delta^{13}C = -25.8‰$

Wood from lowest level of midden formed during occupation of stone-walled enclosure. *Comment*: some rootlet contamination evident.

HAR-1254. MUEA 0102 **600 ± 70**

$\delta^{13}C = -25.9‰$

Wood from middle level of midden (same midden as HAR-1253). *Comment* (PSG): deposit is stratigraphically later than HAR-1253 qv.

HAR-1255. MUIA110 **780 ± 80**

$\delta^{13}C = -25.4‰$

Wood from midden immediately beneath stone wall of enclosure and assoc with its erection. *Comment* (PSG): sample, with HAR-1240 and -1285 qv can be taken to date 1st occupation of site.

HAR-1285. MUED/120 **750 ± 100**

$\delta^{13}C = -25.8‰$

Replicate sample from residual CO_2 from HAR-1240 qv. *Comment*: small sample size accounts for larger than normal error term.

II. GEOLOGIC SAMPLES

A. British Isles

HAR-931. RHU **11,520 ± 250**

$\delta^{13}C = +1.4‰$

Marine shells from Rhu on N side of Clyde Estuary, Scotland (56° 0′ 25″ N, 4° 46′ 45″ W, NGR: NS26448392). Shells are incorporated in glacially reworked estuarine silt. Shell fauna is typical of "Clyde Beds" of Devensian Late-Glacial age. Deposit incorporated in basal part of Loch Lomond Readvance moraine at Rhu in Gareloch and overlain by glaciofluvial sand and gravel deposited during Loch Lomond Readvance and beach gravel deposited during Flandrian Transgression. Coll Nov 1974 and subm Dec 1974 by J Rose, Dept Geog, Birkbeck Coll, Univ London. *Comment* (JR): date is in general accord with dates derived from other shells coll from "Clyde Beds" in region of Clyde Estuary.

Finchampstead series

Two samples of assoc peat and wood from Valley Bog, near Moorgreen Farm, Finchampstead, Berkshire, England (51° 21′ 10″ N, 0° 50′ 25″ W, NGR: SU802625). Coll and subm Sept 1975 by D M Keith-Lucas, Dept Bot, Univ Reading.

HAR-1314. DMKLFIN1 **7000 ± 90**

$\delta^{13}C = -29.9‰$

Wood (*alnus glutinosa*) from depth in peat bog corresponding to Boreal, Pollen Zone VIB. *Comment* (DMK-L): date indicates wood is not contemporaneous with peat (HAR-1319 qv) with which it was assoc and probably represents roots of alder of Atlantic age (Pollen Zone VII a) penetrating surface of Boreal peat.

HAR-1319. DMKLFIN2 **7900 ± 110**
$\delta^{13}C = -28.6‰$

Peat, coarse detritus gyttja containing abundant wood fragments (larger fragments removed before subm) including *Alnus glutinosa*, and attributable by pollen analysis to Boreal period (Pollen Zone VIb). *Comment* (DMK-L): date not inconsistent with that indicated by pollen analysis.

B. Iran

Jask series

Two samples from Jask, Iran (25° 39′ 10″ N, 57° 49′ E) subm as part of prog aimed at elucidating recent coastal deformation in S Iran, to see whether sequential dating following leaching would reveal contamination by younger carbon. Coll Nov 1974 and subm Feb 1975 by C Vita-Finzi, Univ Coll, London.

HAR-1097. IBR2 **23,390 ± 400**
$\delta^{13}C = +1.3‰$

Shell (*Circe* [*Parmulophora*] *corrugata* [Dillwyn, 1817]) from cemented shelly deposit ca 5.5m above high water. *Comment*: given ca 30% leach.

HAR-1115. IBR2 **25,610 ± 640**
$\delta^{13}C = +1.4‰$

Same sample as HAR-1097. *Comment*: given ca 75% leach.

General Comment (CV-F): results point to some contamination as inner date is older; confirmed by X-ray diffraction. High age, thus, taken to be minimum for deposit (Vita-Finzi, 1975). Other ages being run on unaltered shell.

HAR-1114. ILT2 **110 ± 90**
$\delta^{13}C = -18.6‰$

Charcoal, mixed with silt, taken at depth 0.55m in sec 2.9 m deep exposed by wadi incision of Minab Alluvium, younger of 2 alluvial fills id in W part of coastal Iranian Makran (Vita-Finzi, 1975). Sample coll at Hasan Langi (27° 20′ 33″ N, 56° 56′ 49″ E) Nov 1974 and subm May 1975 by C Vita-Finzi. *Comment* (CV-F): date compares well with those obtained for analogous fill in N and central Iran and in Musandam Peninsula of Oman.

C. Qatar

Qatar series

Shell and charcoal samples coll in Nov and Dec 1973 by C Vita-Finzi, Univ Coll, London, during archaeol and environmental study of Qatar (de Cardi, 1978). Subm by C Vita-Finzi, 1974. Shell ages not corrected for $\delta^{13}C$. Values for shells are provided for information only.

HAR-522. QB 23 **>35,000**

$\delta^{13}C = +2.4‰$

Unaltered shells (*Circe callipyga* Born, *Trachycardium rubicundum* [Reeve]) from fossil beach ca 4.5m above high water at al-Wakrah (25° 10′ N, 51° 37′ E).

HAR-523. QB 19 **4690 ± 80**

$\delta^{13}C = +3.0‰$

Unaltered shells (*Asaphis deflorata* [Linnaeus]) from fossil beach 1.7m above high water N of Khor (25° 42′ N, 51° 32′ E).

HAR-524. QB 20 b **>35,000**

$\delta^{13}C = +2.6‰$

Unaltered shells (*C callipyga, Pinctada* cf *margaritifera* [Linnaeus]) from fossil beach ca +6m, 4.5 km NE of Shaqrah (24° 51′ N, 51° 26′ E).

HAR-525. QB 13 **5830 ± 70**

$\delta^{13}C = +3.0‰$

Unaltered shells (*P* cf *margaritifera*) from beachrock 2m above high water seawards of al-Wusail (25° 30′ N, 51° 30′ E).

HAR-526. QB 17 **27,100 ± 900**

$\delta^{13}C = +2.1‰$

Shells (cerithiids) from beachrock 5m above high water NW of Dukhan (25° 26′ N, 50° 46′ E). Shell aragonite almost wholly replaced by high-magnesium calcite.

HAR-527. QB 4 **>35,000**

$\delta^{13}C = +2.6‰$

Beachrock containing shell fragments (*A deflorata, Circe* cf *arabica*) overlying beach gravels 4m above high water on E coast of Ras Abaruk (25° 35′ N, 50° 51′ E). Aragonite wholly replaced by high-magnesium calcite; calcitic matrix.

HAR-528. QB 10 **5370 ± 80**

$\delta^{13}C = +4.2‰$

Unaltered cerithiids cemented by aragonite (<5% of sample) 1.5m above high water N of Bir Zekrit (25° 36′ N, 50° 50′ E).

HAR-529. QB 21 **21,950 ± 550**

$\delta^{13}C = +2.4‰$

Shells (cerithiids and small pelecypod valves) with some replacement of aragonite by high-magnesium calcite from beach 5m above high water 5km N of Dukhan (20° 23′ N, 50° 45′ E).

HAR-638. AM 2 **1850 ± 90**

$\delta^{13}C = -27.1‰$

Charcoal from slightly disturbed hearth 5cm below surface of basin fill at Bir Markhiyah (25° 03′ N, 51° 10′ E).

HAR-639. RA 3 **600 ± 90**

Charcoal from slightly disturbed hearth 2 to 4cm below surface of basin fill at Bir Abaruk (25° 35′ N, 50° 51′ E).

General Comment (CV-F): HAR-523, -525, and -528 indicate slight uplift of Qatar peninsula over last 5000 yr (Vita-Finzi, 1978; 1979). Remaining dates, either explicitly or implicitly minima, do not conflict with this view but their main value is to demonstrate need for rigorous sample selection and pretreatment. Two charcoal ages support contention that phase of silt deposition affected inland basins of Qatar during historical period (Vita-Finzi, 1978).

References

Allen, D, 1974, Brenig 48A Post-Medieval settlement: Denbighshire Hist Trans, v 23, p 43-49.

Bradley, R, Over, L, Startin, D W A, and Weng, R, 1975/6, The excavation of a Neolithic site at Cannon Hill, Maidenhead, Berkshire 1974-5: Berkshire Archaeol Jour, v 68, p 5-19.

Coles, J M (ed), 1978, Somerset Levels Papers 4: Univ Cambridge, Dept Archaeol.

——— 1979, Somerset Levels Papers 5: Univ Cambridge, Dept Archaeol.

Coles, J M and Orme, B J, 1976, The Sweet Track, Railway site, *in* Somerset Levels Papers 2: Univ Cambridge, Dept Archaeol, p 34-65.

——— 1979, The Sweet Track, Drove site: Somerset Levels Papers 5, p 43-64.

Coles, J M, Orme, B J, Hibbert, F A, and Wainwright, G J, 1975, Somerset Levels Papers 1: Univ Cambridge, Dept Archaeol.

——— 1976, Somerset Levels Papers 2: Univ Cambridge, Dept Archaeol.

——— 1977, Somerset Levels Papers 3: Univ Cambridge, Dept Archaeol.

Coombs, D G, 1976, Callis Wold round barrow, Humberside: Antiquity, v 50, no. 198, p 130-131.

de Cardi, B (ed), 1978, Qatar Archaeological Report: Excavations 1973: Oxford, Oxford Univ Press.

Dix, B, 1975a, Excavations at Odell, Bedfordshire: an interim report: Bedfordshire Co Council, Spring, p 3-4.

——— 1975b, Excavations at Odell, Bedfordshire: A second interim report: Bedfordshire Co Council, Autumn, p 4-5.

——— 1979, Excavations at Harrold Pit, Odell, 1974-78: A preliminary report: Bedfordshire Archaeol Jour, v 14, in press.

Donaldson, P, 1977, The excavation of a multiple round barrow at Barnack, Cambridgeshire 1974-1976: Antiquaries Jour, v 57, pt II, p 197-231.

Drury, P J, 1973, Little Waltham: Current Archaeol, v 36, p 10-13.

Fairless, K J and Coggins, D, 1974, Excavations at Forcegarth Pasture, Teesdale: Durham Co Local Hist Soc Bull 17, p 36-38.

——— 1978, Excavations in Upper Teesdale 1972-77, in Archaeol Repts 1977: Univ Durham, p 13.

Garlake, P S, 1976a, Excavation of a zimbabwe in Mozambique: Antiquity, v 50, p 146-148.

——— 1976b, An investigation of Manekweni, Mozambique: Azania XI, p 25-47.

Green, C J S, 1974, Interim report on excavations at Poundbury, Dorchester 1973: Dorset Nat Hist & Archaeol Soc Proc, v 95, p 97-100.

Guilbert, G C, 1975a, Planned hillfort interiors: Prehist Soc Proc, v 41, p 203-221.

——— 1975b, Moel-y-Gaer, 1973: an area excavation on the defences: Antiquity, v 49, no. 194, p 109-117.

——— 1976, Moel-y-Gaer (Rhosesmor) 1972-3 — an area excavation in the interior, *in:* Harding, D W, (ed) Hillforts: later prehistoric earthworks in Britain and Ireland, London, Academic Press.

Heighway, C M, 1976, Ancient Gloucester, the story of the Roman and medieval city: Gloucester City Mus.

Hill, C, Blagg, T, and Millet, M, in press, The Roman riverside wall at Upper Thames Street, London, 1974-76: London and Middlesex Archaeol Soc, Spec Paper No. 3.

Hobley, B and Schofield, J, 1977, Excavations in the City of London. First interim rept, 1974-1975: Antiquaries Jour, v 57, pt 1, p 31-66.

Hurst, H, 1972, Excavations at Gloucester 1968-71: Antiquaries Jour, v 52, p 58-62.
Jackson, D A, 1976, The excavation of Neolithic and Bronze age sites at Aldwincle, Northants. 1967-71: Northamptonshire Archaeol, v 11, p 12-71.
Lawson, A J, 1976, Excavations at Whey Curd Farm, Wighton: East Anglian Archaeol, rept no. 2, Norfolk, p 65-99.
Lucas, A T, 1969, A horizontal mill at Knocknagranshy, County Limerick: North Munster Antiquarian Jour, v 12, p 12-22.
Lynch, F and Allen, D, 1975, Brenig Valley Excavations 1974 (interim report): Denbighshire Hist Soc Trans, v 24, p 13-37.
Lynch, F, Waddell, J, Allen, D, and Grealey, S, 1974, Brenig Valley excavations 1973: interim report. Denbighshire Hist Soc Trans, v 23, p 9-64.
Macpherson-Grant, N C, 1977, Bridge-by-Pass: archaeological sites: East Kent Archaeol, Occasional paper no. 1.
Morgan, R A, 1976, Tree-ring studies in the Somerset Levels: The Sweet Track, Somerset Levels Papers 2, p 66-78.
———— 1979, Tree-ring studies in the Somerset Levels: floating oak tree-ring chronologies from the trackways and their radiocarbon dating: Somerset Levels Papers 5, p 98-101.
Otlet, R L, 1976, An assessment of laboratory errors in liquid scintillation methods of ^{14}C dating: Internatl radiocarbon conference, 9th, Proc, Univ California, June 20-26, 1976 (in press).
Otlet, R L and Warchal, R M, 1977, Liquid scintillation counting of low-level ^{14}C, *in:* Crook, M A and Johnson, P, (eds) Liquid scintillation counting 5: London, Heyden & Son Ltd, p 210-217.
Rogerson, A, 1976, Excavations on Fuller's Hill, Great Yarmouth: East Anglian Archaeol, Rept No. 2, Norfolk, p 131-245.
Schofield, J and Miller, L, 1976, New Fresh Wharf: I The Roman Waterfront: The London Archaeologist, v 2, no. 15, p 390-395.
Shoesmith, R, in press, Saxon and Medieval Hereford: Mono.
Vita-Finzi, C, 1975, Quaternary deposits in the Iranian Makran: Geog Jour, v 141, p 415-420.
———— 1978, Environmental history, *in*: de Cardi, B, (ed) 1978, Qatar Archaeological Report: Excavation 1973: Oxford, Oxford Univ Press, p 11-25.
———— 1979, Rates of Holocene folding in the coastal Zagros near Bandar Abbas, Iran: Nature, v 278, p 632-634.
Wakeman, W F, 1872/3, Paper on some antiquities of oak in the possession of J G V Porter, Esq, of Bellisle, Lisbellaw, Co Fermanagh: Royal Soc Antiquaries of Ireland Jour, v 12, p 16-18.
Ward, A H, 1975, A radio-carbon date for the Bronze age in South-West Wales: a preliminary note on the excavation of a composite mound on Pentre Farm, Pontardulais, West Glamorgan: The Carmarthenshire Antiquary, v 11, p 3-20.
———— 1978, The excavation of a Bronze age composite mound and other features on Pentre Farm, Pontardulais, West Glamorgan: Archaeol Cambrensis, v 127, in press.
Williams, J, 1975, Northampton: Current Archaeol, v 46, p 340-348.

[RADIOCARBON, VOL. 21, No. 3, P. 384-404]

UNIVERSITY OF LUND RADIOCARBON DATES XII

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INTRODUCTION

Most of the ^{14}C measurements reported here were made between October 1977 and October 1978. Equipment, measurement, and treatment of samples are as reported previously (R, 1968, v 10, p 36-37; 1976, v 18, p 290) except for some minor improvements of the electronic equipment.

Age calculations are based on a contemporary value equal to 95% of the activity of NBS oxalic acid standard and on the conventional half-life for ^{14}C of 5568 yr. Results are reported in years before 1950 (years BP). Errors quoted ($\pm 1\sigma$) include standard deviations of count rates for the unknown sample, contemporary standard, and background. When measured activity is less than 2σ above background, minimum age is given. Basis for calculation of age limit is measured net activity plus 3σ. If net activity is negative, only $+3\sigma$ is used for age limit.

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 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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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Sweden

Herrestads mosse series

Sediment and peat from bog Herrestads mosse, S Scania (55° 25.5′ N, 13° 52′ E). Coll 1975 and subm by J Mikaelsson, Dept Quaternary Geol, Univ Lund. Dated as part of study of water-level changes in area and vegetational development in surrounding region (Mikaelsson & Liljegren, 1978). Depths given refer to bog surface. All samples pretreated with HCl. Some received additional mild treatment with NaOH.

Lu-1225. Herrestads mosse, 390cm **9620 ± 95**
$\delta^{13}C = -26.7‰$

Coarse detritus gyttja. *Comment*: additional mild NaOH treatment.

Lu-1226. Herrestads mosse, 380cm **9420 ± 95**
$\delta^{13}C = -27.3‰$

Coarse detritus gyttja.

Lu-1227. Herrestads mosse, 370cm **9250 ± 90**
$\delta^{13}C = -26.1‰$

Coarse detritus gyttja.

Lu-1228. Herrestads mosse, 335cm **8560 ± 85**
$\delta^{13}C = -23.5‰$

Coarse detritus gyttja. *Comment*: additional mild NaOH treatment.

Lu-1229. Herrestads mosse, 315cm **7680 ± 80**
$\delta^{13}C = -25.8‰$

Drift gyttja.

Lu-1230. Herrestads mosse, 305cm **7590 ± 80**
$\delta^{13}C = -25.6‰$

Fine detritus gyttja with some root material.

Lu-1231. Herrestads mosse, 250cm **6350 ± 75**
$\delta^{13}C = -26.5‰$

Fine detritus gyttja. *Comment*: additional mild NaOH treatment.

Lu-1232. Herrestads mosse, 200cm **6090 ± 70**
$\delta^{13}C = -26.8‰$

Fine detritus gyttja with few root hairs. *Comment*: additional mild NaOH treatment.

Lu-1233. Herrestads mosse, 150cm **5600 ± 70**
$\delta^{13}C = -27.0‰$

Fine detritus gyttja with some root material and few minute mollusk shells. *Comment*: additional mild NaOH treatment.

Lu-1234. Herrestads mosse, 120cm **5050 ± 65**
$\delta^{13}C = -26.5‰$

Fine detritus gyttja with many minute mollusk shells. *Comment*: additional mild NaOH treatment. Carbonate from this sample was dated separately at 5940 ± 125 ($\delta^{13}C = -7.7‰$).

Lu-1235. Herrestads mosse, 45cm **3590 ± 60**
$\delta^{13}C = -25.0‰$

Strongly humified peat. *Comment*: additional mild NaOH treatment.

Olsäng series

Peat and peaty drift gyttja from area with beach ridges (Mikaelsson, 1978) at Olsäng, SE Blekinge (56° 12.5′ N, 16° 58.5′ E). Coll 1976 and 1977 and subm by J Mikaelsson. Dated as part of study of chronology of beach ridges and of shoreline displacement in area. For stratigraphy of dated samples, see *op cit*, above, p 42-43, 47.

Lu-1461. Olsäng I, Bp 27 **5690 ± 70**
$\delta^{13}C = -26.4‰$

Strongly compacted peat from Boring Point 27. *Comment*: pretreated with HCl and NaOH.

Lu-1462. Olsäng II, Bp 23 **9150 ± 90**
$\delta^{13}C = -26.6‰$

Highly humified *Sphagnum* peat from Boring Point 23. *Comment*: no pretreatment; small sample.

Lu-1463. Olsäng III, Bp 11 **9220 ± 90**
$\delta^{13}C = -26.8‰$

Peat with some gyttja from Boring Point 11. *Comment*: no pretreatment; small sample.

Lu-1460. Olsäng IV, Bp 13 **9120 ± 90**
$\delta^{13}C = -26.0‰$

Peaty drift gyttja from Boring Point 13. *Comment*: pretreated with HCl and NaOH.

Sämbosjön series (II)

Sediment from Lake Sämbosjön, Halland, SW Sweden (57° 10′ N, 12° 25′ E). Coll 1976 and subm by G Digerfeldt, Dept Quaternary Geol, Univ Lund. Dated as complement to Sämbosjön series (R, 1978, v 20, p 418-419). Depths given are below sediment surface. Pretreated with HCl and NaOH.

Lu-1280. Sämbosjön, 100 to 105cm **1500 ± 50**
$\delta^{13}C = -28.2‰$

Detritus gyttja.

Lu-1281. Sämbosjön, 60 to 65cm **1200 ± 50**
$\delta^{13}C = -27.8‰$

Detritus gyttja.

Lu-1418. Sämbosjön, 25 to 30cm **1140 ± 50**
$\delta^{13}C = -25.4‰$

Detritus gyttja.

Åsbotorpsjön series

Sediment from Lake Åsbotorpsjön, Billingen, S Sweden (58° 25′ N, 13° 50′ E). Alt 280m; area 2.5ha; max depth 7.5m. Coll 1976 and subm by G Digerfeldt. Dating is part of study of Late Weichselian development of lake and surrounding region. Samples come from profile in southern part of lake (Livingstone sampler, diam 10cm). Water depth ca 4m at sampling point. Depths given are below sediment surface. All samples pretreated with HCl.

Lu-1448. Åsbotorpsjön, 587 to 589.5cm **14,020 ± 155**
$\delta^{13}C = -25.1‰$

Clay gyttja. *Comment*: sample undersized; diluted; 67% sample. (3 1-day counts.)

Lu-1449. Åsbotorpsjön, 584 to 586cm **12,010 ± 130**
$\delta^{13}C = -25.0‰$

Clay gyttja. *Comment*: sample undersized; diluted; 80% sample.

Lu-1450. Åsbotorpsjön, 576 to 578cm **11,520 ± 120**
$\delta^{13}C = -25.2‰$

Clay gyttja. *Comment*: sample undersized; diluted; 88% sample.

Lu-1451. Åsbotorpsjön, 569.5 to 571.5cm **10,440 ± 105**
$\delta^{13}C = -23.9‰$

Clayey gyttja. *Comment*: sample undersized; diluted; 92% sample.

Lu-1452. Åsbotorpsjön, 566 to 568cm **10,200 ± 100**
$\delta^{13}C = -25.8‰$

Clayey gyttja.

Lu-1453. Åsbotorpsjön, 558 to 560cm **9670 ± 90**
$\delta^{13}C = -30.0‰$

Clayey gyttja.

Lu-1454. Åsbotorpsjön, 548 to 550cm **9170 ± 85**
$\delta^{13}C = -28.5‰$

Clayey gyttja.

Lu-1455. Åsbotorpsjön, 538 to 540cm **9020 ± 85**
$\delta^{13}C = -28.2‰$

Detritus gyttja.

Lu-1456. Åsbotorpsjön, 522 to 524cm **8630 ± 85**
$\delta^{13}C = -27.3‰$

Detritus gyttja.

Lillsjön series

Sediment from Lake Lillsjön, Stockholm (59° 20′ N, 17° 57′ E). Alt 0.3m; area 12ha; max depth 2.9m. Coll 1976 and subm by G Digerfeldt. Dating is part of study of isolation and recent development of lake. Samples come from profile in central part of lake (Livingstone corer, diam 6cm). Water depth 2.9m at sampling point. Depths given are below sediment surface. Pretreated with HCl. All samples undersized; diluted. Amount of CO_2 from sample is given in *Comments* below as "% sample".

Lu-1430. Lillsjön, 90 to 92.5cm **850 ± 55**
$\delta^{13}C = -28.3‰$

Clay gyttja. *Comment*: 75% sample.

Lu-1429. Lillsjön, 70 to 72.5cm **780 ± 50**
$\delta^{13}C = -29.3‰$

Clay gyttja. *Comment*: 86% sample.

Lu-1428. Lillsjön, 50 to 52.5cm **640 ± 50**
$\delta^{13}C = -28.7‰$

Clay gyttja. *Comment*: 91% sample.

Lu-1426. Laduviken **320 ± 50**
$\delta^{13}C = -18.7‰$

Algae gyttja from 95 to 97.5cm below sediment surface in profile in central part of Lake Laduviken, Stockholm (59° 22′ N, 18° 05′ E). Alt 0.7m; area 6ha; max depth 1.5m. Coll 1976 and subm by G Digerfeldt. Dated as part of study of recent development of lake. Water depth 1.5m at sampling point. Pretreated with HCl. *Comment*: 95% sample.

Lu-1427. Långsjön **490 ± 50**
$\delta^{13}C = -30.1‰$

Detritus gyttja from 52.5 to 55cm below sediment surface in profile in deepest part of Lake Långsjön, Stockholm (59° 16′ N, 17° 58′ E). Coll 1976 and subm by G Digerfeldt. Dated as complement to Långsjön series (R, 1978, v 20, p 420-421). Pretreated with HCl.

Sjömyretjärn series

Sediment from Lake Sjömyretjärn, Dalsland, W Sweden (58° 48′ N, 12° 05′ E). Alt 152m; area 10ha; max depth 4.55m. Coll 1977 and subm by G Digerfeldt. Dating is part of study of Holocene development of lake and vegetational history of surrounding region. Samples come from profile in central part of lake (Livingstone corer, diam 10cm). Water depth 4.55m at sampling point. Depths given are below sediment surface. All samples pretreated with HCl. Lu-1418, -1420, -1491, and -1492 received additional treatment with NaOH.

Lu-1486. Sjömyretjärn, 405 to 410cm **9750 ± 90**
$\delta^{13}C = -23.5‰$

Clay gyttja.

Lu-1487. Sjömyretjärn, 375 to 380cm **9500 ± 90**
$\delta^{13}C = -22.5‰$

Clayey gyttja.

Lu-1488. Sjömyretjärn, 345 to 350cm **9630 ± 90**
$\delta^{13}C = -23.1‰$

Clayey gyttja.

Lu-1489. Sjömyretjärn, 315 to 320cm **8880 ± 85**
$\delta^{13}C = -24.0‰$

Detritus gyttja.

Lu-1490. Sjömyretjärn, 275 to 280cm **7680 ± 75**
$\delta^{13}C = -29.2‰$

Detritus gyttja.

Lu-1491. Sjömyretjärn, 235 to 240cm **7050 ± 90**
$\delta^{13}C = -29.7‰$

Detritus gyttja. Insoluble fraction. *Comment*: undersized; diluted; 72% sample.

Lu-1491A. Sjömyretjärn, 235 to 240cm, soluble **7030 ± 75**
$\delta^{13}C = -29.3‰$

Acid-precipitated part of NaOH-soluble fraction.

Lu-1492. Sjömyretjärn, 195 to 200cm **5490 ± 65**
$\delta^{13}C = -29.9‰$

Detritus gyttja.

Lu-1493. Sjömyretjärn, 155 to 160cm **4390 ± 60**
$\delta^{13}C = -27.6‰$

Detritus gyttja.

Lu-1494. Sjömyretjärn, 115 to 120cm **3770 ± 60**
$\delta^{13}C = -25.6‰$

Detritus gyttja.

Lu-1420. Sjömyretjärn, 75 to 80cm **2350 ± 55**
$\delta^{13}C = -29.1‰$

Detritus gyttja.

Lu-1419. Sjömyretjärn, 35 to 40cm **1190 ± 50**
$\delta^{13}C = -29.8‰$

Detritus gyttja.

Central Blekinge series (I)

Sediment from lakes in Central Blekinge, SE Sweden. All samples except Lu-1554 coll 1977 and subm by S Björck, Dept Quaternary Geol, Univ Lund. Dating is part of study of age of isolation level in lakes of different alt and of pollen zonation in area. Samples are from cores taken with Livingstone sampler, diam 10cm, except Lu-1554 (diam 6cm). Depths refer to water surface, except for overgrown Lake Paddegölen, where depths refer to quagmire surface. Most of the samples were undersized and were diluted. Amount of CO_2 from sample is given in *Comments* below as "% sample". All samples pretreated with HCl.

Galtsjön

(56° 13′ N, 15° 13′ E), alt 32m. Water depth ca 5m at sampling point.

Lu-1422. Galtsjön, 794 to 797cm **11,000 ± 175**
$\delta^{13}C = -20.8‰$

Muddy clay, overlying isolation level. *Comment*: 48% sample.

Lu-1423. Galtsjön, 778.5 to 781.5cm **10,470 ± 110**
$\delta^{13}C = -22.3‰$

Muddy clay. *Comment*: 83% sample.

Lu-1424. Galtsjön, 762 to 765cm **10,050 ± 100**
$\delta^{13}C = -22.0‰$

Clay gyttja. *Comment*: 91% sample.

Lu-1425. Galtsjön, 759 to 761cm **10,020 ± 120**
$\delta^{13}C = -22.8‰$

Clayey gyttja. *Comment*: 67% sample.

Paddegölen

(56° 11′ N, 15° 13′ E), alt 27m.

Lu-1471. Paddegölen, 615 to 620cm **13,670 ± 295**
$\delta^{13}C = -21.9‰$

Clay. *Comment*: 24% sample. (4 1-day counts.)

Lu-1472. Paddegölen, 596 to 600cm **11,310 ± 175**
$\delta^{13}C = -22.5‰$

Clay, underlying isolation level. *Comment*: 38% sample. (3 1-day counts.)

Lu-1473. Paddegölen, 592 to 595cm **10,820 ± 110**
$\delta^{13}C = -19.7‰$

Clay gyttja, at isolation level. *Comment*: 84% sample.

Lu-1474. Paddegölen, 576 to 578.5cm **10,100 ± 95**
$\delta^{13}C = -21.0‰$

Fine detritus gyttja.

Kroksjön

(56° 16′ N, 15° 01′ E), alt 46m. Water depth ca 2m at sampling point.

Lu-1477. Kroksjön, 510 to 515cm **13,920 ± 340**
$\delta^{13}C = -20.7‰$

Clay, overlying isolation level. *Comment*: 26% sample. (3 1-day counts.)

Lu-1479. Kroksjön, 491 to 494cm **11,710 ± 115**
$\delta^{13}C = -21.2‰$

Clay gyttja. *Comment*: 67% sample. (3 1-day counts.)

Lu-1480. Kroksjön, 484 to 487cm **11,100 ± 130**
$\delta^{13}C = -22.6‰$

Clay gyttja. *Comment*: 68% sample.

Lu-1481. Kroksjön, 468 to 472cm **10,460 ± 95**
$\delta^{13}C = -21.8‰$

Clay gyttja.

Lu-1482. Kroksjön, 456 to 459cm **10,330 ± 95**
$\delta^{13}C = -21.6‰$

Clay gyttja.

Bredsjön

(56° 10′ N, 15° 12′ E), alt 12m. Water depth ca 1.7m at sampling point.

Lu-1555. Bredsjön, 533 to 540cm **14,310 ± 265**
$\delta^{13}C = -23.7‰$

Slightly muddy clay, underlying isolation level. *Comment*: 43% sample.

Lu-1556. Bredsjön, 526 to 530cm **11,380 ± 160**
$\delta^{13}C = -22.8‰$

Slightly muddy clay, at isolation level. *Comment*: 44% sample. (3 1-day counts.)

Lu-1557. Bredsjön, 522 to 525cm **10,230 ± 105**
$\delta^{13}C = -25.3‰$

Clay gyttja, overlying isolation level. *Comment*: 86% sample.

Logylet

(56° 18′ N, 14° 59′ E), alt 61m. Water depth ca 5.5m at sampling point.

Lu-1444. Logylet II, 970 to 974cm **11,430 ± 140**
$\delta^{13}C = -23.6‰$

Clay gyttja. *Comment*: 69% sample.

Sjalbredan

(56° 17′ 30″ N, 15° 01′ 30″ E), alt 42m. Coll 1978 by R Liljegren and J Mikaelsson; subm by S Björck.

Lu-1554. Sjalbredan, 577 to 581cm **10,990 ± 135**
$\delta^{13}C = -21.1‰$

Clay gyttja, overlying isolation level. *Comment*: 53% sample. (3 1-day counts).

Öppenskär I series

Peat from soil profile in *Calluna* heath on Öppenskär I., Torhamn archipelago, SE Blekinge (56° 04′ N, 15° 47′ E). Coll 1977 and subm by B E Berglund, Dept Quaternary Geol, Univ Lund. Area described by Berglund (1966, p 107-108). Pollen diagram from profile discussed by Berglund (1978). Depths refer to soil surface. Pretreated with HCl and NaOH.

Lu-1485. Öppenskär I:1, 25 to 26.5cm, insoluble **130 ± 45**
$\delta^{13}C = -26.0‰$

Insoluble fraction of fen peat from just above mineral soil and below *Calluna* peat.

Lu-1485A. Öppenskär I:1, 25 to 26.5cm, soluble **220 ± 45**
$\delta^{13}C = -26.6‰$

Acid-precipitated part of NaOH-soluble fraction of same peat. *Comment* (BEB): dates expansion of *Calluna* and possibly a local embogging. Lu-1485A indicates that younger roots may influence date of insoluble fraction.

Vieskär III series

Charcoal and peat from fen profile in bedrock depression on Vieskär I., Torhamn archipelago, SE Blekinge (56° 04′ N, 15° 47′ E). Coll 1977 and subm by B E Berglund. Pollen diagram discussed by Berglund (1978). Depths refer to fen surface. Peat pretreated with HCl and NaOH.

Lu-1468. Vieskär III:1, 34cm **1210 ± 50**
$\delta^{13}C = -26.5‰$

Charcoal of *Betula* and *Salix* or *Populus*, id by T Bartholin, from drift gyttja layer. Dates clearing phase, expansion of *Calluna* heath, and local embogging. *Comment*: no pretreatment; small sample; diluted; 65% sample. (3 1-day counts.)

Lu-1484. Vieskär III:2, 27 to 28.5cm, insoluble **420 ± 45**
$\delta^{13}C = -27.7‰$

Insoluble fraction of fen peat which dates end of *Calluna* phase and expansion of grass-juniper heath.

Lu-1484A. Vieskär III:2, 27 to 28.5cm, soluble **420 ± 45**
$\delta^{13}C = -27.4‰$

Acid-precipitated part of NaOH-soluble fraction of same peat.

Lummelunda Cave series

Gyttja from Lummelunda Cave, N Gotland (57° 44′ 18″ N, 18° 24′ 44″ E). Coll 1977 by R Engh; subm by L Engh, Dept Phys Geog, Univ Lund. Dated as part of study of chronology of cave deposits. In samples were some small fresh-water mollusks. Pretreated with HCl.

Lu-1511. Lummelunda Cave, Sample 8 **3570 ± 45**
$\delta^{13}C = -24.1‰$

Sample from 7cm thick gyttja layer in Mailbox Hall, overlain by silt and underlain by travertine alternating with silt. *Comment*: 3 1-day counts.

Lu-1512. Lummelunda Cave, Sample 24 **3530 ± 60**
$\delta^{13}C = -24.3‰$

Sample from 22cm thick gyttja layer in Siphon Hall, overlain by coarse sand and underlain by ca 1m laminated sandy sediments.

Lu-1513. Strimasund **8080 ± 80**
$\delta^{13}C = -26.9‰$

Peat from rd cutting 700m E of Strimasund farm at Rd E79, SW Lappland (66° 03′ 10″ N, 14° 52′ 09″ E). Coll 1976 and subm by L Engh. Peat is underlain by glaciofluvial deposits in fossil canyon.

Svedaskogen series

Barnacle and bivalve shells from Svedaskogen, ca 3km N of Fjärås church, Halland (57° 28′ 45″ N, 12° 10′ 30″ E). Coll 1977 and subm by Å Hillefors, Dept Phys Geog, Univ Lund. Dated as part of study of deglaciation of area (Hillefors, 1975; R, 1976, v 18, p 295-297).

Lu-1446. Svedaskogen, Sample 1:1977 **13,290 ± 125**
$\delta^{13}C = +0.1‰$

Shells (*Balanus* sp) from silty clay underlain by glaciofluvial material and overlain by wave-washed sand and gravel. Some specimens still had all side plates attached to basal plate. Sample also contained few shells of bivalves (*Macoma calcarea, Hiatella arctica, Mya truncata,* and *Mytilus edulis*); not used for dating. *Comment*: outer 45% removed by acid leaching.

Lu-1447. Svedaskogen, Sample 2:1977 **12,970 ± 120**
$\delta^{13}C = -0.2‰$

Barnacle shells (*Balanus* spp) and few fragments of bivalve shells (*Mytilus* sp) from glacial-tectonized glacial-marine clay overlain by till. *Comment*: outer 13% removed by acid leaching. Sample undersized; diluted; 78% sample. (3 1-day counts.)

General Comment: corrections for deviations from $\delta^{13}C = -25‰$ PDB are applied also for shell samples. No corrections are made for apparent age of shells of living marine organisms. For apparent age of recent mollusk shells, see R, 1975, v 17, p 183-184 and Håkansson (1975b).

B. Finland

Iso-Mustajärvi series

Sediment from Lake Iso-Mustajärvi, Ylitornio, Finland (66° 13′ 30″ N, 23° 48′ E). Alt ca 75m. Coll 1976 and subm by M Hjelmroos, Dept Quaternary Geol, Univ Lund. Dated as complement to Merijänjärvi and Pilpajärvi series (R, 1978, v 20, p 427-428). Samples are from core taken with Livingstone sampler. Depths given are below sediment surface. Water depth ca 1.3m at sampling point. Pretreated with HCl.

Lu-1431. Iso-Mustajärvi I, 206 to 215cm **5380 ± 65**
$\delta^{13}C = -28.8‰$

Slightly clayey gyttja. First impact of human influence; max of *Plantago major, Urtica,* and *Humulus*.

Lu-1432. Iso-Mustajärvi II, 84 to 93cm **3910 ± 60**
$\delta^{13}C = -29.1‰$

Gyttja. Grazing stage with *Plantago lanceolata;* empiric *Calluna* limit.

C. Norway

Lu-1421. Haugalia, Kvam **>43,400**
$\delta^{13}C = -19.5‰$

Collagen from mammoth tusk fragment from *Skarsanden* gravel pit at Haugalia, Kvam, Gudbrandsdalen (61° 39′ 36″ N, 9° 37′ 57″ E). Coll June 1977 and subm by K Garnes, Geol Dept, Univ Bergen, Norway. Deposits at Haugalia studied by submitter (Bergersen & Garnes, 1971). For other mammoth dates from area, see Berglund *et al* (1976, p 185) and Garnes (1978, p 197). Collagen extracted as described previously (R, 1976, v 18, p 290) including NaOH treatment. Organic carbon content: 5.8%. *Comments*: 4 1-day counts. Three σ were used for calculation of min age. Average net activity was almost exactly zero. (KG): in Garnes (1978, p 197) because of printing error this date is quoted as a definite date 43,400 BP.

Sotra series (II)

Sediment from small lakes on Sotra I., Hordaland, W Norway. Coll 1977 by K Krzywinski, B Stabell, M Kvamne, and E Risnes; subm by B Stabell and K Krzywinski, Bot Mus, Univ Bergen. Dated as complement to Sotra series (R, 1978, v 20, p 423-424). Preliminary repts of study pub by Krzywinski and Stabell (1978) and Berge *et al* (1978). Acid-precipitated part of NaOH-soluble fraction used for dating, except for Lu-1552 (dated on total organic material).

Lu-1495A. Sotra No. 10526/27 **2790 ± 55**
$\delta^{13}C = -27.6‰$

Lacustrine gyttja from Bakketjønn (60° 23′ N, 4° 59′ E) overlying isolation contact.

Lu-1496A. Sotra No. 10613 **4880 ± 65**
$\delta^{13}C = -28.2‰$

Lacustrine gyttja from "Einerhaugen", Tjørna (60° 21′ N, 4° 59′ E), overlying isolation contact formed after Tapes-transgression.

Lu-1497A. Sotra No. 10648/49 **7720 ± 80**
$\delta^{13}C = -27.7‰$

Lacustrine gyttja from "Einerhaugen", Tjørna, underlying ingression contact.

Lu-1498A. Sotra No. 10665 **9460 ± 90**
$\delta^{13}C = -22.4‰$

Lacustrine gyttja from "Einerhaugen", Tjørna, overlying isolation contact formed during 1st postglacial regression.

Lu-1527A. Sotra No. 10442 **2240 ± 55**

$\delta^{13}C = -18.3‰$

Lacustrine gyttja from Angeltveitvatnet, Angeltveit (60° 24′ N, 5° 00′ E), overlying isolation contact. *Comment*: sample undersized; diluted; 81% sample.

Lu-1528A. Sotra No. 10730 **2490 ± 55**

$\delta^{13}C = -29.2‰$

Lacustrine gyttja from Skrubbisvatn, Telavåg (60° 15′ N, 4° 59′ E), overlying isolation contact.

Lu-1529A. Sotra No. 12006 **10,260 ± 100**

$\delta^{13}C = -23.6‰$

Lacustrine gyttja from Tresskjønn, Kårtveit (60° 23′ N, 5° 00′ E), overlying isolation contact. *Comment*: sample undersized; diluted; 87% sample.

Lu-1530A. Sotra No. 12168 **9920 ± 90**

$\delta^{13}C = -23.5‰$

Lacustrine gyttja from Sekkingstadtjønn, Sekkingstad (60° 21′ N, 5° 00′ E), overlying isolation contact.

Lu-1552. Sotra No. 10904 **10,870 ± 195**

$\delta^{13}C = -23.9‰$

Sediment from ingression contact in Kvemavatn, Fjaereide (60° 22′ N, 5° 04′ E). *Comment*: very small organic content, hence dated on total organic material. Insoluble fraction combusted at <650°C. Sample diluted; 29% sample. (3 1-day counts.)

Lu-1553A. Sotra No. 12237 **6050 ± 70**

$\delta^{13}C = -28.4‰$

Sediment from Torkevikstjønn (60° 23′ N, 4° 58′ E); mainly lacustrine gyttja but with a thin layer showing marine influence and representing absolute max of Tapes-transgression.

D. Iceland

Lu-1433. Flateyjardalur **9650 ± 120**

$\delta^{13}C = -17.3‰$

Gyttja from lake at Flateyjardalur, N Iceland (66° 05′ 55′ N, 17° 54′ 20″ W). Coll 1977 by H Norddahl and G Hjaltason; subm by H Norddahl, Dept Quaternary Geol, Univ Lund. Dated as part of study of deglaciation of area. *Comment*: no pretreatment; small sample; diluted; 51% sample. (3 1-day counts.)

E. Greenland

Lu-1506. Sengstackes Bugt **44,700 +4700 −2900**

$\delta^{13}C = +0.3‰$

Large shells (*Mya truncata*) from clay reaching ca +30m SW of Sengstackes Bugt, N Shannon Ö, NE Greenland (75° 20′ N, 18° 26′ W). Coll 1976 by C Hjort and H Bruch; subm by C Hjort, Dept Quaternary Geol, Univ Lund. Dated as complement to East Greenland Series I through VI (R, 1972, v 14, p 388-390; 1973, v 15, p 504-507; 1974, v 16, p 319-322; 1975, v 17, p 184-187; 1976, v 18, p 301-303; 1978; v 20, p 424-427). *Comment*: outer 58% removed by acid leaching. (3 1-day counts.)

F. Spitsbergen

Lu-1508. Kaffiöyra **9700 ± 90**

$\delta^{13}C = -16.5‰$

Collagen from well-preserved unid. whale bone from surface of elev marine terrace, alt +6 to 7m, ca 700m from recent sea cliff at Kaffiöyra, Spitsbergen (78° 36′ N, 12° 10′ E). Coll 1975 by E Drozdowski and J Szypryczyński; subm by J Szupryczyński, Inst Geog, Polish Acad Sci, Toruń, Poland. Dated as part of continued study of glacial history of Spitsbergen (Klimaszewski, 1960). *Comment*: organic carbon content: 7.5%.

G. Poland

Lu-1507. Male Słońca **>39,500**

$\delta^{13}C = -1.4‰$

Thick shell fragments, mostly of *Arctica* (*Cyprina*) *islandica*, from glaciofluvial deposits at Małe Słońca, S of Tczew in lower Vistula valley, N Poland (54° 03′ N, 18° 50′ E). Coll 1977 and subm by E Drozdowski, Inst Geog, Polish Acad Sci, Toruń, Poland. Dated as complement to Lower Vistula valley series (R, 1976, v 18, p 303-304; 1978, v 20, p 429). *Comment*: outer 67% removed by acid leaching. (4 1-day counts.)

H. Switzerland

Lu-1483. Genève **>44,500**

$\delta^{13}C = -24.9‰$

Lignite from sec exposed at Pont de Sous-Terre (Jayet & Amberger, 1969, p 630-632) in town of Geneva (46° 12′ 16″ N, 6° 07′ 56″ E). Coll 1968 and subm by G F Amberger, Service Cantonal de Geol, Geneva, Switzerland. Stratigraphy, fauna, and flora described by Jayet and submitter (*op cit*, above); pollen study by Girard (1970). *Comment*: sample pretreated with HCl and NaOH. (5 1-day counts).

II. ARCHAEOLOGIC SAMPLES

Sweden

Varris series

Charcoal from Sites Raä 518b and Raä 503 at Varris, Lake Malgomaj, Vilhelmina parish, Lappland (64° 42′ N, 16° 25′ E). Coll 1976 and subm by L G Spång, Västerbottens Mus, Umeå. Dated as part of archaeol study of Stone age sites at Lake Malgomaj. Lu-1382 received normal pretreatment with HCl and NaOH; all other samples were small and received only mild pretreatment with NaOH and HCl.

Lu-1374. Varris, Raä 518b, K 1 **950 ± 50**
$\delta^{13}C = -23.8‰$

Charcoal from earth oven in piled up sand bank; depth ca 15cm.

Lu-1375. Varris, Raä 518b, K 2 **940 ± 55**
$\delta^{13}C = -24.7‰$

Charcoal from same earth oven as Lu-1374; depth ca 25cm. *Comment*: sample undersized; diluted; 80% sample.

Lu-1376. Varris, Raä 518b, K 3 **1160 ± 55**
$\delta^{13}C = -24.2‰$

Charcoal from same earth oven as Lu-1374; depth ca 40cm. *Comment*: sample undersized; diluted; 81% sample.

Lu-1377. Varris, Raä 518b, K 4 **1090 ± 50**
$\delta^{13}C = -24.9‰$

Charcoal from same earth oven as Lu-1374; depth ca 45cm.

Lu-1383. Varris, Raä 503, K 2 **1570 ± 50**
$\delta^{13}C = -24.8‰$

Charcoal from bottom of earth oven with heat-cracked stone.

Vojmsjöluspen series

Charcoal from Site Raä 554 at Vojmsjöluspen, Vilhelmina parish, Lappland (64° 52′ N, 16° 45′ E). Coll 1976 by L G and K Spång; subm by L G Spång. Dated as part of archaeol study of Stone age sites at Lake Vojmsjön. All samples were small and received therefore only mild pretreatment with NaOH and HCl. All except Lu-1381 undersized; diluted. Amount of CO_2 from sample is given in *Comments* below as "% sample".

Lu-1373. Vojmsjöluspen, Raä 554, Sample 1 **5540 ± 75**
$\delta^{13}C = -24.5‰$

Charcoal from layer with soot and heat-cracked stone ca 30cm below surface. Sq X108, Y322; +416.53 to 416.68. *Comment*: 86% sample.

Lu-1378. Vojmsjöluspen, Raä 554, Sample 2 **5320 ± 70**
$\delta^{13}C = -23.7‰$

Charcoal from refuse pit in till, depth ca 50cm. Sq X110, Y316; +416.17, K 1. Assoc with quartzite scrapers. *Comment*: 93% sample.

Lu-1379. Vojmsjöluspen, Raä 554, Sample 3 **5150 ± 65**
$\delta^{13}C = -23.6‰$

Charcoal from bank of heat-cracked stone ca 50cm below surface. Sq X107, Y321; +416.48. *Comment*: 60% sample. (4 1-day counts.)

Lu-1380. Vojmsjöluspen, Raä 554, Sample 4 **5340 ± 70**
$\delta^{13}C = -24.0‰$

Charcoal from silty sand ca 30cm below surface. Sq X112, Y318; +416.60 to 416.87. Assoc with quartzite core and quartz scraper. *Comment*: 68% sample. (3 1-day counts.)

Lu-1381. Vojmsjöluspen, Raä 554, Sample 5 **5550 ± 70**
$\delta^{13}C = -24.1‰$

Charcoal from bottom of refuse pit in humous gravel with bones. Sq X110, Y315; +416.0.

Lu-1382. Vojmsjöluspen, Raä 554, Sample 6 **3410 ± 90**
$\delta^{13}C = -23.3‰$

Charcoal from layer of rust-earth, depth ca 20cm, in till at Brännåker 1:70. *Comment*: 39% sample. (3 1-day counts.)

Valleberga series

Charcoal from settlement area at Valleberga, SE Scania (Strömberg, 1978a). Coll 1973 and 1977 and subm by M Strömberg, Hist Mus, Univ Lund. For other dates from Valleberga, see R, 1974, v 16, p 324-325; 1975, v 17, p 192-193; 1976, v 18, p 313-314. Pretreated with HCl and NaOH.

Lu-1415. Valleberga 29:12, Sample 8:76-77 **8610 ± 85**
$\delta^{13}C = -23.6‰$

Charcoal from hearth in settlement layer at Valleberga 29:12 (55° 24′ N, 14° 03′ E). Assoc with pottery and flints. *Comment* (MS): older than expected judging from archaeol finds.

Lu-1416. Valleberga 33[1] A, Sample 9:76-77 **1060 ± 50**
$\delta^{13}C = -25.0‰$

Charcoal from pit-house at Valleberga 33[1] A (55° 25′ N, 14° 04′ E). Assoc with pottery indicating Early Middle ages. *Comment* (MS): slightly older than expected.

Lu-1417. Valleberga 50[4], Sample 10:76-77 **3810 ± 60**
$\delta^{13}C = -25.2‰$

Charcoal from hearth at base of cultural layer, Trench II, Sq x = +2, y = +9 (*op cit*, above, p 90 and 95) at Valleberga 50[4] (55° 24′ N, 14° 04′ E). Assoc with flints and pottery. *Comment* (MS): date agrees with archaeol estimate based on assoc pottery.

Ystad series

Charcoal and bone from settlement area at Block Tankbåten in W part of Ystad town, S Scania (55° 25′ N, 13° 48′ E). Coll 1977 and subm by M Strömberg. Preliminary excavation rept with comment on this series pub by Strömberg (1978b). Charcoal pretreated with HCl and NaOH; bone collagen extracted as described previously (R, 1976, v 18, p 290).

Lu-1435. Kv Tankbåten, Sample 11:76-77 **1430 ± 50**
$\delta^{13}C = -24.8‰$

Charcoal from hearth in SW sec of Pit-house 2:77 (*op cit*, above, p 20, Fig 4), just below plough-disturbed soil. Assoc with animal bone and pottery.

Lu-1436. Kv Tankbåten, Sample 12:76-77 **1310 ± 50**
$\delta^{13}C = -24.6‰$

Charcoal from hearth at base of cultural layer in NE sec of Pit-house 2:77. Assoc with bone and pottery.

Lu-1437. Kv Tankbåten, Sample 1:HT77 **1640 ± 50**
$\delta^{13}C = -22.5‰$

Charcoal from hearth close to and NE of Pit-house 12:77 (*op cit*, above, p 25, Fig 9).

Lu-1438. Kv Tankbåten, Sample 2:HT77 **1620 ± 50**
$\delta^{13}C = -24.5‰$

Charcoal from hearth E of Pit-house 3:77 (*op cit*, above, p 21, Fig 5). Assoc with bones.

Lu-1439. Kv Tankbåten, Sample 3:HT77 **1310 ± 50**
$\delta^{13}C = -25.0‰$

Charcoal from bottom layer in Pit-house 10:77 (*op cit*, above, p 25, Fig 9).

Lu-1440. Kv Tankbåten, Sample 4:HT77 **1210 ± 50**
$\delta^{13}C = -24.4‰$

Charcoal from oven in SW sec of Pit-house 13:77 (*op cit*, above, p 26-27, Figs 10-11; p 46, Fig 18). Assoc with pottery and bones.

Lu-1514. Kv Tankbåten, Sample 5:HT77 **1470 ± 50**
$\delta^{13}C = -20.5‰$

Collagen from bone of *Bos*, id by O Persson, from gyttja layer in Trench III (*op cit*, above, p 50-52, Fig 21; p 85, Fig 38). Assoc with bone, horn, and some sherds of pottery. *Comment*: organic carbon content: 2.9%.

General Comment (MS): dates support archaeol dating of main occupation of settlement area to Vendel period.

Lödde kar series

Wood from underwater structures assoc with Viking period harbor (Ohlsson, 1973; Lindqvist, 1976) of the mouth of Lödde R, E Scania (55° 45′ N, 13° 00′ E). Coll 1975 and 1977 by T Ohlsson and P-I Lindqvist; subm by T Ohlsson, Hist Mus, Univ Lund. For other dates from underwater structures of similar age, see R, 1968, v 10, p 50; 1969, v 11, p 448-449; 1972, v 14, p 397-398; 1974, v 16, p 327; 1977, v 19, p 433-434. Pretreated with HCl and NaOH.

Lu-1159. Lödde kar, Log No. 1 **930 ± 50**
$\delta^{13}C = -25.5‰$

Unid. wood from 5 annual rings taken ca 10 rings inside bark.

Lu-1466. Lödde kar, Log No. 2 **980 ± 50**
$\delta^{13}C = -24.7‰$

Oak wood, id by T Bartholin, from ca 15 of outermost annual heartwood rings. Only few sapwood rings remained uneroded.

Lu-1467. Lödde kar, Log No. 4 **890 ± 50**
$\delta^{13}C = -26.4‰$

Beech wood, id by T Bartholin, from relatively superficial part of log with ca 35 annual rings.

Löddeköpinge No. 10 series (I)

Human bones from grave field at Löddeköpinge No. 10, Löddeköpinge parish, E Scania (55° 45′ N, 13° 00′ E). Coll 1976 and subm by T Ohlsson. Rept from excavation of Viking age settlement at Löddeköpinge pub by submitter (Ohlsson, 1976). For other dates on material from Löddeköpinge area, see R, 1973, v 15, p 512-513; 1976, v 18, p 317-318, and Lödde kar series, above. Collagen extracted as described previously (R, 1976, p 290), but without NaOH treatment. Vertebrae and other bones with thin outer walls and consisting mainly of spongiose bone, were not crushed before extraction.

Lu-1398. Löddeköpinge No. 10, Structure 10 **1010 ± 45**
$\delta^{13}C = -18.9‰$

Collagen from mixture of small human bones. *Comment*: undersized; diluted; 82% sample. (3 1-day counts.) Organic carbon content: 6.6%.

Lu-1399. Löddeköpinge No. 10, Structure 63 **910 ± 40**
$\delta^{13}C = -18.3‰$

Collagen from mixture of ill-preserved human bones. *Comment*: organic carbon content: 1.8%. (3 1-day counts.)

Lu-1400. Löddeköpinge No. 10, Structure 76 **1000 ± 50**
$\delta^{13}C = -18.2‰$

Collagen from 2 ankle bones, 1 vertebra, and other small human bones. *Comment*: organic carbon content: 7.7%.

Lu-1401. Löddeköpinge No. 10, Structure 81 **990 ± 50**
$\delta^{13}C = -18.4‰$

Collagen from human vertebrae. *Comment*: organic carbon content: 7.4%.

Lu-1402. Löddeköpinge No. 10, Structure 94 **980 ± 50**
$\delta^{13}C = -18.8‰$

Collagen from mixture of ill-preserved human bones. *Comment*: organic carbon content: 4.1%.

Lu-1403. Löddeköpinge No. 10, Structure 153 **890 ± 50**
$\delta^{13}C = -18.9‰$

Collagen from mixture of ill-preserved human bones. *Comment*: organic carbon content: 3.2%.

Lu-1404. Löddeköpinge No. 10, Structure 155 **990 ± 50**
$\delta^{13}C = -18.1‰$

Collagen from fragments of ill-preserved human bones. *Comment*: organic carbon content: 3.2%.

Lu-1405. Löddeköpinge No. 10, Structure 164 **990 ± 50**
$\delta^{13}C = -18.5‰$

Collagen from mixture of ill-preserved small human bones. *Comment*: organic carbon content: 3.4%.

Lu-1406. Löddeköpinge No. 10, Structure 179 **1010 ± 50**
$\delta^{13}C = -18.6‰$

Collagen from 2 heel bones, 2 ankle bones, 2 kneecaps, and some other small human bones. *Comment*: organic carbon content: 6.4%.

Lu-1407. Löddeköpinge No. 10, Structure 211 **1000 ± 50**
$\delta^{13}C = -18.8‰$

Collagen from 1 heel bone, 1 ankle bone, 2 kneecaps and some other small human bones. *Comment*: organic carbon content: 8.2%.

Lu-1408. Löddeköpinge No. 10, Structure 216 **1050 ± 50**
$\delta^{13}C = -18.9‰$

Collagen from 2 heel bones, 2 ankle bones, and some other small human bones. *Comment*: organic carbon content: 6.8%.

Lu-1409. Löddekopinge No. 10, Structure 237 **950 ± 50**
$\delta^{13}C = -18.5‰$

Collagen from tubular human bones. *Comment*: organic carbon content: 7.8%.

Lu-1410. Löddeköpinge No. 10, Structure 248 **1130 ± 50**
$\delta^{13}C = -18.0‰$

Collagen from 1 heel bone, 1 ankle bone, and some human vertebrae. *Comment*: organic carbon content: 6.2%.

Lu-1411. Löddeköpinge No. 10, Structure 251 **990 ± 50**
$\delta^{13}C = -18.4‰$

Collagen from ill-preserved human femur. *Comment*: organic carbon content: 3.3%.

Lu-1412. Löddeköpinge No. 10, Structure 272 **910 ± 50**
$\delta^{13}C = -19.0‰$

Collagen from fragments of human vertebrae and heel bones. *Comment*: organic carbon content: 5.7%.

Lu-1413. Löddeköpinge No. 10, Structure 274 **1030 ± 50**
$\delta^{13}C = -18.9‰$

Collagen from mixture of ill-preserved small human bones: *Comment*: organic carbon content: 3.7%.

Lu-1414. Löddeköpinge No. 10, Structure 311 **970 ± 50**
$\delta^{13}C = -18.6‰$

Collagen from fragments of ill-preserved vertebrae, rib bones, and other small human bones. *Comment*: organic carbon content: 3.0%.

General Comment: all dates are older than expected judging from coins found in some graves. Bones from those graves will be dated to give information about age discrepancies, which are too large to be explained by ^{14}C variations and apparent age of bone collagen in living adult humans due to the slow turnover in bone material (R, 1972, v 14, p 112). Discrepancies may possibly be explained by influence from frequent use of marine food, which is deficient in ^{14}C compared to food from terrestrial environments when it is normalized to the same $^{13}C/^{12}C$ ratio (R, 1972, v 14, p 112-113).

Ageröd series (II)

Charcoal and bone from Mesolithic settlement area at raised bog Ageröds mosse, Munkarp parish, Scania (55° 56.5′ N. 13° 25′ E). Coll 1974 and 1977 and subm by L Larsson, Hist Mus, Univ Lund. Results of archaeol study pub by submitter (Larsson, 1978). Dated as complement to Ageröd series (R, 1976, v 18, p 304-308). Charcoal id by T Bartholin; bone id by O Persson. No pretreatment of charcoal samples; undersized; diluted. Collagen extracted from bone sample as described previously (R, 1976, v 18, p 290).

Lu-1499. Ageröd I:HC, Sample 15 **7820 ± 90**
$\delta^{13}C = -24.9‰$

Charcoal (*Ulmus, Corylus,* and *Quercus*) from bottom layer. *Comment*: 84% sample.

Lu-1500. Ageröd I:HC, Sample 16 **7200 ± 90**
$\delta^{13}C = -24.9‰$

Charcoal (*Corylus, Alnus, Quercus,* and *Salix* or *Populus*) from upper peat. *Comment*: 75% sample.

Lu-1502. Ageröd V, Sample 4 **6710 ± 70**
$\delta^{13}C = -21.4‰$

Collagen from fragment of scapula of red deer from refuse layer, Sq C17. *Comment*: organic carbon content: 5.5%.

Lu-1501. Segebro, Sample 6 **7140 ± 75**
$\delta^{13}C = -24.0‰$

Charcoal (*Corylus, Ulmus,* and *Tilia*) from hearth on Mesolithic settlement Segebro in delta of Sege R, SW Scania (55° 37′ 25″ N, 13° 03′

35″ E). Coll 1976 and subm by L Larsson. Dated as complement to Segebro series (R, 1976, v 18, p 308-309).

Saxtorp series

Charcoal from Mesolithic pit-house and refuse pit (Larsson, 1975) at Saxtorp 11[9], Saxtorp parish, W Scania (56° 17′ N, 12° 57′ E). Coll 1972 and subm by L Larsson. Assoc finds of arrowheads and other worked flints indicate Kongemose culture. Pretreated with HCl and NaOH.

Lu-1524. Saxtorp 11[9], Sample 1 **6970 ± 70**
$\delta^{13}C = -23.1‰$

Charcoal (*Pinus*) from pit-house bottom. Assoc with oblique arrowheads and flint waste.

Lu-1525. Saxtorp 11[9], Sample 2 **4860 ± 65**
$\delta^{13}C = -24.2‰$

Charcoal (*Quercus*) from small refuse pit. Assoc with oblique arrowheads, transverse arrowhead, and flint waste.

Lu-1464. Källby **270 ± 45**
$\delta^{13}C = -20.8‰$

Collagen from horse tibia found in secondary position assoc with human bones during excavation for artificial dam at Källby, Lund, SW Scania (55° 41′ N, 13° 10′ E). Coll 1971 by O Persson, who id the bones; subm by J Callmer, Hist Mus, Univ Lund.

References

Berge, J, Bostwick, L G, Krzywinski, K, Myhre, B, Stabell, B, and Ågotnes, A, 1978, Ilandføring av olje på Sotra. De arkeologiske undersøkelser 1977: Vindenes, Hist Mus, Univ Bergen, Rept, 292 p.

Bergersen, O F and Garnes, K, 1971, Evidence of sub-till sediments from a Weichselian interstadial in the Gudbrandsdalen Valley, Central East Norway: Norsk Geog Tidsskr, v 25, p 99-108.

Berglund, B E, 1966, Late-Quaternary vegetation in eastern Blekinge, southeastern Sweden. II. Post-Glacial time: Op Bot a Soc Lundensi, v 12, no. 2, 190 p.

———— 1978, Landskapsförändringar i Östblekinge. 2. Vieskär och Öppenskär i Torhamns skärgård: Blekinges Natur 1978 (Karlskrona), p 15-36.

Berglund, B E, Håkansson, Sören, and Lagerlund, Erik, 1976, Radiocarbon-dated mammoth (*Mammuthus primigenius*, Blumenbach) finds in South Sweden: Boreas (Olso), v 5, p 177-191.

Garnes, Kari, 1978, Zur Stratigraphie der Weichseleiszeit im zentralen Südnorwegen, *in*: Schneiderbauer, H and Nagl, H (eds), 1978, Beiträge zur Quartär — und Landschaftsforschung. Festschrift zum 60. Geburtstag von Julius Fink, Verlag Ferdinand Hirt, Wien, p 195-220.

Girard, Michel, 1970, Analyse pollinique de l'Interglaciaire Riss-Würm de Sous-Terre à Genève (Suisse): Soc Phys et Hist Nat, Genève, Compte rendu, ns, v 5, Fasc 1, p 70-74.

Håkansson, Sören, 1968, University of Lund radiocarbon dates I: Radiocarbon, v 10, p 36-54.

———— 1969, University of Lund radiocarbon dates II: Radiocarbon, v 11, p 430-450.

———— 1972, University of Lund radiocarbon dates V: Radiocarbon, v 14, p 380-400.

———— 1973, University of Lund radiocarbon dates VI: Radiocarbon, v 15, p 493-513.

———— 1974, University of Lund radiocarbon dates VII: Radiocarbon, v 16, p 307-330.

———— 1975a, University of Lund radiocarbon dates VIII: Radiocarbon, v 17, p 174-195.

Håkansson, Sören, 1975b, Radiocarbon dating of shell samples from Western Sweden, Appendix, *in* Hillefors, Åke, 1975, Contributions to the knowledge of the chronology of the deglaciation of Western Sweden with special reference to the Gothenburg moraine: Svensk Geog Årsb, Årg 51, p 78-80.

——— 1976, University of Lund radiocarbon dates IX: Radiocarbon, v 18, p 290-320.

——— 1977, University of Lund radiocarbon dates X: Radiocarbon, v 19, p 424-441.

——— 1978, University of Lund radiocarbon dates XI: Radiocarbon, v 20, p 416-435.

Harkness, D D and Walton, A, 1972, Glasgow University radiocarbon measurements IV: Radiocarbon, v 14, p 111-113.

Hillefors, Åke, 1975, Contributions to the knowledge of the chronology of the deglaciation of Western Sweden with special reference to the Gothenburg moraine: Svensk Geog Årsb, Årg 51, p 70-81.

Jayet, Adrien and Amberger, Gad, 1969, L'Interglaciaire Riss-Würm de Sous-Terre à Genève: Eclogae geol Helvetiae (Basel), v 62, no. 2, p 629-636.

Klimaszewski, M, 1960, Studia geomorfologiczne w zachodniej części Spitsbergenu między Kongs-Fjordem a Eidem Bukta: Zeszyty Naukowe Uniw Jagiellońskiego, 32, Prace Geog, Ser Nowa 1, Kraków, 166 p.

Krzywinski, Knut and Stabell, Bjørg, 1978, Senglasiale undersøkelser på Sotra: Arkeo, arkeol medd fra Hist Mus, Univ Bergen, no. 1, 1978, p 27-31.

Larsson, Lars, 1975, A contribution to the knowledge of Mesolithic huts in southern Scandinavia: Lunds Univ Hist Mus Medd 1973-1974, p 5-28.

——— 1978, Ageröd I:B — Ageröd I:D. A study of Early Atlantic settlement in Scania: Acta Archaeol Lundensia, ser in 4°, No. 12, 258 p.

Lindqvist, P-I, 1976, Marinarkeologi i Öresund: Ale, Hist Tidsskr för Skåneland, 1976, no. 1, p 17-29.

Mikaelsson, Jan, 1978, Strandvallskomplexet vid Olsäng: Blekinges Natur 1978 (Karlskrona), p 37-52.

Mikaelsson, Jan, and Liljegren, Ronnie, 1978, Öja-Herrestads mosse: Våra Härader 1978, Ljunits och Herrestads Hembygdsförening, no. 11, p 16-22.

Ohlsson, Tom, 1973, Vikingatid och medeltid i Löddeköpinge: Ale, Hist, Tidsskr för Skåneland, 1973, no. 1, p 27-42.

——— 1976, The Löddeköpinge investigation I. The settlement at Vikhögsvägen: Lunds Univ Hist Mus Medd 1975-1976, ns, v 1, p 59-161.

Strömberg, Märta, 1978a, Three Neolithic sites. A local seriation?: Lunds Univ Hist Mus Medd 1977-78, ns, v 2, p 68-97.

——— 1978b, En kustby i Ystad före stadens tillkomst: Ystads Fornminnesförenings årsb, v 23, p 11-101.

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LYON NATURAL RADIOCARBON MEASUREMENTS VIII

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INTRODUCTION

This list includes most of the measurements made in 1977 and 1978 using the two Packard liquid scintillation spectrometers described in Lyon VII (R, 1978, v 20, p 19). The backgrounds of both spectrometers decreased by about 30% with new photomultipliers, giving 1.9 ± 0.1cpm and 2.4 ± 0.2 cpm, respectively, for 3ml C_6H_6 (depending on counting vessels). Proportional detectors are only used for very small samples. Counting procedures are described in the text. Dilution ratios indicate the amount of sample versus the total quantity of C_6H_6 or CO_2 introduced in the detectors. No change was made either in chemical treatment or in the calculation method (half-life: 5570 ± 0, one standard deviation, standard ^{13}C correction only for bones).

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Samples from peat bogs of low altitudes

Ly-1669. Marais de Lavours, Vongnes, Ain **Modern**
$\delta^{14}C = +18.6\% \pm 1.6\%$

Plant debris from alluvial sediments of Le Séran R at Les Rosières in Le Marais peat bog, near Vongnes, Ain (45° 49′ N, 5° 39′ E). Coll and subm 1975 by R Vilain, Geol Dept, Univ Lyon. *Comment* (RV): indicates that sample deposited by recent fluctuation of Le Séran R, and is unrelated to filling of Lavours peat bog.

Ly-1044. Marais de Saint-Gond, Morains, Marne **1530 ± 120**

Sediment rich in organic matter from boring in sediments of upper course of Petit Morin R, near Morains, Marne (48° 48′ N, 3° 59′ E). Coll and subm by F Megnien, Bur recherches Geol Min, Brie-Comte-Robert. Peat thickness established in E termination of Saint-Gond peat bog which was formed by capture of upper course of Petit Morin R by Somme Soude R. *Comment* (FM): approximately indicates when occurred, but further studies are necessary

Aigues-Mortes series, Gard

Sediments, mainly organic debris, deposited by branches of Rhône R in W part of its delta, near Aigues-Mortes, Gard. Coll by A L'Homer and subm by A Marcé, Bur recherches Geol Min, Orléans La Source.

Ly-1041. Rempart LU2, Aigues-Mortes **1980 ± 130**

Pure powdered plant remains coll at 0.4m depth between 2 ancient offshore bars (see Le Grau du Roi series, below) just outside Medieval walls of Aigues-Mortes city (43° 35′ N, 4° 12′ E). Coll and subm 1975.

Ly-1264. Le Canet, Aigues-Mortes **1720 ± 130**

Sandy powdered plant remains coll at 0.6m depth on side of ancient lagoon, in connection with Lairon pond. Vegetals were deposited by an ancient lateral channel of Paccaïs Rhône R at Mas du Canet (43° 33′ N, 4° 14′ E). Coll and subm 1976.

General Comment (AL): both dates agree and are max for closing of fluvial drift system near Aigues-Mortes.

Ly-1040. Marais de Fourchon, Arles, Bouches du Rhône **5850 ± 240**

Peaty sediment rich in organic matter from 8.5m depth at base of SA 1 or SA 3 boring in Fourchon peat bog near Arles, Bouches du Rhône (43° 40′ N, 4° 38′ E). Coll 1975 by A L'Homer and subm 1975 by A Marcé. Pollen diagram studied by H Triat, Lab Bot Hist, Univ Aix-Marseille, 2/3 diluted sample. *Comment* (AL and HT): formation of Fourchon peat bog occurred behind offshore bar formed during period of stable sea level. At this level, pollen diagram indicates development of *Fagus* forest, which, according to botanic data in region (Triat-Laval, 1978), has been attributed to the Atlantic period. Date agrees with Ly-1038, below, and with unpub result from 9.1m depth at same site: MC-1165, 6580 ± 100 BP.

Marais de Meyranne series, Raphèle lès Arles, Bouches du Rhône

Peat from 3 levels of SA 4 boring in Meyranne peat bog, near Raphèle lès Arles, Bouches du Rhône (43° 39′ N, 4° 43′ E). Coll 1975 by A L'Homer and subm 1975 by A Marcé. Pollen diagram studied by H Triat.

Ly-1037. Marais de Meyranne, 2 **2930 ± 270**

From 2m depth, 1/6 diluted sample.

Ly-1038. Marais de Meyranne, 4.3 **5010 ± 310**

From 4.3m depth, 1/2 diluted sample.

Ly-1039. Marais de Meyranne, 6 **8010 ± 400**

From 6.0m depth, 1/6 diluted sample.

General Comment (AL & HT): like Fourchon and Fos peat bogs, Meyranne peat bog grew behind offshore bar during same period of stable sea level. Pollen diagram shows beginning of climatic improvement phase at level of Ly-1039, above stratigraphic lacuna. Ly-1038 is just before increase of *Fagus* curve that remains constant until deforestation by humans, a little after Ly-1037 at level of which *Abies* disappears, (Triat-Laval, 1978).

Les Courtins series, Muron, Charente Maritime

Peat from 2 levels of 658/3/501 boring in *Scrobicularia* clays "Bri", of Rochefort peat bog at Les Courtins, near Muron, Charente Maritime (46° 2′ N, 0° 49′ W). Coll 1975 by B Bourgueil, Bur recherche Geol Min, Poitiers, and subm 1975 by A Marcé.

Ly-1042. Les Courtins, 14m **8380 ± 250**

From 14.03m to 14.05m depth, 2/3 diluted sample.

Ly-1043. Les Courtins, 16m **8140 ± 330**

From 16.07m to 16.10m depth, 1/3 diluted sample.

General Comment (BB): considering counting error, both dates are similar, indicating rapid sedimentation and confirming expected Holocene age.

Canal de la Fure series, Charavines, Isère

Peat from top and base of peaty layer, 1m thick, submerged at 1.3m in Fure channel, artificial overflow of Paladru lake at Charavines, Isère (45° 25′ N, 5° 31′ E). Coll and subm 1978 by M Girard and A Bocquet, Inst Dolomieu, Grenoble.

Ly-1663. Canal de la Fure, Sommet **1210 ± 130**

From top of peat layer, underlying lacustrian chalk layer.

Ly-1664. Canal de la Fure, Base **4780 ± 150**

From base of peat layer, overlying another lacustrian chalk layer.

General Comment (AB): Late Neolithic settlement on lowest lacustrine chalk layer in neighboring Les Baigneurs bay gave numerous pub dates from 4440 to 4100 BP (R, 1976, v 18, p 73). Between both dates lake level probably rose slowly to allow growth of homogeneous peat layer without clay and chalk. Waters rose high enough to involve chalk layer overlying present submerged Medieval (12th century) settlement.

Le Moulin de Siarne series, Ebréon, Charente

Peat from 2 40m neighbouring excavations in Aigre peat bog at Le Moulin de Siarne near Ebréon, Charente (45° 57′ N, 0° 01′ E). Coll and subm 1976 by Y Guillien, Bourg la Reine. Peat interstratified in calcareous tufa rich in organic matter and called "Bouchot".

Ly-1620. Moulin de Siarne II **4800 ± 150**

From 2m depth in excavation near side of peat bog.

Ly-1619. Moulin de Siarne I **5350 ± 170**

From 6m depth in excavation near middle of peat bog.

General Comment (YG): as peaty layer in Excavation II dips towards Excavation I and both dates are in 2σ statistical margins, peat may be only one layer which occurred during Atlantic period. This indicates quick growth for 6m thickness of "Bouchot".

Le Parc Borély series, Marseille, Bouches du Rhône

Peat from 2 levels of boring in town park Borély in Le Prado quarter, at Marseille, Bouches du Rhône (43° 16′ N, 5° 22′ E). Coll 1973 and subm 1977 by H Triat.

Ly-1466. Parc Borély, 395cm **3370 ± 140**

Ly-1467. Parc Borély, 590cm **6380 ± 140**

General Comment (HT): both dates agree with expected ages. Pollen diagram indicates disappearance of *Tilia, Ulmus,* and *Quercus pubescens.* This demonstrates rapidity and amount of deforestation in Marseille region where 1st clearing of woods by humans occurred during Neolithic period at Ly-1467 level (Triat-Laval, 1978).

Marais des Grands Paluds series, Fos sur Mer, Bouches du Rhône

Peaty sediments from 3 close borings in N part of Les Grands Paluds peat bog, near Fos sur Mer, Bouches du Rhône (43° 28′ N, 4° 52′ E). Coll and subm 1977 by H Triat-Laval.

Ly-1493. Les Grands Paluds de Fos, 130 to 135cm, No. 1 **2240 ± 140**

Peat coll from 130 to 135cm depth by plastic tubing drill; pollen diagram indicates late increase of *Fagus* in Sub-Atlantic period.

Ly-1494. Les Grands Paluds de Fos, 130 to 135cm, No. 2 **2260 ± 150**

Peat from same level as Ly-1493 but coll by Smith's drill.

Ly-1495. Les Grands Paluds de Fos, 140cm **3000 ± 130**

Clay, rich in organic matter, coll by plastic tubing drill at 140cm depth.

Ly-1496. Les Grands Paluds de Fos, 184 to 189cm **4450 ± 300**

Peat, little evolved from 184 to 189cm depth, coll by sovietic drill. 1/5 diluted sample. Pollen diagram indicates beginning of continuous curve of *Fagus* in Sub-Boreal period.

General Comment (HT): Ly-1493 and -1494, from same level, coll to test 2 boring systems in very wet peat bog where peaty sediment remains fluid. As expected, similarity of both results excludes mixture contamination of samples. Pollen diagram indicates beginning of Sub-Boreal period at level of Ly-1496, which then agrees with generally proposed chronology for beginning of this climatic phase. Hiatus occurred in sedimentation between Ly-1493/1494 and Ly-1495 at about limit of Sub-Boreal and Sub-Atlantic periods. Previously pub value, Ly-364: 5600 ± 150 (R, 1973, v 15, p 136) from 4.1m depth in S part of peat bog, at Le Pont des Clapets, fits with present series and corresponds to end of Atlantic (Triat-Laval, 1978).

Les Paluds series, Courthézon, Vaucluse

Peat from 2 levels of boring with Smith's drill in Les Paluds peat bog, near Courthézon, Vaucluse (44° 5′ N, 4° 53′ E). Coll 1975 and subm 1977 by H Triat to complete and confirm 5 previously pub dates (R, 1978, v 20, p 20).

Ly-1465. Les Paluds de Courthézon, 260 to 265cm **4250 ± 250**

Peat from 260 to 265cm depth where pollen diagram indicates beginning of *Fagus* extension, 1/2 diluted sample. *Comment* (HT): date a little younger than generally accepted (4700 BP) age of this pollen event in N Europe.

Ly-1582. Les Paluds de Courthézon, 480 to 500cm **11,570 ± 200**

Peat from 480 to 500cm depth, underlying level dated by Ly-1136: 11,530 ± 230, 470 to 475cm deep. *Comment* (HT): confirms previous result; indicates either complex evolution of vegetation during Alleröd period or rejuvenation of all samples from base of boring, due to local edaphic conditions.

General Comment (HT): 2 present results and previous series show vegetation history since Tardiglacial period. Extension of *Pinus* forest from Alleröd (Ly-1582/1136) or earlier (contamination) to Pre-Boreal (Ly-1263) is interrupted by phase of more steppe-like vegetation during Late Dryas. Short extension of *Corylus* may be seen at Boreal period (Ly-1262). First appearances of *Abies*, after those of *Quercus ilex* occurred in Atlantic period (Ly-1135) and increase of *Fagus* mark beginning Sub-Boreal (Ly-1465). Human influence may be detected as soon as Neolithic time.

Les Autures series, L'Isle sur la Sorgue, Vaucluse

Peat from 3 levels of boring in ancient Les Autures peat bog, near L'Isle sur la Sorgue, Vaucluse (43° 56′ N, 5° 03′ E). Coll 1977 and subm by H Triat-Laval.

Ly-1563. Les Autures, 129 to 132 cm **5620 ± 360**

From 129 to 132cm depth, 1/3 diluted sample. Pollen diagram indicates beginning of *Fagus* curve. *Comment* (HT): seems to be a little too old with respect to Ly-1465, above, for same botanic event but agrees with previously pub date, Ly-911: 4450 ± 150 (R, 1976, v 18, p 62) at nearby site.

Ly-1564. Les Autures, 149 to 151cm **6020 ± 230**

From 149 to 151cm depth, 9/10 diluted sample. *Comment* (HT): just before level, pollen diagram has continuous curve of *Abies* consistent with prosperity of fir forests in South Alps as, for instance, shown by Col des Lauzes and Lac Long Inférieur series (R, 1978, v 20, p 27-29; de Beaulieu, 1977). After level, *Abies* curve reflects regional fir forest.

Ly-1565. Les Autures, 303 to 307cm **7610 ± 190**

From 303 to 307cm depth, assumed from Atlantic period. *Comment* (HT): agrees with Ly-910: 6880 ± 180 (R, 1976, v 18, p 62) from L'Isle sur la Sorgue, neighboring site, and may mark beginning of Atlantic period, with small frequency of *Quercus pubescens* but without *Quercus ilex* and *Abies* pollen

Barbegal series, Arles, Bouches du Rhône

Samples from several levels of boring made by sovietic drill in Barbegal peat bog, near Arles, Bouches du Rhône (43° 41′ N, 4° 42′ E). Coll and subm 1976 by H Triat-Laval.

Ly-1460. Barbegal 80-85 **3670 ± 140**

Peat from 80 to 85cm depth. Pollen diagram indicates decrease of *Betula* and *Quercus pubescens* and increase of *Fagus* and *Quercus ilex*.

Ly-1461. Barbegal 120 **5140 ± 130**

Peat from 120cm depth. Pollen diagram indicates beginning of continuous curve of *Abies* which should correspond to Atlantic A period.

Ly-1462. Barbegal 160 **5160 ± 230**

Peat from 160cm depth, 2/3 diluted sample. Pollen diagram indicates beginning of *Fagus* curve which could correspond to beginning of Atlantic A period.

Ly-1463. Barbegal 240 **6860 ± 340**

Peaty clay from 240cm depth, at base of boring, 1/3 diluted sample. At overlying depth, 235cm, *Quercus ilex* pollens could imply pre-Atlantic date for lowest levels of site (Triat-Laval, 1978).

General Comment (HT): Ly-1460 proves early human influence by clearing of woods which favored *Fagus* extension. Time proximity of Ly-1461 and -1462, despite 40cm distance, shows very rapid filling. Ly-1463 seems too young for hypothesis of pre-Atlantic sediment at base of Barbegal peat bog.

Marais des Baux series, Mouriès, Bouches du Rhône

Organic sediments from several levels of borings coll by Smith's drill in middle of Les Beaux dried peat bog, near Mouriès, Bouches du Rhône (43° 41′ N, 4° 48′ E). Coll 1976 and subm 1977 by H Triat-Laval.

Ly-1504. Les Baux 70-75 **3370 ± 190**

Dark gray marl from 70 to 75cm depth. Just below curve of *Quercus ilex* and *Fagus* begins, while *Pinus* falls sharply. *Comment* (HT): same pollen event and date in Barbegal site: Ly-1460, above.

Ly-1505. Les Baux 85-90 **3100 ± 290**

Clear gray marl from 85 to 90cm depth, 2/3 diluted sample. Pollen diagram shows beginning of *Fagus* curve. *Comment* (HT): younger than expected for *Fagus* appearance with respect to Ly-1040 at Le Fourchon and Ly-1563 at Les Autures peat bogs, above.

Ly-1506. Les Baux 120-125 **5180 ± 390**

Very clear gray marl with small organic content, 1/5 diluted sample, from 120 to 125cm depth. Beginning of *Abies* curve in pollen diagram. *Comment* (HT): shows more recent age for *Abies* appearance than in Courthézon site: Ly-1135, 7350 ± 170 (R, 1978, v 20, p 20).

Ly-1507. Les Baux 155-160 **7260 ± 1140**

Chalky marl with very poor organic content, 1/15 very diluted sample, from 155 to 160cm depth. *Comment* (HT): too young, as pollen diagram defines end of pre-Boreal period.

Ly-1464. Les Baux 245-255 **8130 ± 750**

White clay with some organic debris, 1/10 very diluted sample, from 245 to 255cm depth. *Comment* (HT): too young, as pollen diagram indicates pre-Boreal period.

Ly-1508. Les Baux 280-285 **9750 ± 960**

Sandy gray clay with very low organic content, 1/15 very diluted sample. Pollen diagram shows an increase of *Pinus* probably during pre-Boreal period. *Comment* (HT): contrary to 2 previous results, and considering large counting error, date agrees with Ly-1558 from Beauchamp-Panières site, below.

General Comment (HT): all results from this site seem too young except those from samples with normal organic content. Discrepancies may be due to clayey nature of sediments or to another unknown reason, specific to sampling site (Triat-Laval, 1978).

Beauchamp-Panières series, Saint-Rémy de Provence, Bouches du Rhône

Samples from several levels in borings coll by Smith's drill in Beauchamp-Panières ancient peat bog, near Saint-Rémy de Provence, Bouches du Rhône (43° 32′ N, 4° 53′ E). Coll and subm 1977 by H Triat.

Ly-1554. Beauchamp-Panières, 85-90 **8320 ± 510**

Gray marl with low organic content, 1/3 diluted sample. From 85 to 90cm depth. Pollen data corresponding to beginning of Atlantic period. *Comment* (HT): date is younger than expected and disagrees with results below as well as with pollen data.

Ly-1555. Beauchamp-Panières, 95-100 **6770 ± 450**

Gray marl with low organic content, 1/5 diluted sample, from 95 to 100cm depth. Just before *Abies* appearance that corresponds to Atlantic A period. *Comment* (HT): younger than expected by Ly-1135: 7350 ± 170 for pollen event in Courthézon site (R, 1978, v 20, p 20), but agrees with Ly-910: 6880 ± 180 (R, 1976, v 18, p 62) from L'Isle sur la Sorgue site.

Ly-1556. Beauchamp-Panières, 120-125 **8210 ± 700**

Gray marl with few plant remains, 1/10 very diluted sample, from 120 to 125cm depth. Pollen diagram indicates extension of *Quercus pubescens* forest. *Comment* (HT): agrees with expected age and Ly-1262: 8480 ± 200 from Les Paluds de Courthézon and Ly-1019: 7880 ± 200 for Mollégès sites (R, 1978, v 20, p 20).

Ly-1557. Beauchamp-Panières, 136-140 **8390 ± 210**

Peat from 136 to 140cm depth. A high but short extension of *Corylus* occurs at level attributed to Boreal period. *Comment* (HT): confirms attribution and also agrees with Ly-1262 (see above).

Ly-1558. Beauchamp-Panières, 143-146 **10,140 ± 220**

Peaty marl from 143 to 146cm depth, just before a sedimentation hiatus. *Comment* (HT): may attribute max *Pinus* forest in beginning of Pre-Boreal period.

Ly-1559. Beauchamp-Panières, 220-225 **11,320 ± 1060**

Sandy clay, very poor in organic matter, 1/10 very diluted sample, from 220 to 225cm depth. Pollen diagram implies end of Alleröd period. *Comment* (HT): despite very large counting error, date agrees with expected period.

Ly-1560. Beauchamp-Panières, 328-332 **12,740 ± 480**

Gray marl from 328 to 332cm depth, 1/2 diluted sample. Pollen diagram shows phase of better climate with presence of *Quercus pubescens* and *Corylus*, which may correspond to Alleröd and Bölling periods as middle Dryas period cannot be seen in any pollen diagram in region.

Ly-1561. Beauchamp-Panières, 395-400 **12,580 ± 640**

Sandy gray clay with some plant debris from 395 to 400cm depth, 1/3 diluted sample. Pollen data should suggest Early Dryas. *Comment* (HT): date agrees with assumed climatic period only with 2σ statistical margin.

Ly-1562. Beauchamp-Panières, 40-50 **12,320 ± 1020**

Gray clay with small organic matter content from base of another boring coll by sovietic drill, 1/5 diluted sample. Pollen diagram comparison here makes oldest date of site expected. *Comment* (HT): much too close to Ly-1560 and -1561, date is younger than expected. Thus, most samples from bases of borings yield less reliable results which may be due to small amount of available organic matter.

General Comment (HT): pollen history of site begins with no mesothermic sp but with a steppe phase which may be contaminated by younger carbon. Subsequent increase of *Quercus pubescens, Alnus,* and *Corylus* pollen initiated a long phase (Ly-1559 and -1560) of *Pinus* forest of which max occurred during Boreal period. Late Dryas (Ly-1558) is very well marked by decrease of arboreal pollen. Extension of *Quercus* forest 1st due to *Q. pubescens* (Ly-1556) sp then to *Q. ilex* at Atlantic period where human influence becomes apparent. *Abies* appears at Atlantic period (Ly-1555) followed by *Fagus* at beginning of Sub-Boreal (Triat-Laval, 1978).

B. Samples from peat bogs of high altitudes

Dar Fatma series, Aïn Draham, Tunisia

Peat from 2 levels of core coll by Coûteaux' drill in Dar Fatma peat bog at 910m alt, near Aïn Draham, Tunisia (36° 46′ N, 8° 42′ E). Coll 1977 by A Pons and subm 1978 by A Pons and M Reille, Lab Bot Hist and Palynol, Univ Marseille.

Ly-1627. Dar Fatma, Sommet **Modern**
$\delta^{14}C = +20.0\% \pm 3.0$

Ly-1650. Dar Fatma, 63 to 71cm **700 ± 110**

General Comment (MR): pollen diagram shows last great deforestation just before Ly-1650. As shown in pollen diagram from Moroccan Rif (Reille, 1977) this event is a consequence of Arabian invasion.

Ly-1335. Col de Zad, Azrou, Morocco **1150 ± 120**

Peat from 70 to 72.5cm depth of core coll by Coûteaux' drill at alt 2000m at Le Col de Zad, near Azrou, Morocco (33° 00′ N, 5° 03′ W). Coll 1971 and subm by M Reille. Pollen diagram indicates disappearance of deciduous *Quercus* (Reille, 1976). *Comment* (MR): base of core gave unpub date: Lv-672, 2860 ± 60 and transition between Sub-Boreal and Sub-Atlantic periods cannot be seen in pollen diagram where deciduous *Quercus* should be reliable marker.

Ly-1233. Tizirène, Bab Taza, Morocco **1390 ± 140**

Peat with *Cyperaceae* sp from 130 to 140cm of core coll by Coûteaux' drill at alt 1400m in pond at Tizirène, near Bab Taza, Rif, Morocco (35° 01′ N, 5° 00′ W). Coll 1971 and subm 1976 by M Reille. Should correspond to Sub-Atlantic phase, before olive cultivation which began in Rif region ca 1000 BP. *Comment* (MR): agrees with expected age and approximates date of base of core from a neighboring pond, top of which yielded unpub date: Lv-647, younger than 210 BP (Reille, 1977).

Ly-1459. Oukaïmeden, Marrackech, Morocco **1610 ± 140**

Peat from 115 to 120cm depth in core coll at alt 2600m in Agdal of Oukaïmeden, near Marrackech, Morocco (31° 12′ N, 7° 51′ W). Coll 1971 and subm 1976 by M Reille. Pollen diagram indicates disappearance of *Quercus* at level. *Comment* (MT): consistent with unpub result from

150cm depth in core, Lv-693: 2680 ± 50 BP, which marks end of Sub-Boreal. As in Col de Zad site, above, transition from Sub-Boreal to Sub-Atlantic periods is not botanically characterized. Disappearance of deciduous *Quercus* is probably due to dry tendency during Sub-Atlantic period and may be used as marker for region.

Pélléautier series, Haute Alpes

Samples from levels of several cores close to each other in La-Motte-qui-Tremble peat bog, near Pélléautier, Hautes Alpes (44° 31′ N, 6° 11′ E). Cores I and III were coll by Coûteaux' drill in 1971 and Cores IV, V, and VI by Smith's drill in 1973, 1973 and 1976 respectively. Samples subm and pollen diagrams studied by J L de Beaulieu as part of general study of South Alps late and postglacial vegetation. All other Lyon radiocarbon results were pub previously (R, 1978, v 20, p 22-30). Site lies at alt 975m on side of Céüze mt ca 400m above large glacial valley of Durance R. Because of its very open position in landscape, site may well reflect vegetational history of region (de Beaulieu, 1977), and studies on coll cores are still in process. Often due to scarcity of organic matter in lowest levels, difficulties encountered in countings sometimes involved large counting errors and control measurements. Numbers indicate depths in cores and climatic phases are deduced from pollen diagrams.

Ly-581. Pélléautier I, 70 to 75cm **660 ± 210**

Gray clayey peat with mollusk shells. Disappearance of *Abies* and *Quercus*, appearance of *Juglans* and many non-arboreal pollens. High deforestation probably due to Middle age grazing fields, 5/6 diluted sample.

Ly-797. Pélléautier I, 260cm **4640 ± 190**

Black peat, 20cm above limit of lacustrine chalk, *Abies* predominance, end of Atlantic period.

Ly-582. Pélléautier III, 145 to 150cm **4850 ± 250**

Lacustrine chalk with low organic content giving a 7/12 diluted sample. Pollen diagram demonstrates large hiatus at 39cm depth in boring made on peat bog side. Predominance of *Pinus* Pre-Boreal or Alleröd. *Comment* (JL de B): aberrant result may be due to sampling system or secondary disturbance in levels.

Ly-1211. Pélléautier IV, 175 to 180cm **6430 ± 190**

Peat, predominance of *Abies*. Atlantic period.

Ly-1212. Pélléautier IV, 185 to 195cm **7600 ± 230**

Peat, *Pinus* predominance, *Quercus* presence and beginning of continuous curve of *Abies*; end of Boreal period.

Ly-1213. Pélléautier IV, 305 to 315cm **9090 ± 230**

Peat from 1st peaty level above lacustrine chalk, *Pinus* predominance on mesothermic sp, Pre-Boreal.

Ly-1214. Pélléautier IV, 465 to 475cm 11,000 ± 460

White chalk with little organic content involved counting in proportional detectors even after 1/2 dilution of sample. Only *Pinus* with some *Betula* pollen; Alleröd or Bölling phase.

Ly-1215. Pélléautier IV, 504 to 513cm 11,750 ± 500

Same as Ly-1214 for dating material, pollen date and counting procedure but without dilution.

Ly-1216. Pélléautier IV, 540 to 550cm 13,210 ± 410

Gray marl with higher content of carbon precluding dilution before measurement in small counters. Short shift of *Pinus* pollen percentage due to somewhat larger quantity of *Betula* pollens. End of continuous curve of *Juniperus*. Max of *Betula* is presumed during Bölling period.

Ly-1218. Pélléautier V, 565 to 574cm 14,320 ± 680

Marl with small organic content involving 3/4 diluted sample and measurement in proportional detectors. Predominance of *Juniperus* with *Betula* and *Pinus* presence; early Dryas.

Ly-1217. Pélléautier V, 587 to 595cm 10,990 ± 660

Same dating material and counting procedure with 4/7 dilution. Before *Juniperus* max. Large amount of *Pinus* pollen, Early Dryas. *Comment* (JL de B): aberrant result for unknown reason.

Ly-1775. Pélléautier VI, 415 to 422cm 12,810 ± 280

Peaty clear marl with many shells. Beginning of *Pinus* forest extension corresponding to large *Betula* decrease and end of *Juniperus* continuous curve; beginning of Bölling-Alleröd period.

Ly-1776. Pélléautier VI, 462 to 470cm 13,200 ± 550

Gray marl with plant debris and shells, 1/2 diluted sample, min of *Pinus,* max of *Juniperus,* just before expansion of *Betula;* before or during beginning of Bölling-Alleröd period.

Ly-1342. Pélléautier VI, 545 to 555cm 15,300 ± 320

Marl rich in organic debris but poor in pollen. Predominance of *Juniperus*. *Comment* (JL de B): does not fit with all other results for unknown reason.

Ly-1794. Pélléautier VI, 605 to 615cm 14,560 ± 420

Peaty marl with organic debris and shells, beginning of first *Juniperus* max; before Bölling. Same pollen proportion in Core V at Ly-1218 level, 4/5 diluted sample.

Ly-1795. Pélléautier VI, 620 to 625cm 15,090 ± 430

Peaty marl, just before beginning of 1st *Juniperus* max, 3/5 diluted sample.

Ly-1468. Pélléautier VI, 625 to 635cm 14,770 ± 300

Same material and pollen event as Ly-1795.

Ly-1796. Pélléautier VI, 690 to 708cm **23,730 +1900 −1500**

Clay very poor in organic matter, 4/30 very diluted sample and long counting time. Pollen diagram shows some changes in composition of steppe-like vegetation together with reduced percentage of long distance pollen (*Pinus*) Down to the base of core, at 780cm depth, sediment and pollen composition remain similar.

General Comment (JL de B): on 18 results, only Ly-582 and -1217 are not consistent for unknown reasons. All other dates give continuous chronology of site vegetation that fits very well with generally accepted absolute chronology of assumed climatic phases. Dates also agree with most values from neighboring sites, such as Siguret (de Beaulieu, 1977), Saint-Léger, Le Forest and Les Lauzes series (R, 1978, v 20, p 24-27) where last max of *Juniperus*, 1st max of *Pinus*, and appearance of *Abies*, are contemporaneous. Oldest dates are more interesting as they establish, for 1st time, an absolute chronology within Early Dryas period during steppe-like and steppe-bush phases. Nevertheless, Ly-1796 needs confirmation with further measurements on largest samples.

C. Bone samples from fill of grottos

Ly-1292. Aven du Nonoss, Entremont le Vieux, Savoie **4210 ± 160**

Bones (*Bovidae*) from base of Le Nonoss "aven", near Entremont le Vieux, Savoie (45° 27′ N, 5° 54′ E). Coll 1975 by M Ulysse and subm 1975 by M Philippe, Hist Nat Mus Lyon. *Comment* (MP): much younger than expected but may fit with fauna.

Causse du Gramat series, Lot

Bones from various fauna from fillings of several "avens", holes or grottos scattered on kastified calcareous plateau. Causse de Gramat, between valleys of Dordogne and Lot R, Lot dept. Samples were coll during survey of paleontol sites to complete previous pub series (R, 1975, v 17, p 13) by M Philippe.

Ly-1578. Igues de Bramarie, Diaclase supérieure, Caniac du Causse **1900 ± 600**

Bones (*Equidae*) found close to entrance of Igues de Barrière aven, near Caniac du Causse, Lot (44° 39′ N, 1° 37′ E), 1/10 very diluted sample. Coll 1975 and subm 1976.

Ly-1577. Igues de Bramarie, Conduite forcée, Caniac du Causse **2880 ± 630**

Bones (*Bovidae*) from 40m depth at base of Igues de Bramarie aven, near Caniac du Causse, Lot (44° 39′ N, 1° 37′ E), 1/6 very diluted sample. Coll 1975 and subm 1976.

Ly-1367. Igues du Pepin, Caniac du Causse **5350 ± 380**

Bones from various fauna from 25 to 35m depth between aven-shafts 2 and 3 of Le Pépin aven, near Caniac du Causse, Lot (44° 38′ N, 1° 40′ E), 1/3 diluted sample. Coll 1971 and subm 1976. *Comment* (MP): as some sp of fauna are obviously Würmian, such as reindeer, date proves mixture of ancient and recent bones in sites.

Ly-1576. Igues de Barrière, Miers **19,940 ± 800**

Bones (*Bovidae*) from 40m depth at base of Igues de Barrière aven, near Miers, Lot (44° 53′ N, 1° 42′ E), 2/3 diluted sample. Coll 1972 and subm 1976.

Ly-1294. Perte de Bramarie, Caniac du Causse, Lot **$31,500^{+2000}_{-1600}$**

Bones (*Elephas*) from 50m depth at base of Perte de Bramarie aven, near Caniac du Causse, Lot (44° 39′ N, 1° 37′ E). Coll 1974 and subm 1975.

General Comment (MP): as shown by dilution ratios, organic contents of bones is variable and, here, inversely proportional to absolute age. Loss of organic carbon in bones depends mainly on burial since more recent bones, such as those from Igues de Bramarie, were found overlying karstic fill and were submitted to meteoric water leachings. Bones underlying or in karstic fill are generally packed in waterproof clay. Contrary to previously pub series, ages are time scattered and Ly-1294 is as old as most samples from Le Causse de Martel sites: Ly-1225, below, and Causse de Martel series, below and R, 1976, v 18, p 66-67 (Evin *et al*, 1980).

Causse de Martel series, Lot and Corrèze

Bones from various sp from fills of several aven, holes or grottos scattered on karstified calcareous plateau Causse de Martel, between Brive bassin and Dordogne R valley. Coll during paleontol excavation (Ly-1225) or during survey of paleontol sites.

Ly-1293. Grange Cournille, Saint-Cernin de Larche, Corrèze **Modern**
$\delta^{14}C = -1.5\% \pm 1.6$

Bones (*Bovidae, Equidae*) filled Grange Cournille grotto, near Saint-Cernin de Larche, Corrèze (45° 6′ N, 1° 25′ E). Coll 1974 and subm 1975.

Ly-1574. Grotte Linoire, Turenne, Corrèze **1420 ± 220**

Bones of small sp from wastes of excavation in Linoire grotto, near Turenne, Corrèze (45° 03′ N, 1° 35′ E), 1/2 diluted sample. Coll 1974 and subm 1975.

Ly-1575. Pech de l'Ajasse, Gignac, Lot **$16,200^{+1300}_{-1500}$**

Bones (*Rangifer tatandus* & micro fauna) from base of Le Pech de l'Ajasse aven, near Gignac, Lot (44° 58′ N, 1° 29′ E), 1/10 very diluted sample. Coll 1974 and subm 1975. *Comment* (MP): despite thick concretions on bones and large statistical margins, date is youngest for Würmian sites of Causse de Martel plateau and is, then, contemporaneous with many samples from Causse de Gramat plateau, above and R, 1975, v 17, p 13.

Ly-1225. Siréjol, Couche très profonde, Gignac, Lot **30,100 +1400 −1700**

Bones (*Bovidae*) from lowest filling layer of Siréjol grotto, near Gignac, Lot, (44° 59′ N, 1° 29′ E). Coll 1975 and subm 1976. *Comment* (MP): perfectly confirms 2 previous measurements (Ly-614 and -767), of which average is 30,100 ± 1100, from upper layers of site fill which is then homogeneous in time (R, 1976, v 18, p 67). Three dates may be compared to results from Jaurens site (R, 1976, v 18, p 66; Evin *et al*, 1980).

General Comment (MP): as in series above, amount of organic content seems independent of absolute age of bones, and is more correlated with burial process.

Ly-1177. Locus 3 de la Falaise, Vergisson, Saône et Loire **28,680 ± 660**

Bones of various sp (*Bovidae, Equidae, Rodentia, Hyaenidae*) from fill of fissure, called Locus 3, in calcareous cliff of Vergisson, Saône et Loire (46° 18′ N, 4° 42′ E). Coll 1974 and subm 1977 by M Philippe. Two neighboring fissures, Locus 1 and 2, are prehistoric sites in which were found *Homo neandertalensis* remains. *Comment* (MP): no systematic excavation was made to establish contemporaneity between dated fauna and Mousterian industry or human fossils.

La Sartanette series, Remoulins, Gard

Bones from 3 levels in deepest room, called "Couloir des Trépassés" of La Sartanette grotto, near Remoulins, Gard (43° 56′ N, 4° 32′ E) (Bonnet *et al*, 1946) Coll 1941 by A Bonnet and J du Cailar, preserved in Nîmes Mus and subm 1974 by A Bonnet, Nîmes. Because of low organic content all samples were measured in small detectors after dilutions.

Ly-1589. La Sartanette Couche Z **4720 ± 110**

Human bones from Layer Z overlying stalagmitic Floor T, assoc with ceramic industry attributed to Early Bronze age. *Comment* (AB): too old for assumed assoc industry but makes sepulture contemporaneous with other Late Neolithic sepultures of same type with trepanned human skulls. In another part of grotto were found somewhat younger ages for a Late Neolithic industry of Chalcolithic-Ferrières type (Bonnet *et al*, 1973).

Ly-1590. La Sartanette, Couche T **21,900 ± 1500**

Bones (*Capra ibex*) embedded in stalagmitic cover assumed from Layer T to be from Late Würm period, 3/4 diluted sample. *Comment* (AB): indicates end of Würm III, climatic phase of which cold climate is compatible with stalagmitic formation. Within statistics it may be contemporary with Ly-1591, below, from underlying Level P.

Ly-1591. La Sartanette, Couche P **22,700 ± 1700**

Bones (*Ursus spealeus*) from Layer P, underlying stalagmitic Floor T, 3/4 diluted sample. *Comment* (AB): fauna (*Ursus spelaeus*) found in European grottos from Rumania to Spain were generally assumed from Würm I or Würm II glacial periods, such as in Prélétang grotto: Ly-167: older than 32,000 BP (R, 1971, v 13, p 45). Present results indicate Würm III agrees with similar fauna at Arlay, Jura: Ly-498/499: 25,720 ± 700 (R, 1973, v 15, p 520).

Ly-1597. Gouffre d'Abdala, Bagnères de Bigorre, Hautes Pyrénées **⩾29,200**

Bones from clay fill of fissure presently filled in deep gallery of Abdala gulf, near Bagnères de Bigorre, Hautes Pyrénées. (43° 05′ N, 0° 09′ E). Coll 1967 and subm 1976 by A Clot, Bordères sur Echez. Assoc fauna contains a large bovine (maybe bison), a deer and a large hamster, found only once before in Middle Paleolithic site at Fontechevade, Charente. *Comment* (AC): as expected, date suggests Würm II is min so that fauna may be contemporaneous with Fontechavade site.

D. Samples from fluviatile sediments

Ly-1100. Damerey, Saône et Loire **1930 ± 300**

Small amount of bones from 2.5m depth in drainage ditch in La Saône R alluvium at Damerey Saône et Loire (46° 51′ N, 4° 58′ E). Coll 1975 by R Fleury, Bur recherches Geol Min, Orléans, and subm 1975 by A Marcé; 1/10 very diluted sample. *Comment* (RF): younger than expected considering burial depth of bones that may have been deposited during exceptional flood of La Saône R.

Ly-1553. Source 1, Bagnols les Bains, Lozère **1490 ± 130**

Wood from frame of ancient catchment of thermal waters at well called "Source 1" at Bagnols les Bains, Lozère (44° 30′ N, 3° 37′ E). Coll 1977 by J J Risler, Bur recherches Geol Min Clermont-Ferrand and subm 1977 by A Marcé. Coll to determine age of 1st use of site. *Comment* (JJR): as expected, shows that catchment was 1st made during Roman time and may have been restored at end of this period.

Ly-1552. Bois de Laives, Laives, Saône et Loire **3500 ± 110**

Wood from gravel quarry Le Bois de Laives, near Laives, Saône et Loire (46° 30′ N, 4° 49′ E). Coll 1977 by R Fleury, and subm 1977 by A Marcé. Comes from same level as a previously dated wood: Ly-461: 5380 ± 380 (R, 1973, v 15, p 136). Level lies between fine and coarse alluvium of La Grosne R. *Comment* (RF): agrees with previous date and gives approx value to accumulation rate of vegetal horizons and alluvium in La Saône R, tributary of which is La Grosne R.

Barrage des Beaumes series, Saint-André d'Embrun Hautes Alpes

Wood from several morainic layers lying on left bank of Durance R, discovered in exploratory pit made to study dam settlement at Les Beaumes near Saint-André d'Embrun, Hautes Alpes (44° 24′ N, 6° 31′ E). Coll and subm 1977 by M Giafferi, Geol Dept, Electricité de France, Paris.

Ly-1584. Les Beaumes 1 **3080 ± 140**

Wood from 4.6m depth.

Ly-1585. Les Beaumes 2 **2860 ± 230**

Wood from 4.6m depth, 5/6 diluted sample.

Ly-1586. Les Beaumes 3 **2920 ± 110**

Wood from 5.6m depth.

General Comment (MG): three dates statistically yield same age and indicate rapid deposition.

Ly-1609. La Ratissou, Sablons, Isère **2880 ± 130**

Fragment of oak trunk found at 5m depth on left bank of Rhône R in main channel at Ratissou, near Sablons, Isère (45° 20′ N, 4° 46′ E). Coll and subm 1976 by G Chapotat, Centre recherches archeol Vienne. *Comment* (GC): dates youngest alluvium of Rhône R in site where Salaise series, below dates lowest terraces.

Villa San Maria, series, Chieti, Abruzzi, Italia

Wood from 2 levels of boring at Villa San Maria, near Chieti, Abruzzi, Italy (41° 57′ N, 14° 22′ E). Coll by M Spilotro and subm 1974 by G S Tazioli, Inst Geol Appl Geotech, Univ Bari.

Ly-1011. Villa San Maria A **3990 ± 120**

From 5.5m depth

Ly-1012. Villa San Maria B **5240 ± 120**

From 12.5m depth.

General Comment (GST): dates landslide phenomena that embedded woods in fluvio-lacustrine formation.

Nuovo Porto di Gioiatauro, Reggio di Calabria, Calabria, Italia

Lignite from 2 neighboring borings at Nuovo Porto di Gioiatauro, near Reggio di Calabria, Calabria, Italy (38° 28′ N, 15° 55′ E). Coll 1977 by A Guericchio and G Melidoro and subm 1977 by G Melidoro, Ist Geotech, Univ Bari.

Ly-1665. Nuovo Porto di Gioiatauro L **3870 ± 430**

Small amount of material from 42m depth in boring L, 1/5 diluted sample.

Ly-1666. Nuovo Porto di Gioiatauro H **4000 ± 160**

From 30m depth in Boring H.

General Comment (GM): as expected, both dates yield similar Holocene age to fluviatile formation in which they were embedded and show rapid sedimentation rate.

Les Vollaires series, Lazer, Hautes Alpes

Lignite from 3 levels of fluvio-lacustrian formation, outcropping on side of Le Clapier small R at Les Vollaires, near Lazer, Hautes Alpes (44° 21′ N, 5° 47′ E). Coll and subm by G Monjuvent, Inst Dolomieu, Grenoble. Stratigraphic series is 10m thick and has 14 layers of which 9 are lignite and 3 tufa. Pollen diagram studied by J L de Beaulieu.

Ly-1329. Les Vollaires 14 **5680 ± 160**

From upper layer.

Ly-1327. Les Vollaires 5 **6870 ± 180**

From layer in middle of tufa in central part of series.

Ly-1328. Les Vollaires 1 **12,250 ± 430**

From lowest layer with organic matter, 5/6 diluted sample.

General Comment (GM and JL de B): pollen diagram indicates Atlantic period for tufa embedding Ly-1627, agreeing perfectly with date. Despite their scarcity, pollen from lowest layer implies more temperate climate than generally assumed for late glacial climatic phase indicated by Ly-1328. As expected, all values attribute Late Würm or Holocene age for lowest level of glacier of Saint-Genis Mt. Date between Ly-1328 and -1327 was previously obtained in similar series made nearby in Les Barbiers small R valley, near Lazer: Ly-555: 9250 ± 190 (R, 1973, v 15, p 516). Both series assoc with slimes overlying lowest terrace of Le Buech R.

Ly-1704. La Borde, Joze, Puy de Dôme **7020 ± 180**

Tree trunk interstratified in pebble formation that constitutes lowest terrace of Allier R at La Borde, near Joze, Puy de Dôme (45° 51′ N, 3° 18′ E) (Daugas *et al*, 1978). Coll and subm 1978 by J P Daugas, Dir Ant Préhist, Auvergne Clermont-Ferrand and J P Raynal, Inst Quat Univ, Bordeaux. *Comment* (JP and JPR): peat layer was previously found near site and dated: Sa-103: 13,500 ± 450 (R, 1965, v 7, p 241). Depth of this last sample was 14m; it was at about same relative alt above present channel of Allier R, as Ly-1704. Thus comparison of both dates supports hypothesis of Holocene tectonic up or down motions which involved recent filling and deepening phases in E part of Grande Limagne plain.

Chonas series, La Terrasse, Isère

Wood from several levels of Isère R alluvia in sand-pit at Chonas, near La Terrasse, Isère (45° 23′ N, 5° 55′ E). Coll 1975 by C Hannss, Inst Geog, Univ Tübingen, and F Serre and C Goeury, Lab Bot et Palynol, Univ Aix-Marseille; subm 1977 by F Serre.

Ly-1648. Chonas G II 1 **1040 ± 150**

Indeterminable wood with diffuse pores, from pit base, 11.5 and 8.5m below ground surface.

Ly-1649. Chonas G II 4 **4970 ± 170**

Fragment of *Quercus pubescens* trunk from an unknown level in pit.

Ly-1647. Chonas G II 3 **11,520 ± 260**

Wood (cf *Pinus sylvestris*) from same level as Ly-1648.

General Comment (FS): Ly-1647 supports unpub Heidelberg lab result: 11,850 ± 100 from same pit. Other results from neighboring pits also agree (Hannss, 1977). Ly-1648 shows disturbance due to quarrying, Ly-1649 fits with all other values in surrounding sites.

Ly-1319. Graffen Weiher, Engenthal, Bas Rhin **10,580 ± 270**

Peaty sand from 5.2 to 5.3m depth of boring in peat bog at Graffen Weiher, near Engenthal, Bas Rhin (48° 38′ N, 7° 18′ E). Coll 1976 by M Menillet, Bur recherches Geol Min, Orléans, and subm 1976 by A Marcé. Pollen diagram studied by G Farjanel, Bur recherches Geol Orléans. *Comment* (GF): pollen diagram at level indicates large extension of *Betula*, decrease of *Pinus*, and may correspond to Late Dryas period as implied by date.

Aéroport Nice-Côte d'Azur series, Nice, Alpes Maritimes

Samples from 3 levels of Core S Q 613 coll by boring in Le Var R alluvia in planned extension zone of Nice-Côte d'Azur airport, near Nice, Alpes Maritimes (43° 39′ N, 7° 12′ E). Coll by Exploration Soc and subm by A Marcé.

Ly-1517. Nice Côte d'Azur, SQ 613, 32.7m **6750 ± 410**

Small bit of charcoal from 32.7m depth, 8/30 very diluted sample.

Ly-1518. Nice Côte d'Azur, SQ 613, 67.6m **11,460 ± 520**

Black clay from 67.6m depth, 1/3 diluted sample.

Ly-1519. Nice Côte d'Azur, SQ 613, 69.5m **12,760 ± 710**

Black clay with some charcoal bits from 69.5m depth, 1/5 diluted sample.

General Comment (AM): despite large counting error dates make it possible to estimate rapidity of recent Var R alluviation.

Salaise sur Sanne series, Isère

Bones from alluvium of 2 terraces of Rhône R near Salaise sur Sanne, Isère. Coll 1976 by G Mabilon, Le Péage de Roussillon and subm by G Chapotat.

Ly-1689. Les Blaches, Salaise sur Sanne **14,110 ± 620**

Equus femur and indeterminable humerus from ca 15 to 18m depth in Champagne terrace at Les Blaches N quarry (45° 21′ N, 4° 47′ E); 1/3 diluted sample.

Ly-1690. Le Stade, Salaise sur Sanne **20,370 ± 460**

Fragment of *Elephas primigenius* humerus from 17m depth in Saint-Rambert d'Albon terrace at Le Stade quarry (45° 21′ N, 4° 47′ E).

General Comment (GC): Ly-1690 confirms -360: 18,800 ± 490 (R, 1973, v 15, p 138) from same terrace 5km upstream and assumed Late Würmian age of Saint-Rambert d'Albon terrace (David *et al,* 1972). Ly-1689 is youngest date obtained for Rhône terrace system (Chapotat *et al,* 1980).

Ly-1587. Le Pont de Mirabeau, Saint-Paul lès Durance, Bouches du Rhône **26,550 +5000 −3000**

Small charcoal bits found scattered in lithochrome colluvium interstratified in loess on left bank of Durance R at Pont de Mirabeau, near Saint-Paul lès Durance, Bouches du Rhône (43° 41′ N, 5° 30′ E). Coll and subm 1974 by P Ambert, Inst Geog, Univ Aix en Provence; 1/2 diluted sample, measurement in proportional counters. *Comment* (PA): despite large counting error, date comparable with 2 previously pub results from similar stratigraphic series at Vautubière in same region: Ly-769: 31,900 $^{+1900}_{-1500}$ (R, 1975, v 17, p 9) and Ly-1002: 30,100 $^{+3400}_{-2600}$ (R, 1976, v 18, p 69). This agreement between 3 values makes questionable currently accepted chronology of slope deposits, which has been attributed to late interglacial in Provence (Ambert *et al,* 1974).

L'Amourette series, Mens, Isère

Woods from several level of series of torrential sediments at l'Amourette, near Mens, Isère (44° 48′ N, 5° 43′ E). Coll and subm 1975 by M Archambault, Inst Etudes Ligériennes, Univ Orléans. Because very old ages of samples were expected, pyrophosphate treatment was lengthened to remove contamination.

Ly-1033. L'Amourette 2 **⩾36,600**

From 42m depth in W part of series. Counting of only 3ml benzene.

Ly-1184. L'Amourette 6 **43,000 +1780 −1460**

From 9m depth: counting of 10ml benzene.

Ly-1322. L'Amourette 5 **43,800 +1860 −1520**

From 11m depth: counting of 10ml benzene.

Ly-1321. L'Amourette 3 **45,500 +2060 −1320**

From 36m depth: counting of 10ml benzene prepared from CO_2 obtained by combustion of pyrolyzation gas.

Ly-1320. L'Amourette 3b **≥46,000**

Same as Ly-1321 but 10ml benzene from sample combustion after pyrolization.

General Comment (MA): compatible with pub Le Villard series (R, 1978, v 20, p 33). Should attribute Würm II age to sampled series which should be then contemporaneous with max advance of Isère glacier which formed Le Triève lake. Like Villard series, however pollen analysis indicates temperature climate which is somehow surprising during Würm II period.

Ly-1551. Forêt de Chaux, Falletans, Jura **>30,000**

Peaty lignite from 7.6m depth in boring in superficial formations of Chaux forest, near Falletans, Jura (47° 03′ N, 5° 44′ E). Coll 1976 by Y Kerien, Bur recherches Geol Min, Lyon, and subm 1976 by A Marcé. *Comment* (YK): as lignite horizon overlies several different formations, it might be assumed, with lack of fauna or pollen data, either very recent or coming from the Pliocene-Pleistocene limit, like other similar formations in region. Date rather supports the last hypothesis.

E. Samples from various continental sediments

Chavannes series, La Thuile, Aosta, Italia

Woods found in rocks falls at alt ca 1900m in Chavannes small R valley, near La Thuile, Aoste, Italy (45° 44′ N, 6° 54′ E). Coll 1975 by A Cerutti and subm 1976 by R Vivian, Inst Geog, Grenoble. Woods were uprooted by rock fall from Ciavaretta mt slope at ca alt 2100m. At present, very large trees cannot grow at high alts in valley. Growth period of dated trees is assumed to be before Little Glacial age, cold climatic phase that began approx in the 16th century and shifted timber line down.

Ly-1617. Chavannes 1 **170 ± 130**

Fragment of *Larix*.

Ly-1618. Chavannes 2 **450 ± 140**

Fragment of *Pinus*.

General Comment (RV): Ly-1618 agrees with hypothesis as it probably grew ca AD 1500. Ly-1617 is much younger than expected and should correspond to uplift of timber line after Little Glacial age, an hypothesis which remains very questionable.

Ly-1655. Glacier du Chardon, La Bérarde, Savoie **560 ± 120**

Fragments of tree trunk from sediments lying on Le Chardon glacier at alt 2500m at La Bérarde, near Saint-Christophe en Oisans, Savoie (44° 54′ N, 6° 18′ E). Coll 1976 by R Lambert and subm 1977 by R Vivian. Wood probably comes from rock falls of lateral moraine that was covered by forest before Little Glacial age. *Comment* (RV): date is ca AD 1390, *ie*, before beginning of last cold climatic phase. Agrees with Ly-

1618, above, and with previous measurement of another wood from front of same glacier: Ly-280: 750 ± 130 (R, 1973, v 15, p 135; Vivian, 1975).

Ly-1219. Les Eymards, Lans en Vercors, Isère 860 ± 130

Charcoal from assumed fossil soil at 150cm depth at Les Eymards near Lans en Vercors, Isère (45° 6′ N, 5° 34′ E). Coll and subm 1974 by G Monjuvent. *Comment* (GM): disagrees with expected age. Despite fossil aspect and depth, soil is recent and was probably covered by superficial slope deposits.

Ly-1656. Corbassière, Fionnay, Valais, Suisse 4080 ± 150

Fragment of tree trunk from channel of Corbassière, torrent at alt 2150m, 150m downstream of tongue of Corbassière glacier, near Fionnay, Valais, Switzerland (46° 02′ N, 7° 18′ E). Coll 1976 by M Willaud, Soc Forces motrices Mauvoisin, Sion, and subm by R Vivian. *Comment* (RV): although nothing is known of growth place of tree, as it was found in torrent alluvium, date aligns it with other dated tree trunks from neighboring glacier Ferpècle, such as Ly-685: 3360 ± 230 or Ly-683: 5340 ± 250 (R, 1975, v 17, p 7-8; Bezinge, 1974).

Ly-1060. Saint-Bauzile, Ardèche >40,540

Lignitic debris from diatomitic layer outcropping in quarry near Saint-Bauzile, Ardèche (44° 40′ N, 4° 40′ E). Coll and subm 1975 by P Délétie, Geol Dept Electricité de France, Paris. Layer assoc with recent basaltic flows, 1978 K/ar dating of which gave ca 4.1 MA, and confirmed no radiocarbon activity of sample.

F. Samples from marine and lagoonal sediments

Ly-1265. Marais de la Fosse, Saint-Gilles du Gard 3820 ± 140

Shells (*Cardium edule*) picked up on surface of La Fosse coastal peat bog, near Saint-Gilles du Gard, Gard (43° 37′ N, 4° 14′ E). Coll 1976 by F Bazile, Vauvert, and A L'Homer and subm 1976 by A Marcé. *Comment* (FB and AL): dates closing of presently filled lagoon in Rhône R delta and fits with 2 other results from another lagoon in delta, MC-1161: 4190 ± 70 and MC-1162: 4160 ± 100 (Bazile, 1976).

Ly-1159. Le Relais, Fos sur Mer, Bouches du Rhône 5890 ± 200

Large shells coll on offshore bar at alt −1.5m at pumping sta Le Relais near Fos sur Mer, Bouches du Rhône (43° 28′ N, 4° 49′ E). Coll 1976 by A L'Homer and subm 1976 by A Marcé. *Comment* (AL): as in W part of Le Rhône R delta a contemporaneous offshore bar (see, Ly-1514, below) is at alt +1.5m; difference between both dates shows importance of subsidence movement that occurs in central part of Rhône R delta.

Le Grau du Roi series, Hérault and Gard

Marine shells from offshore bars, approx parallel to present coast in W part of Le Rhône R delta. Coll 1977 by A L'Homer and subm 1977 by A Marcé.

Ly-1514. Le Grau du Roi 25647, Aigues-Mortes, Gard **5460 ± 160**

From youngest offshore bar, 1km W Aigues-Mortes, Gard (43° 45′ N, 4° 10′ E).

Ly-1512. Le Grau du Roi 25645, Le Grand Travers, Hérault **6080 ± 170**

From youngest offshore bar, between Maugio pond and sea, at Le Grand Travers (43° 44′ N, 4° 03′ E).

Ly-1513. Le Grau du Roi 25646, Bergerie de Haute Plage, Hérault **6660 ± 170**

From intermediate offshore bar, at La Bergerie de Haute Plage, near La Grande Motte, Hérault (43° 45′ N, 4° 05′ E).

Ly-1511. Le Grau du Roi 25644, Le Petit Travers, Hérault **7050 ± 190**

From oldest offshore bar between Maugio pond and sea, at Le Petit Travers, Herault (43° 43′ N, 4° 02′ E).

General Comment (AL): all results agree with series of MC lab dates on shells from other sampling points on same bars between Maguelonne and Aigues-Mortes (Bazile, 1974). Both series elucidate emerging sequence of recent ages of parallel bars according to proximity to present sea coast, *ie,* land advancement in that part of Rhône delta.

Ile des Madeleines series, Sénégal

Marine shells from 2 places on small island Les Madeleines, W Dakar, Sénégal (14° 34′ N, 17° 29′ W). Coll and subm 1978 by P Elouard, Geol Dept, Univ Lyon.

Ly-1671. Plage de l'Ile des Madeleines **Modern**
$\delta^{14}C = +0.5\% \pm 1.5$

Shells (*Patella safiana*) from beach at alt +2m. *Comment* (PE): proves that shells are recent storm sediments and are not sediments of assumed raised beach.

Ly-1670. Sommet de l'Ile des Madeleines **1130 ± 130**

Shells (*Thais haemastoma*) from kitchen midden at top of island. *Comment* (PE): confirms human occupation of island at same period in which kitchen midden of Le Fadiout or Le Salaun region was built (see, eg, Bangaléré series: R, 1975, v 17, p 13).

Rao and Gandon series, Sénégal

Shells (*Arca senelis*) from marine terraces near Rao (15° 56′ N, 16° 26′ W) and Gandon (15° 57′ N, 16° 26′ W) villages, near Saint-Louis, Sénégal. Coll 1973 by J Monteillet, Saint-Louis, and subm 1978 by P Elouard. Measurements made to complete previously pub results (R, 1976, v 18, p 69; Monteillet, 1974).

Ly-1344. Rao R I A **4220 ± 160**

Ly-1347. Rao R I E **4580 ± 520**

4/30 very diluted sample because of accidental loss of most of the sample.

Ly-1346. Gandon G I C **5200 ± 210**

2/3 diluted sample.

Ly-1345. Gandon G I A **5670 ± 240**

1/2 diluted sample.

General Comment (PE): Ly-1344 and -1345 come from level that marks small transgressive oscillation during general regression following max of Nouakchottian transgression. They both confirm Ly-982: 4670 ± 120 and Ly-986: 4720 ± 140. Ly-1345 and -1346 mark max of Nouakchottian transgression and agree with previous dates for same event on same site Ly-983: 5250 ± 120, Ly-985: 5650 ± 150 and Ly-987: 5590 ± 140 and on numerous sites of W African coast (Elouard, 1968).

Côte de l'Angola series, Angola

Shells from marine terraces, lying behind present shore and attributed to Nouakchottian transgression, ca 6000 BP, because of alt and fauna. Coll 1974 by P Giresse and M Kouyoummtzakis, Univ Brazzaville, Congo, and subm 1975 by P Elouard.

Ly-1271. Estrada de Catumbela G K AN 1/47b **28,600 $^{+1300}_{-1140}$**

Shells (*Arca senelis*) from 7 to 10m alt on Catumbela rd side (12° 28′ S, 13° 35′ E).

Ly-1273. Baia de Azal G K AN 2/57 **29,300 $^{+1700}_{-1400}$**

Shells (*Arca senelis, Typonatinus fuscatus*), from 10 to 12m alt on Azal beach (12° 38′ S, 13° 15′ E).

Ly-1272. Estrada da Baia des Pipas G K AN 2/40 **≥31,400**

Shells (*Cardium rigens*) from 15m alt on Pipas beach rd (15° 07′ S, 12° 12′E).

General Comment (PE): series does not confirm expected Holocene age and indicates that terraces were probably formed during Inchirian transgression, ca 30,000 BP (Elouard & Faure, 1967).

II. ARCHAEOLOGIC SAMPLES

A. Historic and Protohistoric periods

Ly-1581. Saint-Cyr sur Rhône, Rhône **820 ± 100**

Skull from Grave 2 of an ancient cemetery, Saint-Cyr sur Rhône (45° 31′ N, 4° 50′ E); coll and subm 1976 by G Chapotat. No assoc industry was found in grave which was dug in loess and surrounded by stones. *Comment* (GC): any age was expected; date shows that cemetery was used during Middle Age.

Ly-1626. Le Pusmin, Sarzeau, Morbihan **1250 ± 150**

Fragment of a wooden beam from stud-work of ground level of Medieval house at Le Pusmin, near Sarzeau, Morbihan (47° 31′ N, 2° 48′ W). Coll and subm 1977 by P Gévin, Dept Geol, Univ Lyon. 9/10 diluted sample. *Comment* (PG): 1st story of house has large windows and is precisely dated by inscription on beam from AD 1568. Ly-1626 shows that lowest part of house with windows was built during Early Middle Age, agreeing with architectural style of popular houses from this period.

Ly-1667. Cimetière des Chouennes, Brens, Ain **1340 ± 240**

Human bones from ancient cemetery, "Burgonde", constituted of sepultures with small flag-stones at Les Chouennes, near Brens, Ain (45° 42′ N, 5° 41′ E). Coll and subm 1977 by R Vilain; Dept Geol, Univ Lyon. Bones lay in sandy sediment exposed to leaching by meteoric waters. Organic matter was badly preserved and samples were too diluted to be counted in small proportional detectors. *Comment* (RV): date, ca 4th to 6th century, agrees with expected range of dates for such "Burgonde" cemetery.

Ly-1580. Sainte-Blandine, Vienne, Isère **1720 ± 110**

Human skull from ca 2m depth in alluvia at foot of Sainte-Blandine hill at Vienne, Isère (45° 31′ N, 4° 53′ E). Coll 1972 by M Eynaud and subm 1976 by G Chapotat, Centre Recherches Archeol, Vienne. *Comment* (GC): as bones were found near La Tène III site, expected age was 50 BC. Date rather indicates end of Roman period, during which boundary of Roman town was very close to sampling site.

Ly-1410. Grigny RH 83, Rhône **2250 ± 120**

Fragment of wooden (*Pinus picea*) handle of iron object, presumably a ploughshare, dredged from Rhône R at Grigny, Rhône (45° 36′ N, 4° 47′ E). Coll 1972 and subm 1977 by G Chapotat. *Comment* (GC): agrees with other measurements from similar wooden handles of metal objects from same site (R, 1976, v 18, p 71) ranging from Middle Bronze to La Tène III periods (Chapotat *et al*, 1978).

Agay and Bataignerseries, Var and Alpes Maritimes series

Human bones found on sea bottom, very close to 2 wrecks submerged near Mediterranean seashore. Artifacts assoc with wrecks date from ca AD 950 (Arnaud *et al*, 1978). Subm 1977 by G and S Arnaud, Paleo-anthropology Lab, Draguignan.

Ly-1469. Agay, Var **1790 ± 110**

From −50m alt, in Agay bay, near Agay, Var (43° 26′ N, 6° 51′ E). Coll 1968 by A Visquis.

Ly-1471. Bataigner B, Cannes, Alpes Maritimes **1390 ± 300**

From −54m alt, 500m E Sainte-Marguerite I. in Napoule bay near Cannes, Alpes Maritimes (43° 31′ N, 7° 01′ E). Coll 1974 by J P Joncheray; 5/6 diluted sample.

Ly-1472. Bataigner C, Cannes, Alpes Maritimes **1350 ± 150**

From another skeleton from same location as Ly-1471.

General Comment (GA & SA): younger than expected by artifacts assoc with wrecks. Relationship between skeletons and ships is not well established, as many shipwrecks occurred in region for 2 millennia.

Ly-1625. Le Parc, Yzeron, Rhône **1700 ± 200**

Charcoal fragment from shallow ashy layer in meadow at Le Parc, near Yzeron, Rhône (45° 43′ N, 4° 36′ E). Coll and subm 1977 by L Jeancolas, Tassin. 1/3 diluted sample. Site is shallow circular mound presumably starting point of Roman aqueduct supplying "Lugdunum", Roman city of Lyon. *Comment*: despite uncertainty, date confirms hypothesis of aqueduct origin.

Ly-1657. Saré Dioulдé, IFAN 123, Koussanar, Sénégal **430 ± 130**

Charcoal from 0.5m depth under top of stoney funeral tumulus at Saré Dioudlé Koussanar Dist, Sénégal (14° 7′ N, 13° 50′ W). Coll 1977 by G Thilmans and subm 1977 by C Descamps, Inst Fondamental Afrique Noire, Dakar. This Megalithic Senegambian monument included ca 20 burials with only a few potsherds. *Comment* (CD): Senegambian megaliths are found in 3 regions. Date proves that those from E region are much younger than those from central (Tiekene Boussoura, Ly-1343, below) or W (Sine Ngayéne, Dak-201: 867 ± 117; R, 1977, v 19, p 161) regions.

Ly-1343. Tiekene-Boussoura, IFAN 109, Koupentoum, Sénégal **1160 ± 220**

Powder of black potsherds from 1m depth in Megalithic Circle 4 of Tiekene-Boussara site, Koupentoum Dist, Sénégal (14° 00′ N, 14° 35′ W). Coll 1975 by G Thilmans and subm 1976 by C Descamps (Thilmans & Descamps, 1975). 1.2kg of potsherds were powdered and burned to get 2/3 diluted sample. *Comment* (CD): agrees with other results from similar monuments at Kodian site: Dak-41: 1356 ± 126; Dak-54: 1212 ± 125; at Wassu site, Dak-2: 1200 ± 110 (Thilmans & Descamps, 1974).

Koumbi Saleh series, Timbedra, Mauritania

Charcoal from several different places in Koumbi Saleh archaeol site, 55km NE Timbedra, Mauritania (15° 46′ N, 7° 59′ W). Site is probably one of former capitals of ancient empire of Ghana (7th to 19th centuries). Site was excavated several times since 1913. Samples come from last excavation period (1975, 1976). Excavations were directed by S Robert, Inst Mauritanien recherches Sci, Nouakchott, helped by A Cross, French Center of French Embassy, Libreville; and S Berthier, Hist Dept, Univ Lyon II. SB I and SB II refs indicate samples from 2 neighboring excavations in 1975 and 1976 by S Berthier in SE part of town, near an old mosque. S Robert excavated here in 1975 and 1976 and got samples with SR II and SR III refs. Occupation of Koumbi Saleh site seems to have been continuous for at least 7 centuries, from about end of 7th century to 15th century. Stratigraphy of site could be divided in 3 important periods, each comprising 2 to 4 levels. Period of Levels I a/b may correspond to ancient pre-urban or to 1st urban occupation from 7th to 9th centuries; period of Levels II a/b corresponds to 1st important city from beginning of 9th to 12th centuries; period of Levels III a/b/c/d correspond to most recent occupation with recently well-preserved walls and house from 12th to 15th centuries.

Ly-1525. Koumbi Saleh SB I 56 **440 ± 180**

From 335cm depth, Level III/c; 1/2 diluted sample.

Ly-1524. SB I 48 **550 ± 230**

From 350cm depth, Level III/c; 1/5 diluted sample.

Ly-1526. SB I 73 **860 ± 210**

From 410cm depth, Level III/b; 1/3 diluted sample.

Ly-1520. SB I 95 **590 ± 120**

From 465cm depth, Level III/a.

Ly-1521. SB II 15 **230 ± 120**

From 255/260cm depth, Level III/d.

Ly-1341. SB II 46 **1000 ± 150**

From 395/400cm, Level III/b; 1/2 diluted sample.

Ly-1523. SR II 39 **500 ± 110**

From 340/350cm depth, Level III/c.

Ly-1522. SR II 40 **500 ± 120**

From 340/350cm depth, Level III/c.

Ly-1610. SR II 41a **1400 ± 160**

From 350cm depth, Level III/c; 5/6 diluted sample.

Ly-1792. SR II 41b **1280 ± 150**

From 350cm depth, Level III/c.
Repeat of previous sample. Average of both 1340 ± 100.

Ly-1612. SR III 163 **940 ± 120**

From 290cm depth, Level III b/c.

Ly-1615. SR III 177 **980 ± 130**

From 340cm depth, Level III/b.

Ly-1613. SR III 165 **1210 ± 140**

From 360cm depth, Level III a/b.

Ly-1614. SR III 170 **540 ± 120**

From 355/360cm depth, Level III/b.

Ly-1616. SR III 196 **1290 ± 130**

From 620/650cm depth, Level I/c-II/a.

Ly-1611. SR III 152 **870 ± 120**

From 630cm depth, Level Ib/II/a.

General Comment (SR): most results from excavation SB I, SB II and SR III (except Ly-1521, -1610, -1792) seem to connect hypothetical stratigraphy (Berthier, 1978) and previous measurements: Dak-156: 981 ± 114 and Dak-157: 1122 ± 125 from Level Ia in 1972 excavation by A Cros and S Robert (R, 1977, v 19, p 162). Two results appear older than previously imagined: Ly-1526 and -1341. Ly-1792 check does not confirm eventual inversion between Ly-1611 and -1610 which was believed would explain discrepancy of both results. From excavation SR III only Ly-1611 and -1614 seem to conform obviously to other investigations. The other 4 dates seem too old without precise importance of divergence, particularly between Ly-1612 and -1615, for unknown reason (D Robert & S Robert, 1979).

Kandiama series, Velingara, Sénégal

Charcoal from several places in Kandiama site, Velingara Dist, Sénégal (13° 10′ N, 13° 51′ W). Coll and subm by J Girard, Univ Lyon. This enigmatic site is system of shallow intersecting galleries, filled by secondary lateritic sediments.

Ly-1312. Kandiama 2 **Modern**

$\delta^{14}C = -1.7\% \pm 2.1$

From base of gallery alpha. 5/6 diluted sample. Coll and subm 1976.

Ly-1313. Kandiama 3 **Modern**

$\delta^{14}C = -2.0\% \pm 1.7$

From inside filling of gallery alpha. Coll and subm 1976.

Ly-1156. Kandiama 1 **1540 ± 180**

From gallery 5m deep. 1/2 diluted sample. Coll and subm 1975.

Ly-1780. Kandiama C **490 ± 160**

From base of filling of C gallery. Coll and subm 1978

Ly-1781. Kandiama C′ **1050 ± 170**

From base of inside filling of C′ Gallery. Coll and subm 1978.

Ly-1782. Kandiama C″ **1310 ± 380**

From base or inside filling of C″ gallery. 1/4 diluted sample counted in proportional detector. Coll and subm 1978.

General Comment (JG): Ly-1312, -1313, and -1780 prove that secondary materials entered galleries before and after excavations. Ly-1781, -1782, and -1156 agree with expected age, as oral tradition since 11th century mentions gallery habitation in region.

Ly-1604. Santourin, Billième, Savoie **2240 ± 260**

Small bits of charcoal from 4 places in archeol layer with poor ceramic industry. At 1.7m depth near Megalithic monument (Lagier-Bruno, 1973), called "La Pierre de Santourin" at Santourin, near Billième, Savoie (45° 48′ N, 5° 23′ E). Coll 1975 and 1976 by L Lagier-Bruno, Yenne. *Comment* (LLB): indicates La Tène period and supports attribution of layer to temporary settlement of sheep-fold on site, which is, thus, independent of Megalithic monument.

Ly-1573. Vallée des Reines, Luxor, Egypt **2490 ± 250**

Fragment of human mummy from ancient excavation in Les Reines valley near Luxor, Egypt (25° 41′ N, 32° 28′ E). Coll 1976 and subm 1977 by R Laurent, Villeurbanne. *Comment* (RL): despite poor preservation conditions and unscientific collection procedures, date proves mummy is authentic and may come from Late Empire epoch.

Dikili Tash series, Krinides, Kavala, Greece

Charcoal from several levels of Dikili Tash site, near Krinides, Kavala province, Greece (41° 00′ N, 24° 40′ E). Coll and subm by J Deshayes, Univ Paris I.

Ly-1306. Dikili Tash C 75-2 **2870 ± 370**

From Soil 2 in Boring B′C′. Coll and subm 1975; assoc with Late Bronze industry. Expected age: 1500 BC. Very, 8/30, diluted sample.

Ly-1063. Dikili Tash C 74-6 **3430 ± 120**

From 1.5m depth under remains of fallen Late Bronze wall. Coll and subm 1974. Expected age: ca 1500 BC.

Ly-1304. Dikili Tash C 75-6 **2370 ± 230**

From Soil 3 in Boring A′B′. Coll and subm 1975; assoc with industry attributed to end of Troie I culture. Expected age: ca 2500 BC; 2/3 diluted sample.

Ly-1305. Dikili Tash C 75-7 **5030 ± 160**

From Soil 3 in Boring P 24. Coll and subm 1975, assoc with industries attributed to end of Troie I culture. Expected age: ca 2500 BC.

Ly-1061. Dikili Tash C 74-1 **6480 ± 270**

From soil at 1m depth. Coll and subm 1974. Assoc with industry of "Baden" culture. Expected age: ca 3000 BC; 1/3 diluted sample.

Ly-1602. Dikili Tash C 74-2 **3700 ± 230**

From same soil as Ly-1061. Coll and subm 1975; 1/3 diluted sample. Measurement in proportional detector.

Ly-1064. Dikili Tash C 74-7 **6040 ± 120**

From ditch at 1.75m depth. Coll and subm 1974; assoc with some Chalcolithic potsherds. Expected age: 3500 BC or Expected age if from the beginning of Late Bronze level :3000 BC.

Ly-1062. Dikili Tash C 74-5 **6100 ± 200**

From soil at 1.85m depth. Coll and subm 1974, assoc with end of Chalcolithic industry. Expected age may agree with 2 unpub Gif dates: Gif-1425: 5750 ± 140 and Gif-1738: 5600 ± 150. 2/3 diluted sample.

General Comment (JD): most results do not fit expected ages, especially Ly-1304 and -1602, which are much too young. Ly-1061 is much too old and does not agree with strat order, for unknown reason. Ly-1063 shows that Level 2 of site belongs to Late Bronze period, as confirmed by further excavations. Even taking into account its large statistical margin, Ly-1306 inexplicably remains younger than Ly-1063. Ly-1305 is a little older than 6 unpub Pennsylvania lab results: P-917-923: 2300 to 2450 BC. Ly-1064 demonstrates that the ditch is Chalcolithic and is a little older than previous results and Ly-1062.

Pirak series, Baluchistan, Pakistan

Charcoal from several levels of tell, 9m high, at Pirak, near Sibi, Baluchistan, Pakistan (29° 30′ N, 67° 54′ E). Coll by French Archaeol Mission of Indus; subm 1978 by J F Jarrige, Guimet Mus Paris (Jarrige & Enault, 1976).

Ly-1644. Pirak 5 **1800 ± 170**

From Layer 3 at 1.5m depth, Sq 3-O, Loc 88. Coll 1974. Assoc with mixed industry from Bronze and Iron ages Expected age: ca 900 BC.

Ly-1643. Pirak 4 **2970 ± 140**

From Layer 8 at 2.5m depth, Sq 4-L, Loc 84. Coll 1974. Assoc with industry from beginning of Iron age. Expected age: ca 1000 BC.

Ly-1642. Pirak 3 **3150 ± 150**

From Layer 34 at 6m depth, Sq 3-I. Coll 1971. Assoc with industry from end of Bronze age. Expected age: ca 1400 BC.

Ly-1641. Pirak 2 **4080 ± 290**

Form Layer 39N at 8m depth and 1m above present plain level, Sq 3-I. Coll 1973. Assoc with Bronze age industry. Expected age: ca 1450 BC. 1/2 diluted sample.

Ly-1640. Pirak 1 **3410 ± 140**

From Layer 40 at 9m depth and at present plain level, Sq 3-I, Loc 73. Coll 1973. Assoc with Bronze age industry. Expected age: ca 1550 BC.

General Comment (JFJ): Ly-1644 is much younger than expected which may be due to contamination by recent roots or deep burrow holes in upper levels of tell. Ly-1641 is too old either because of statistical variation, or, more probably, because of intrusion of ashes from older occupation level, presently almost completely eroded. Three other results agree with expected values.

Ly-1409. La Madeleine des Albis, Penne, Tarn **890 ± 180**

Charcoal from a hearth at 0.25m depth in large room of La Madeleine grotto near Penne, Tarn (44° 05′ N, 1° 43′ E). Coll 1976 by H Bessac and subm by J Lautier, Albi. Assoc with mixed industries from several epochs of Bronze age period. *Comment* (JL): proves that sediment probably was redeposited in Middle age, as confirmed later by discovery of potsherds from AD era, in site border.

Ly-1566. Hohlandsberg 76 L II, Wintzenheim, Haut-Rhîn **3290 ± 150**

Charcoal from soil at 0.8m depth in alt habitat at Holandsberg, near Wintzenheim, Haut-Rhîn (48° 02′ N, 7° 11′ E). Coll and subm 1976 by S Plouin, Ingersheim. Industries found at site are attributed to Late Bronze II and III periods, but exact assoc of sample with either of these periods is uncertain. *Comment* (SP): dates occupation soil from early period: Late Bronze II agrees closely with Gsy-85: 3215 ± 150 (R, 1966, v 8, p 132) from another Late Bronze II site at Cronenbourg, Bas-Rhîn. However, both dates are a little older than expected according to generally accepted chronology of Bronze age in region.

Ouroux series, Ouroux sur Saône, Saône et Loire

Samples from homogeneous archaeol level which is fire destroyed dwelling of riverside site of Ouroux, near Ouroux-sur-Saône, Saône et Loire (46° 43′ N, 4° 56′ N). As site is presently submerged in La Saône R, sample was coll 1973 by dredging and subm by L Bonnamour, Denon Mus, Châlon sur Saône. Late Bronze IIIb industry gives expected date ca 750 BC (Bonnamour, 1974).

Ly-1025. Ouroux, 38/52 **3110 ± 110**

Charred wood, from beam; subm 1974.

Ly-1570. Ouroux 1 **2720 ± 150**

Charcoal from twigs; subm 1976.

Ly-1571. Ouroux 2 **2710 ± 130**

Charred twigs; subm 1976.

General Comment (LB): very old date of Ly-1025 is probably due to age of beam when used for dwelling construction. Dates from twigs agree perfectly with expected age.

B. Neolithic period

Ly-1624. La Côte de Bar, Saint-Mihiel, Meuse **3770 ± 230**

Charcoal from upper level of Boring M2 in Shaft 2 at 1 end of Neolithic flint mine at La Côte de Bar, near Saint-Mihiel, Meuse (48° 48′ N, 5° 31′ E). Coll 1976 by V Blouet and subm 1977 by C Guillaume, Dir Antiquités Préhist, Lorraine, Metz. Assoc with a Neolithic industry (may be Seine-Oise-Marne), 9/10 diluted sample *Comment* (CG): at other end of mine, 2 structures were previously dated: Ny-285: 4170 ± 70 (R, 1974, v 16, p 122) and MC-573: 4060 ± 50 (unpub). Three dates, even with their maximal statistical margins, prove that mining lasted for only a short time (Guillaume, 1974).

Le Trou des Fées series, Bayonville sur Mad, Meurthe et Moselle

Charcoal from 1 level in Neolithic sepulchral grotto Le Trou des Fées, near Bayonville sur Mad, Meurthe et Moselle (49° 01′ N, 5° 58′ E). Coll by V Blouet and subm 1977 by C Guillaume.

Ly-1622. Bayonville sur Mad, 1/76 **4170 ± 200**

From Pit X2. Coll 1976; 3/5 diluted sample.

Ly-1623. Bayonville sur Mad, 1/77 **4280 ± 150**

From Hearth 3, in W gallery. Coll 1977.

General Comment (CG): both dates are very close to each other and agree with expected age for this type of Late Neolithic monument. In nearby Noveant sur Moselle site, 2 sepultures assoc with same industry were dated by Nancy at 4520 ± 70 (unpub) for Sepulture 2 and Ny-297: 4140 ± 70 for Sepulture 1 (Guillaume, 1978).

Conjux series, Savoie

Wood from several levels of lake margin site, discovered in boring lake sediments in N part of Le Bourget lake, at Conjux, Savoie (45° 47′ N, 5° 49′ E). Coll 1975 by R Castel, Aix les Bains, and subm 1975 by R Laurent, Villeurbanne. Boring showed 2 intact superimposed occupation levels, in sta to S and separated from formerly excavated lake margin site.

Ly-1326. Conjux 4 **2870 ± 140**

Fragment of pile from house of upper level at 0.6m depth.

Ly-1325. Conjux 3 **3820 ± 140**

Fragment of pile from house of lower level at 1.5m depth.

Ly-1324. Conjux 2 **3970 ± 140**

Fragment of tree branches from partition between 2 piles of house of lower level at 1.9m depth.

Ly-1323. Conjux 1 **3970 ± 140**

Fragment of wooden joist sustaining floor of house of lower level at 1.9m depth.

General Comment (RL): agrees with expected ages, indicating that upper level is contemporaneous with Late Bronze neighboring coastal sta of Chatillon, near Chindrieux, in same N part of Le Bourget lake, eg, Ly-18: 2730 ± 160 (R, 1969, v 11, p 114). Three other results are very close to each other and make lower level contemporaneous with Chalcolithic coastal sta lying in S part of lake at Meymart and dated by Ly-190: 4060 ± 120 (R, 1975, v 17, p 57).

La Jonquière series, Foissac, Aveyron

Samples from several places in La Jonquière grotto, near Foissac, Aveyron (44° 30′ N, 2° 01′ E). Subm 1975 by J Clottes, Dir Antiquités préhist Midi-Pyrénées, Foix (Clottes, 1976).

Ly-1221. La Jonquière, habitation **3950 ± 130**

Charcoal from surface sediment near Late Chalcolithic habitation. Coll 1972 by M Lorblanchet and L Genot.

Ly-1592. La Jonquière, Squelette **4050 ± 600**

Bits of charcoal underlying human skeleton without assoc industry but assumed contemporaneous with Chalcolithic habitation. Coll 1975 by P Soleihavoup; 1/4 diluted sample measured in proportional detector.

Ly-1593. La Jonquière, couches colonnes **3930 ± 410**

Charcoal from zone between sepulture and habitation. Coll 1975 by P Soleihavoup; 2/5 diluted sample.

General Comment (JC): despite large statistical margins due to scarcity of material, dates are very close. They show that all archaeol remains in grotto are contemporaneous and from same epoch as the one dated Chalcolithic site in Quercy region: Les Grèzes tumulus near Souillac, Lot: Ly-895: 3910 ± 100 (R, 1976, v 18, p 73).

Le Fournet series, Montmaur, Drôme

Samples from several levels in Neolithic sepulchral grotto Le Fournet, near Montmaur, Drôme (44° 41′ N, 5° 20′ E). Coll 1966 by A Héritier and subm by A Cogoluènhes Geol Dept Univ Lyon (Anthony, 1914).

Ly-1733. Le Fournet 4 **3950 ± 180**

Splinters of human bones from several sqs at base of grotto; subm 1978.

Ly-1178. Le Fournet 1 **4140 ± 190**

Human tibia from Sq 1/2 at base of grotto. Subm 1975; 2/3 diluted sample.

Ly-1302. Le Fournet 2 **4570 ± 140**

Charcoal from Sq 10 at middle of grotto. Subm 1975.

Ly-1407. Le Fournet 3 **4720 ± 200**

Human tibia from Sq 14 in lowest layer at base of grotto. Subm 1976. 4/30 very diluted sample but very long measurement.

General Comment (AC): series shows sepulchral grotto were used for 2 periods: one period ca 4600 BP may be contemporaneous with Chassean habitation found in grotto nearby, the other period ca 4000 BP during Chalcolithic, assumed from industry assoc with bones. Anthropologic study seems to confirm 2 different populations (Cogoluènhes, 1979).

Ly-1659. Les Sarrasins, 68, Seyssinet-Pariset, Isère 4630 ± 290

Charcoal from hearth in Layer 10, Sq B-1, in Les Serrasins grotto, near Seyssinet-Pariset, Isère (45° 10′ N, 5° 41′ E). Coll 1976 and subm 1977 by A Bocquet Dolomieu Inst, Grenoble. Assoc with Late Neolithic ceramic industry. Pollen diagram indicates major deforestation caused by human activity. *Comment* (AB): confirms Late Neolithic attribution to industry and its contemporaneity with lake margin site of Conjux (above). Three dates from younger layer in site were previously pub (R, 1971, v 13, p 55; R, 1973, v 15, p 52).

Ly-1588. La Roche Dumas, Arsac en Velay, Haute-Loire 5120 ± 320

Bits of charcoal from Level 3b in La Roche Dumas site, near Arsac en Velay, Haute-Loire (44° 59′ N, 3° 56′ E). Coll and subm 1974 by A Crémillieux, Le Monastier sur Gazeille. Assoc crude industry which may be attributed to Chassean culture with respect to another more characteristic industry occurring nearby. 1/2 diluted sample counted in proportional detectors. *Comment* (AC): sample confirms Middle Neolithic attribution and is similar to Ly-1549, below, from neighboring Le Chambon site (Cremillieux, 1974).

Ly-1549. Le Chambon, Goudet, Haute-Loire 5160 ± 250

Charcoal from 0.6m depth in base of Chassean hut of Le Chambon site, near Goudet, Haute-Loire (44° 50′ N, 3° 55′ E). Coll and subm 1976 by A Crémillieux. 2/5 diluted sample counted in proportional detectors. *Comment* (AC): together with Ly-1588, above, dates Chassean of Velay region, despite isolated geog position, from about same epoch as other Chassean industries of France.

Le Camp de César series, La Groutte, Cher

Samples from 2 levels of Le Camp de César site, near La Groutte, Cher (46° 42′ N, 2° 31′ E). Subm 1977 by J Allain, Dir Antiquités préhist Centre, Bourges. Site is prehistoric camp of barred spur type, isolated from plateau by front rampart, excavation of which proved was continuously occupied from Chassean period (Ly-1515) to Christian era. During beginning of Iron age, rampart was around whole spur as shown by Boring 16 (Ly-1516).

Ly-1516. Camp de César, Sondage 16 1850 ± 200

Charcoal from 1.8m depth in burned layer at base of circular Iron age rampart. Coll 1968 by J Allain. 5/6 diluted sample. *Comment* (JA): date is ca 600 yr too young; sample polluted by roots.

Ly-1515. Camps de César, fosse **5000 ± 170**

Bones from ditch underlying front rampart and belonging to oldest outworks system. Assoc with pure Chassean industry of Bourgogne type. Coll 1974 by M Vannier, Saint-Amand-Montrond. *Comment* (JA): fits in expected chronologic margins of Les Ponts site (Eure et Loir): Gif: 2774: 4550 ± 130, Gif-2772: 4790 ± 130 and Gif-2773: 4860 ± 130 (Haricot, 1978).

Ly-1350. Buderfeld, Uckange, Moselle **2100 ± 150**

Charcoal from 1.2m depth in Ditch C of Danubian Rubané-récent site Buderfeld near Uckange, Moselle (49° 17′ N, 6° 08′ E). Coll 1975 by V Blouet and subm 1976 by C Guillaume. Site is row of ditches with lineal Rubané-Récent industry of rough or decorated potsherds (Lepape, 1970). *Comment* (CG): by comparison of German sites with similar industry, expected age was ca 4000 BC. Date is much younger and may be explained by fact that sampling was made only some days after opening of ditch, and may have been contaminated.

Bougon series, Deux-Sèvres

Human bones from lowest archaeol level of funerary room of Neolithic Megalithic necropolis of Bougon (Deux-Sèvres) (46° 21′ N, 0° 11′ W). Coll and subm 1977 by J P Mohen, Mus Antiquités Nath, Saint-Germain en Laye. Funerary room is round dolmen with stony corridor buried in cairn and assoc with Tumulus F (Mohen, 1973).

Ly-1699. Bougon, Tumulus FO, Sud **5480 ± 170**

Fragment of several bones from S part of room.

Ly-1700. Bougon, Tumulus FO, Nord **5830 ± 140**

Femur from N part of room.

General Comment (JPM): 3 results were previously obtained from site which was occupied for 1500 yr, divided in 4 phases (R, 1976, v 18, p 74-75): Phase I, the oldest, has not been precisely dated, Phase II occurred in Tumulus E (Ly-966: 5800 ± 230) which fits with Ly-1700 from Tumulus F, while Ly-1699 should mark end of this phase. Phase III corresponds to Chassean industry dated in Tumulus F2 by Ly-967: 4790 ± 200 and lately, during Phase IV, monument was reused by Charente-Vienne people also dated in Tumulus F2 by Ly-968: 4470 ± 230 (Mohen, 1977).

Schamli series, Reichtett, Bas-Rhin

Charcoal from 3 ditches of open-air Neolithic site Schamli near Reichtett, Bas-Rhin (48° 38′ N, 7° 45′ E). Coll 1976 by J Sainty and subm 1976 by A Thevenin, Dir Antiquités préhist Alsace, Strasbourg.

Ly-1567. Reichtett, Fosse 146 **5930 ± 250**

From ditch containing industry of Michelsberg style, assumed younger than neighboring Vendenheim site: Ly-866: 4870 ± 110 (R, 1976, v 18, p 72) assoc with pottery of Lingolsheim group. 1/3 diluted sample.

Ly-1568. Reichtett, Fosse 107 **6420 ± 230**

From ditch containing industry of Rubané Récent style, assumed younger than Rubané Ancien level in site. Previously dated using fossil pitch: Ly-865: 5940 ± 140 (R, 1976, v 18, p 76). 2/3 diluted sample.

Ly-1569. Reichtett, Fosse 75 **6870 ± 260**

From ditch with same industry as Ly-1568. 1/2 diluted sample.

General Comment (AT): large statistical errors are due to scarcity of carbon available after basic dissolution which solubilized most of sample. Despite this, dates are very consistent with each other but do not fit with expected ages. Discrepancy may be explained by long continuous occupation of site where many ditches were dug in loess to make house walls in wattle (Thevenin *et al*, 1977), so that ditches might have been used several times and samples and industries of different ages might be mixed.

Ly-1621. Schwindratzeim, Bas-Rhin **6230 ± 300**

Charcoal from ditch in open air habitation site at Le Village near Schwindratzeim, Bas-Rhin (48° 45′ N, 7° 36′ E). Coll 1975 by F Wendling and subm 1977 by A Thevenin. Assoc with Rubané Récent industry. Strong dilution in basic treatment involving 1/3 diluted sample. *Comment* (AT): despite large statistical margin, date should confirm assumed age of Rubané Récent industry. Contrary to Reichtett site, only 1 occupation period occurred in site (Thévenin, 1976).

C. Mesolithic and Epipaleolithic periods

Ly-1668. Sous Balme, Culoz, Ain **8640 ± 380**

Human bones assoc with Sauveterrian industry, from sepulture dug in thick ashy layer containing same industry in W part, called "Abri", of Sous Balme site, at Culoz, Ain (45° 5′ N, 5° 47′ E). Coll 1959 and subm 1977 by R Vilain, Dept Geol, Univ Lyon; 2/5 diluted sample *Comment* (RV): in statistical range of Ly-286: 9150 ± 160 (R, 1973, v 15, p 142) from charcoal of ashy layer. Date proves that sepulture marks end of rockshelter occupation.

La Borie del Rey series, Blanquefort, Lot et Garonne

Bones from 2 levels in La Borie del Rey grotto, near Blanquefort, Lot et Garonne (44° 36′ N, 0° 58′ E). Coll 1973, subm 1977 by J M Le Tensorer, Inst Géodynamique, Univ Bordeaux. Site was formerly excavated by L Coulonges (1963).

Ly-1402. La Borie del Rey, Couche 3 **9870 ± 320**

From Layer 3 (= Coulonges' Layer 4) assoc with Epi-Azilian industry with microliths, called "Epilaborian". Sedimentologic analyses indicate cool followed by temperate climate; 2/3 diluted sample.

Ly-1401. La Borie del Rey, Couche 5 **10,350 ± 340**

From Layer 5 (= Coulonges' Layer 3) assoc with peculiar Azilian industry, called "Laborian". Sedimentologic analyses indicate cold and fairly humid climate suggesting middle of Late Dryas period; 2/3 diluted sample.

General Comment (JM LT): both dates are consistent with each other. They fit in range of dates expected by Late Dryas attribution of levels given by sediment studies and absence of reindeer in assoc fauna (Le Tensorer, 1979).

Chez-Jugie series, Cosnac, Corrèze

Charcoal from several levels and loci in Chez-Jugie rockshelter near Cosnac Corrèze (45° 07′ N, 1° 36′ E). Coll and subm by G Mazière, Dir Antiquités Préhist Limousin, Limoges and JP Raynal, Inst Quaternaire, Univ Bordeaux. Rockshelter is in sandstone cliff. Erosion has caused loose sand in which small bits of charcoal are scattered. As pH of sediment varies between 4 and 6, bone remains were too small to be used for dating. Charcoal samples were used despite scarcity of material after treatment and risks of contamination by roots, rootlets, and burrows. Assoc industry suggests 2 occupation periods: Sauveterrian in Layer 3 and Azilian in Layer 5 (Mazière, 1978; Mazière & Raynal, 1978).

Ly-1330. Chez-Jugie, I **1890 ± 200**

From base of Layer 2, Sq J-III, underlying microlithic industry with Le Martinet trapezoïds. Coll 1975 and subm 1976. Assumed contamination. 1/5 diluted sample.

Ly-1395. Chez-Jugie, V **4540 ± 200**

From top of Layer 3, Sq I-IV. Coll 1974 and subm 1977. Assoc with industry, probably redeposited, with Le Martinet trapezoïds. 1/2 diluted sample.

Ly-1600. Chez-Jugie, IV **7010 ± 430**

From upper part of Layer 3, Sq H-III, assoc Sauveterrian industry. Coll 1974 and subm 1977. 1/3 diluted sample counted in proportional detectors.

Ly-1396. Chez-Jugie, III **7060 ± 140**

From upper part of Layer 3, Sq H-III. Coll 1975 and subm 1977. Assoc with Sauveterrian industry with trapezoïds.

Ly-1652. Chez-Jugie, XV **8080 ± 280**

From middle of Layer 3, Sq H-III and H-IV. Coll 1977 and subm 1978. Assoc with Sauveterrian industry with micro-triangles. 23/30 diluted sample.

Ly-1331. Chez-Jugie, II **8040 ± 260**

From middle of Layer 3, Sq H-III. Coll 1975 and subm 1976. Assoc with Sauveterrian industry with micro-triangles. 2/3 diluted sample.

Ly-1651. Chez-Jugie, XIV **7650 ± 510**

From base of Layer 3, Sq I-IV. Coll 1977 and subm 1978. Assoc with Sauveterrian industry with micro-triangles. 1/2 diluted sample counted in proportional detectors.

Ly-1572. Chez-Jugie, XII **11,840 ± 580**

From whole Layer 5, Sq A-III. Coll 1976 and subm 1977. Assoc with Azilian industry. 1/3 diluted sample.

Ly-1601. Chez-Jugie, I & XIII **11,730 ± 530**

From base of Layer 5, Sq A-II. Coll 1976 and subm 1977 and 1978. Assoc with Azilian industry. 1/2 diluted sample counted in proportional detectors.

Ly-1802. Chez-Jugie, XVI & XVII **13,000 ± 1,000**

From extreme base of Layer 5, Sq J-II and H-III. Coll and subm 1978. Assoc with scarce pré-Azilian industry.

General Comment (GM and JPR): despite difficulties of measurements and risk of contamination, most results are consistent. Ly-1330 and -1395 may show evidence of human caused stratigraphic disturbance and contamination by recent roots. A Mesolithic occupation of site with Le Martinet trapezoïds took place about 7000 BP (Ly-1600 and -1396). Two dates from middle part of Layer 3, Ly-1331 and -1652, attribute satisfactory age, ca 8000 BP, to typical Sauveterrian industry. Ly-1651, a little younger, may correspond to end of Sauveterrian period as excavation revealed basin hearths dug into underlying layers by last Sauveterrian people. Statistical fluctuation or slight contamination may have occurred. Layer 5, with Azilian industry, seems to be from beginning of Alleröd period, according to Ly-1572 and -1601. Statistical margin of Ly-1802 make this result less significant but it does not disagree with other results. Entire series agrees with conclusions deduced from sedimentologic, botanic, and paleontologic studies which attribute Azilian industry to Alleröd climatic phase and Sauveterrian to boundary of Boreal and Atlantic periods (Mazière & Raynal, 1977).

Zatoya series, Abaurrea Alta, Navarra, Spain

Samples from several levels in Zatoya grotto, near Abaurrea Alta, Navarra, Spain (42° 54′ N, 1° 15′ W). Coll 1976 and subm 1977 by I Barandiaran, Univ Santander. Site has presumably continuous stratigraphy from end of Late Paleolithic to Neolithic periods.

Ly-1397. Zatoya, ZM 31 **6320 ± 280**

Bones from Level I, Sq 5-Z, 80 to 85cm depth. Assoc with Early and Middle Neolithic industry and presumably of Atlantic period. 1/2 diluted sample.

Ly-1457. Zatoya, ZM 33 **8260 ± 550**

Charcoal from Level I, Sq 1Z, 120 to 125cm depth. Assoc with Epipaleolithic industry with geometric microliths. Presumably of beginning Atlantic period. 7/30 very diluted sample.

Ly-1398. Zatoya, ZM 25 **8150 ± 170**

Charcoal from upper part of Level II, Sq 3A, at 140cm depth. Assoc with Epipaleolithic industry without geometrics. Presumably of Boreal period.

Ly-1599. Zatoya, ZM 27 **11,620 ± 360**

Small amount of bones from Level II, Sq 3B, 150 to 160cm depth. Assoc with industry of Azilian type with micro-grattoirs. Probably from Boreal or Pre-Boreal periods. 1/3 diluted sample counted for a long time in proportional detector.

Ly-1399. Zatoya, ZM 47 **11,480 ± 270**

Bones from lower part of Level II, Sq 1Z, 170 to 180cm depth. Assoc with industry of Azilian type in Late Paleolithic tradition. Probably of Pre-Boreal period.

Ly-1458. Zatoya, ZM 29 **⩾10,940**

Bones from Level b^3, Sq 15B, 212 to 227cm depth. Assoc with Azilian industry with micro-grattoirs. Presumably of Boreal or Pre-Boreal periods. Min age given, as only 1 count could be made because of laboratory accident. 1/3 diluted sample.

Ly-1400. Zatoya, ZM 34 **11,840 ± 240**

Bones from same level assoc with same industry in Sq 13B, 209 to 231cm.

General Comment (IB): despite difficulties of measurements for some samples due to scarcity of material, series is coherent and may be divided in 2 parts: 3 1st results conform with expected ages and show that passage from Mesolithic to Neolithic took place at beginning of Atlantic period (Barandiaran, 1977). Four other results are older than expected, as they indicate Alleröd period instead of Pre-Boreal. This should mark long hiatus in sedimentation at Level II and, thus, Azilian industry should be contemporaneous with many other Epipaleolithic industries in S France.

Mallaha series, Eynan, Israel

Small amounts of charcoal from 2 soils in open air site Mallaha, near Houlé lake, Eynan dist, Israel (33° 05′ N, 35° 35′ E). Subm 1977 by F Valla, French Mission Centre Natl recherches sci, Jerusalem, Israel. Mallaha may be oldest sedentary habitation site presently known. Site consists of bases of circular huts, 5 to 10m diam, in which was found Late Paleolithic, Natufian, industry of Levant region. This industry occurs between Kebarian and prepottery Neolithic A types. Expected ages lies between 11,000 and 12,000 BP; (Lechevallier & Valla, 1974).

Ly-1662. Mallaha, 4012 **11,310 ± 880**

From soil of House 51. Coll 1975 by M Lechevallier. Marks old occupation phase of site. 1/6 very diluted sample.

Ly-1661. Mallaha, 4040 **11,740 ± 570**

Same origin as previous one. 8/30 diluted sample.

Ly-1660. Mallaha, 4568 **11,590 ± 540**

From soil of House 131. Coll 1976 by F Valla. Marks oldest occupation phase of site. 1/2 diluted sample counted in proportional detectors. *General Comment* (FV): despite large statistical margins, dates are in expected time period. Industries assoc in both soils are from same Early Natufian phase but, as Soil 131 underlies Soil 51, statistical fluctuations apparently inverted 2 soil dates that are very close to each other.

D. Late and Middle Paleolithic periods

Les Romains series, Virigin, Ain

Small bits of charcoal from 3 Magdalenian levels in Les Romains grotto at Pierre-Châtel, near Virignin, Ain (45° 41′ N, 5° 21′ E). Coll 1969 and subm 1976 by R Desbrosse, Blanzy (Desbrosse, 1976).

Ly-1594. Les Romains, Niveau IIa **10,100 ± 350**

From Level IIa, 1/2 diluted sample counted for a long time in proportional detectors.

Ly-1307. Les Romains, Niveau IIb **10,280 ± 630**

From Level IIb, 7/30 very diluted sample.

Ly-1308. Les Romains, Niveau III **10,770 ± 410**

From Level III, 1/2 diluted sample.

General Comment (RD): series seems too young for assoc Late Magdalenian industry. Previous measurements were made on bones: Ly-356: 12,980 ± 240 (R, 1973, v 15, p 167) from Level III; on charcoal: Ly-16: 14,380 ± 380 (R, 1969, v 11, p 116) from Level IIa; on gastropod shells: MC-1274: 8230 ± 110 and MC-1275: 12,540 ± 400 from Level IIb and MC-1276: 12,540 ± 230 from Level III (unpub). Discrepancy of dates may be due to downward migration of charcoal or rootlets or to environment and biological effect of terrestrial shells (Evin & Maréchal, 1979).

Ly-1729. Longetraye 6D C1, Freycenet la Cuche, Haute Loire **9360 ± 270**

Charcoal from Layer 1 in Sq 6D of basaltic rockshelter Longetraye, near Freycenet-la-Cuche, Haute-Loire (44° 52′ N, 3° 55′ E). Coll 1974 and subm 1977 by D Philibert, Univ Lyon. Assoc with Late Magdalenian industry. *Comment* (DP): does not agree with Ly-512: 12,720 ± 750, from Layer 4, Sq 6E in site, assoc with same industry (R, 1973, v 15, p 524) (Elouard *et al*, 1974). Date is too young either because of downward migration of charcoal, frequently occurring in fillings of such basaltic site, or because Layer 1 is transition level between Magdalenian occupation (Ly-512) and subsequent Mesolithic settlement from which several samples were dated: Ly-760: 8590 ± 590 (R, 1975, v 17, p 22).

Ly-1351. Les Coudrays, Etiolles, Essonne **12,000 ± 220**

Fragment of *Elephas primigenius* scapula from 4th occupation level from surface in open-air site Les Coudrays, near Etiolles, Essonne. Coll and subm 1975 by Y Taborin, Univ Paris I. Assoc with Late Magdalenian industry. Climatic phase presumably cold because of frost-fractured flints (Taborin, 1977). *Comment* (YT): in expected range of dates according to Hamburgian character of industry in region.

Ly-1406. Espelugues, Lourdes, Hautes Pyrénées **13,170 ± 260**

Bones from base of S gallery, Loc 1, Espelugues grotto, at Lourdes, Hautes Pyrénées (43° 06′ N, 0° 03′ W). Coll and subm 1976 by J Omnès, Lourdes. Assoc with some artifacts of Late Magdalenian industry (Omnès, 1977). *Comment* (JO): agrees with attribution of industry to Late phase of Magdalenian. May be compared to Espèche series, below, and to Layer IV in Duruthy site (Magdalenian IV): Ly-859: 13,510 ± 220, and Ly-860: 13,840 ± 210 (R, 1976, v 18, p 79).

Le Bois du Cantet series, Espèche, Hautes Pyrénées

Bones from 2 levels of Le Bois du Cantet grotto at Espèche, Hautes Pyrénées (43° 03′ N, 0° 08′ E). Coll 1964 and 1972 and subm 1976 by A Clot, Bordères-sur-Echez.

Ly-1403. Le Bois du Cantet, Sec II **13,370 ± 270**

Bones coll on stalagmitic floor in Sec II of grotto, assoc with Magdalenian industry.

Ly-1404. Le Bois du Cantet, Sec I **13,060 ± 430**

Bones coll in archaeol layer under stalagmitic floor in Sec I of grotto. Assoc with Late Magdalenian industry. 2/3 diluted sample.

General Comment (AC): both dates agree statistically and should indicate homogeneous occupation of site. Date is compatible with archaeol attribution of industry to Late Magdalenian (Clot & Cantet, 1974). Comparable to Ly-1406, above, and slightly younger than Ly-1405, below, and Caubeta series (R, 1978, v 20, p 48): Ly-1107: 13,910 ± 230 and Ly-1055: 14,280 ± 300 with similar assoc industry (Clot & Omnès, 1979).

Ly-1405. La Grande Grotte, Labastide, Hautes Pyrénées **14,260 ± 440**

Bones found on surface grotto filling 400m inside La Grande Grotte, near Labastide, Hautes Pyrénées (43° 08′ N, 0° 23′ E). Coll and subm 1976 by J Omnès. Formerly excavated grotto on sampling site contained hearths with engraved plates of stone and Magdalenian IV industry (Begouën, 1938). 5/6 diluted sample. *Comment* (JO): agrees with archaeol attribution and with Caubeta series (R, 1978, v 20, p 48, and above) (Clot & Omnès, 1979).

Ly-1628. Paglicci IV-73, Rignano Garganico, Foggia, Italy **13,720 ± 870**

Bones from Level 7c, Sq 35NOP in Paglicci grotto, near Rignano Garganico, Foggia, Italy (41° 39′ N, 15° 37′ E). Coll 1973 by A Galiberti, and subm 1976 by P Gambassini, Inst Antropol Paleontol Umana, Univ Siena. Assoc with Epigravettian industry. Expected age: ca 14,000 BP. 1/6 very diluted sample. *Comment* (PG): close to expected age, but ca 1000 yr younger than charcoal sample from same Level: F-65: 14,800 ± 210 (R, 1977, v 19, p 165). Large statistical margin due to small amount of organic matter preserved in bones may explain difference in apparent age.

Lascaux series, Montignac, Dordogne

Bits of charcoal from 2 locations in gallery called "Diverticule axial" of Lascaux grotto, near Montignac, Dordogne (45° 01′ N, 1° 11′ E). Subm by Arl Leroi-Gourhan, Mus de l'Homme, Paris.

Ly-1196. Cheval renversé de Lascaux 7510 ± 650

From upper clay filling of gallery, under painting called "Cheval renversé". Coll 1959 by A Glory and subm 1975. 1/5 diluted sample.

Ly-1197. Faille Méandre de Lascaux 8660 ± 360

From clayey filling in small fissure in wall at meander of gallery. Coll 1975 by Arl Leroi-Gourhan. 1/2 diluted sample.

General Comment (AL): samples were subm once more to date painting and Early Magdalenian industry with which all clayey filling was assumed contemporaneous. Three results were previously pub for unique human occupation of Lascaux grotto ca 16,800 BP at end of Lascaux interstade (Libby, 1955, p 85; R, 1963, v 5, p 168; R, 1964, v 6, p 247). Present results and new studies (Leroi-Gourhan & Allain, 1979) show that clayey sediments in "diverticule" gallery are probably redeposited. Holocene charcoal has already been found and dated at entrance of grotto: GrN-1182: 8510 ± 100 and in "Les Gours" passage: GrN-1514: 8300 ± 75 and GrN-1182: 9070 ± 90 (De Vries & Waterbolk, 1958). Thus presence of Holocene charcoal in axial gallery demonstrates transport of sediments by water in grotto during Boreal period (Leroi-Gourhan & Evin, 1979).

Terre Sève series, Solutré, Saône et Loire

Bones from several levels in Terre Sève zone of Solutré foot of limestone cliff site, Saône et Loire (46° 18′ N, 4° 43′ E). Coll and subm 1976 by J Combier, Dir Antiquités Préhist, Rhône-Alpes, Romanèche-Thorins.

Ly-1530. Terre Sève de Solutré, 165-170 13,680 ± 240

From Sqs I/10-37, 165 to 170cm depth. Assoc with Magdalenian industry.

Ly-1531. Terre Sève de Solutré, 170-175 13,710 ± 230

From Sqs I/10-37, 170 to 175cm depth. Assoc with Magdalenian industry.

Ly-1532. Terre Sève de Solutré, 180-190 14,360 ± 280

From Sqs I/10-37-47-57, 180 to 190cm depth. Assoc with Middle Magdalenian industry containing same bone points with geometric decoration found in Arlay site, below. Sediments lying from 175 to 180cm depth are sterile and there is no Magdalenian industry lower than 190cm level.

Ly-1533. Terre Sève de Solutré, Strate supérieure **19,590 ± 280**

From Sqs I/11-97 and I/10-7, 240 to 250cm depth. Assoc with a Middle Solutrean industry.

Ly-1534. Terre Sève de Solutré, Strate inférieure **17,310 ± 470**

From Sqs I/10-37-47-57, 210 to 250cm depth. Assoc with Middle Solutrean industry.

General Comment (JC): Except for Ly-1534, all dates are consistent with each other and with expected values. Ly-1530 and -1531 places Magdalenian industry before Late Magdalenian level previously dated from another sec of site: Ly-393: 12,580 ± 250 (R, 1973, v 15, p 148) and after Ly-1532, which is comparable to 4 results from Magdalenian levels of Arlay site, below. Ly-1533 perfectly agrees with GrN-4442: 19,600 ± 140 and GrN-4495: 19,740 ± 140 (R, 1967, v 9, p 116) from Level 5 of Laugerie Haute site, Dordogne, which contains same Middle Solutrean industry. Ly-1534, from lowest level of Middle Solutrean level, might be older than Ly-1533; it is however, similar to previous result from level with same industry: Ly-316: 17,150 ± 300 (R, 1974, v 14, p 63). This remains unexplained and may be coincidental.

Grotte Grapin series, Arlay, Jura

Bones and reindeer horns from Level C of Grapin grotto, near Arlay, Jura (46° 46′ N, 5° 31′ E). Coll 1961 by M Vuillemey, Lons le Saunier, and subm 1976 by J Combier. Level corresponds to cold climate with steppic fauna. Assoc peculiar type of Magdalenian industry is not easily correlated with classic Magdalenian of SW France.

Ly-1509. Arlay Niveau C, Bois de Renne, partiel **14,220 ± 560**

Small amount of reindeer horn, 1/3 diluted sample.

Ly-1535. Arlay Niveau C, Bois de Renne **14,530 ± 290**

Reindeer horn.

Ly-1510. Arlay Niveau C, Os de Renne **14,820 ± 370**

Reindeer bones.

Ly-1536. Arlay Niveau C, Os et bois de Renne **14,840 ± 360**

Mixing of fragments of bones and horns of reindeer.

General Comment (JC): 2 previous results from same site, Ly-457: 15,320 ± 370 and Ly-559: 15,770 ± 390 (R, 1973, v 15, p 520) were too old for assoc industry. Sampling of those former measurements is now questionable: it may have been mixing of Magdalenian bones with some bone fragments of carnivore sp from lowest level of site dated twice from ca

25,500 BP (Ly-498 and -499). Both present results remain a little older than expected and than Level D of La Colombière site: Ly-433: 13,390 ± 300 (R, 1973, v 15, p 149) but they agree with Ly-1532 from Solutré site, above. The 2 samples (bones and horns) were carefully selected from zone of site where sterile level separates Magdalenian and older non-artifact bearing levels; chosen bone-splinters also had butchery marks (Combier & Vuillemey, 1976).

Laraux series, Lussac les Châteaux, Vienne

Bones from 2 levels in Laraux Rockshelter, near Lussac les Châteaux, Vienne (46° 24′ N, 0° 43′ E). Coll 1949 and subm 1978 by L Pradel Chatellerault. Sterile level separates overlying Layer 3 from Layer 5 (Pradel & Cholet, 1950).

Ly-1739. Laraux, Couche 3 **21,530 ± 910**

From Layer 3, assoc with Perigordian V_c industry with Noailles and Le Raysse burins. 1/3 diluted sample.

Ly-1740. Laraux, Couche 5 **23,510 ± 640**

From Layer 5, assoc with Perigordian V_b industry with truncated artifacts of same type as those from Layer K in La Ferrassie site, Dordogne, where there is also a Late Perigordian industry.

General Comment (LP): age difference between both levels is greater than expected but may be explained by large statistical margin of Ly-1739, which seems a little too young by comparison with dates of Late Perigordian industries in W France, eg, Abri Pataud (R, 1969, v 9, p 113). Date is contemporaneous with Proto-Magdalenian levels of Abri Pataud and Laugerie Haute sites (R, 1963, v 5, p 167). Ly-1740 perfectly agrees with Late Perigordian dates from these 2 sites and fits with 6 other Gif lab results from 22,500 to 24,600 BP from Late Perigordian levels of La Ferrassie site (Delibrias *et al*, 1976, p 1509). Absolute chronology of beginning of Late Paleolithic is not well known even in W part of France and comparisons with similar industries in other regions are questionable. Two similar dates exist, however, from E France sites containing Late Perigordian industries: Ly-309: 24,150 ± 550 from Saint-Martin-Sous-Montaigu, and Ly-317: 24,050 ± 600 from Solutré (R, 1969, v 13, p 63).

La Baume de Gigny series, Gigny sur Suran, Jura

Bones from 2 upper levels of filling of La Baume site near Gigny sur Suran, Jura (46° 27′ N, 5° 27′ E). Coll and subm 1978 by M Vuillemey. Site consists of thick filling in narrow fissure of limestone cliff (Piningre & Vuillemey, 1976).

Ly-1798. La Baume de Gigny, Niveau IV, No. 2 **12,370 ± 460**

Bones of small mammals from Upper and Middle part of Level IV from side of walls of rock fissure. Coll 1978, assoc with undiagnostic industry; 1/2 diluted sample. *Comment* (MV): dated to check following measurement to detect contamination by migration of small bones. Bones were carefully selected and sampled from layer out of contact with underlying Level V.

Ly-1702. La Baume de Gigny, Niveau IV, No. 1 13,620 ± 480

Bones of small mammals from entire Level IV in middle of rock fissure. Coll 1972 and 1973. Fauna is mixture of very cold and forest sp; 2/5 diluted sample.

Ly-1703. La Baume de Gigny, Niveau V 22,430 ± 500

Bear and microfauna bones from Level V. Assoc with undiagnostic industry.

General Comment (MV): both results from Level IV are very close to each other and in stratigraphic order. They are older than expected by malaco-fauna which suggest Atlantic period. Instead of Pre-Boreal or Boreal periods which might be assumed by the mixing of mammifera sp, Ly-1798 and -1702 attribute Level IV to Late Würm (Würm IV) and the rather temperate climatic phase could be Bölling. Ly-1703 occurs in expected range of date and confirms that upper part of fissure filling belongs to Late Würm III. Older levels of site (Levels VIII, XV, and XX) corresponding to Early Würm (Würm III or II) were previously dated (R, 1973, v 15, p 521; R, 1976, v 18, p 83).

Ly-1579. Le Trou du Renard, Soyons, Ardèche ⩾32,100

Bones from 1.5m depth in Boring 2 of Le Trou du Renard site, near Soyons, Ardèche (44° 54′ N, 4° 50′ E). Coll and subm 1976 by V Dumazel and A Grève, Soyons. Assoc with Mousterian industry presumed from beginning of Würm III. *Comment* (VD): agrees with expected age as chronology and definition of Würm II/III interstadial is still uncertain. As bedrock lies 1m below sampling level, unlimited ^{14}C result leads to possibility of obtaining older ages by other dating methods.

III. HYDROGEOLOGIC SAMPLES

E Lyon aquifer system series, France

Samples from wells in E Lyon region, coll by J Evin and G Marien to monitor ^{14}C activities of ground waters previously sampled from Spring 1971 to Autumn 1973. Previous results and description of aquifer were pub in Lyon V (R, 1975, v 17, p 29). All present samples were coll Autumn 1977 in "Couloir de Décines" geol unit from sites selected by D Rousselot, Bur recherches Geol Min, Lyon, except Ly-1158 which comes from "Couloir d'Heyrieux" and was suggested by N Mongereau, Dept Geol, Univ Lyon and coll Autumn 1976.

General Comment: all values are same as those obtained 5 yr earlier. They confirm that no change occurred in aquifer system despite extension of industrial zone in E Lyon region and operation of new airport of Satolas. As before, 2 superimposed free ground waters of the aquifer are distinguishable. Values about 70% modern indicate waters from lowest level of aquifer from which Satolas airport is supplied (Ly-1634).

Values about 85% modern indicate upper level of aquifer, while ^{14}C activities higher than 100% modern come from surface rain waters (Evin *et al*, 1979).

Sample no.	Sample	N Lat	E Long	Dilution ratio	^{14}C% Modern
Ly-1636.	Puits Troquet, No. 1	45°45′	5°4′	1/2	115.8 ± 3.2
Ly-1637.	Saugnieu, No. 1	45°43′	5°6′	2/3	109.5 ± 3.1
Ly-1550.	Ferme de Montchat, No. 1	45°41′	5°5′	1/2	88.7 ± 2.8
Ly-1638.	Meyzieux ville, No. 1	45°47′	5°0′	2/3	88.1 ± 2.6
Ly-1639.	Meyzieux zone industrielle, No. 4	45°46′	5°1′	2/3	83.8 ± 2.6
Ly-1634.	Ferme de Planaise, No. 1	45°43′	5°4′	2/5	84.5 ± 2.8
Ly-1633.	Satolas Aéroport, No. 3	45°44′	5°2′	1/2	71.8 ± 2.5
Ly-1635.	Satolas Carrière Perrier, No. 2	45°42′	5°4′	5/6	74.9 ± 2.2
Ly-1158.	Saint-Pierre de Chandieu, No. 1	45°39′	5°1′	1/3	73.6 ± 2.9

Az Zawiah series, NW Lybia

Samples from aquifer system around Az Zawiah, NW region of Lybia (32° 52′ N, 12° 56′ E). Coll 1974 by GERSAR Soc during program of studies called GEFLI and subm 1974 by A Marcé, Bur recherches Geol Min, Orléans. As Miocene limestone of Cyrenaic in NE Lybia (Castany *et al*, 1974), aquifer is confined with natural outlets along Mediterranean sea coast.

Sample no.	Sample	Localization		Dilution ratio	^{14}C% Modern
Ly-930.	Wadi Al Hira	RDH1	18/11/73	1	4.5 ± 0.4
Ly-931.	Wadi R'Mel	DW2	14/02/74	2/3	3.4 ± 0.5
Ly-932.	Az Zawiah	GZW	15/02/74	1/3	7.8 ± 1.2
Ly-933.	Az Zawiah	GZW4	26/11/73	1/2	7.8 ± 0.7
Ly-934.	Az Zawiah	GZW3	7/01/74	2/3	4.7 ± 0.5
Ly-935.	Az Zawiah	GZW6	—	2/3	2.2 ± 0.4
Ly-936.	Az Zawiah	GZW5	—	1/2	6.0 ± 0.7
Ly-947.	Az Zawiah	DW1	longue durée	1/2	10.8 ± 0.6
Ly-948.	Wadi R'Mel	DW2	13/03/74	1	4.7 ± 0.4
Ly-949.	Wadi R'Mel	DW5	30/03/74	1	5.2 ± 0.3
Ly-950.	Wadi R'Mel	DW6	13/04/74	1/2	3.1 ± 0.5
Ly-951.	Wadi Al Hira	RDM3	23/05/74	1	2.6 ± 0.3
Ly-992.	Tawarghah	Source	8/07/74	2/3	2.3 ± 0.7
Ly-993.	Tawarghah	T4	7/07/74	1/3	3.4 ± 0.7
Ly-994.	Tawarghah	TW1	9/07/74	2/3	1.6 ± 0.3

General Comment: contrary to Cyrenaic series (R, 1976, v 18, p 85) and despite expected values, results show very low ^{14}C content in entire aquifer, indicating lack of recent feeding in region.

References

Ambert, P, Evin, J, and Gabert, P, 1974, Datation d'un horizon lithochrome würmien en Basse Provence Occidentale: Acad sci (Paris) Comptes rendus, ser D, v 278, p 33-35.

Anthony, 1914, Les ossements humains vraissemblablement quaternaires recueillis par le Dr Laval dans la grotte du Fournet: Rev Anthropologique, v 1914, no. 3, p 107-116.

Arnaud, G, Arnaud, S, Ascenzi, A, Bonucci, E, and Graziani, G, 1978, The problem of preservation of human bones in sea water: Jour Human Evolution, v 7, no. 6, p 409-420.

Azzi, C M, Biglioca, L, and Gulisana, F, 1977, Florence radiocarbon dates II: Radiocarbon, v 19, p 165-169.

Barandiaran, I, 1977, El proceso de transition Epipaleolitico-Neolitico en la cueva de Zatoya: Rev Principe Viana, v 146-147, p 5-46.

Bazile, F, 1974, Nouvelles données sur l'age des cordons littoraux récents du golfe d'Aigues-Mortes: Actes Colloquium "Approche géologique des quinzes derniers millénaires": Soc Languedocienne Geogr Bull, v 8, p 199-206.

———— 1976, Les lignes de rivage quaternaire du Languedoc méditerranéen: La Préhistoire Française: Paris, CNRS Press, v 1, p 326-329.

de Beaulieu, J L, 1977, Contribution pollenanalytique à l'histoire tardiglaciaire et holocène de la végétation des Alpes méridionales françaises: Thesis, Univ Marseille, 358 p.

Begouën, H, 1938, Les Plaquettes de pierre gravées de la grotte de Labastide (Hautes Pyrénées): Ipek, Berlin, v X, p 1-10.

Berthier, S, 1978, Une maison du quartier de la mosquée à Koumbi Saleh: Mém Maîtrise d'Histoire, Univ Lyon II, preprint.

Bezinge, A, 1974, Vieux troncs morainiques et climats postglaciaires sur les Alpes: Coll Soc Hydrotechnique Grenoble Comptes rendus, 7-8 March 1974, 34 p.

Bonnamour, L, 1974, Trouvailles de la fin de l'Age du Bronze dans la Saône, sur le site d'Ouroux-Marnay (S et L): Soc Préhist Française Bull, v 71, no. 6, p 185-191.

Bonnet, A, du Cailer, J, and Royer, P, 1946, Ossements préhistoriques de La Sartanette à Remoulins, Gard: Soc Etudes Sci Nat Nîmes Bull, v 48, p 125-136.

Bonnet, A, Gutherz, X, and Pelenc, J N, 1973, Fosses néolithiques datées par le C 14 à la grotte de La Sartanette (Remoulins, Gard): Soc Préhist Française Bull, v 70, p 157-160.

Castany, G, Marcé, A, Margat, J, Moussu, H, Vuillaume, Y, and Evin, J, 1974, Etude par les isotopes de milieu du régime des eaux souterraines dans les aquiféres de grandes dimensions: IAEA symposium on isotopes in hydrology, Vienna, SM 182/26, p 243-258.

Chapotat, G, David, L, Evin, J, Guérin, C, and Walter, B, 1980, Chronologie des terrasses alluviales quaternaires de la moyenne vallée du Rhône. Datation par le radiocarbone: Acad Sci (Paris) Comptes rendus, ser D, in press.

Chapotat, G, Evin, J, Méry, A, and Samuel, E, 1978, Archéologie, datation radiocarbone, anthropologie et paléobotanique dans la vallée moyenne du Rhône en amont de Vienne: Soc Linnéenne Lyon Bull, v 47 no. 10, p 606-629.

Cheikh Anta Diop, 1977, Institut Fondamental d'Afrique noire radiocarbon dates II: Radiocarbon, v 19, p 161-164.

Clot, A and Cantet, M, 1974, La grotte ornée du Bois du Cantet, à Espèche (Hautes Pyrénées): Gallia Préhist, v 17, no. 1, p 69-100.

Clot, A and Omnès, J, 1979, Premiers datages radiocarbone du Magdalénien des Hautes Pyrénées: Soc Préhist Française Bull, in press.

Clottes, J, 1976, La grotte de Foissac: Cong UISPP 9th, Nice, 1976: Livret-guide de l'excursion A 5: Les Pyrénées, p 147-161.

Cogoluènhes, A, 1979, La grotte sépulchrale du Fournet: Thesis, Univ Lyon, in press.

Combier, J and Vuillemey, M, 1976, La grotte d'Arlay: Cong UISPP 9th, Nice, 1976: Livret-Guide de l'excursion A 8: Le Bassin du Rhône, p 74-81.

Coulonges, L, 1963, Magdalénien et Périgordien post-glaciaire. La grotte de la Borie del Rey (Lot et Garonne): Gallia Préhist, v 6, p 1-29.

Crémillieux, A, 1974, Stratigraphie, typologie et palethnologie de quelques remplissages d'abris sous-basaltiques en Haute vallée de la Loire (Velay): Documents Lab Géol Faculté Sci Lyon, v 62, 127 p.

Daugas, J, Evin, J, Paquereau, M M, Raynal, J P, and Tixier, L, 1978, Eléments de datation pour la basse terrasse de l'Allier à Joze (Puy de Dôme): Nouv Achives Mus Lyon, v 16, p 59-62.

David, L, Evin, J, Guérin, C, Mongereau, N, and Walter, B, 1972, Datation par le radiocarbone de la terrasse quaternaire de Saint-Rambert d'Albon (Drôme). Würm de la moyenne vallée du Rhône: Acad Sci (Paris) Comptes rendus, ser D, v 274, p 2007-2008.

Delibrias, G, Guillier, M T, Ervin J, Thommeret Y; 1976, Les datation ^{14}C Paléolithique supérieur en France: La Préhistoire Française, v 1, p 1509-1512.

Delibrias, G, Guillier, M T, Labeyrie, J, 1966, Gif natural radiocarbon measurements I: Radiocarbon, v 8, p 128-141.

————1972, Gif natural radiocarbon measurements VII: Radiocarbon, v 14, p 280-320.

Desbrosse, R, 1976, Les civilisations du paléolithique supérieur dans le Jura méridional et dans les Alpes du Nord: La Préhistoire Française, Paris CNRS Press, v 1, p 1196-1213.

De Vries, H L and Waterbolk, H T, 1958, Groningen radiocarbon dates III: Science, v 128, p 1550-1556.

Elouard, P, 1968, Le Nouakchottien, étage du Quaternaire de Mauritanie: Annales Fac Sci Dakar, v 22, p 121-137.

Elouard, P and Faure, H, 1967, Quaternaire de l'Inchiri, du Taffoli et de la région de Nouakchott: Cong Panafricain de Préhist 6th, Comptes rendus, p 466-492.

Elouard, P, Philibert, P, Debard, E, Mçon-Vilain, H, and Crémillieux, A, 1974, Coupe géologique et interprétation climatique du gisement préhistorique post-würmien de Longetraye: Soc Languedocienne Géogr Bull, v 8, no. 3-4, p 275-284.

Evin, J, Chauviré-Mourer, C, and Philippe, M, 1980, Les gisements de vertébrés pléistocènes des Causses de Martel et de Gramat: Chronologie relative et datations ^{14}C: Nouvelles arch Mus Lyon, in press.

Evin, J, Longin, R, Marien, G, and Pachiaudi, C, 1971, Lyon natural radiocarbon measurements II: Radiocarbon, v 13, p 52-73.

Evin, J, Longin, R, and Pachiaudi, C, 1969, Lyon natural radiocarbon measurements I: Radiocarbon, v 11, p 112-117.

Evin, J and Maréchal, J, 1979, Conditions involved for getting reliable dates from gasteropoda shells: ms in preparation.

Evin, J, Marien, G, and Pachiaudi C, 1973, Lyon natural radiocarbon measurements III; Radiocarbon, v 15, p 134-155.

——— 1973, Lyon natural radiocarbon measurements IV: Radiocarbon, v 15, p 514-533.

——— 1975, Lyon natural radiocarbon measurements V: Radiocarbon, v 17, p 4-34.

——— 1976, Lyon natural radiocarbon measurements VI: Radiocarbon, v 18, p 60-88.

——— 1978, Lyon natural radiocarbon measurements VII: Radiocarbon, v 20, 19-57.

Evin, J, Mongereau, N, and Rousselot, D, 1979, Utilisation du radiocarbone pour une meilleure connaissance de l'alimentation des nappes aquifères. Origine des eaux souterraines du couloir fluvio-glaciaire de Meyzieux (69): Réunion annuelle Sci de la Terre 7th, Comptes rendus, Lyon, April 1979, p 182.

Guillaume, C, 1974, A Saint-Mihiel: extraction et taille de silex il y a 4000 ans: Archéologia, v 67, p 40-49.

——— 1978, La grotte sépulcrale néolithique des "Roches de la Frasse" à Novéant-sur-Moselle (Moselle): Rev archéol de l'Est et du Centre-Est, v 29, no. 3-4, p 265.

Hannss, C, 1977, Spätpleistozäne bis postglaziale Talverschüttungsund Vergletcherungsphasen im Bareich des Sillon Alpin der französischen Nord-alpen: Thesis, Univ Tübingen, 2 v, in press.

Haricot, M, 1978, Eperon barré de Montgasteau, Cne de St-Denis-les-Ponts: Comptes rendus Colloque interrégional sur le Néolithique, Saint-Amand-Montrond, April 1978, in press.

Hassko, B, Guillet, B, Jaegy, R, and Coppens R, 1974, Nancy natural radiocarbon measurements III: Radiocarbon, v 16, p 118-130.

Jarrige, J F and Enault, 1976, Les fouilles de Pirak: Arts asiatiques, v 32, p 29-70.

Lagier-Bruno, L, 1973, Les blocs à cupules et à bassins de la région de Yenne-Belley: Rev Le Bugey, v 60, p 5-31.

Lechevallier, M and Valla, F, 1974, Mallaha (Eynan): Paléorient, v 2, no. 1.

Lepape, A, 1970, Buderfeld: Etudes Mosellanes, v 3, p 179-191.

Leroi-Gourhan, Arl and Allain, J, 1979, Lascaux inconnu: 12th supp Gallia Préhist, in press.

Leroi-Gourhan, Arl and Evin J, 1979, Les datations de Lascaux: *ibid*, p 81-86.

Libby, W F, 1955, Radiocarbon dating: Chicago, Univ Chicago Press, 175 p.

Mazière, G, 1978, Le Paléolithique en Corrèze: Thesis, Univ Paris, 526 p.

Mazière, G and Raynal, J P, 1977, La fin des temps glaciaires en Limousin: Colloquium internatl CNRS Comptes rendus "La fin des temps glaciaires en Europe, Bordeaux, May 1977, Preprint, v 2, p 267-285.

——— 1978, Le gisement de Chez-Jugie près de Cosnac; Campagne de fouilles 1977: Soc Lettres Sci Arts de Corrèze, Bull, v 18, p 31-35.

Mohen, J P, 1973, Les Tumulus de Bougon, nécropole néolithique: Soc Hist et Sci Deux-Sèvres, Bull, v 1973, no. 2-3, 54 p.

——— 1977, Les Tumulus de Bougon: cinq années de recherches (1972-1977): Soc Hist et Sci Deux-Sèvres, Bull, v 1977, no. 2-3, 48 p.

Monteillet, J, 1974, Etude quantitative d'un échantillonage de faune Quaternaire récent de la région de Saint-Louis, Sénégal: Inst Fondamental Afrique noire Bull, ser A, v 36, p 257-290.

Omnès, J, 1977, La préhistoire au Calvaire de Lourdes: découvertes anciennes et nouvelles: Recherches sur Lourdes, v 60, p 229-232.

Piningre, J F and Vuillemey, M, 1976, Les civilisations du Paléolithique moyen en Franche-Comté: La Préhistoire Française, Paris, CNRS press, v 1, p 1120-1130.

Pradel, L and Chollet, A, 1950, L'abri périgordien de Laraux, commune de Lussac-les Châteaux, Vienne: L'Anthropologie, v 54, no. 3-4, p 214-227.

Reille, M, 1976, Analyses polliniques de sédiments post-glaciaires dans le Haut Atlas marocain: premiers résultats: Ecol Mediterranea, v 2, p 153-170.

——— 1977, Contribution pollenanalytique à l'histoire holocène de la végétation des montagnes du Rif: Assoc française Etudes Quaternary Bull, v 50, p 53-76.

Robert, D and Robert, S, 1979, Recherches archéologiques à Tegdaoust et Koumbi-Saleh: Annales Inst Mauritanien Recherches Sci, in press.

Taborin, Y, 1977, Les habitats paléolithiques des bords de la Seine: Etioles: Colloquium internatl CNRS Comptes rendus "La fin des temps glaciaires en Europe, Bordeaux, May 1977, preprint v 2, p 116-132.

Le Tensorer, J M, 1979, Recherches sur le Quaternaire du Lot et Garonne: stratigraphie, paléoclimatologie et préhistoire paléolithique, Thesis, Univ Bordeaux III, 812 p.

Thévenin, A, 1976, Informations archéologiques: Gallia Préhist, v 19, p 490.

Thévenin, A, Gies, C, Sainty, J, Scheider, M L, Jeunesse, C, and Rapp, J P, 1977, Le site néolithique de Reichstett, fouilles de 1976: Revue Archéol de l'Est et du Centre-Est, v 28, no. 3-4, p 175-228.

Thilmans, G and Descamps, C, 1974, Le site mégalithique de Tiékène-Boussoura (Sénégal). Fouilles de 1974-1975: Inst Fondamental Afrique noire Bull, v 37, ser B, no. 3, p 447-496.

——— 1975, Le site mégalithique de Tiékène-Boussoura (Sénégal). Fouilles de 1974-1975: Inst Fondamental Afrique noire Bull, v 37, ser B, no. 2, p 261-306.

Triat-Laval, H, 1978, Contribution pollenanalytique à l'histoire tardi et post-glaciaire de la végétation de la Basse Vallée du Rhône: Thesis, Univ Marseille, 308 p.

Vivian, R, 1975, Les glaciers des Alpes occidentales, études géographique: Allier press, Grenoble, 513 p.

Vogel, J C and Waterbolk, H T, 1963, Groningen radiocarbon dates IV: Radiocarbon, v 5, p 163-202.

——— 1964, Groningen radiocarbon dates V: Radiocarbon, v 6, p 349-369.

——— 1969, Groningen radiocarbon dates VII: Radiocarbon, v 9, p 107-155.

——— 1972, Groningen radiocarbon dates X: Radiocarbon, v 14, p 6-110.

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NANCY NATURAL RADIOCARBON MEASUREMENTS V

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The following list includes some measurements made during 1975-1978 since our last list (R, 1978, v 20, p 62-67) in the National Radiocarbon Laboratory of the Ecole Nationale Supérieure de Géologie Appliquée et de Prospection Minière (ENSG) de Nancy.

Laboratory procedures and techniques are as reported in Hassko *et al* (1974) where the sample is synthesized to benzene. The only difference is in the counting equipment. We now use a Packard Tricarb 3305 liquid scintillation spectrometer where samples are counted for 24 or 48 hours. Radiocarbon ages are calculated using ^{14}C half-life of 5568 years and 95% activity of NBS oxalic acid is used as modern standard. Anthracite coal and Merck commercial benzene are used for the dead carbon run.

Counting errors are expressed at 1σ confidence level. AD/BC* dates are corrected using ^{14}C half-life of 5730 years and according to the Masca correction curve (Ralph *et al*, 1973).

Description and comments are generally based on information supplied by those who submitted the samples.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC AND HISTORIC SAMPLES

A. Peru

The following samples from different prehistoric villages in Peru are a continuation of the series previously described (R, 1978, v 20, p 62-67). Coll and subm by Frederic Engel, Dir Mission archaeol française au Pérou and Inst Antropol y Agric Precolombina, Univ Nac Agraria, Lima, Peru.

Chillon program series

Sites with Neolithic IV or V pottery

Ny-367. Chillon valley, V 3563 — **2060 ± 70** / **2080***

Plant material from Village 11 b X-131, Chacra alta Layer 100, alt 15m (11° 56′ 00″ S, 77° 05′ 00″ W). *Comment* (FE): dates a post-Chavin, pre-early Lima settlement in the Chillon valley. *Cf* Willey's white on red coll 1973 by F Engel and B Ojeda.

Southern deserts series

1. Preagricultural sites

Pampa Colorado Fog oasis series

Ny-383. Fog oasis V 3653 — **10,200 ± 140**

Charcoal from Encampment 17 c VIII-280A, Layer 400, alt 30 to 50m (16° 31′ 30″ S, 72° 51′ 30″ W). *Comment* (FE): could be one of oldest

Holocene settlements known in deep south of Peru. Located in fog oasis extending to bluff overhanging ocean. Estimated age: 9000 BP. Coll 1975 by F Engel.

Ny-381. Fog oasis V 3651 **9310 ± 120**

Shells from Encampment 18 b IX-5, Las Higueras, alt 10m, (16° 14′ 20″ S, 71° 34′ 57″ W). *Comment* (FE): will date 1 of early Holocene encampments found on bluff overhanging ocean. Coll 1975 by F Engel.

Ny-387. Fog oasis V 3657 **8490 ± 150**

Shells from Encampment 17 c VIII-2015, El Carrizal, alt 200m (16° 29′ S, 72° 55′ W, central point). *Comment* (FE): will date early settlement in Pampa Colorado fog oasis. Coll 1975 by F Engel.

Ny-386. Fog oasis, V 3656 **6620 ± 100**

Shell from Encampment 19 a V-300, Punta Icuy, Layer 200, alt 25m (17° 49′ 00″ S, 71° 08′ 20″ W). *Comment* (FE): will help date encampments found on bluff overhanging ocean. Coll 1975 by F Engel.

2. Pottery-yielding settlements, Neolithic

Ny-380. Fog oasis, V 3650 **3510 ± 80**
3990*

Charcoal from very large, La Buitrera village, 19 a II-100, from foot of fog oasis in marshy area. Alt 150m (17° 45′ S, 71° 10′ W, central area). *Comment* (FE): La Buitrera was occupied at least twice, first during preforming days. Sample is from Layer 200, typologically showing early occupation by settlers using pottery. Coll 1975 by F Engel.

3. Pottery yielding settlements, alloyed metal period

Ny-384. Fog oasis, V 3654 **1100 ± 100**
AD 890*

Bones from Village 19 b VII-105, Loma el Platanillo, Layer 100 (18° 02′ 25″ S, 76° 46′ 00″ W) alt 270m. *Comment* (FE): correct date for Tiahuaneo influenced village would read 1200 to 900 BP, AD 750 to 1050.

Ny-358. Fog oasis **870 ± 80**

Village at mouth of Ica R; raft made of reeds was found hidden in sand dune. Some reeds were used for dating. Alt 20m (14° 52′ 00″ S, 75° 33′ 34″ W). *Comment* (FE): raft was decorated with fragments of shells (*Spondylus* sp), typical Tiahunacoid cultural trait in Peru (only Precolombian raft known in South America, now in Mus Nat Agrarian Univ, Lima). Coll 1974 by F Engel.

Ny-385. Fog oasis, V 3655 **650 ± 70**
AD 1300*

Bones from Encampment 17 c VII-715, Palo Parado, on bluff. Alt 75 to 100m. Stone bldg (16° 29′ 00″ S, 73° 03′ 00* W central point). *Comment* (FE): could be late Pre-Incaic. Coll 1975 by F Engel.

Central coast program series

1. Preceramic horizons

Ny-414. Fog oasis, V 3704 **4885 ± 90**
5650*

Charcoal from Village 13 a II-90, Quilmana I, Layer 200. Alt 440m (12° 53′ 58″, 76° 26′ 03″). *Comment* (FE): will help date early farming settlements on central coast. Coll 1976 by B Ojeda.

Ny-415. Fog oasis, V 3708 **4250 ± 70**

Charcoal from Village 12 b XI-500, Omaniso I, Layer 100, alt 440m (12° 57′ 20″ S, 76° 27′ 54″). *Comment* (FE): same as Ny-414. Coll 1976 by B Ojeda.

Ny-418. Fog oasis, V 3757 **3580 ± 80**
5530*

Charcoal from Village 13 a II-45, Carretilla, Layer 200, alt 150m (12° 58′ 26″ S, 76° 27′ 56″ W). *Comment* (FE): same as Ny-414. Coll 1976 by B Ojeda.

Ny-416. Fog oasis, V 3709 **3550 ± 80**
5500*

Charcoal from Village 13 a II-70, Quilmana II, Layer 100, alt 350m (12° 55′ 30″ S, 76° 26′ 45″ W). *Comment* (FE): same as Ny-414. Coll 1976 by B Ojeda.

Ny-417. Fog oasis, V 3750 **3430 ± 80**
5380*

Charcoal from Village 13 a II-10, Quilmana III, Layer 100, alt 310m (12° 56′ 50″ S, 76° 26′ 42″ W). *Comment* (FE): same as Ny-414. Coll 1976 by B Ojeda.

Ny-419. Fog oasis, V 3760 **3240 ± 80**

Charcoal from Village 13 a II-20, Cerro Grande, Layer 200, alt 330m (12° 56′ 55″ S, 76° 26′ 52″ W). *Comment* (FE): same as Ny-414. Coll 1976 by B Ojeda.

Ny-392. Fog oasis, V 3700 **4740 ± 100**
5535*

Carbonized wood fragment from village 12 b IV-490 (12° 20′ 30″ S, 76° 43″ W). Los Icasos, alt 280m. *Comment* (FE): estimated age: 5000 BP?. Could be a coastal Neolithic I village. Coll 1975 by F Engel.

Ny-393. Fog oasis, V 3702 **3965 ± 100**
4520*

Structure seems to be related to late preceramic or Neolithic III without maize. It seems to be a common structure which is very rare at that time. Estimated age: 3500 BP. Coll 1975 by F Engel.

2. Alloyed metal periods

680 ± 75
Ny-477. V 6170 A **AD 1275***

Fragment of beam supporting roof of stone house, Village 12 b II-15, Orcocoto, Lurin Valley, alt 2070m (12° 06′ 40″ S, 76° 27′ 00″ W). *Comment* (FE): will help date "Cuculi period" villages of 13th-14th centuries AD. Coll 1977 by F Engel.

B. Ivory Coast

Samples were dated to study history of Kingdom of Kong, commercial area in savannah between forest and Sahel, Sahara and North Africa.

Kong (Ferkessidougou Dept) series
(9° 10′ N, 4° 30′ W)

350 ± 120
Ny-395. Kong, Site 5000 **AD 1440***

Estimated age: AD 1400 to 1800. Coll 1975 by V Diabaté Tiégré.

195 ± 85
Ny-405. Kong, Site 6000 **AD 1650***

Charcoal coll at 210cm below surface. Estimated age: AD 1400 to 1800. Coll 1976 by V Diabaté Tiégré.

185 ± 90
Ny-406. Kong, Site 7000 **AD 1650***

Charcoal coll at 130cm below surface. Estimated age: AD 1400 to 1800. Coll 1976 by V Diabaté Tiégré.

410 ± 90
Ny-409. Kong, Mosquée de Sitafa **AD 1440***

Charcoal coll 150cm below surface. Estimated age: AD 1400 to 1800. Coll 1976 by V Diabaté Tiégré.

335 ± 85
Ny-410. Kong, Grande Mosquée **AD 1490***

Charcoal coll 60cm below surface. Estimated age: AD 1400 to 1800. Coll 1976 by V Diabaté Tiégré.

160 ± 65
Ny-404. Labiné, 2km SE Kong, Site 1000 **AD 1760***

Charcoal coll 150cm below surface. Estimated age: AD 1300 to 1700. Coll 1976 by V Diabaté Tiégré.

340 ± 90
Ny-407. Ténéguéla, 9km Sud Kong **AD 1470***

Charcoal coll 180cm below surface. Estimated age: AD 1400 to 1800. Coll 1976 by V Diabaté Tiégré.

2290 ± 310
Ny-399. Ténéguéla, 9km Sud Kong **130 BC***

Humus 15 to 20cm. Coll 80cm below surface. Coll 1975 by J Polet.

Sud Aby lagoon series

Samples were dated to establish historic population maps of SE Ivory Coast.

125 ± 85
Ny-401. Assoco—Mossobaha Island **AD 1740***

Wood fragments from piles (3° 30′ W, 5° 20′ N). Coll 75cm below surface. Coll 1975 by J Polet.

2250 ± 95
Ny-408. Nyamva Island **410 BC***

Charcoal under dense forest (10cm humus). Coll 1975 by J Polet 130cm below surface.

C. Afghanistan

Shortugaï series

Charcoal from hearths and ash layers. Ash with burned soils (marl) at different stratigraphic levels, coll from Protohistoric site of Shortugaï (NE Afghanistan). Project was undertaken to study relations between Indus Valley and Central Asian civilizations in Bronze age period (Francfort & Pottier, 1978). Coll by H P Francfort and subm by J C Gardin.

3535 ± 165
Ny-421. SHB 76, late Period III, Level 4 **4000***

Estimated age: ca 3450 BP.

3180 ± 335
Ny-424. SHB 76, Level 3, early Period III **3480***

Estimated age: ca 3650 BP. Sample was very small. Benzene obtained was minimal.

3710 ± 100
Ny-427. SHB 76, Level 5, early Period III **4110***

Estimated age: ca 3650 BP.

4190 ± 125
Ny-428. SHB 76, Level 5, early Period III **4875***

Estimated age: ca 3650 BP.

3050 ± 250
Ny-422. SHB 76, Level 2, Period II **3330***

Estimated age: ca 3750 BP.

4375 ± 160
Ny-429. SHB 76, Level 3, early Period II **5106***

Estimated age: ca 3850 BP.

4075 ± 95
Ny-430. SHB 76, Level 1, late Period I **4710***

Estimated age: ca 3950 BP.

4040 ± 100
Ny-425. SHB 76, Level 1, early Period I **4605***

Estimated age: ca 4050 BP.

General Comment: Masca corrected dates run generally several centuries older than tentative chronology based on ceramic typology. Discrepancy perhaps is due to contamination of samples by older mineralogic carbon.

D. France

Gordes series, Vaucluse, France

Wood fragments from cellar, estimated age: 15th or 16th century. Coll and subm by J L Morand.

380 ± 50
Ny-473. **AD 1450***

Wood from an ancient oil mill.

200 ± 90
Ny-541. **AD 1644***

Wood from beam in wall of cellar.

255 ± 95
Ny-542. **AD 1580***

Well-preserved wood from wooden chimney funnel in wall of cellar.

General Comment (RC): beam and chimney funnel seem to be same age, ca AD 1600, late 16th or early 17th century, and suggest redisposition of cellar. Oil mill seems older, 15th century. Either is truly older or corresponds to re-use of old wood in new structure.

1980 ± 80
Ny-485. Limoges, Haute Vienne, rue du Clos Adrien 30 BC*

Charcoal from Gallo Roman well with pottery and tegulae, of 2nd century. Coll 1977 by J P Loustaud and subm by J M Desbordes. Estimated age: 2nd century. *Comment*: date appears older than expected based on historic correlations, but wood may be really older.

770 ± 75
Ny-498. Roman church of Meymac, Corrèze AD 1270*

Charcoal from glass-founder furnace in chancel of church. Sample No. 2 c/III. Durst hole furnace No. 2. Coll and subm by J M Desbordes. Estimated age: 12th century.

265 ± 75
Ny-497. Roman church of Meymac, Corrèze AD 1570*

Charcoal from site below choir of church in Roman surroundings. Coll 1978 and subm by J M Desbordes. Estimated age: 12th century.

2020 ± 70
Ny-499. Tarnac, Corrèze 55 BC*

Finely dispersed charcoal from base of funeral mound embedded in brown and tamped soil. Coll 1977 and subm by J M Desbordes. Estimated age: 12th century Iron age. *Comment*: date is younger than expected. Sample does not belong to Prehistoric occupation or may be contaminated by rootlets or humic acids.

Ny-486. Jarnages, Creuse, lieu-dit Martinfort **2440 ± 85**
490 BC*

Carbonized wood from early Gallo-Roman site with pottery and tiles. Coll 1977 by M Bord and subm by J M Desbordes. Estimated age: 1st century.

Ny-489. Razes, Haute-Vienne, lieu-dit Augères **660 ± 80**
AD 1305*

Carbonized wood from fill of underground gallery with post Gallo-Roman pottery. Coll 1977 by R Saumande and subm by J M Desbordes. Estimated age: post-Gallo-Roman period.

Ny-488. Saint Pardoux, Haute Vienne, lieu-dit La Ribière **600 ± 90**
AD 1380*

Carbonized wood from fill of underground gallery with post-Gallo-Roman pottery. Coll 1977 by R Saumande and subm by J M Desbordes. Estimated age: post-Gallo-Roman period.

Ny-487. Cloister of Obazine, Corrèze **960 ± 65**
AD 1020*

Wood fragment from stick (bishop's crook). Coll 1977 by B Barrière and subm by J M Desbordes. Estimated age: 13th century. Obazine abbey was founded AD 1130. *Comment*: date older than expected. Crook may have been transmitted by inheritance.

Jabreilles-les-Bordes series, Haute-Vienne, lieu-dit Le Chatelard

Study of ditch fill at foot of Historic fence (late Tene III or early Gallo-Roman period). Archael study made to determine absolute age and influence of human activities on environment.

Ny-479. CH 77—1 and 1 bis **820 ± 80**
AD 1165*

Charcoal from excavation at back of fields under cultivation. Sample may date early ploughing. Coll by B Valadas and subm by J M Desbordes. Estimated age: 12th century. *Comment*: ^{14}C date confirms interpretation above.

Ny-482. CH 77—6 **940 ± 135**
AD 1030*

Charcoal from fill of ditch. Date may indicate surrender of ramparts and beginning of fill of ditch. Coll 1977 and subm by J M Desbordes. Estimated age: probably 10th century. *Comment*: ^{14}C date agrees with expected age.

Ny-480. CH 77—3 and 3 bis **670 ± 100**
AD 1275*

Charcoal from fill of ditch. Coll 1977 and subm by J M Desbordes. No age expected.

Ny-481. CH 77—5 **Modern <180**

Charcoal from top of fill of ditch. Dates end of fill of ditch. Coll 1977 and subm by J M Desbordes. Estimated age: modern. ^{14}C date agrees with expected age.

E. French West Indies

Ny-500. Marie Galante Island **1515 ± 85 AD 470***

(61° 17′ W, 15° 50′ N). Charcoal from Taliseronde site. Coll and subm by D Emond.

Ny-478. La Martinique, Fond Brulé site **1600 ± 250 AD 390***

Charcoal from hearth, depth 130cm. Coll 1977 by M Mattoni. Site is between La Salle site (S), dated by Yale (Y-1116: 1770 ± 80 BP, R, 1963, v 5, p 336). Vive site (N), dated by FSU, 1730 ± 100 BP. Masca corrected dates are AD 190 ± 100* and AD 235 ± 125*. Our sample was of poor quality, very small (0.4173g C). Benzene obtained was minimal, yielding large statistical error, but result seems archeologically acceptable.

II. GEOLOGIC SAMPLES

Etang de Batéguier, Ile Ste Marguerite series, Alpes Maritimes France

Shells from lacustrine sediments, Etang de Batéguier (5 gr 21, 9′ W, 48 gr 35, 8′ N). Cores taken in sediments of pool, depth 2.5m with level of numerous shells (*Bytinidae* sp, *Clausilidae* sp), undoubtedly killed by sudden disturbance of environment. Coll and subm 1975 by G Palausi.

Ny-389. Ile Ste Marguerite **3920 ± 90 2530 BC***

Ny-390. Ile Ste Marguerite **1410 ± 80 AD 580***

Ny-391. Ile Ste Marguerite **1490 ± 80 AD 500***

General Comment (GP): Ny-389, taken near shore, is probably not significant because of possible contamination by older shells. Two dates, Ny-390 and -391, agree statistically and help estimate rate of sedimentation for pool. Mean age: 1450 BP. Rate of sedimentation: 1.80 mm/yr.

III. SOIL SAMPLES

A. Andosols

Andosols are soils developed on volcanic ashes. Most are mainly characterized by amorphous hydrous silica–alumina mineral such as allophanes, which can adsorb much organic matter.

Samples from Auvergne and Cantal coll 1974 by J M Hétier and B Guillet; samples from Vivarais, by J Moinereau, E N S A Montpellier.

Puy du Mercoeur, Auvergne
(45° 42′ 12″ N, 2° 55′ 12″ E)

Ny-558. A_{12} horizon, 8.8% C, 20 to 30cm 1680 ± 80

Ny-559. B_1 horizon, 7.2% C, 40 to 50cm 3000 ± 80

Ny-560. B_2 horizon, 3.4% C, 60 to 70cm 3700 ± 90

Comment: Puy du Mercoeur is volcanic cone of basaltic cinders and scoria, S of Chaînes des Puys, 15 km SW Clermont-Ferrand, France. Volcanic eruption of Puy du Mercoeur is estimated at 4000 to 6000 yr, based on local stratigraphy (Hétier, 1975). Mean residence time of B_2 horizon organic matter probably expresses beginning of andosolization processes.

Puy de Dôme, Auvergne
(45° 45′ 25″ N, 2° 55′ 14″ E)

Ny-561. A_1 horizon, 14.2% C, 15 to 25cm 950 ± 70

Ny-562. A_1 B_h horizon, 13.4% C, 30 to 40cm 2040 ± 80

Ny-563. A_1 B_2 horizon, 10% C, 40 to 50cm 2590 ± 80

Ny-564. II A_1 horizon, 1% C, 150 to 160cm 8210 ± 120

Comment: mean residence time of organic matter of buried II A_1 horizon agrees well with dates of charcoals separated from similar buried soils (Brousse *et al*, 1969). Upper ando-podzolic soil is developed on domite material 150cm thick, forming of which began ca 8300 yr BP.

Puy Mey, Auvergne
(45° 42′ 33″ N, 2° 57′ 57″ E)

Ny-565. Buried III A_1 horizon, 6% C, 240 to 245cm 1280 ± 70

Ny-566. Charcoal from buried III A_1 horizon 1510 ± 50

Comment: Puy Mey is a small cone on Puy du Mercoeur and Puy de la Vache, covered by unweathered volcanic scoria. Two buried andosols are observed. Organic matter of deepest, Ny-565, had low residence time, suggesting that recovering by basaltic scoria is recent. Conclusion supported by age of charcoals, Ny-566, measured twice from 2 different samplings. If upper volcanic deposit was really caused by volcanic eruption, age of charcoals would date one of most recent volcanic events in Chaînes des Puys, ca AD 500.

Montagne de Marlieux, Cantal
(45° 13′ N, 2° 35′ 10″ E)

Ny-567. A_1 horizon, 12.4% C, 15 to 25cm 650 ± 70

Ny-568. B_1 horizon, 7.3% C, 40 to 50cm 3190 ± 90

Ny-569. B_2 horizon, 6% C, 60 to 75cm **3910 ± 90**

Comment: andosol developed on weathered material of early Pleistocene basalt, ankaramite, rejuvenated by glacial erosion. Mean residence time gradient of organic matter is very comparable to data obtained for Puy du Mercoeur andosol.

Bois des Chabottes, Vivarais
(44° 40′ 23″ N, 4° 21′ 10″ E)

Ny-570. A_1 horizon, 36% C, 0 to 7cm undecomposed plant debris, size >200μm **Modern**

Ny-571. A_1 horizon, 17.4% C, 0 to 7cm humified material, <200μm **120 ± 50**

Ny-572. B_{ir} horizon, 8.4% C, 7 to 25cm **1340 ± 90**

Ny-573. B_h horizon, 10.2% C, 25 to 45cm **3500 ± 90**

Comment: this profile corresponds to evolution from andosol to podzolic soil by differentiation of ochrous B_{ir} horizon (Moinereau, 1977).

General Comment: as proposed by Sharpenseel (1972), a regression curve may be established between mrt (Y value in yr) and depth of date samples (X value, in cm). Equation for andosols ($Y = 60.9\ X + 80$, $r = 0.918$, $n = 15$) suggests that gradient of mrt with depth is higher than in other soils, such as brownearths, vertisols, chernozems (Guillet, 1979). This is explained by great influence of allophanic and amorphous alumina material that biologically stabilizes adsorbed organic matter, as breakdown and turnover is delayed.

B. Paleosols

Golbey, Vosges

(48° 12′ 47″ N, 6° 26′ 12″ E). Surface of old fluvial terrace of Moselle was covered by loam, 1.40m thick, on which sol lessivé glossique (agric glossaqualf) is differentiated. Old surface corresponds to cryogenic humic soil with charcoals. Samples coll and subm 1976 by M Cailler, CPB Nancy.

Ny-588. Humic paleosol, <500 μm, 1.8% C, 140 to 150cm **$26,390^{+830}_{-750}$**

Ny-589. Humic acids from isolated charcoals **$27,100^{+2500}_{-1900}$**

Ny-590. Charcoals **>40,000**

Comment: humic paleosol was thought to have developed during Kesselt interstade of Würm glaciation (ca 27,000-30,000 BP). But treatments of isolated charcoals with NaOH 0.5 N and Cl H N solutions dated to >40,000 yr BP for residual charcoals. Paleosurface is older than expected and should date at Brorup interstade. Rejuvenation of paleosol humus and of humic acid fraction of charcoals was probably caused by continuous percolation of organic matter and water through cracks of upper loamy soil.

Le Bernardan, Haute Vienne

(46° 19′ 18″ N, 1° 14′ 41″ E) Indurated iron pans in arenaceous granitic parent material coll and subm 1975 by J C Flageollet, Univ Nancy II.

Ny-586. Le Bernardan I, 0.3% C, 30 to 40cm **2230 ± 80**

Ny-587. Le Bernardan II, 0.1% C, 80 to 90cm **15,690 ± 430**

Comment: for deepest pan, older age was expected. Rejuvenation by root decomposition is possible.

C. Soil organic matter fractionation

Various fractions of A_1 and B_1 horizons of Puy du Mercoeur andosol were processed to determine different turnover rates of organic matter fractions. Soil organic matter extractions were performed with successive Na–pyrophosphate 0.1 M and NaOH N solutions. Fulvic acids are soluble when alkaline organic solutions are acidified (pH 1) causing humic acids to precipitate. Humine is non-extractable organic matter. Values in brackets report organic matter extracted as Carbon percent of total C of soil sample.

Puy du Mercoeur, A_1 horizon

Ny-574. Fulvic acids 1, (15) **1330 ± 70**

Precipitated at pH 4.8: β humus.

Ny-575. Fulvic acids 2, (13) **650 ± 70**

Fulvic acid fraction that does not precipitate at pH 4.8.

Ny-576. Humic acids, (13) **1510 ± 70**

Ny-577. Humine, (45) **1460 ± 70**

Comment: except for Fulvic acids 2, mean residence times of humus –C fractions are very similar.

Puy du Mercoeur, B_1 horizon

Ny-578. Fulvic acids 1 (11) **2580 ± 80**

Ny-579. Fulvic acids 2 (12.4) **2130 ± 80**

Ny-580. Humic acids (17.5) **2760 ± 80**

Ny-581. Humic acids: acid hydrolyzate (3.5) **1830 ± 80**

Ny-582. Humic acids: hydrolyzate residue (14) **3270 ± 80**

Ny-583. Humine fraction (55.5) **2870 ± 80**

Ny-584. Humine: acid hydrolyzate (27) **2340 ± 80**

Ny-585. Humine: hydrolyzate residue (29.5) 3180 ± 80

Comment: as expected, hydrolyzate fractions of humic acids and humine are relatively more renewed than residual carbon fractions. This may be considered a constant characteristic of soil organic chemistry, resulting from higher turnover rate of aminopolysaccharides and other metabolic N-products, which may be liberated from humic polycondensates by 6 N HCl hydrolysis procedure for 16 hrs.

References

Brousse, R, Delibrias, G, Labeyrie, J, and Rudel, A, 1969, Eléments de chronologie des éruptions de la Chaîne des Puys: Soc Géol France Bull, v 7, no. 11, p 770-793.

Francfort, H P and Pottier, M H, 1978, Sondage préliminaire sur l'établissement protohistorique harappéen et post-harappéen de Shortugaï (Afghanistan du NE): Arts Asiatiques 1978, v 34, p 29-79.

Guillet, B, 1979, Etude du renouvellement des matières organiques des sols par les radioisotopes (^{14}C) en Pédologie, constituants et propriétés: Paris, Masson éd, p 210-226.

Hassko, B, Guillet B, Jaegy R, and Coppens R, 1974, Nancy natural radiocarbon measurements III: Radiocarbon, v 16, no. 1, p 118-130.

Hétier, J M, 1975, Formation et évolution des andosols en climat tempéré: Thesis, Univ Nancy, 194 p.

Moinereau, J, 1977, Altération des roches, formation et évolution des sols sur basalte, sous climat tempéré humide (Velay–Vivarais–Coirons): Thesis, Univ Montpellier, 139 p.

Ralph, E K, Michael, H N, and Han, M C, 1973, Radiocarbon dates and reality: Masca Newsletter, v 9, no. 1.

Sharpenseel H W, 1972, Natural radiocarbon measurement of soil and organic matter fractions and on soil profiles of different pedogenesis: Internatl conf on radiocarbon dating, 8th Proc, Wellington, New Zealand, E, p 3-11.

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TARTU RADIOCARBON DATES IX

A LIIVA, G ELINA, V TCHATCHKHIANI, and T RINNE

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The following list contains dates of organogenous sediments (peat and sapropel from the Karelian ASSR) made in 1972 to 1977 with the aim of studying the history of the development of peat bogs in the Holocene (Elina, 1969; 1971a,b; Pyavchenko *et al*, 1976). Samples were collected with Hiller or Instorf samplers. Borings were made in the deepest parts of the peat bogs.

Pollen analyses of all the sections described in this paper were conducted by V Tchatchkhiani; botanical analyses were made by L Belova. All samples were submitted for dating by the Institute of Botany, Karelian Branch of USSR Academy of Sciences.

Radiocarbon dates were determined by A Liiva and T Rinne, Biochemical Laboratory of the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR.

Measurement of the activity of ^{14}C was performed by liquid scintillation with the use of benzene. All dated samples were measured in parallel on two single-channel units. Radiocarbon dates have been calculated using 5568 ± 30 as the half-life of ^{14}C, with 1950 as the reference year.

North Karelia

Region covers territory of Karelia from its N boundaries, 66° 30′ to 64° N, excl SE Prebelomorye. List contains description of 16 samples of organogenous sediments coll from 9 peat bogs characteristic of different types of relief.

Ptichye series

Ptichye bog lies in Louhi dist near Lake Sokol in glacial moraine plain, +120m. Fen peat bed, depth 7m. Two samples coll 1977 for dating by O Kuznetsov.

TA-1021. Ptichye **8600 ± 100**

Sample from basal peat layer at 6.7 to 7m depth. Pollen analysis shows Boreal max of birch. *Comment*: date agrees well with palynologic materials from Kuusamo dist, Finland (Vasari, 1962).

TA-1020. Ptichye **6610 ± 100**

Peat from 4.5 to 4.75m depth, contact of AT1/AT2. Empiric boundary of spruce pollen.

Neino suo series

Neino suo peat bog lies in Louhi dist near Lake Sokol in glacial moraine plain. Alt +111.4m. Depth of fen peat, 5m. Two samples coll 1977 by O Kuznetsov.

TA-1026. Neino suo **8695 ± 100**

Benthic peat layer underlain by clay from 4.75 to 5m depth, contact of B01/B02.

TA-1025. Neino suo **7350 ± 90**

Peat coll from 3.75 to 4m depth, contact of B02/AT1.

Mezhgornoye series

Mezhgornoye (intermontane) bog lies in Louhi dist, S of Lake Sokol in deep basin with large ridge-like and hilly relief of denudate-tectonic genesis. Surface alt of bog 160m, ridges rise to +235m. Peat layer of bog is transitional, depth of organogenous sediments, peat and sapropel, 5.9m underlain by clay. Sample coll 1977 by O Kuznetsov.

TA-1019. Mezhgornoye **7920 ± 100**

Peat from 5.6 to 5.9m depth. Pollen analysis attributes age of sample to middle Boreal.

Zapovednoye series

Zapovednoye bog is in Kemi dist between settlements of Shombe and Kepa in slightly hilly moraine plain, +120m. Peat depth, 5.8m. Transitional peat deposit between fen and bog. Two samples coll 1977 by O Kuznetsov.

TA-954. Zapovednoye **899 ± 100**

Benthic peat layer from 5.5 to 5.8m depth underlain by clay. Pollen analysis shows Boreal max of birch (beginning of B01).

TA-955. Zapovednoye **6900 ± 100**

Peat from 4.7 to 5m depth. Pollen spectra indicate lower boundary of continuous curve of elm pollen (AT1).

Shomba suo series

Shomba bog is in Kemi dist near settlement of Shomba in undulating plain, +95 to 100m. Fen peat bed at 2.25m depth. Two samples for dating coll 1978 by O Kuznetsov.

TA-1102. Shomba suo **6945 ± 50**

Benthic peat from 2 to 2.25m depth underlain by clay. Pollen analysis indicates optimum of Atlantic period (AT1).

TA-1103. Shomba suo **3050 ± 60**

Peat from base of lakelet in ridge-pool lake complex 1 to 1.25m deep.

Kepa series

Kepa bog, Kalevala dist near Kepa settlement, in small depression in kame relief. Alt +125m. Peat deposit transitional; depth of organogenous sediments 4.9m. Two samples coll 1977 by O Kuznetsov.

TA-1017. Kepa **8995 ± 100**

Sapropel from benthic layer 4.7 to 4.9m deep in contact with sand. Pollen spectrum displays max of birch (B01).

TA-1018. Kepa **6115 ± 100**

Peat from 3.75 to 4m depth is in contact with sapropel. Pollen analysis displays optimum of Atlantic period (AT2).

July suo series

July bog, Kalevala dist W of Lake Kontokki, developed in narrow ravine in high-ridged denudate-tectonic relief. Borings of lacustrine bog sediments were carried out up to 6.5m depth. Sediments are made up to 5.75m of transitional fen peat and at 0.75m of sapropel. Two samples coll 1974 by O Kuznetsov.

TA-738. July suo **7400 ± 100**

Sapropel from 6.25 to 6.5m depth, attributable to beginning of Atlantic period (AT1).

TA-737. July suo **5700 ± 100**

Peat from 5.25 to 5.5m depth in contact with sapropel. Pollen analysis shows optimum of Atlantic period (AT2).

Kontokki series

Landscape bog, Kalevala dist SW of Lake Kontokki, occupies narrow depression in denudate plain, +202m. Fen peat bed, max depth of organic sediments, 7m. Six m of sediments are peat, 1m is sapropel underlain by clay. Two samples coll 1974 by G Elina and O Kuznetsov.

TA-730. Kontokki **8000 ± 100**

Benthic sapropel, coll from 6.75 to 7m depth, from pollen analysis, assigned to Boreal period (B02).

TA-729. Kontokki **3200 ± 60**

Peat from 4.25 to 4.5m depth. Pollen analysis shows Sub-Boreal max of spruce.

No suo series

No suo bog, Kalevala dist E of Lake Kontokki, occupies a narrow ravine between high eskers. Alt of esker ridges, +170m, relative alt of ridges, ca 8m. Boring exposed bore well, 8m deep. 4.25m of bore hole is transitional peat; 3.75m is sapropel. Sample coll 1972 by Elina and Kuznetsov.

TA-581. No suo

Sapropel coll near boundary of limnotelmatic contact at 4.75 to 5m depth. *Comment*: pollen spectra display optimum of AT1 and beginning and distribution of spruce.

SE Prebelomorye

This region unites territory of Prebelomorsk depression bordering on town of Belomorsk and Vyg R in W, on the boundary of Karelia with Arkhangelsk Region in E. Six samples from peat deposits of 2 bogs are listed.

Zarutskoye series

Zarutskoye bog, Belomorsk dist, SE of Nyukhcha village, on 3rd sea route of Prebelomorsk depression, +20m. Raised bog peat bed, maximum depth 8m, underlain by sea clay and loamy soil. Five samples coll 1975 by G Elina and V Antipin.

TA-836. Zarutskoye **8360 ± 100**

Peat, depth 7.5 to 7.85m, from contact zone of fen and transitional layers. *Comment*: pollen analysis shows Boreal age (B02).

TA-835. Zarutskoye **7120 ± 100**

Peat from 6.25 to 6.5m depth, ascribed by pollen analysis to 1st half of Atlantic period (AT1). *Comment*: dates appearance of spruce (empiric boundary).

TA-834. Zarutskoye **5575 ± 80**

Peat from 5 to 5.25m depth. *Comment*: pollen analysis indicates Upper Atlantic spruce pollen max.

TA-833. Zarutskoye **3500 ± 70**

Peat from 2.25 to 2.5m depth. *Comment*: assigned to Sub-Boreal period by pollen analysis. Dates Sub-Boreal max of spruce.

TA-832. Zarutskoye **1940 ± 60**

Peat from 1 to 1.25m depth. *Comment*: pollen analysis shows Sub-Atlantic max of spruce.

Nyukhcha series

TA-837. Nyukhcha **5010 ± 80**

Peat from 4.15 to 4.3m depth coll from Malyi Nyukhchensky Mokh bog. Belomorsk dist E of Nykhcha village, on 3rd sea terrace of Prebelomorsk depression, alt 20m. Raised bog peat bed, depth, 5m. Sample coll 1975 by V Antipin. *Comment*: pollen analysis indicates end of Atlantic period (AT2) and empiric boundary of spruce pollen.

Central Karelia

Territory between 64°N and 62°N has been least thoroughly studied. Present list contains descriptions of 7 samples coll from 3 peat bogs.

Chelmuzhi series

Bog along Nemina R, Medvezhyegorsk dist E of Chelmuzhi village, has been compressed into narrow valley of Nemina R from which terrace sharply rises at alt, +6m. Three samples coll 1971 by G Elina and O

Kuznetsova from natural outcropping of peat bog with total thickness, 2.65m.

TA-434. Chelmuzhi **4480 ± 60**

Peat from 1.3 to 1.35m. *Comment*: pollen analyses shows that these peat samples were deposited at beginning of Sub-Boreal period.

TA-433. Chelmuzhi **4270 ± 70**

Strongly mineralized peat from 1.15 to 1.2m depth. *Comment*: pollen analyses indicate Sub-Boreal max of spruce.

TA-432. Chelmuzhi **2975 ± 60**

Peat from 0.7 to 0.75m depth. *Comment*: pollen analyses show Sub-Boreal/Sub-Atlantic contact.

Chudesnoye series

Chudesnoye bog, Medvezhyegorsk dist NW of Lake Segozero, occupies narrow depression of lacustrine-glacial plain, at +185m. Two samples of fen peat bed from 6m depth coll 1977 by V Antipin.

TA-1023. Chudesnoye **8450 ± 80**

Peat from 5.5 to 5.75m depth. *Comment*: pollen spectra show Boreal period for their deposition (beginning of BO_2).

TA-1022. Chudesnoye **7760 ± 100**

Peat from 4.75 to 5m depth. *Comment*: pollen analyses indicate end of Boreal period.

Dry Lamba series

Dry Lamba bog, Kontopohja dist Kivach Nature Reserve, among high hills of limno-glacial montane relief, at +60m. Raised bog peat bed 8m deep. Two samples coll 1976 by V Antipin.

TA-890. Dry Lamba **8250 ± 80**

Peat from 7.75 to 8m. *Comment*: pollen analyses from 7.75 to 8m depth show middle of Boreal period.

TA-889. Dry Lamba **7360 ± 80**

Peat from 7.5 to 7.75m. *Comment*: pollen spectra show beginning of Atlantic period.

South Karelia

Territory S of 62°N has been studied rather thoroughly. The following describes 13 samples from 7 bog secs. *Comment*: materials of region under study obtained by authors agree well with data pub 1967 by K Tolonen on Finland (Tolonen, 1967).

Bezdonnoye series

Bezdonnoye bog is in Suoyärvi dist W of Lake Samozero in moraine aqueoglacial undulating plain lying in basin between 2 low ridges, at

+123m. Fen peat bed is transitional. Max depth of organogenous sediments is 13.5m of which 5.25m are made up of peat and 8.25m of sapropel. Four samples coll 1971 by V Antipin and O Kuznetsov.

TA-535A. Bezdonnoye **9880 ± 150**

Sapropel from 13 to 13.5m from base of organogenous sediments. *Comment*: pollen spectra indicate absolute max of birch, which corresponds to beginning of Pre-Boreal period.

TA-534. Bezdonnoye **9470 ± 150**

Sapropel from 120m depth. *Comment*: pollen analysis indicates contact of Pre-Boreal and Boreal periods.

TA-533. Bezdonnoye **9085 ± 120**

Sapropel coll from 12m depth.

TA-532. Bezdonnoye **5065 ± 70**

Peat from 5m depth near limnotelmatic contact of sapropel and peat. *Comment*: pollen spectra of these sediments correspond to contact of Atlantic and Sub-Boreal periods.

Mustu suo series

Mustu suo bog lies in Pryazha dist E of Kindasovo village in extensive basin of Shuisk lowland of limno-glacial origin (Apykhtin *et al*, 1965). Alt marks contact of bog and waterless valley at 102.5m depth. Bog peat bed transitional; max depth, 5.5m. Two samples coll 1973 by V Tchatchkhiani and O Kuznetsov.

TA-579. Mustu suo **8670 ± 100**

Benthic, in contact with clay, peat from 4.75 to 5m depth. Pollen analyses indicate max of birch, which corresponds to Boreal period (end of B01).

TA-578. Mustu suo **7600 ± 100**

Peat from 3.5 to 3.75m depth. Appearance of spruce pollen is noticeable in pollen-analytical spectra.

Kindasovo series

Nenazvannoye bog is in Pryazha dist N of Kindasovo village in higher ridges of Shuisk lowland, at +102.5m. Fen peat bed transitional, 4 to 4.5m deep, underlain by clay. Three samples coll 1974 by V Antipin and O Kuznetsov, 2 samples from bore well in center of bog, 1 from periphery.

TA-838. Kindasovo **8460 ± 100**

Benthic peat from center of bog from 4.25 to 4.4m depth. Pollen analyses assign sample to Boreal period (B01/B02).

TA-855. Kindasovo **4150 ± 40**

Peat from same site (0.75 to 1m depth). Pollen-analytical spectra (sharp decrease of spruce pollen) attribute sediments to 2nd half of Sub-Atlantic period.

TA-779. Kindasovo **4070 ± 80**

Benthic peat from 2.32 to 2.6m depth on periphery of bog. Pollen analysis indicates Sub-Boreal age of sediments.

Rittu suo series

Rittu suo lies in Pryazha dist NE of Kindasovo village in limnoglacial plain at +100m. Raised bog peat bed from 3.15m depth. Sample coll 1975 by V Tchatchkhiani and O Kuznetsov.

TA-580. Rittu suo **7900 ± 100**

Benthic peat from 2.4 to 2.7m depth, assigned by pollen analyses to end of Boreal period (B02).

Koivu suo series

Koivu suo in Pryazha dist borders on Rittu suo in W lying at +97.5m. Fen peat bed 1.5 to 2m deep. Two samples coll 1971 by V Tchatchkhiani and O Kuznetsov.

TA-447. Koivu suo **5780 ± 100**

Peat from 1.3 to 1.4m depth underlain by clay. Pollen spectra show climatic optimum (AT2).

TA-448. Koivu suo **2550 ± 70**

Peat from 0.8 to 0.9m depth. Pollen spectra clearly show contact of Sub-Boreal and Sub-Atlantic periods.

TA-955. Hiili suo **8530 ± 80**

Peat from 5.5 to 5.8m depth from Hiili bog, Prionega dist SE of Petrozavodsk. Bog is on slope of individual elev massif at +147m. Fen peat bed transitional, max peat depth, 6m. Sample coll 1976 by V Antipin and O Kuznetsov. *Comment*: pollen analyses and dates show Boreal period for formation of these layers, contact of B01/B02, which do not confirm Donner's data (Donner, 1951) on formation of this bog in Late-Glacial period.

References

Apukhtin, N L, Ekman, I M and Yakovleva, S V, 1965, New evidence relating to the existence of the Late-Glacial Belomor-Baltic sea-gate on the Onega-Ladoga isthmus Baltica, 2: Vilnius, p 99-112 (Russian).

Donner, I, 1951, Pollen-analytical studies of late-Glacial deposits in Finland: Finland Bull Comm geol, v 154, p 1-92.

Elina, G A, 1969, On the development of bogs in the SE part of the Prebelomor lowland: Bot Zh, 4, p 545-553 (Russian).

——— 1971a, Correlation of the pollen-analytical spectra of the Holocene of the Karelian ASSR, Leningrad Region and Finland: Palynology of the Holocene, Moscow, p 91-104.

——— 1971b, Bog types of the Prebelomor lowland in Bogs of Karelia and ways of utilizing them: Petrozavodsk, p 51-79 (Russian).

Pyavchenko, N I, Elina, G A, and Tchatchkhiani, V N, 1976, Basic stages in the history of vegetation and of peat accumulation in W part of the Baltic Shield in the Holocene: Comm on study of Quaternary period Bull, v 45, p 3-24 (Russian).

Tolonen, K, 1967, Über die Entwicklung der Moore im finnischen Nordkarelien: Annales Bot Fennicae, v 4, no. 3, Helsinki, p 220-416.

Vasari, Y, 1962, A study of the vegetational history of the Kuusamo district (NE Finland) during the late-quaternary period: Annales Bot Soc Zool Bot Fennicae "Vanamo", v 33, no. 1, Helsinki, p 140.

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TEMPLE UNIVERSITY RADIOCARBON DATES I

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INTRODUCTION

Temple's radiocarbon dating facility is housed in the Department of Geology on the Main Campus. The laboratory was established to support research in late Pleistocene and Holocene Geology, Archaeology, and Anthropology.

The method employed is liquid scintillation counting of synthesized benzene using the basic techniques described by Noakes, Kim, and Stipp (1965), Polach and Stipp (1967), and modifications as described by Stipp, Eldridge, and Cadwell (1976) converting sample $\rightarrow CO_2 \rightarrow C_2H_2 \rightarrow C_6H_6$. Over-all yield is approximately 90 to 95%. Shell samples are etched with dilute HCl; organic samples are pretreated with 3N HCl and, with the exception of total organic carbon dates, 2% NaOH.

Counting is done on an automatic Searle Mark III liquid scintillation spectrometer with a background of 7cpm utilizing a 20cc low ^{40}K glass vial. The 4cc cocktail includes PPO and dimethyl-POPOP scintillators. Instrument stability is continuously monitored.

The dates reported here are calculated using a ^{14}C half-life of 5568 yr. 95% of NBS oxalic acid ^{14}C dating standard, converted to CO_2 by a solution of potassium permanganate and sulfuric acid, is used for the modern reference. Errors are reported as one standard deviation which includes only the combined counting uncertainty of the background, modern, and sample. Ages of check samples determined in this laboratory indicate agreement with the results of other laboratories. Reproducibility of multiple runs is satisfactory.

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R Harper of Temple's Skin and Cancer Clinic generously provides use of his liquid scintillation counter. With his unselfish cooperation the laboratory is able to maintain efficient operation.

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SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

A. United States

TEM-129. Arthur Dean site, M52 SE-10-110 1800 ± 80

Charcoal from Arthur Dean site, Sesachacha Pond W, Nantucket, Massachusetts (41° 17′ 35″ N, 69° 59′ 62″ W). Sample excavated 65cm beneath surface from midden located in glacial moraine. Result dates occupation of site by early peoples. Coll 1973 and subm 1979 by D G Crozier, Temple Univ, Philadelphia, Pennsylvania.

TEM-111. Assunpink Creek, AS-1-44-3 2770 ± 60

Charcoal from Assunpink Creek, Hamilton Twp, New Jersey (40° 15′ N, 74° 45′ W). Sample in loose assoc with argillite assemblage from 35 to 45cm beneath surface. Coll 1976 and subm 1978 by J W Gruber, Temple Univ. *Comment*: 2nd date TEM-112: 2950 ± 70 from additional charcoal contemporaneous with TEM-111. *Comment* (JWG): 1st in series of samples to establish spatial chronology est 1150 to 6950 BP of occupation by single component at this site.

B. Pakistan

TEM-118. Sanghao Caves 61 and 62 11,760 ± 260

Charcoal from Sanghao Cave, Sanghao Valley, Peshawar Basin, Pakistan (34° 30′ N, 72° 30′ E). Sample from hearth excavated 2m beneath surface of cave floor. Result establishes regional sequence of archaeol cultures. Coll 1975 and subm 1978 by A J Ranere, Temple Univ. *Comment* (AJR): date expected to be much older from geol and cross-dating estimates. Sample assoc with stone tools which are probably contemporary with Upper Paleolithic industries to W.

C. Guatemala

TEM-113. El Mirador EM 78-1 1450 ± 120

Charcoal from Aguada Limon reservoir, El Mirador, El Peten, Guatemala (17° 47′ N, 89° 55′ W), 20 to 50cm beneath surface. Result dates abandonment of reservoir by early peoples during Classic or Post-Classic Maya phase. Coll by D K Moore; subm 1978 by B H Dahlin, Catholic Univ America, Washington, DC.

D. Panama

Temple Univ is currently involved with members of Am Mus Nat Hist and Smithsonian Tropical Research Inst in research directed towards assessing age and nature of early cultural patterns in New World humid tropics as well as age and nature of hunting-gathering patterns from which they developed. Attention has been focused on Pacific coastal plains of Panama where archaeol investigations conducted in 1940's and 1950's revealed sequence of occupations spanning at least last 7000 yr (Willey & McGimsey, 1954; McGimsey, 1956; Willey, 1971). Re-excavation of Monagrillo and Aguadulce sites was undertaken during 1975 to coll archaeol and paleol samples for accurate dating and to reconstruct environmental and subsistence systems (Ranere, 1972; 1975; 1976; Ranere & Hansell, 1978). Samples excavated in 1974 from the Ladrones site contained Monagrillo-like sherds, providing 3rd ceramic occupation for cross-dating.

The following dates are latest radiocarbon results for Monagrillo, Aguadulce and Ladrones; previous dates are referenced where appropriate. Future work on these and additional sites will include coastal and intertidal sedimentol studies by Temple's Dept Geol.

TEM-109. Monagrillo #70 **5500 ± 100**

Charcoal from coastal shell midden, 5km NE of Chitre on coast of Parita Bay, Monagrillo, Herrera Province, Panama (8° 02′ N, 80° 28′ W). Sample from Block 2, 100 to 110cm beneath surface. Coll 1975 and subm 1978 by A J Ranere. *Comment*: previous dates on site are Y-585: 4090 ± 70 (R, 1959, v 1, p 142-172); I-9384: 3325 ± 85 (Buckley, 1976, written commun); SI-2840: 3615 ± 80 and SI-2841: 5385 ± 95 (Stuckenrath, 1976, written commun).

Aguadulce series

Samples from rockshelter in coastal plains of central Panama, 18km N on coast of Parita Bay, 8km NE of Santa Maria R, 13km W of Aguadulce, Panama (8° 11′ 08″ N, 80° 38′ 28″ W). Coll 1973 and subm 1978-79 by A J Ranere.

General Comment (AJR): stratigraphy was highly compressed yielding ca 5000 yr of cultural deposits between 40 to 85cm depth beneath surface.

TEM-107. Aguadulce #30 **2570 ± 100**

Ostrea corteziensis from Block 3, Layer B_1, 5 to 10cm beneath surface.

TEM-125. Aguadulce #32 **2540 ± 70**

Ostrea corteziensis from Block 3, Layer B_2, 10 to 15cm beneath surface.

TEM-126. Aguadulce #33 **2960 ± 80**

Ostrea corteziensis from Block 3, Layer B_3, 15 to 20cm beneath surface. *Comment* (AJR): TEM-107, -125, and -126 are assoc with Monagrillo ceramics.

TEM-108. Aguadulce #24 **3630 ± 100**

Ostrea corteziensis from Block 2, Layer C_1, 20 to 25cm beneath surface.

TEM-127. Aguadulce #36 **2790 ± 110**

Ostrea corteziensis from Block 3, Layer C_3, 25 to 30cm beneath surface. *Comment*: 2nd date TEM-128; 3700 ± 100 from *Protothaca asperrima*. *Comment* (AJR): TEM-127 expected to be older (assoc with preceramic culture); stratigraphically below TEM-108 and -126.

TEM-130. Aguadulce #37 **4210 ± 90**

Ostrea corteziensis from Block 3, Layer C_4, 30 to 35cm beneath surface. *Comment*: 2nd date TEM-131; 6180 ± 120 from *Anadara tuberculosa.*

TEM-106. Aguadulce #40 **5840 ± 100**

Ostrea corteziensis from Block 3, Layer C_5, 35cm beneath surface to bedrock.

TEM-110. Aguadulce #38 and #41 **3540 ± 120**

Charcoal from Block 3, Layer C_4 and D, #38 from 30 to 35cm beneath surface; #41 from 35cm beneath surface to bedrock. *Comment* (AJR): date expected to be older. Sample coll from both layers as small flecks; reworking by termites could have caused contamination. TEM-108, -127, -128, -130, -131, -106 and -110 are assoc with preceramic culture.

Ladrones series

Samples from rockshelter, Cueva de los Ladrones, Cocle, Panama (8° 30′ 08″ N, 80° 29′ 27″ W). Coll 1974 by J Bird, Am Mus Nat Hist and R Cooke, Smithsonian Tropical Research Inst; subm 1978 by Bird and Cooke.

TEM-120. Ladrones CL-46 **3770 ± 80**

Ostrea from Area 2A, Layer 4, inside drip-line of rockshelter. Date expected to be late preceramic. *Comment*: 2nd date, TEM-121: 3860 ± 90 from *Ostrea*, Layer 5, contemporaneous with TEM-120.

TEM-123. Ladrones #3_c **6860 ± 90**

Charcoal from 0 to 15cm beneath surface, Area 2A, Layer 6. Sample assoc with earliest signs of occupation grading down to bedrock.

TEM-124. Ladrones #1_c **4520 ± 100**

Charcoal lying on base rock, Area 1, Layer 2B. Correlation with early ceramic/late preceramic culture.

TEM-119. Ladrones CL-4 **4800 ± 100**

Ostrea from 30 to 45cm beneath surface, Area 1, Layer 3, assoc with Monagrillo-like sherds. *Comment*: sample stratigraphically related to TEM-124.

TEM-122. Ladrones #2_c **3880 ± 80**

Charcoal from Area 0, Layers 7 and 8. Date expected to be late preceramic.

II. GEOLOGIC SAMPLES

A. United States

TEM-114. Selbyville quad shell **$27,760 {+920 \atop -860}$**

Crassostrea fragments from Selbyville quad, Sussex Co, Delaware (38° 29′ 05″ N, 75° 08′ W), cored 2.4 to 2.8m beneath surface of back barrier marsh environment. Result dates late Pleistocene coastal history in E Sussex Co. Coll and subm 1978 by J Demarest, Univ Delaware, Newark, Delaware. *Comment*: previous date on basal peat is I-7526: > 40,000 (Buckley, written commun).

TEM-115. Selbyville quad peat **33,500 +3860 −2600**

Peat sample from Selbyville quad, Sussex Co, Delaware (38° 29′ 05″ N, 75° 08′ W), cored 8.2 to 8.6m beneath surface. Result dates same geol event as TEM-114. Coll and subm 1978 by J Demarest. *Comment*: total organic carbon content dated.

TEM-116. Bethany Beach quad marsh mud **4340 ± 80**

Marsh mud from median strip on Rt 1, N of Indian R inlet, Bethany Beach quad, Sussex Co, Delaware (38° 38′ N, 75° 04′ W). Sample from core ca 6m beneath surface. Result dates presence of back barrier marsh subsequently buried under barrier island during transgression. Coll and subm 1978 by W Carey, Univ Delaware. *Comment*: total organic carbon content dated.

TEM-117. Biddleford Pool spartina **980 ± 80**

Spartina marsh grass from Biddleford Pool, Saco, Maine (43° 26′ N, 70° 21′ W), exposed in surf of transgressing sandy barrier. Date establishes rate of barrier transgression and relative sea level position. Coll and subm 1978 by J C Kraft, Univ Delaware. *Comment*: duplicate run of sample gave 1070 ± 60 BP.

References

Deevey, E S, Gralenski, L J, and Hoffren, Väinö, 1959, Yale natural radiocarbon measurements IV: Radiocarbon, v 1, p 144-172.

McGimsey, Charles, 1956, Cerro: A preceramic site in Panama: Am Antiquity,

Noakes, J E, Kim, S M, and Stipp, J J, 1965, Chemical and counting advances in liquid scintillation age dating: Internatl ^{14}C and ^{3}H dating conf, 6th, Proc, Pullman, Washington, June 7-11, 1965, p 68-92.

Polach, H A and Stipp, J J, 1967, Improved synthesis technique for methane and benzene radiocarbon dating: Internatl Jour Appl Radiation and Isotopes, v 18, p 359-364.

Ranere, A J, 1972, Early human adaptations to New World tropical forests: the view from Panama: Ph.D. dissert, Dept Anthropol, Univ California, Davis.

——— 1975, Report on the 1975 archaeological investigations at Monagrillo and the Aguadulce Shelter, Central Panama: Rept to the Patrimonio Hist del INAC, Panama. Unpub ms.

——— 1976, The Preceramic of Panama: the view from the interior: 1st Puerto Rican symposium on archael Proc, San Juan, p 103-137.

Ranere, A J and Hansell, P, 1978, Early subsistence patterns along the Pacific Coast of Central Panama: Prehistoric coastal adaptations, New York, Academic Press, Inc.

Stipp, J J, Eldridge, K L, and Cadwell, R, 1976, University of Miami radiocarbon dates VI: Radiocarbon, v 18, p 210-220.

Wiley, Gordon, 1971, An introduction to American archaeology, v 2: South America, Englewood Cliffs, New Jersey, Prentice-Hall.

Willey, Gordon and McGimsey, Charles, 1954, The Monagrillo culture of Panama: Papers Peabody Mus Archaeol and Ethnol, v 49, no. 2, Cambridge, Massachusetts, Harvard Univ.

[RADIOCARBON, VOL. 21, No. 3, 1979, P. 477-483]

UNIVERSITY OF MIAMI RADIOCARBON DATES XVI

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Radiocarbon measurements have been continued on a variety of projects and materials. Chemical and counting procedures remain the same as indicated in R, v 20, p 274-282. Dates are calculated using the Libby ^{14}C half-life of 5568 years; errors are reported as one-standard deviation (1σ) based only on statistical counting uncertainties in background, modern standard, and sample activities. All samples for which $^{13}C/^{12}C$ ratios are available are corrected for isotopic fractionation by normalizing to $-25‰$. A 400-year reservoir age correction has been applied to marine carbonates.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. United States

Cape Cod series

Peat samples from bog and salt marsh were dated to determine development of spit and rate of barrier migration in Cape Cod, Massachusetts. Coll and subm 1979 by S Leatherman, Univ Massachusetts, Amherst.

UM-1592. PL-3-26-10T **890 ± 80**

UM-1593. PL-4-3B-3 **590 ± 120**

UM-1595. PL-2-32-5 **670 ± 70**

UM-1596. PL-1-25-6 **540 ± 120**

The 4 samples above are all bog peats buried by eolian sands from Provincetown, Massachusetts (42° 05′ N, 70° 11′ W).

UM-1594. C-3-60 **810 ± 100**

Salt marsh peat from Nauset spit, Massachusetts (41° 50′ 0″ N, 69° 56′ W). Sample is from behind barrier beach and buried by overwash deposits.

Cape Romain series

Several cores from Cape Roman, South Carolina have yielded assorted shell, plant root and peat samples dated for stratigraphic reconstruction of barrier island and its correlation to sea level. Coll and subm by C Ruby Sept 1978, Univ South Carolina, Columbia.

UM-1626. CRT1-21-C **6600 ± 160**
$\delta^{13}C = -27.29‰$

Plant roots that penetrate muddy-sand with shell fragments (79° 20′ 00″ N, 33° 03′ 00″ W) indicating possible relict back barrier beach.

UM-1627. CRT3-9-D **14,400 ± 170**
$\delta^{13}C = -25.73‰$

Basal peat (probably fresh water) overlain by brackish and salt water facies (79° 21′ 00″ N, 33° 03′ 00″ W).

UM-1628. CRT1-8-H **4410 ± 110**
$\delta^{13}C = -0.47‰$

Shell storm lag overlain by bay fill muds (79° 21′ 00″ N, 33° 01′ 30″ W).

UM-1629. CRT1-15-D **10,360 ± 170**

Basal peat overlain by later brackish and salt water deposits (79° 22′ 00″ N, 33° 01′ 30″ W).

Kiawah and Seabrook Islands series

Samples of shell, wood, and peat coll from Kiawah and Seabrook Is, South Carolina. Dated for construction of stratigraphic time lines for determination of depositional history and sea level fluctuations. Coll June 1978 and subm by T Moslow, Univ South Carolina, Columbia.

UM-1539. SI-8: 4-C **4230 ± 80**

Shell material (*Crassostrea virginica*) taken at depth 11m in silty clay (salt marsh depositional environment) in Seabrook I. (32° 34′ 05″ N, 80° 11′ 01″ W).

UM-1540. KI-1: 9A **1370 ± 60**

Predominantly *Mulinia lateralis* taken from thinly laminated silty sand to silty clay assoc with nearshore marine depositional environment. Sample at base of regressive sequence at depth 8m, Kiawah I. (32° 36′ 15″ N, 80° 04′ 15″ W).

UM-1541. SI-7: 8-B **1650 ± 130**

Wood sample from Seabrook I. at depth 5m (32° 34′ 10″ N, 80° 10′ 45″ W). Found in interbedded, burrowed, silty sand and clay assoc with tidal flat or marsh depositional environment.

UM-1599. KI-2:25′ to 27′ **2710 ± 80**
$\delta^{13}C = +0.50‰$

Shell material, predominantly *Mulinia* occurring in layers of silty sand on Kiawah I. (32° 36′ 25″ N, 80° 04′ 20″ W).

UM-1600. KI-2:30′ to 31′ **4450 ± 80**
$\delta^{13}C = +0.05‰$

Predominantly *Mulinia* in silty clay matrix, basal Holocene sediments on Kiawah I. (32° 36′ 25″ N, 80° 04′ 20″ W).

UM-1601. KI-4:20′ to 22′ **3640 ± 80**
$\delta^{13}C = -0.25‰$

Primarily *Mulinia* in layers in interbedded silty sand and silty clay assoc with Holocene shoreface on Kiawah I. (32° 36′ 50″ N, 80° 04′ 05″ W).

UM-1602. KI-7:-10.5′ **7700 ± 120**
$\delta^{13}C = -29.01‰$

Wood, believed to be root or trunk portion of climax maritime forest tree (Kiawah) (32° 36′ 55″ N, 80° 05′ 18″ W).

UM-1603. SI-9:26′ to 28′ **22,770 +590 −550**
$\delta^{13}C = -16.93‰$

Peat, probably rafted and *Spartina* roots in compact marsh clay (Seabrook) (32° 34′ 55″ N, 80° 09′ 10″ W). Sample taken at base of postulated Holocene sec.

Kiawah Island series

Samples of whole and fragmental shell material predominantly *Mulinia lateralis* coll from Kiawah I., South Carolina. Dated to determine age of depositional event in back barrier of Kiawah. Coll 1978 and subm by A Duc, Univ South Carolina, Columbia.

UM-1590. KIV 11:12 **4420 ± 80**
$\delta^{13}C = -0.65‰$

Sample from near base of Holocene sec 3.5 to 3.9m depth (32° 36′ 58″ N, 80° 04′ 22″ W). Specifically from storm episode unconformably overlying marsh deposits.

UM-1591. NOI 2:16 **31,160 +660 −610**
$\delta^{13}C = +0.19‰$

Sample below ca 2m green clay interpreted as Pleistocene (32° 36′ 40″ N, 80° 07′ 15″ W). Sample depth 4.8 to 5.1m.

Baltimore Canyon series

Carbonaceous clays from continental slope were dated to establish sedimentation rate and to correlate with other cores and dates. Cores 14B (37.53° N, 73.53° W) 14E (37.25° N, 73.14° W) and 14D (37.43° N, 73.36° W) are piston cores taken on continental slope off E United States coast in vicinity of Baltimore Canyon. Coll March 1975 by G Hayward; subm by L Doyle, Univ South Florida, St Petersburg.

UM-1535. 14B-210 to 240cm **7180 ± 120**

UM-1536. 14D-45 to 65cm **25,900 +470 −440**

UM-1537. 14D-80 to 100cm **29,650 +1050 −930**

UM-1538. 14E-260 to 280cm **22,880 $^{+560}_{-520}$**

B. Bermuda

Bermuda Lagoon series

Series of cores and coral samples coll 1979 by P Garrett and E Shinn in Bermuda were dated to reconstruct reef history and measure rate of reef growth. Subm by P Garrett, Univ California, Santa Barbara.

UM-1604. 7m/1115-19 **3900 ± 70**

Diploria from South Olympic reef 2.7km due S of North Rock in Bermuda Lagoon (32° 26′ 52″ N, 64° 46′ 20″ W).

UM-1605. 7m/1247-0 **1760 ± 80**

Montastrea annularis.

UM-1606. 7m/1247-9 **3000 ± 80**

Montastrea annularis.

UM-1607. 7m/1247-32 **4930 ± 90**

Coralline sp unknown.

UM-1608. 7m/1247-40 **5070 ± 110**

Montastrea cavernosa.

General Comment: UM-1605 -1608 are from Bermuda lagoon (32° 26′ 11″ N, 64° 49′ 35″ W) 13.5 N of Dundonald Channel.

UM-1609. 4m/1013-0 **220 ± 70**

Diploria.

UM-1610. 4m/1013-8 **1930 ± 70**

Diploria labyrinthiformis.

UM-1611. 4m/1013-16 **2820 ± 110**

Montastrea cavernora.

UM-1612. 4m/1013-20 **3790 ± 80**

Diploria strigosa.

UM-1613. 4m/1013-30 **3640 ± 90**

Diploria strigosa.

General Comment: UM-1609 -1613 are 2km N of Blue Cut (32° 24′ 30″ N, 64° 52′ 40″ W) on NW Bermuda Ledge Flats.

UM-1614. 4m/1805-1 **4530 ± 90**

Several sp of shells.

UM-1615. 4m/1805-15 **2590 ± 90**

Chama macrophyllo.

General Comment: UM-1614 and UM-1615 are 1km NW of Bailey's Bay on Tepping Shoal (32° 21′ 20″ N, 64° 43′ 50″ W) Bermuda.

UM-1616. DSE-5 **3060 ± 70**

Diploria Labyrintheformis.

UM-1617. DSE-24 **4130 ± 80**

Diploria Labyrintheformis.

UM-1618. DSE-52 **32,360 +1050 −930**

Montastrea cavernosa.

General Comment: UM-1616 -1618 are W of Daniels I. (32° 18′ 25″ N, 64° 53′ 12″ W).

C. South America

Argentina Coastal series

Assorted shell samples from coastal area of Punta Medana. Shells dated to reconstruct stratigraphy. Coll by S Parker Oct 1977; subm by S Parker, Servicia Hidrografia Naval, Buenos Aires, Argentina and D Swift NOAA, Miami, Florida.

UM-1620. Nr1 **24,900 +530 −500**

$\delta^{13}C = +1.53‰$

Below ancient barrier sand and lagoonal mud (on shore) (36° 50′ 45″ S, 56° 44′ 49″ W).

UM-1621. Nr2 **5200 ± 130**

$\delta^{13}C = +1.37‰$

Green clay below barrier (offshore) (36° 45′ 43″ S, 56° 37′ 13″ W).

UM-1622. Nr3 **10,390 ± 180**

$\delta^{13}C = +1.92‰$

Crest of sand ridge (36° 50′ 48″ S, 56° 33′ 36″ W).

UM-1623. 3 bis **11,610 ± 140**

$\delta^{13}C = +1.83‰$

Crest of sand ridge (36° 50′ 48″ S, 56° 33′ 36″ W).

D. India

Western Indian Ocean series

Carbonate ooze coll in piston cores from Western Indian Ocean at (9° 28.4′ S, 52° 09.9 ′ E) and (9° 33.2′ S and 52° 31.5′ E) were dated to reconstruct submarine stratigraphy. Coll 1976 and subm 1978 by D Johnson, Woods Hole Oceanog Inst, Woods Hole, Massachusetts.

UM-1546. AII93 11PC 44 to 50 **$34,470^{+1100}_{-970}$**

UM-1547. AII93 FPC 37 to 43 **21,110 ± 240**

UM-1548. AII93 11PC 72 to 78 **$39,080^{+1800}_{-1520}$**

Geomorphology of India series

Two shell samples, UM-1533 from SE India (8° 10′ N, 77° 38′ E) and UM-1534 from NW Sri Lanka (8° 15° N, 79° 50′ E) were dated to develop geomorphology and Quaternary history of area. Coll by P Deraniyagala and R Gardner; subm by R Gardner, Oxford Univ.

UM-1533. HSE/112 **26,990 ± 50**
$\delta^{13}C = -8.37‰$

UM-1534. SL/1 **2820 ± 80**
$\delta^{13}C = -2.06‰$

II. ARCHEOLOGIC SAMPLES

A. United States

Oleta River series

Shell and charcoal from Oleta R archaeol site (8 Da 1024) North Miami Beach, Dade Co, Florida (25° 50′ 42″ N, 80° 08′ 24″ W) was dated to determine period of occupation of site as well as sea-level change. Coll 1978 and subm by R Carr, Dade Co Hist Survey.

UM-1550. Shell FS-82 **2110 ± 70**
$\delta^{13}C = -2.51‰$

UM-1551. Charcoal FS-82 **2100 ± 70**
$\delta^{13}C = -25.06‰$

General Comment (DSI): UM-1550 and -1551 are 2 different materials dating same event and average as 2100 ± 50 using lab statistics.

UM-1549. Arch Creek FS-47 **1020 ± 60**

Marine shell recovered from Arch Creek site, prehistoric midden in Dade Co, Florida (25° 08′ 17″ N, 80° 10′ 55″ W) was dated to determine settlement pattern chronology in Dade Co. Coll and subm by R Carr, Dade Co Hist Survey, Miami, Florida.

UM-1624. 8-Ma-64 F.S. #50 **4090 ± 75**
$\delta^{13}C = -25.79‰$

Charcoal sample for dating mound construction from gray sand layer in aboriginal sand mound (27° 13′ 45″ N, 82° 08′ 31″ W). Mound located in low pine palmetto flatlands in central Florida. Coll Dec 1978 and subm by R Willis, Florida State Mus, Gainesville.

UM-1625. A-8376 **1630 ± 60**

$\delta^{13}C = -24.65‰$

Fragment of aboriginal dugout canoe (pine) from exposed mucky shore of sand bottom lake in central Florida (29° 40′ 0″ N, 81° 55′ 30″ W). Dating for correlation of canoe styles with culture periods. This canoe resembles UM-1450 (R, 1979, v 21, p 297). Coll and subm 1978 by R Willis, Florida State Mus, Gainesville.

References

Calvert, M, Rudolph, Kim, and Stipp, J J, 1978, University of Miami radiocarbon dates XII: Radiocarbon, v 20, p 274-282.

Introne, D S and Stipp, J J, University of Miami radiocarbon dates XV: Radiocarbon, v 21, p 291-297.

[RADIOCARBON, VOL. 21, NO. 3, 1979, P. 484-494]

LABORATORIES

* Inactive Laboratories have been removed from this list. They are available, separately, upon request from the Managing Editor.

[1] The ^{3}H—Laboratorium of this institute (directed by Klaus Fröhlich) should be addressed separately.

[1a] Lists from this laboratory have not been submitted to RADIOCARBON. See Gdansk I, Acta Physica Polonica, vol 22, p 189, 1962 Gdansk II, *ibid,* vol 32, p 39, 1967.

[2] This designation Gif supersedes both Sa (Saclay) and Gsy (Gif-sur-Yvette). The only Gsy date list to be published is Gsy I (Coursaget and Le Run, RADIOCARBON, v 8).

[3] From January 1, 1961 the Gro numbers have been replaced by GrN numbers. "New" dates are referred to the NBS oxalic-acid standard.

[4] Early dates from this laboratory were given a code designation that represents the name of the sponsoring institution, e g, I (AGS) for American Geographical Society (Heusser, RADIOCARBON SUPPLEMENT, v 1).

[5] Formerly Hazelton Nuclear: code designation HNS has been dropped.

[6] Some dates from this laboratory were published with the code designations S (Pringle *et al*, 1957, Science, v 125, p 69-70).

[7] See SM.

[8] See Gif.

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