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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 20, no. 3 must be submitted in *duplicate* before May 1, 1978, for vol 21, no. 1 before September 1, 1978.

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 physico-chemical (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 8th International Conference on Radiocarbon Dating, Wellington, New Zealand, 1972. 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 indorsed 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 numbers: Winter, Spring, and Summer. The next deadline is May 1, 1978. Contributors who meet our deadlines will be given priority but not guaranteed publication 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.

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. An increasing number of ^{14}C dates, however, appear in more general articles and are never published in a datelist. Inclusion in Radiocarbon of some of the articles containing scientific knowledge derived from ^{14}C data should broaden the scope of the journal and increase its readership. The editors of Radiocarbon are now considering such articles for publication. The content of these articles can be either general or technical. For instance, the type of article considered suitable for inclusion in th Journal would contain subject matter normally presented at International Radiocarbon meetings.

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

The Editors

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LA JOLLA MEASUREMENTS OF RADIOCARBON IN TREE-RING DATED WOOD

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In 1969, at the Nobel Symposium on "Radiocarbon Variations and Absolute Chronology" in Uppsala, a curve was presented that illustrated the functional dependence of measured conventional radiocarbon dates on true historical ages of wood samples (Suess, 1971). The curve was derived from the results of La Jolla measurements of radiocarbon in bristlecone pine wood dendrochronologically dated by and obtained from Professor C W Ferguson of the University of Arizona (Ferguson, 1968). The curve was intended to be adequate for deriving calibrated radiocarbon dates and also for allowing fairly reliable estimates of the accuracy of the absolute dates obtained in this manner. The basis for the validity of this calibration is the well known fact that, for all practical purposes, wood samples that had grown at the same time show the same radiocarbon content. However, the reverse is not always true: Wood samples showing the same radiocarbon content do not necessarily have the same age because of the windings and steps of the curve (Stuiver and Suess, 1966).

An accurate knowledge of the secular variations of radiocarbon is desirable not only for calibration purposes but also for understanding the geophysical and geochemical factors that cause these variations. The curve published in 1971 illustrated appropriately the character of the variations but was not sufficiently complete to show quantitatively the fine structure features and details that were undoubtedly present. Measurements by other laboratories confirmed the general trend of the curve but have not contributed to our knowledge of the more rapid fluctuations on a time scale of some 100 ys, the so-called "wiggles" of the calibration curve.

Since 1969 our measurements on tree-ring dated wood have been carried out primarily for the purpose of obtaining more detailed information on secular radiocarbon variations. For many years the number of measurements that could be carried out was limited by the number of samples that Profesor Ferguson made available. Unfortunately, these samples often did not come from a time range that appeared particularly interesting. Since 1972, however, long "floating" tree-ring sequences from logs of oak trees in riverbeds of central Europe have been compiled by Becker (1978). Results of measurements from these sequences and their comparisons with bristlecone pine results were presented at the Conference on Dendrochronology at Mainz in 1974 (Suess and Becker, 1977). It was shown that the "δ ^{14}C wiggles" were synchronous in the wood of European oak and of California bristlecone pine and that they had the same amplitudes within limits of errors of the measurements. About 200 numerical values of δ ^{14}C were published at that time. Samples from these oak trees, obtained from Becker, have also made it possible to carry out a sufficient number of measurements for the 4th millenium BC, so that a consistent picture of the variations during this time interval could be established. A graphic presentation of these results was published at the Ninth International Radiocarbon Conference in 1976 (Suess, 1978); their numerical values are included in the tables below. Some values deviate slightly from those given previously because of minor adjustments in counter calibrations.

It was intended to postpone publication of the individual numerical values of these and of the additional results until a statistical analysis of the data, as well as "computer-matching" of floating data with dendrochronologically derived absolute data, and also Fourier analyses could be carried out. Unfortunately, National Science Foundation funding for this purpose was denied, and it now appears that it will take another year or two before the reduction and interpretation of the experimentally obtained raw data will be completed. Therefore, following the requests of many colleagues, the conventional "Libby" ages obtained for wood samples, dendrochronologically dated or belonging to "floating" tree-ring series, are now listed here, in sequence of their ages. The results of the analyses of the data, and their discussion, in particular with respect to their geophysical significance, will be published later.

The results listed in the following tables are published here primarily to help to derive calibrated radiocarbon dates and to estimate their accuracy. At the time the Uppsala curve was published, it was not known that the two Öeschger-Houtermans counters (denoted here B and M respectively) used (Linick, 1976) showed a memory, even after three or four hours of pumping. The errors caused by this memory, in general, did not exceed expected statistical counting errors of the individual measurements but could be recognized by combining a number of results. Many standard and background measurements appeared affected by the ^{14}C-content of the preceding samples, so that all the results on which the curve was based had to be recalculated with revised values. Also, results that were obtained in the run immediately following the counting of a gas with considerably different radiocarbon content, such as a background or standard gas, were routinely omitted. These revised values deviate significantly only for limited time periods from those from which the Uppsala curve was derived. For optimally accurate conversion of conventional radiocarbon dates it is best simply to compare the numerical value of the conventional radiocarbon date of a given sample with those listed in appendix 1.

Column 1 of appendixes 1 and 2: Measurements were carried out approximately in sequence of their LJ-number. Before 1965 they were assigned LJ-numbers smaller than LJ-1150. These results were numerically published before (Suess, 1965) and are not included here.

Except for the results that were excluded for the reasons given above, all data obtained in La Jolla before Sept 1977 for radiocarbon in tree-rings are listed in the two appendices. No further attempts were made to screen the results, although, as can easily be seen, some of them are undoubtedly in error. For example, for several measurements the results from the two sets of counting equipment (B and M) differ by considerably more than the expected statistical variation, indicating that one of the two sets was out of order. It will certainly be possible to find and exclude questionable results on the basis of well defined criteria after an analysis of the raw data is made. For further remarks on errors see below.

Until 1969 the La Jolla Radiocarbon Laboratory was located in the basement of Ritter Hall, Scripps Institute of Oceanography. Measurements carried out there have LJ-numbers smaller than LJ 1930. In 1970 the laboratory moved to a new building on Mt Soledad, interrupting operations for about 6 months. During the following 2 years determinations were primarily carried out of radiocarbon in wood less than 100 ys old (Cain and Suess, 1976). These results were not included. In 1972, B Becker of the University of Stuttgart-Hohenheim made available the first samples from his floating European oak chronology. The LJ-numbers of the measurements listed in the two tables correspond approximately to the following years of operations:

1965 to 1969:	LJ 1150 - LP 1930
1970 to 1973:	LJ 2150 - LP 2890
1974:	LJ 2900 - LJ-3175
1975:	LJ 3180 - LJ 3465
1976:	LJ 3465 - LJ 3800
to 8-31-1977:	> LJ 3800

Column 2 of appendix 1: TRL numbers denote bristlecone pine samples and identify the respective tree from which the sample came (Ferguson, 1968). For dendrochronologically dated European samples (available back to 800 BC, the time for which an absolute tree ring chronology was established in Europe) the name of the submitter is listed (for provenience of these samples see Becker (1978) and Holstein [to be published]).

In appendix 2 the name of the floating tree-ring series and the name of the submitter (unless submitted by Becker) is listed in this column.

Column 3: Appendix 1 gives the midpoints of the years of growth of the sequence of rings used for the measurements. Negative numbers denote BC dates, except that, as Ferguson is anxious to point out, these numbers differ from the historical BC dates by 1 year because historians do not use a year zero in their time scale, whereas dendrochronologists and geophysicists do. In appendix 2 this column gives the midpoints of the respective ring numbers of the rings used for the measurements.

Column 4: The number of rings used for each measurement is listed here. With a few exceptions Ferguson makes available samples of ten rings of bristlecone pine wood. From European oak trees, samples consisting of one single ring can frequently be obtained.

Column 5 gives the measured $\delta\ ^{13}C$ as conventionally defined. These values however are not necessarily those for the $\delta\ ^{13}C$ in the original wood sample but rather for the gas used for counting. Until approximately 1967, this counting gas, acetylene, was prepared via strontium carbide. It can be seen from the $\delta\ ^{13}C$ values that this method leads to a much greater isotope fractionation than the method using lithium carbide which is now employed. Values in parentheses are estimates used for the calculations of the ages. Until 1970 the $\delta\ ^{13}C$ measurements were made in the laboratories of Harmon Craig and Samuel Epstein. Since then the old Chicago mass spectrometer of the laboratory of H C Urey, now in the hands of K Marti, is being used.

Column 6 lists the results expressed in conventional (Libby) radiocarbon years. With a few exceptions they were obtained by counting in succession for about 40 hrs in each of two Öeschger Houtermans counters. The characteristics of the two counters were published previously (Linick, 1977). Approximately 20 grams of wood was available for each measurement. The wood was treated with acetone, azide, and base as described previously (Cain and Suess, 1976; Linick, 1977).

Column 7 lists the statistical one sigma standard counting errors of the results. These errors include the statistical uncertainty of backgrounds and standards but not the uncertainties in the ^{14}C-contents of the used standards. Until about 1973 late 19th century wood specimens were used as standards. Comparison measurements with the NBS oxalic acid standard were made only occasionally. It appears now, that the ^{14}C content in these wood samples may have varied by some 30 per mil, but no accurate figure can be given as such variations are well within the accuracy of the comparison measurements with the NBS oxalic acid, and additional wood to repeat these measurements is no longer available. During the more recent years both wood as well as NBS oxalic acid were used as standards. The conventional radiocarbon ages of these samples were obtained relative to a radiocarbon content of 0.944 ± 0.002 times that of the NBS oxalic acid. No attempts were made to correct for the differences in the used standards, although minor corrections by "computer matching" of data sequences obtained earlier with those obtained with optimally defined standards may be possible and will be attempted.

For several reasons a decrease in the listed statistical errors by increasing counting times and/or counter volumns is of no advantage and uneconomical. With the exception of some rare cases of malfunctioning of electronics, the main additional errors appear to be due to carbon impurities in the samples. In order to avoid these completely, the cellulose would have to be separated and purified, but neither sufficient wood quantities nor necessary manpower is available to carry out such laborious additional work.

Column 8 lists the difference in years of the results obtained for each sample from the two sets of counting equipment M and B. For some samples only one valid measurement was obtained, and in these cases the symbol for the set in which the result was obtained is shown instead of the difference.

As can be seen from the tables, the number of measurements for a given time interval varies greatly over the total period for which measurements have been carried out which is from 1300 AD to around 6000 BC. This is in part a consequence of the limited availability of samples and in part due to the fact that some periods of time appeared particularly interesting. Nevertheless, from the samples so far measured it can be seen already that the carbon-14 in the atmosphere did not fluctuate randomly but followed certain patterns so that one might be tempted to believe in the existence of cycles or at least in the significance of certain "magic numbers" of years. It can be expected that further measurements, which will be carried out during the next year or two, will complete the picture for the whole period of time for which tree-ring dated wood is available and will then make it possible to decide whether or not the observed patterns have a true physical meaning. It will then be time to look for correlations with other geophysical and geochemical parameters and to speculate about the explanations and interpretations of the findings.

ACKNOWLEDGMENTS

The results reported here represent only a fraction of the total number of measurements that are being carried out by the laboratory. Thanks to the unusual enthusiasm, efficiency, and dedication of the staff, in particular of Ms Carol Hutto and Dr Timothy Linick, the laboratory has for more than 6 years operated practically uninterruptedly on a 24 hour a day, 7 day a week basis. Besides taking care of all the technical operations for the radiocarbon determinations, Dr Linick is carrying out computerized data reductions and, together with Ms Hutto, mass spectrometric carbon-13 determinations. In this connection thanks are due also to Drs K Marti and G Lugmair for assistance and advice in the mass spectrometer operations.

As always it should be emphasized that this work is based entirely on the tree-ring sequence established for the past 8000 yrs by C W Ferguson. The dendrochronologically dated wood samples came from Dr. Ferguson with the exception of some samples from the European chronology that extends back to 800 BC. Almost all the samples from the floating chronologies were obtained from B Becker of the University of Stuttgart-Hohenheim. Dr E Hollstein, Landesmuseum Trier, supplied samples from the fifth and sixth century BC.

Operation of the La Jolla Radiocarbon Laboratory is financed by the National Science Foundation, Division of Earth Sciences, Geochemistry Program through Grant EAR76-22623, and predecessor grants.

APPENDIX 1

Conventional radiocarbon ages of dendrochronologically-dated wood (TRL samples supplied by C W Ferguson; Holstein samples by E Holstein, Trier, W Germany, to be pub; all others by B Becker, 1978.)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-3314	TRL 70-46	−6045	10	−21.3	7095	51	73
LJ-3306	TRL 70-46	−6025	10	−20.4	7116	51	−220
LJ-3312	TRL 70-46	−6015	10	−20.1	7149	51	78
LJ-2874	TRL 70-46	−6015	10	−20.9	7027	57	154
LJ-2875	TRL 70-46	−5995	10	−21.5	7119	57	87
LJ-3311	TRL 70-46	−5995	10	−21.1	7187	52	79
LJ-3310	TRL 70-46	−5985	10	−20.7	7117	51	125
LJ-3313	TRL 70-46	−5975	10	−20.0	7046	50	−25
LJ-2877	TRL 70-46	−5975	10	−21.3	7087	57	69
LJ-3308	TRL 70-46	−5965	10	−21.1	6949	51	−247
LJ-2196	TRL 70-20	−5402	10	−21.1	6352	60	−17
LJ-2206	TRL 70-20	−5362	10	−21.6	6248	58	−6
LJ-1921	TRL 67-35	−5290	14	−21.9	6111	87	−68
LJ-2207	TRL 70-20	−5282	10	−21.4	6117	59	9
LJ-2198	TRL 70-20	−5263	10	−21.5	6311	59	−67
LJ-2204	TRL 70-20	−5243	10	−21.2	6143	60	−39
LJ-2194	TRL 70-20	−5223	10	−21.2	6224	62	28
LJ-2197	TRL 70-20	−5203	10	−21.2	6126	60	38
LJ-2435	TRL 70-20	−5182	10	−21.8	6163	55	132
LJ-2439	TRL 70-20	−5162	10	−22.2	6188	55	−56
LJ-2395	TRL 70-20	−5143	10	−20.4	6049	61	60
LJ-1538	TRL 63-92E	−5083	54	(−22.0)	6082	68	20
LJ-1492	TRL 63-92E	−5075	10	−21.8	6139	63	29
LJ-1713	TRL 63-92E	−5055	10	−21.9	6031	75	B
LJ-1712	TRL 63-92E	−5035	10	−21.4	6151	96	M
LJ-1734	TRL 63-92E	−4965	10	(−22.0)	6009	59	−85
LJ-1732	TRL 63-92E	−4945	10	(−22.0)	5958	58	−73
LJ-1739	TRL 63-92E	−4895	10	−22.5	5921	58	14
LJ-1740	TRL 63-92E	−4875	10	−22.0	5916	58	12
LJ-1539	TRL 63-92E	−4795	10	−21.4	5969	66	5
LJ-2164	TRL 63-92E	−4753	16	−22.2	5784	57	−5
LJ-2179	TRL 63-92E	−4735	10	−22.0	5738	73	B
LJ-2167	TRL 63-92E	−4695	10	−21.2	5625	57	−14
LJ-2177	TRL 63-92E	−4675	10	−22.8	5782	58	143
LJ-2160	TRL 63-92E	−4655	10	−22.3	5703	95	M
LJ-2170	TRL 63-92E	−4635	10	(−21.0)	5795	58	107
LJ-2165	TRL 63-92E	−4615	10	−21.6	5684	56	18
LJ-2173	TRL 63-92E	−4575	10	−21.9	5802	59	31
LJ-1543	TRL 63-92	−4373	34	−22.8	5433	84	B
LJ-1503	TRL 63-92	−4325	10	−22.3	5334	59	9
LJ-1506	TRL 63-92	−4305	10	−21.8	5387	60	−13
LJ-1505	TRL 63-92	−4265	10	−21.8	5404	104	M
LJ-3548	TRL 71-52	−4235	10	−19.4	5390	48	−9
LJ-1504	TRL 63-92	−4225	10	−21.8	5241	103	M
LJ-3547	TRL 71-52	−4215	10	−20.3	5334	47	−46
LJ-1553	TRL 63-92	−4205	10	−22.8	5174	64	102
LJ-3546	TRL 71-52	−4205	10	−21.0	5305	47	−93
LJ-3554	TRL 71-52	−4185	10	−21.4	5327	52	80
LJ-1542	TRL 63-92	−4179	22	−23.1	5269	61	67
LJ-3553	TRL 71-52	−4175	10	−20.4	5327	47	−22
LJ-3552	TRL 71-52	−4155	10	−20.6	5286	53	26
LJ-3555	TRL 71-52	−4135	10	−21.0	5308	47	71
LJ-2632	TRL 71-52	−4125	10	−20.6	5150	54	−147
LJ-3556	TRL 71-52	−4115	10	−20.6	5370	47	−39
LJ-2633	TRL 71-52	−4105	10	−20.9	5167	53	−37
LJ-1302	TRL 65-F131	−4077	52	−28.7	5209	59	−100

Appendix 1 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-2757	TRL 71-52	−4065	10	−21.3	5272	51	−177
LJ-1307	TRL 65-F131	−4035	35	−27.3	5186	81	M
LJ-2818	TRL 71-52	−4025	10	−21.1	5203	50	73
LJ-2820	TRL 71-52	−4005	10	−21.5	5300	51	49
LJ-1305	TRL 65-F131	−4005	26	−25.6	5204	59	8
LJ-2817	TRL 71-52	−3985	10	−20.4	5264	50	−147
LJ-2821	TRL 71-52	−3965	10	−21.0	5171	50	54
LJ-2819	TRL 71-52	−3945	10	−20.4	5210	50	−60
LJ-1306	TRL 65-F131	−3938	26	−24.6	5203	82	M
LJ-2825	TRL 71-52	−3905	10	−21.3	5101	49	25
LJ-2826	TRL 71-52	−3885	10	−20.9	4979	49	57
LJ-2828	TRL 71-52	−3865	10	−21.2	5024	49	−71
LJ-2830	TRL 71-52	−3845	10	−20.8	5117	49	−140
LJ-1304	TRL 65-F131	−3822	17	−23.7	5057	59	−19
LJ-2832	TRL 71-52	−3805	10	−20.3	5031	49	31
LJ-1299	TRL 63-34	−3790	20	−26.3	4945	58	−23
LJ-3504	TRL 71-52	−3785	10	−20.7	4865	46	−40
LJ-1301	TRL 63-34	−3772	24	−30.1	5027	56	−113
LJ-3505	TRL 71-52	−3765	10	−19.4	5001	46	−239
LJ-3526	TRL 71-52	−3745	10	−20.8	4842	46	49
LJ-3529	TRL 71-52	−3725	10	−20.0	4951	46	3
LJ-3512	TRL 71-52	−3705	10	−20.2	4983	45	−129
LJ-1300	TRL 63-34	−3700	20	−25.5	4927	58	8
LJ-3520	TRL 71-52	−3685	10	−20.3	4874	46	−17
LJ-3521	TRL 71-52	−3665	10	−20.0	4893	45	67
LJ-3513	TRL 71-52	−3645	10	−20.1	4893	46	1
LJ-1298	TRL 63-34	−3635	10	−22.9	4840	56	124
LJ-1340	TRL 63-34	−3625	10	−35.1	4717	55	−75
LJ-3510	TRL 71-52	−3625	10	−20.3	4767	45	41
LJ-1341	TRL 63-34	−3605	10	−26.3	4759	57	62
LJ-3511	TRL 71-52	−3605	10	−20.3	4758	45	−97
LJ-3522	TRL 71-52	−3585	10	−20.6	4779	45	−142
LJ-3523	TRL 71-52	−3565	10	−20.6	4748	45	−10
LJ-3525	TRL 71-52	−3545	10	−20.6	4918	46	26
LJ-3528	TRL 71-52	−3525	10	−21.1	4732	45	−53
LJ-3524	TRL 71-52	−3505	10	−20.6	4752	45	−92
LJ-1286	TRL 63-89	−3495	10	−23.9	4710	58	33
LJ-3527	TRL 71-52	−3485	10	−20.8	4673	46	−93
LJ-1705	TRL 63-89	−3485	10	−22.1	4632	53	23
LJ-1288	TRL 63-89	−3465	10	−26.8	4628	57	22
LJ-1294	TRL 63-89	−3455	10	−24.9	4626	55	1
LJ-1342	TRL 63-89	−3445	10	−22.9	4660	56	45
LJ-1290	TRL 63-89	−3435	10	−23.4	4636	55	−12
LJ-1322	TRL 63-89	−3415	10	−24.0	4715	55	3
LJ-1289	TRL 63-89	−3405	10	−23.8	4637	55	−102
LJ-3929	TRL 71-52	−3355	10	−21.2	4560	46	52
LJ-3934	TRL 71-52	−3335	10	−21.0	4469	46	−92
LJ-1585	TRL 63-34	−3325	10	−21.9	4448	65	99
LJ-3937	TRL 71-52	−3315	10	−20.6	4434	45	−13
LJ-3932	TRL 71-52	−3301	10	−21.2	4485	46	115
LJ-1287	TRL 63-89	−3290	20	−30.4	4440	56	−53
LJ-1529	TRL 63-34	−3275	10	−22.6	4392	59	−6
LJ-1526	TRL 63-34	−3255	10	−21.8	4332	60	−9
LJ-1276	TRL 63-89	−3220	20	−23.8	4444	57	−12
LJ-1524	TRL 63-34	−3175	10	−22.2	4434	56	60
LJ-1489	TRL 63-34	−3125	10	−23.3	4365	56	0
LJ-1487	TRL 63-34	−3115	30	−21.6	4399	58	34
LJ-1275	TRL 63-89	−3105	10	−30.7	4371	77	M
LJ-1497	TRL 63-89	−3065	10	−23.2	4375	56	84
LJ-1512	TRL 63-89	−3045	10	−22.5	4436	56	−59

Appendix 1 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-1494	TRL 63-89	–3025	10	–23.7	4419	56	153
LJ-1704	TRL 63-34	–3005	10	–20.9	4363	47	20
LJ-1268	TRL 63-89	–2995	10	–22.7	4337	57	–32
LJ-1496	TRL 63-89	–2985	10	–22.7	4315	55	–21
LJ-1662	TRL 63-89	–2965	10	–22.2	4330	50	3
LJ-1498	TRL 63-89	–2945	10	–22.7	4323	55	115
LJ-1663	TRL 63-89	–2925	10	–22.0	4220	50	95
LJ-1495	TRL 63-89	–2905	10	–23.1	4217	55	–75
LJ-1267	TRL 63-89	–2875	10	–23.2	4184	78	M
LJ-1511	TRL 63-89	–2825	10	–22.0	3977	54	–18
LJ-1510	TRL 63-89	–2805	10	–21.6	4125	54	–30
LJ-1692	TRL 63-89	–2785	10	–23.2	4113	51	43
LJ-1270	TRL 63-89	–2780	20	–26.0	4093	56	19
LJ-1584	TRL 63-89	–2745	10	–22.5	4088	63	–30
LJ-1519	TRL 63-89	–2718	25	–22.1	4057	73	B
LJ-1269	TRL 63-89	–2680	20	–22.3	4087	59	12
LJ-1313	TRL 63-89	–2645	10	–23.4	4021	53	–53
LJ-1319	TRL 63-89	–2613	35	–32.6	4137	76	M
LJ-1316	TRL 63-89	–2585	10	–23.6	4103	54	–109
LJ-1320	TRL 63-89	–2565	10	–27.5	4050	53	–58
LJ-1321	TRL 63-89	–2545	10	–25.8	3978	53	67
LJ-1327	TRL 63-89	–2485	10	–22.7	4019	76	M
LJ-1326	TRL 63-89	–2465	10	–27.6	3949	75	M
LJ-1333	TRL 63-89	–2445	10	–36.2	3851	52	–76
LJ-1325	TRL 63-89	–2425	10	–23.1	4007	76	M
LJ-1328	TRL 63-89	–2405	10	–24.0	3926	55	–33
LJ-1185	TRL 63-53	–2362	7	–22.0	3856	96	B
LJ-1187	TRL 63-53	–2345	7	–21.8	3734	58	97
LJ-3852	TRL 63-53	–2324	4	(–24.9)	3666	84	M
LJ-3831	TRL 63-53	–2315	6	–19.4	3745	46	33
LJ-1198	TRL 63-53	–2308	5	–23.3	3770	55	–25
LJ-3836	TRL 63-53	–2308	4	–20.0	3819	45	62
LJ-1197	TRL 63-43	–2302	28	–25.4	3837	75	M
LJ-3834	TRL 63-53	–2300	4	–19.9	3751	54	159
LJ-1193	TRL 63-53	–2298	5	–22.2	3727	54	44
LJ-3835	TRL 63-53	–2284	4	–20.0	3756	45	62
LJ-1194	TRL 63-43	–2282	23	–23.7	3769	54	18
LJ-1186	TRL 63-53	–2282	5	–22.0	3749	59	–161
LJ-2951	TRL 63-53	–2279	3	–20.6	3710	41	–119
LJ-3240	TRL 63-53	–2275	4	–20.1	3755	42	3
LJ-2415	TRL 63-53	–2272	16	–19.7	3683	47	–8
LJ-3238	TRL 63-53	–2268	5	–20.5	3754	33	17
LJ-3832	TRL 63-53	–2268	4	–19.7	3759	46	–90
LJ-3236	TRL 63-53	–2252	5	–20.0	3679	42	56
LJ-3242	TRL 63-53	–2248	5	–20.3	3779	42	–114
LJ-1204	TRL 63-53	–2246	8	–22.4	3823	75	M
LJ-3023	TRL 63-53	–2245	10	–20.3	3774	42	31
LJ-3830	TRL 63-53	–2244	4	–20.0	3666	47	–10
LJ-3235	TRL 63-53	–2238	5	–19.4	3803	42	203
LJ-3827	TRL 63-53	–2236	4	–20.2	3795	45	28
LJ-3237	TRL 63-53	–2222	5	–20.4	3708	42	–70
LJ-3851	TRL 63-53	–2220	4	–19.8	3703	59	B
LJ-2950	TRL 63-53	–2214	3	–21.5	3719	41	75
LJ-3829	TRL 63-53	–2213	6	–19.9	3751	46	57
LJ-2924	TRL 63-53	–2210	4	–21.2	3726	42	–129
LJ-2952	TRL 63-53	–2207	3	–21.2	3665	41	119
LJ-2923	TRL 63-53	–2204	3	–20.7	3729	41	–25
LJ-3239	TRL 63-53	–2202	5	–20.4	3736	41	119
LJ-2947	TRL 63-53	–2201	3	–21.8	3691	40	–46
LJ-3833	TRL 63-53	–2197	4	–20.2	3713	45	–88

APPENDIX 1 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-3241	TRL 63-53	−2190	5	−20.5	3650	42	14
LJ-3828	TRL 63-53	−2188	4	−19.1	3660	42	0
LJ-1180	TRL 63-53	−2186	20	−23.2	3892	83	B
LJ-3022	TRL 63-53	−2178	10	−20.2	3663	43	−61
LJ-3021	TRL 63-53	−2117	5	−20.5	3717	43	−30
LJ-1199	TRL 63-53	−2105	10	−24.0	3629	54	−34
LJ-1181	TRL 63-53	−2074	8	−21.9	3670	59	24
LJ-1188	TRL 63-53	−2044	18	−23.9	3566	75	M
LJ-1183	TRL 63-53	−2025	10	−23.1	3583	59	−122
LJ-1483	TRL 63-89	−2005	10	−22.0	3635	55	−34
LJ-1694	TRL 63-89	−1945	10	−20.9	3574	49	6
LJ-1475	TRL 63-89	−1925	10	−22.3	3482	53	−15
LJ-1589	TRL 63-89	−1905	10	(−22.0)	3643	78	M
LJ-1476	TRL 63-89	−1885	10	−22.6	3515	53	−3
LJ-1592	TRL 63-89	−1865	10	−21.5	3501	77	M
LJ-1472	TRL 63-89	−1845	10	−22.1	3558	67	B
LJ-1596	TRL 63-89	−1825	10	−21.4	3490	77	M
LJ-1473	TRL 63-89	−1805	10	−22.3	3469	53	−6
LJ-1467	TRL 63-89	−1785	10	−22.4	3524	57	3
LJ-1853	TRL 63-89	−1775	10	−21.3	3483	63	−30
LJ-1850	TRL 63-89	−1755	10	−21.5	3475	63	17
LJ-1468	TRL 63-89	−1745	10	−22.1	3366	74	B
LJ-1852	TRL 63-89	−1735	10	−21.4	3387	62	−165
LJ-1474	TRL 63-89	−1725	10	−22.1	3427	53	10
LJ-1851	TRL 63-89	−1715	10	−21.4	3421	62	−10
LJ-1469	TRL 63-89	−1705	10	−21.7	3420	75	B
LJ-1857	TRL 63-89	−1695	10	−21.0	3429	62	27
LJ-1583	TRL 63-89	−1665	10	−21.1	3246	59	−21
LJ-1839	TRL 63-89	−1655	10	−21.8	3320	62	101
LJ-1465	TRL 63-89	−1645	10	−21.5	3321	57	26
LJ-1537	TRL 63-89	−1625	10	−21.8	3325	55	−29
LJ-1845	TRL 63-89	−1615	10	−22.6	3246	61	58
LJ-1847	TRL 63-89	−1595	10	−21.2	3266	62	−88
LJ-1693	TRL 63-89	−1585	10	−21.0	3179	48	−71
LJ-1258	TRL 63-43	−1580	20	−27.3	3236	78	B
LJ-1840	TRL 63-89	−1575	10	−21.7	3252	61	12
LJ-1531	TRL 63-89	−1555	30	−22.4	3152	69	B
LJ-1846	TRL 63-89	−1555	10	−21.6	3189	61	33
LJ-1466	TRL 63-89	−1545	10	−21.1	3275	57	35
LJ-1838	TRL 63-89	−1515	10	−21.7	3160	61	88
LJ-1828	TRL 63-89	−1505	10	−22.0	3212	61	−23
LJ-1525	TRL 63-89	−1505	10	−21.5	3149	55	76
LJ-1253	TRL 63-430	−1500	20	(−23.0)	3147	78	B
LJ-1833	TRL 63-89	−1495	10	−21.5	3100	61	5
LJ-1482	TRL 63-89	−1485	10	−21.9	3142	52	−4
LJ-1530	TRL 63-89	−1479	17	−22.6	3190	52	−42
LJ-1837	TRL 63-89	−1475	10	−21.2	3102	61	122
LJ-1834	TRL 63-89	−1455	10	−21.5	3211	61	−63
LJ-1481	TRL 63-89	−1445	10	−22.0	3154	52	150
LJ-1259	TRL 63-43	−1412	15	−22.8	3167	53	−27
LJ-1703	TRL 63-89	−1405	10	−20.8	3011	62	B
LJ-1903	TRL 63-43	−1395	10	−21.8	3061	79	M
LJ-1885	TRL 63-43	−1385	10	−22.6	3003	91	B
LJ-1882	TRL 63-43	−1375	10	−22.1	3044	59	−61
LJ-1894	TRL 63-43	−1365	10	−22.6	2927	59	80
LJ-1884	TRL 63-43	−1355	10	−22.3	3012	59	−61
LJ-2399	TRL 63-43	−1345	10	−22.0	2937	46	−125
LJ-1893	TRL 63-43	−1325	10	−22.2	3095	60	−77
LJ-1881	TRL 63-43	−1315	10	−22.7	2943	59	95
LJ-1870	TRL 63-43	−1285	10	−21.7	2976	91	B

Appendix 1 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-1345	TRL 63-43	−1250	40	−26.5	2980	51	80
LJ-1872	TRL 63-43	−1235	10	−22.9	2970	60	27
LJ-1871	TRL 63-43	−1225	10	−22.0	2973	60	17
LJ-1254	TRL 63-43	−1215	30	(−23.0)	2874	77	B
LJ-1865	TRL 63-43	−1205	10	−21.1	2862	60	11
LJ-1876	TRL 63-43	−1195	10	−22.4	2933	60	−9
LJ-1548	TRL 63-43	−1185	10	−22.7	2860	52	6
LJ-1861	TRL 63-43	−1175	10	(−21.0)	2924	60	−80
LJ-1878	TRL 63-43	−1165	10	−21.3	2989	59	−41
LJ-1858	TRL 63-43	−1155	10	−22.1	2985	60	41
LJ-1873	TRL 63-43	−1145	10	−21.8	3032	61	−88
LJ-1877	TRL 63-43	−1135	10	−22.2	2945	59	74
LJ-1249	TRL 63-43C	−1125	30	−26.1	2943	52	−70
LJ-1859	TRL 63-43	−1125	10	−21.8	2983	60	41
LJ-1860	TRL 63-43	−1115	10	−21.6	2957	61	102
LJ-1205	TRL 63-43	−1085	30	−23.5	2831	56	−45
LJ-1550	TRL 63-43	−1065	10	−21.6	2787	51	−55
LJ-1556	TRL 63-43	−1025	10	−22.2	2790	53	30
LJ-1549	TRL 63-43	−1005	10	−22.0	2819	51	−6
LJ-1209	TRL 63-43	−988	25	−24.4	2768	51	−42
LJ-1554	TRL 63-43	−985	10	−22.3	2752	54	−66
LJ-1695	TRL 63-43	−975	10	−22.2	2681	46	−123
LJ-1250	TRL 63-43	−962	25	−27.0	2726	51	76
LJ-1208	TRL 63-43	−938	25	−22.9	2850	52	22
LJ-1564	TRL 63-43	−905	10	−21.4	2798	54	27
LJ-1557	TRL 63-43	−895	10	−22.7	2708	56	−127
LJ-1210	TRL 63-43	−888	25	−23.2	2677	52	144
LJ-1566	TRL 63-43	−885	10	−21.4	2684	53	7
LJ-1559	TRL 63-43	−879	18	−22.8	2774	75	B
LJ-1696	TRL 63-43	−865	10	−21.5	2639	47	12
LJ-1248	TRL 63-43	−862	25	−23.0	2663	51	−21
LJ-1558	TRL 63-43	−855	10	−23.5	2775	57	7
LJ-1590	TRL 63-43	−845	10	−21.8	2740	74	M
LJ-1207	TRL 63-43	−834	31	−25.4	2702	75	B
LJ-1591	TRL 63-43	−825	10	−22.2	2718	73	M
LJ-1565	TRL 63-43	−815	10	−22.1	2597	53	41
LJ-1567	TRL 63-43	−805	10	−21.7	2579	53	−23
LJ-1570	TRL 63-43	−785	10	−22.2	2584	56	−18
LJ-3913	TRL 63-43	−785	10	(−21.8)	2454	64	M
LJ-3915	TRL 63-43	−775	10	−21.8	2486	41	27
LJ-3911	TRL 63-43	−765	10	−21.7	2465	41	38
LJ-3912	TRL 63-43	−755	10	−21.6	2398	41	−83
LJ-3907	TRL 63-43	−745	10	−21.8	2414	41	35
LJ-3914	TRL 63-43	−735	10	−21.4	2496	41	−4
LJ-1572	TRL 63-43	−725	10	−22.2	2423	55	25
LJ-1213	TRL 62-68	−712	25	−23.2	2416	50	−40
LJ-1595	TRL 63-43	−705	10	−22.1	2444	73	M
LJ-3910	TRL 63-43	−705	10	−22.4	2382	41	−14
LJ-3908	TRL 63-43	−695	10	−22.0	3435	41	−9
LJ-1283	TRL 62-68	−685	20	−22.7	2518	51	−98
LJ-1573	TRL 63-43	−685	10	−22.1	2439	55	124
LJ-3906	TRL 63-43	−685	10	−22.0	2487	42	23
LJ-1697	TRL 63-43	−665	10	−21.7	2418	46	−31
LJ-1571	TRL 63-43	−645	10	(−22.0)	2508	55	9
LJ-3909	TRL 63-43	−645	10	−22.4	2395	42	86
LJ-1574	TRL 63-43	−625	10	−22.0	2517	55	51
LJ-1284	TRL 62-68	−610	20	−22.4	2514	69	M
LJ-1577	TRL 63-43	−605	10	−22.2	2358	83	M
LJ-3903	TRL 63-43	−595	10	−21.7	2441	42	−82
LJ-1575	TRL 63-43	−585	10	−22.1	2294	55	−87

APPENDIX 1 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-3891	TRL 63-43	–585	10	–22.3	2162	45	–43
LJ-3892	TRL 63-43	–575	10	–21.9	2397	41	75
LJ-1578	TRL 63-43	–545	10	–22.4	2432	56	29
LJ-3889	TRL 63-43	–545	10	–22.1	2288	42	45
LJ-3900	TRL 63-43	–535	10	–21.8	2374	42	–4
LJ-1576	TRL 63-43	–525	10	–22.0	2399	56	–88
LJ-3902	TRL 63-43	–525	10	–21.8	2348	41	–127
LJ-3901	TRL 63-43	–515	10	–21.1	2407	41	–66
LJ-1671	TRL 63-43	–495	10	–22.1	2230	45	–10
LJ-3890	TRL 63-43	–495	10	–22.3	2333	46	102
LJ-3864	Holstein	–488	10	–25.2	2331	42	–3
LJ-3860	Holstein	–478	10	–25.4	2313	42	–16
LJ-1669	TRL 63-43	–475	10	–21.2	2420	45	63
LJ-3865	Holstein	–470	5	–24.8	2274	46	–74
LJ-3866	Holstein	–465	5	–25.1	2404	41	76
LJ-3859	Holstein	–458	10	–25.6	2336	42	–118
LJ-1672	TRL 63-43	–455	10	–21.1	2136	45	–88
LJ-3863	Holstein	–448	10	–25.7	2334	42	19
LJ-3861	Holstein	–438	10	–25.7	2294	42	–155
LJ-1670	TRL 63-43	–415	10	–22.7	2339	45	–50
LJ-3876	TRL 63-43	–405	10	–22.4	2247	45	65
LJ-1678	TRL 63-43	–395	10	–21.6	2243	45	–70
LJ-3874	TRL 63-43	–395	10	–21.4	2243	41	26
LJ-3878	TRL 63-43	–385	10	–21.5	2196	41	–105
LJ-1682	TRL 63-43	–375	10	–21.1	2145	45	9
LJ-3872	TRL 63-43	–375	10	–22.0	2147	41	–138
LJ-3877	TRL 63-43	–365	10	–22.1	2152	42	66
LJ-3862	Holstein	–358	10	–25.1	2157	42	28
LJ-1679	TRL 63-43	–355	10	–21.5	2171	45	–2
LJ-3875	TRL 63-43	–355	10	–21.3	2131	41	–63
LJ-3341	D4 Becker	–338	1	–26.3	2141	39	–40
LJ-3423	D4 Becker	–336	1	–25.4	2240	39	170
LJ-3342	TRL 63-43	–335	10	–21.9	2141	38	–51
LJ-1687	TRL 63-43	–335	10	–21.4	2129	45	–39
LJ-3419	D4 Becker	–334	1	–26.0	2192	38	69
LJ-3415	D4 Becker	–332	1	–25.5	2139	38	69
LJ-3412	D4 Becker	–330	1	–25.4	2265	39	–5
LJ-3345	D4 Becker	–326	1	–24.1	2197	55	M
LJ-3346	TRL 63-43	–325	10	–21.5	2165	38	–42
LJ-3411	D4 Becker	–324	1	–25.3	2267	39	–3
LJ-3422	D4 Becker	–320	1	–24.4	2257	39	208
LJ-3421	TRL 63-43	–315	10	–21.9	2213	38	144
LJ-1680	TRL 63-43	–315	10	–21.2	2146	45	13
LJ-1219	TRL 62-68	–312	25	–21.8	2305	71	B
LJ-3413	TRL 63-43	–305	10	–21.4	2178	39	–13
LJ-3414	D4 Becker	–300	1	–23.5	2151	38	–39
LJ-3340	TRL 63-43	–295	10	–21.7	2218	39	154
LJ-1686	TRL 63-43	–295	10	–20.7	2176	45	44
LJ-3339	D4 Becker	–295	1	–24.5	2215	38	–112
LJ-3333	D4 Becker	–289	1	–24.0	2221	38	74
LJ-3332	TRL 63-43	–285	10	–21.5	2215	38	–55
LJ-3416	TRL 63-43	–275	10	–21.3	2175	38	–57
LJ-1681	TRL 63-43	–275	10	–21.5	2195	45	–59
LJ-3343	D4 Becker	–268	1	–23.9	2168	38	–103
LJ-3344	TRL 63-43	–265	10	–21.6	2174	39	–135
LJ-3331	D4 Becker	–258	1	–23.4	2178	39	26
LJ-3418	TRL 63-43	–255	10	–22.4	2246	39	66
LJ-3334	TRL 63-43	–245	10	–22.5	2191	42	16
LJ-3335	D4 Becker	–240	1	–24.6	2221	38	95
LJ-3336	TRL 63-43	–235	10	–21.2	2197	38	108

APPENDIX 1 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-3338	TRL 63-43	−225	10	−22.4	2198	38	62
LJ-1232	TRL 62-68	−225	10	−23.2	2221	50	36
LJ-1231	TRL 62-68	−200	20	−22.1	2228	69	M
LJ-3420	D4 Becker	−190	1	−24.4	2196	38	−36
LJ-1233	TRL 62-68	−180	20	−22.4	2158	50	−54
LJ-1230	TRL 62-68	−160	20	−22.7	2119	50	−39
LJ-1229	TRL 62-68	−90	20	−23.2	2007	49	84
LJ-1216	TRL 62-68	−55	30	−23.1	2057	49	−19
LJ-1221	TRL 62-68	−30	20	−21.3	1979	49	76
LJ-1214	TRL 62-68	−10	20	−22.3	2036	49	87
LJ-2441	TRL 71-51	5	10	−20.7	1988	43	−78
LJ-2444	TRL 71-51	25	10	−21.3	1861	44	−224
LJ-2443	TRL 71-51	45	10	−20.0	1910	43	−18
LJ-2478	TRL 71-51	85	10	−21.8	1796	44	−34
LJ-2480	TRL 71-51	125	10	−21.2	1792	46	38
LJ-2624	TRL 71-51	185	10	−20.1	1831	45	−84
LJ-2626	TRL 71-51	205	10	−19.7	1857	44	100
LJ-2627	TRL 71-51	225	10	−19.8	1769	43	−32
LJ-2622	TRL 71-51	245	10	−20.3	1953	44	122
LJ-1746	TRL 63-48	285	10	−20.1	1722	45	68
LJ-2371	TRL 63-48	295	10	−19.6	1738	56	B
LJ-1759	TRL 63-48	305	10	−19.6	1682	45	−24
LJ-1752	TRL 63-48	315	10	−19.8	1691	45	−28
LJ-2383	TRL 63-48	335	10	−19.6	1704	43	−13
LJ-1747	TRL 63-48	345	10	−20.2	1635	45	134
LJ-1756	TRL 63-48	355	10	−20.7	1595	44	96
LJ-2385	TRL 63-48	375	10	−20.1	1566	43	75
LJ-1751	TRL 63-48	385	10	−20.1	1615	45	−54
LJ-2380	TRL 63-48	395	10	−19.8	1596	43	−38
LJ-1758	TRL 63-48	405	10	−19.2	1601	45	31
LJ-2389	TRL 63-48	415	10	−20.1	1625	43	−9
LJ-1748	TRL 63-48	425	10	−20.2	1572	45	77
LJ-2382	TRL 63-48	435	10	−19.6	1543	57	B
LJ-1757	TRL 63-48	455	10	−19.9	1544	45	28
LJ-1750	TRL 63-48	475	10	−19.8	1472	44	−60
LJ-2368	TRL 63-48	495	10	−19.9	1358	43	−83
LJ-1749	TRL 63-48	505	10	−19.9	1414	44	−32
LJ-1718	TRL 67-30	705	10	−21.1	1254	70	M
LJ-1815	TRL 67-30	715	10	−20.8	1228	45	−24
LJ-1744	TRL 67-30	728	4	−21.8	1266	44	19
LJ-1715	TRL 67-30	735	10	−21.1	1221	44	−32
LJ-1730	TRL 67-30	745	10	−20.7	1204	44	−134
LJ-1722	TRL 67-30	755	10	−20.7	1233	44	18
LJ-1724	TRL 67-30	775	10	−20.2	1210	44	54
LJ-1149	TRL 63-48	778	15	−22.4	1172	54	12
LJ-1811	TRL 67-30	785	10	−21.0	1153	45	89
LJ-1714	TRL 67-30	795	10	−20.3	1251	44	−6
LJ-1813	TRL 67-30	805	10	−21.4	1276	45	34
LJ-1721	TRL 67-30	815	10	−20.6	1097	44	−70
LJ-1743	TRL 67-30	821	3	−22.0	1201	44	4
LJ-1723	TRL 67-30	835	10	−20.2	1129	44	3
LJ-1731	TRL 67-30	845	10	−21.0	1160	44	24
LJ-1720	TRL 67-30	855	10	−20.7	1210	70	M
LJ-1814	TRL 67-30	865	10	−21.2	1217	45	11
LJ-1716	TRL 67-30	875	10	−20.4	1075	44	−32
LJ-1812	TRL 67-30	885	10	−20.5	1112	45	20
LJ-1719	TRL 67-30	895	10	−20.7	1080	44	28
LJ-3223	TRL 67-3	1085	10	−21.2	830	37	102
LJ-3228	TRL 67-3	1095	10	−21.7	961	37	43
LJ-3222	TRL 67-3	1105	10	−21.5	909	36	−43

APPENDIX 1 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-3229	TRL 67-3	1115	10	–21.0	892	37	29
LJ-3250	Eschelbronn	1120	2	–24.9	977	37	0
LJ-3224	TRL 67-3	1125	10	–21.2	935	37	–70
LJ-3227	TRL 67-3	1135	10	–22.0	862	37	5
LJ-3249	Eschelbronn	1140	1	–24.5	853	37	–65
LJ-3226	TRL 67-3	1145	10	–20.9	864	36	–79
LJ-3259	Eschelbronn	1160	1	–25.6	801	36	118
LJ-3234	TRL 67-3	1165	10	–20.8	831	37	5
LJ-3256	Eschelbronn	1170	1	–25.6	858	36	96
LJ-3251	Eschelbronn	1180	1	–26.3	847	36	–4
LJ-3225	TRL 67-3	1185	10	–21.4	802	36	–131
LJ-3255	Eschelbronn	1190	1	–25.8	815	37	13
LJ-3277	Gottlieben	1193	7	–26.5	838	37	–100
LJ-3254	Eschelbronn	1200	1	–25.9	851	36	72
LJ-3231	TRL 67-3	1205	10	–21.7	769	37	–2
LJ-3275	Gottlieben	1206	4	–26.5	880	37	114
LJ-3257	Eschelbronn	1210	1	–26.0	784	36	32
LJ-3281	Eschelbronn	1214	2	–26.2	818	60	B
LJ-3276	Gottlieben	1216	4	–26.0	839	37	5
LJ-3260	Eschelbronn	1220	1	–25.8	847	37	–18
LJ-3232	TRL 67-3	1225	10	–21.0	782	36	–8
LJ-3253	Gottlieben	1230	1	–25.5	776	36	–63
LJ-3278	Gottlieben	1236	4	–26.0	669	52	M
LJ-3258	Eschelbronn	1241	3	–25.9	758	36	52
LJ-3233	TRL 67-3	1245	10	–21.2	744	37	–102
LJ-3261	Gottlieben	1252	4	–26.1	729	37	101
LJ-3297	TRL 67-3	1255	10	–21.0	696	36	37
LJ-3299	TRL 67-3	1265	10	–21.6	692	36	–167
LJ-3252	Gottlieben	1270	2	–25.3	705	36	18
LJ-3301	TRL 67-3	1275	10	–21.3	706	37	6
LJ-3230	TRL 67-3	1285	10	–21.8	579	36	–98
LJ-3298	Gottlieben	1290	2	–25.6	673	36	–9
LJ-3300	Gottlieben	1296	2	–25.4	617	36	–8

APPENDIX 2

Floating tree-ring series

1.	2.	3.	4.	5.	6.	7.	8.
Fischbeck series, estimated zero point ca 6120 BC							
LJ-3490	Fischbeck	30	5	–26.3	7098	52	–23
LJ-3489	Fischbeck	90	5	–25.2	7147	53	–50
LJ-3488	Fischbeck	270	5	–24.6	7016	52	–127
LJ-3491	Fischbeck	330	5	–24.0	6921	52	–66
Donau 11 incomplete series, B Becker							
LJ-2968	D11A	25	10	–25.6	7065	49	–74
LJ-3004	D11A	55	10	–25.0	6983	49	63
LJ-3000	D11A	75	10	–26.0	6904	50	26
LJ-3003	D11A	125	10	–26.6	6985	49	63
LJ-2999	D11A	175	10	–24.9	6710	49	–42
LJ-3033	D11A	195	10	–27.0	7027	51	82
LJ-3034	D11B	205	10	–26.4	6215	48	–71
LJ-2985	D11B	225	10	–24.8	6206	48	–43
LJ-3001	D11B	275	10	–26.3	6116	47	3
LJ-3002	D11B	325	10	–25.3	6101	47	–47
LJ-2984	D11B	365	10	–24.8	6070	47	–79

APPENDIX 2 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
Main 6 series, B Becker, estimated zero point ca 6075 BC							
LJ-3315	M6	100	1	−25.5	6992	51	−70
LJ-3305	M6	110	1	−26.2	6928	51	59
LJ-3307	M6	120	1	−26.1	6961	55	63
LJ-3316	M6	150	1	−25.3	7013	52	−101
LJ-3480	M6	190	1	−25.3	6841	52	−105
LJ-3309	M6	200	1	−25.9	7060	52	−10
LJ-3476	M6	210	1	−25.8	6933	52	33
LJ-3320	M6	235	10	−23.6	6902	52	127
LJ-3317	M6	300	1	−23.7	6886	52	28
LJ-3478	M6	310	1	−25.3	6668	51	6
LJ-3319	M6	350	1	−23.3	6717	51	−28
LJ-3318	M6	390	1	−24.1	6625	50	82
LJ-3477	M6	408	5	−23.5	6843	52	138
Donau 8 series, B Becker, estimated zero point ca 4430 BC							
LJ-3057	D8	5	1	−26.4	5534	47	8
LJ-3010	D8	12	1	−26.4	5635	45	−160
LJ-3039	D8	17	1	−26.7	5547	47	−103
LJ-3077	D8	19	1	−25.5	5578	47	69
LJ-2968	D8	23	1	−24.9	5552	46	3
LJ-3147	D8	26	1	−25.8	5502	47	15
LJ-3146	D8	29	1	−26.1	5509	48	72
LJ-3005	D8	33	1	−25.6	5508	47	−46
LJ-3072	D8	35	1	−25.5	5448	47	−146
LJ-3149	D8	37	1	−24.3	5497	47	50
LJ-2981	D8	39	1	−25.1	5443	63	M
LJ-3148	D8	41	1	−25.2	5461	47	37
LJ-3037	D8	44	1	−25.0	5551	70	M
LJ-3145	D8	49	1	−25.0	5441	47	−35
LJ-3144	D8	51	1	−24.1	5360	47	41
LJ-3060	D8	53	1	−24.9	5372	46	−10
LJ-3143	D8	58	1	−25.2	5365	47	−53
LJ-3142	D8	61	1	−25.3	5292	47	−195
LJ-2966	D8	65	1	−25.7	5417	46	−101
LJ-3062	D8	72	1	−24.5	5366	46	98
LJ-3500	D8	75	5	−24.7	5493	47	91
LJ-3502	D8	80	6	−25.8	5426	47	20
LJ-3038	D8	89	4	−27.5	5356	46	58
LJ-3117	D8	91	3	−26.7	5362	46	−125
LJ-3035	D8	99	3	−27.9	5471	46	122
LJ-3134	D8	102	1	−27.1	5351	46	15
LJ-2967	D8	104	1	−2[illegible].2	5457	46	32
LJ-3133	D8	106	1	−27.8	5363	45	177
LJ-3118	D8	110	3	−27.4	5363	46	11
LJ-3501	D8	114	6	−25.4	5371	47	28
LJ-3014	D8	115	1	−26.3	5546	46	165
LJ-3168	D8	118	1	−26.8	5476	46	30
LJ-3075	D8	120	1	−26.9	5380	46	68
LJ-3169	D8	124	1	−26.7	5374	46	−5
LJ-3040	D8	126	1	−26.9	5358	46	−93
LJ-3171	D8	130	1	−27.1	5372	47	81
LJ-3170	D8	133	1	−26.4	5351	47	−79
LJ-3167	D8	136	1	−26.6	5316	47	−19
LJ-3012	D8	138	1	−27.2	5328	45	−167
LJ-3193	D8	143	1	−26.4	5346	47	−17
LJ-2983	D8	151	1	−25.9	5307	45	49
LJ-3379	D8	157	1	−26.4	5339	45	78
LJ-3378	D8	158	9	−29.6	5343	45	−56

APPENDIX 2 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-3194	D8	160	1	−26.6	5346	47	74
LJ-3380	D8	167	8	−28.3	5317	45	16
LJ-3013	D8	170	1	−26.5	5356	45	41
LJ-3195	D8	174	1	−26.9	5337	47	−30
LJ-3376	D8	174	7	−28.3	5293	46	−165
LJ-3377	D8	179	3	−27.9	5200	45	−44
LJ-3076	D8	179	1	−27.2	5345	46	153
LJ-3119	D8	189	1	−26.4	5261	46	−16
LJ-3381	D8	197	5	−27.7	5376	46	35
LJ-3197	D8	199	1	−27.8	5319	46	−132
LJ-2978	D8	204	1	−27.1	5274	45	−29
LJ-3382	D8	204	4	−27.1	5290	45	−35
LJ-3196	D8	206	1	−26.9	5381	47	33
LJ-3383	D8	208	4	−26.6	5317	45	−135
LJ-3179	D8	208	1	−27.1	5377	47	17
LJ-3192	D8	210	1	−26.8	5285	46	104
LJ-3386	D8	211	3	−26.1	5337	45	15
LJ-3387	D8	214	2	−25.4	5321	45	−7
LJ-3006	D8	214	1	−27.7	5433	45	41
LJ-3178	D8	216	1	−27.2	5251	46	72
LJ-3056	D8	218	1	−27.3	5282	46	114
LJ-3402	D8	223	3	−26.0	5287	45	36
LJ-3122	D8	224	1	−26.8	5300	46	−77
LJ-2964	D8	227	1	−27.3	5247	44	−8
LJ-2965	D8	231	1	−26.5	5230	44	95
LJ-3404	D8	234	4	−25.6	5298	45	78
LJ-3123	D8	238	6	−26.4	5295	46	−82
LJ-3403	D8	244	4	−25.9	5269	45	−35
LJ-3401	D8	252	4	−25.0	5297	44	166
LJ-3385	D8	262	6	−24.3	5362	45	−110
LJ-3503	D8	282	6	−25.6	5264	46	−70
LJ-3384	D8	288	6	−26.5	5323	45	124
Neolithic master chronology (see Becker, 1978) incorporating Thayngen-Burgaschisee series (Ferguson, Huber, and Suess, 1966), estimated zero point ca 4050 BC							
LJ-3610	D9/12	88	3	−26.5	5159	46	−265
LJ-1266	Thayngen	101	12	−26.3	5070	61	11
LJ-1262	Thayngen	137	40	−31.1	5037	60	87
LJ-3636	Thayngen	139	15	−24.2	5003	46	−14
LJ-3598	D9/12	141	2	−26.3	5058	46	130
LJ-3611	D9/12	174	1	−25.3	5023	47	76
LJ-1278	Thayngen	182	10	−26.4	4992	58	−116
LJ-3609	D9/12	197	1	−25.6	5029	46	42
LJ-1293	Burgasch	207	40	−35.2	5053	58	−71
LJ-1277	Thayngen	217	20	−25.3	4925	58	−106
LJ-3614	D9/12	222	1	−25.6	4976	46	−198
LJ-1261	Thayngen	227	20	−28.0	5050	60	−56
LJ-3596	D9/12	257	2	−24.5	4912	46	−90
LJ-3625	D9/12	277	2	−24.7	4963	46	−78
LJ-1279	Thayngen	287	20	−27.2	4917	58	−11
LJ-3626	D9/12	299	2	−24.1	4931	47	−106
LJ-1265	Thayngen	307	20	−25.6	4962	60	24
LJ-3608	D9/12	335	2	−23.9	4873	46	60
LJ-3627	D9/12	369	5	−24.5	4935	46	−129
LJ-3628	D9/12	396	3	−23.9	4723	45	−89
LJ-3613	D9/12	421	2	−24.5	4742	45	9
LJ-3615	D9/12	447	2	−24.5	4727	45	−52
LJ-3644	D7	460	1	−23.6	4881	46	−173
LJ-3655	D7	470	1	−24.3	4786	45	−62
LJ-3645	D7	480	1	−24.3	4758	45	20

APPENDIX 2 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-3667	D7	490	1	−24.6	4766	46	−100
LJ-3597	D9/12	497	2	−25.9	4773	45	−44
LJ-3640	D7	500	1	−24.9	4797	46	−63
LJ-3656	D7	510	1	−24.5	4786	46	−104
LJ-3643	D7	520	1	−24.7	4773	46	−85
LJ-3654	D7	530	1	−24.6	4733	45	−86
LJ-3641	D7	540	1	−24.9	4650	45	27
LJ-3659	D7	550	1	−24.5	4642	47	−132
LJ-3646	D7	560	1	−24.6	4673	45	−55
LJ-3657	D7	570	1	−24.8	4608	45	20
LJ-3642	D7	580	1	−24.5	4597	46	−10
LJ-3666	D7	590	1	−24.4	4614	45	77
LJ-3658	D7	600	1	−24.7	4576	46	54
LJ-3007	D7	608	3	−28.5	4642	43	123
LJ-2957	D7	614	1	−28.1	4564	42	−58
LJ-2956	D7	619	1	−27.8	4612	42	−9
LJ-3081	D7	630	1	−26.8	4604	44	−26
LJ-3111	D7	636	1	−26.8	4647	45	−44
LJ-3015	D7	643	1	−26.2	4715	52	42
LJ-3938	D7	649	1	−26.6	4651	46	−15
LJ-3116	D7	651	1	−25.8	4663	44	−6
LJ-3931	D7	656	1	−26.7	4679	46	19
LJ-3017	D7	670	1	−26.0	4636	45	43
LJ-3078	D7	674	1	−26.1	4627	45	−48
LJ-3018	D7	680	1	−24.5	4552	45	47
LJ-3928	D7	689	1	−26.4	4449	46	140
LJ-2976	D7	693	1	−26.0	4487	43	−97
LJ-3930	D7	695	1	−25.6	4528	46	−108
LJ-3009	D7	698	1	−26.0	4458	42	26
LJ-2975	D7	712	1	−26.2	4498	42	−30
LJ-3132	D7	727	1	−25.1	4479	44	116
LJ-3082	D7	730	1	−25.8	4405	44	2
LJ-3935	D7	732	1	−25.4	4494	46	83
LJ-3131	D7	734	1	−25.2	4426	45	−14
LJ-3936	D7	751	1	−25.9	4417	46	−58
LJ-3113	D7	757	1	−25.6	4473	43	84
LJ-3933	D7	760	1	−25.8	4451	45	92
LJ-2960	D7	761	1	−25.7	4469	42	21
LJ-3016	D7	767	1	−24.4	4417	44	45
LJ-2958	D7	773	1	−24.9	4439	44	−86
LJ-2959	D7	799	1	(−26.2)	4441	42	−90
Main 5 series, B Becker, estimated zero point ca 3250 BC (uncertain)							
LJ-3698	M5	73	5	−25.0	4418	45	59
LJ-3739	M5	126	2	−26.2	4471	45	104
LJ-3591	M5	154	8	−26.3	4475	47	−88
LJ-3738	M5	200	1	−25.0	4392	44	−225
LJ-3740	M5	225	1	−25.2	4369	45	−121
LJ-3702	M5	256	1	−23.8	4315	44	−57
LJ-3742	M5	274	2	−24.9	4397	45	−1
LJ-3741	M5	305	1	−25.8	4296	44	23
LJ-3701	M5	325	1	−23.8	4335	44	−59
LJ-3694	M5	350	1	−24.1	4270	45	82
LJ-3737	M5	373	1	−25.9	4219	44	−81
LJ-3693	M5	399	1	−23.2	4192	44	23
LJ-3743	M5	440	2	−24.5	4080	44	75

APPENDIX 2 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
Donau 3 and Donau 10 series, Bronze Age master chronology of B Becker, estimated zero point ca 2860 BC							
LJ-3458	D3/10 Ner 51-61	45	2	−24.9	4125	43	59
LJ-3696	D3/10 Ner 51-61	74	1	−23.9	4044	44	−26
LJ-3440	D3/10 Ner 51-61	80	1	−24.6	4118	43	−62
LJ-3436	D3/10 Ner 51-61	130	1	−24.7	4171	43	0
LJ-3691	D3/10 Ner 51-61	145	1	−25.7	4154	44	50
LJ-3692	D3/10 Ner 51-61	171	1	−26.3	4125	44	−83
LJ-3464	D3/10 Ner 51-61	209	1	−25.2	4088	60	B
LJ-3465	D3/10 Ner 51-61	226	1	−24.3	4072	61	B
LJ-3457	D3/10 Ner 51-61	250	1	−24.2	4041	43	6
LJ-3695	D3/10 Ner 51-61	250	2	−23.7	4040	44	−65
LJ-3699	D3/10 Ner 51-61	261	1	−24.2	4106	44	−67
LJ-3437	D3/10 Ner 51-61	270	1	−24.3	4076	43	75
LJ-3703	D3/10 Ner 51-61	280	2	−24.0	3978	44	−10
LJ-3294	D3/10 Ner 51-61	301	1	−24.2	3940	43	6
LJ-3700	D3/10 Ner 51-61	310	1	−24.1	4117	44	55
LJ-3290	D3/10 Ner 51-61	328	1	−24.4	3930	60	M
LJ-3291	D3/10 Ner 51-61	343	1	−25.0	3918	43	−56
LJ-3704	D3/10 Ner 47	388	1	−26.0	3911	44	−9
LJ-3706	D3/10 Ner 36	400	1	−23.9	3818	43	−42
LJ-3705	D3/10 Ner 1	420	1	−24.3	3824	43	64
LJ-3776	D3 Bur H534	430	1	−26.5	3788	81	M
LJ-3774	D3 Bur H52	470	1	−25.7	3791	43	31
LJ-3773	D3 Bur H52	476	1	−25.6	3823	62	M
LJ-3806	D3 Bur H52	490	1	−25.2	3992	42	202
LJ-3292	D3/10 Bur H26	500	1	−24.7	3842	43	−55
LJ-3779	D3 Bur H52	515	1	−25.4	3819	44	135
LJ-3793	D3 Bur H52	540	1	−24.6	3816	45	48
LJ-3293	D3/10 Bur H26	542	1	−25.2	3816	41	−95
LJ-3778	D3 Bur H52	560	1	−26.4	3754	48	−10
LJ-3791	D3 Ner 4	570	1	−25.6	3801	60	B
LJ-3792	D3 Ner 4	575	1	−24.0	3826	46	−129
LJ-3813	D3 Ner 4	590	1	−24.6	3793	46	−140
LJ-3439	D3/10 Bur H26	604	1	−24.7	3855	43	−96
LJ-3807	D3 Lei 42	645	1	−24.8	3699	45	−78
LJ-3441	D3/10 Lei 39	650	1	−25.3	3790	42	−84
LJ-3808	D3 Lei 42	665	1	−23.5	3715	60	B
LJ-3724	D3/10 Gun 34	676	1	−23.9	3685	43	−3
LJ-3782	D3 Lei 42	685	1	−24.5	3664	45	−32
LJ-3462	D3/10 Lei 39	700	1	−24.5	3667	42	18
LJ-3780	D3 Bur 15	710	1	−25.4	3659	45	30
LJ-3721	D3/10 Gun 34	725	1	−23.8	3789	43	−38
LJ-3775	D3 Bur 15	736	1	−26.4	3811	43	−82
LJ-3781	D3 Bur 15	745	1	−24.9	3710	45	49
LJ-3463	D3/10 Lei 39	750	1	−24.7	3668	42	−67
LJ-3789	D3 Bur 15	750	1	−24.3	3652	46	−9
LJ-3788	D3 Bur 15	765	1	−24.8	3606	46	19
LJ-3723	D3/10 Gun 34	774	1	−23.8	3641	43	49
LJ-3438	D3/10 Lei 39	800	1	−24.6	3716	42	−108
LJ-3765	D3/10 Bur 15	817	1	−26.0	3585	43	8
LJ-3725	D3/10 Gun 34	832	1	−24.5	3626	42	−213
LJ-3722	D3/10 Gun 37	856	1	−25.1	3566	42	1
LJ-3727	D3/10 Gun 37	873	1	−26.2	3631	43	8
LJ-3759	D3/10 Gun 37	897	1	−26.5	3749	43	62
LJ-3764	D3/10 Gun 37	925	1	−26.1	3516	42	35
LJ-3726	D3/10 Gun 37	947	1	−25.2	3520	42	−53
LJ-3766	D3/10 Gri 2	975	1	−23.9	3617	43	36
LJ-3785	D3 Bur 1	985	1	−24.9	3480	42	−19
LJ-3783	D3 Bur 1	995	1	−25.3	3429	42	−127

APPENDIX 2 (continued)

1.	2.	3.	4.	5.	6.	7.	8.
LJ-3757	D3/10 Gri 2	1008	1	−24.2	3484	42	−15
LJ-3763	D3/10 Bur H	1027	3	−24.6	3500	42	−225
LJ-3814	D3 Bur 1	1035	1	−24.1	3444	45	9
LJ-3443	D3/10 Bur H22	1050	1	−25.3	3458	42	−64
LJ-3811	D3 Bur 1	1060	1	−23.6	3385	45	117
LJ-3767	D3/10 Bur H22	1070	2	−23.6	3451	42	−41
LJ-3784	D3 Bur 1	1090	1	−23.0	3471	42	−30
LJ-3459	D3/10 Bur H22	1100	1	−24.4	3485	42	33
LJ-3760	D3/10 Hoc 67	1125	1	−25.0	3439	42	8
LJ-3461	D3/10 Bur H22	1150	1	−25.3	3383	59	M
LJ-3758	D3/10 Hoc 67	1173	1	−25.3	3417	42	−32
LJ-3460	D3/10 Bur H22	1200	1	−25.6	3435	42	48
LJ-3442	D3/10 Bur H22	1250	1	−25.4	3338	41	123
Zug Sumpf series, obtained from Veronika Giertz Siebenlist, estimated zero point ca 1250 BC							
LJ-3028	Giertz	28	14	−27.3	2915	39	−36
LJ-2917	Giertz	50	10	−27.8	2899	39	−46
LJ-2949	Giertz	70	10	−26.5	2877	39	17
LJ-2918	Giertz	90	10	−27.9	2892	39	−40
LJ-2916	Giertz	110	10	−27.6	2951	39	20
LJ-2920	Giertz	130	10	−26.4	2815	39	−28
LJ-2919	Giertz	150	10	−26.4	2885	39	89
LJ-2915	Giertz	170	10	−28.6	2762	39	−70
LJ-2939	Giertz	190	10	−26.7	2842	39	78
LJ-2922	Giertz	210	10	−25.2	2796	39	56
LJ-3024	Giertz	245	10	−26.1	2787	38	−8
LJ-2921	Giertz	260	10	−26.6	2709	39	117
LJ-3025	Giertz	280	10	−27.8	2723	40	−17

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LYON NATURAL RADIOCARBON MEASUREMENTS VII

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INTRODUCTION

This list includes most of the measurements made in 1975 and 1976. Results lower than Ly-1000 are old measurements obtained with counters previously described, especially in R, 1973, v 15, p 134, when the laboratory was in the basement of the Nuclear Physics Institute. At the end of 1974 all the apparatus was transferred to a specially designed building with an isolated counting room overlain by 4m non-radioactive earth.

The new well-shielded spectrometer described in R, 1976, v 18, p 60 decreased the background by about 20%, now remaining at 3.1 ± 0.1 cpm (according to the counting vessels) for 3ml C_6H_6, which does not change appreciably for 10ml C_6H_6. A new spectometer of the same type with a background of 4.0 ± 0.2 cpm has been set up without any shield but with better photomultipliers.

For technical reasons (obsolescence of the anticoincidence crown of Geiger counters), the two proportional detectors could not be used in routine counting. All the results in the new laboratory (after Ly-1000) were obtained by the two Packard liquid scintillation spectometers.

Chemical treatments and calculation methods (half-life: 5570 ± 0, one standard deviation, standard ^{13}C correction only for bones) remain the same.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Samples from peat bogs of low altitudes

Ly-1101. Sondage SM 6, Termoli, Prov Campobasso, Italia **8800 ± 350**

Peat from level of lagoonal clay from ca 14m below present sea level in Boring SM 6, in coastal plain 14km SE Termoli, Prov Campobasso, Italy (41° 55′ N, 15° 8′ E). Coll and subm 1975 by G Magri, Lab Geol Ambientale, CNEN, Roma 1/3 sample diluted. *Comment* (GM): date distinguishes between Tyrrenian or Holocene age for peat. Peat is

Holocene and sea level was 14m lower than at present, 8800 yr ago, concurring with data on sea-level rise during Post-Würmian time.

Mollégès series, Bouches du Rhône

Peaty marl from 2 levels of boring in alluvial plain of La Durance R at Mollégès, Bouches du Rhône (43° 48′ N, 4° 57′ E). Coll 1973 with "Coûteau" drill by M Reille, and subm 1974 by H Triat, Lab Bot Hist et Palyn, Univ Marseille.

Ly-1019. Mollégès 85 **7880 ± 200**

From 85cm depth 2/3 sample diluted. *Comment* (HT): as compared with Ly-364: 5600 ± 150 (R, 1973, v 15, p 36) at Le Pont des Clapets in Rhône delta, a younger date was expected for Post-Würmian expansion of Mediterranean oak-grove shown by pollen diagram.

Ly-1020. Mollégès 200 **10,670 ± 340**

From 200cm depth, at base of boring. 2/3 sample diluted. *Comment* (HT): date agrees with pollen analysis which shows species with Late-Würmian affinity. Level should mark beginning of alluvial sedimentation in that part of La Durance plain after Alleröd period.

Paluds series, Courthézon, Vaucluse

Samples from boring with "Smith" drill in peat bog near Courthézon Vaucluse (44° 5′ N, 4° 53′ E). Coll and subm 1975 by H Triat.

Ly-1134. Les Paluds de Courthézon, 165-170cm **3470 ± 130**

Peat from 165 to 170cm depth. Shows decrease of dense forest in plain and appearance of crop cultivation.

Ly-1135. Les Paluds de Courthézon, 345-350cm **7350 ± 170**

Peat from 345 to 350cm depth. Levels correspond with more humid climate in pollen diagram. *Comment* (HT): slightly earlier date was expected, close to Ly-910: 6880 ± 180 (R, 1976, v 18, p 62) from Isle sur la Sorgue in same region. Result possibly indicates beginning of Atlantic.

Ly-1262. Les Paluds de Courthézon, 395-399cm **8480 ± 200**

Peaty marl from 395 to 399cm depth. At this level, pollen analysis suggests Boreal with, eg, a short phase marked by *Corylus avellana* L. *Comment* (HT): date fits with a Boreal attribution in Provence, ca 8400.

Ly-1263. Les Paluds de Courthézon, 439-443cm **9740 ± 200**

Peaty marl from 439 to 443cm depth. *Comment* (HT): date suggests a Pre-Boreal attribution to level concurring with pollen analysis showing preponderance of pine forest.

Ly-1136. Les Paluds de Courthézon, 470cm **11,530 ± 230**

Peaty marl from 470cm depth at base of boring. Pollen analysis shows species with Late-Würmian affinities. *Comment* (HT): a date earlier than Ly-1020 above was expected because of the difficulty in distinguishing

Late Dryas. But warmer climate shown in pollen diagram may be attributed to Alleröd period.

General Comment (HT): more details on these results will be given in a general study of history of vegetation in low valley of Rhône R by H Triat (1978).

Molesme series, Cote d'Or

Samples from several levels of geol sec taken from steep side of small Le Laignes R, Molesmes, Côte d'Or (47° 57′ N, 4° 21′ E). Coll and subm 1972 by J J Puisségur, Lab Geol, Univ Dijon. All measurements made to date a malacologic diagram and to check the possibility of using micro-gasteropod shells for radiocarbon dating. Only shell pretreatment was washing which eliminated clay and calcareous gangue but small size, < 1mm, of shells did not permit complete internal washing.

Ly-840. Molesme, Level 10 **5130 ± 120**

Peat from 1.25 to 1.35m depth.

Ly-835. Molesmes, Level 10 **5250 ± 140**

Shells of micro-gasteropoda, 1.25 to 1.35m depth.

Ly-839. Molesmes, Level 9 **5230 ± 130**

Peat from 1.35 to 1.55m depth.

Ly-834. Molesmes, Level 9 **6270 ± 170**

Shells of micro-gasteropoda, 1.35 to 1.55m depth.

Ly-833. Molesmes, Level 7 **9510 ± 210**

Shells of micro-gasteropoda, 1.9 to 2m depth.

Ly-838. Molesmes, Level 6 **8720 ± 150**

Peat from 2 to 2.05m depth.

Ly-837. Molesmes, Level 4 **9280 ± 170**

Peat from 2.2 to 2.4m depth.

Ly-836. Molesmes, Level 3 **9900 ± 290**

Peat from 2.4 to 2.6m depth, 2/3 sample diluted.

Ly-832. Molesmes, Level 3 **11,670 ± 340**

Shells from 2.4 to 2.6m depth, 1/3 sample diluted, very long counting time.

General Comment (JJP): taking into account only dates obtained from samples, all attributions to classic climatic phases for levels agree with ecologic data of fauna of micro-gasteropoda in region (Puisségur, 1976): Atlantic = Levels 10 and 9, Boreal = Level 6, Pre-Boreal = Level 4, and Late Dryas = Level 3. Using only dates obtained from shell samples, only Ly-835 agrees with that chronology. All other dates are obviously 1000 to 1500 yr too old. However most of these gasteropoda live out of water and their old ages cannot be due to low ^{14}C content of carbon they used for making their shells. It seems more likely that some clayed and calcareous gangue remained in the apex of the small shells after the pretreatment.

Clény series, Côte d'Or

Samples from base of boring in flood plain of little La Norges R at Clénay, Côte d'Or (47° 24′ N, 5° 7′ E). Coll and subm 1972 by J J Puisségur.

Ly-841. Clénay, Level 15 **7900 ± 170**

Peat from 5.2 to 5.4m depth.

Ly-842. Clénay, Level 16a **8010 ± 130**

Peat from 5.4 to 5.5m depth.

Ly-843. Clénay, Level 16b **8540 ± 170**

Peat from 5.5 to 5.6m depth.

Ly-844. Clénay, Level 17a **8410 ± 180**

Peat from 5.6m depth.

Ly-831. Clénay, Level 17a **9440 ± 250**

Shells of micro-gasteropoda from same level as Ly-844. 2/3 sample diluted.

General Comment (JJP): malacologic fauna indicate same climate as present for Levels 15 and 16, and, in agreement with dates, a Boreal attribution for these sediments. Level 17, as compared with Levels 1, 2 and 3 at Molesmes, are attributed to Late Dryas (Puisségur, 1976) despite Ly-844. Same discrepancy found between results from shells or peat of same level with same cause as at Molesmes, but here, none of the values fit ages expected by stratigraphy and especially by fauna.

B. Samples from peat bogs of high altitudes

All results reported here, except Ly-1030, were obtained as part of a general study of history of vegetation in S French Alps by J L de Beaulieu (1977).

Vallée des Merveilles series, Saint-Dalmas de Tende, Alpes Maritimes

Peaty soils of piedmont or perilacustrian peat of small lake of high alt in Les Merveilles Valley near St Dalmas de Tende, Alpes Maritimes. Coll and subm 1975 by H de Lumley, Lab Prehist, Univ Marseille. Many peculiar protohistoric engravings appear on rocks, mostly of Bronze age (Lumley *et al*, 1976). Measurements are from lakes: Long-inferieur, Mouton and Huile and were made to follow retreat of glaciers from lowest part of Les Merveilles Valley to highest lakes which, according to their orientation, still have some névés which are no longer permanent.

Ly-1250. Lac du Diable 1 **1410 ± 140**
Alt: 2408m (44° 3′ N, 7° 26′ E).

Ly-1251. Lac du Diable 2 **660 ± 140**
Alt: 2408m (44° 3′ N, 7° 26′ E).

Ly-1252. Lac du Trem 3 **890 ± 140**
Alt: 2242m ,44° 3′ N, 7° 27′ E).

Ly-1253. Roche de l'Autel 4 **1090 ± 160**
Alt: 2320m (44° 4′ N, 7° 27′ E).

Ly-1254. Fond de la Vallée A **1430 ± 140**
Alt: 2513m (44° 5′ N, 7° 26′ E).

Ly-1255. Fond de la Vallée, Cote 2383 **650 ± 140**
Alt: 2383m (44° 5′ N, 7° 26′ E).

Ly-1256. Pied des Merveilles 101 **1430 ± 170**
Alt: 2390m (44° 4′ N, 7° 26′ E).

Ly-1257. Pied des Merveilles 102 **1700 ± 130**
Alt: 2410m (44° 4′ 7° 26′ E).

Ly-1258. Pied des Merveilles 103 **1420 ± 130**
Alt: 2405m (44° 4′ N, 7° 26′ E).

Ly-1259. Pied des Merveilles 104 **Modern**
Δ ^{14}C = **+2.5% ± 1.5**
Alt: 2380m (44° 4′ N, 7° 26′ E).

Ly-1260. Pied des Merveilles 105 **2090 ± 150**
Alt: 2375m (44° 4′ N, 7° 26′ E).

Ly-1261. Pied des Merveilles 106 **1100 ± 160**
Alt: 2370m (44° 4′ N, 7° 26′ E).

General Comment (H de L): all dates which evidently post-date engravings and occurred from end of antiquity to the early middle ages. During that period some peaty soils formed and persisted in these high alt. Soils probably rejuvenated either at times by advance of moraine névé, or continuously by persolation of organic matter (Beaulieu, 1976). Presence of *Olea* at Lac du Trem (Ly-1252) and Les Merveilles valley fits well with late Sub-Atlantic age of sediment. However, diagram corresponding to Ly-1260 shows late Sub-Atlantic pollen spectra much younger than 2090 BP, explained either by percolation of pollen or older wood embedded and decomposed in peaty sediments. Ly-1261 seems too young because of absence of *Olea* but presence of Picea and Abies suggest 2000 to 3000 BP.

Ly-1137. Baïssescure 572, 90-95, Murat sur Vèbre, Hérault **3700 ± 130**

Peat from 90 to 95cm depth in Braïssescure peat bog near Murat sur Vèbre, Hérault (43° 33′ N, 2° 48′ E). Coll 1972 and subm 1973 by J L de Beaulieu, Lab Bot Hist, Univ Marseille. At that level pollen, diagram shows maximum of *Fagus* curve. *Comment* (JL de B): agrees with expected age. Beginning of *Fagus* was previously dated at 100 to 105cm depth in same boring (R, 1975, v 17, p 9), Ly-777: 4720 ± 150.

Ly-1030. Praveilles, La Versanne, Loire **6720 ± 160**

Peat from 1.20cm at base of peat bog at 1000m alt on gentle slope near crest line of Le Pilat massif near La Versanne, Loire (45° 21′ N, 4° 30′ E). Coll and subm 1975 by A M Domenach and N Gilet, Lab d'écol végétale, Univ Lyon. *Comment* (AMD & NG): indicates beginning of Atlantic period; agrees with date of pollen analysis which shows species characteristic of Boreal (*Quercus, Corylus, Pinus,* and *Betula*) assoc with species resembling Atlantic more closely (*Tilia, Abies,* and *Fagus)* (Domenach and Gilet, 1974). Previous dates from Central Massif, Le Pont de Clamouse: Gif-1162: 4100 ± 130 (R, 1972, v 14, p 307) and from Les Cevennes Massif, Baïssescure: Gif-1104: 6000 ± 150 (R, 1972, v 13, p 235).

Lac de Saint-Léger series, Montclar, Alpes de Haute Provence

Samples from levels in peat bog in Saint-Léger lake near Montclar Alpes de Haute Provence (44° 25′ B, 6° 20′ E). Coll 1973 from boring in middle of lake, except Ly-724, which comes from boring made in 1972 at side of lake and subm by J L de Beaulieu.

Ly-1285. Saint-Léger 973, 120-130 **1760 ± 130**

Clayey peat from 120 to 130cm depth. Coll with "Smith" drill and subm 1975. Pollen diagram shows destruction of the *Alnus* forest by man.

Ly-1332. Saint-Léger 973, 330-335 **2800 ± 120**

Peat from 330 to 335cm depth. Coll with "Smith" drill and subm 1976. Pollen show settlement of a *Alnus* forest on lake side.

Ly-1286. Saint-Léger 973, 335-345 **2770 ± 220**

Peat sample from 335 to 345cm depth. Coll with "Smith" drill and subm 1975. 2.5/3 sample diluted. Same pollen event as previous.

Ly-1287. Saint-Léger 973, 445-450 **3310 ± 140**

Peat from 445 to 450cm depth. Coll with "Smith" drill and subm 1975. Pollen diagram indicates a slight increase of *Fagus* (continuous curve) and presence of *Larix,* indicating climatic phase of human influence.

Ly-1288. Saint-Léger 973, 595-600 **5580 ± 160**

Peat from 595 to 600cm depth. Coll with "Smith" drill and subm 1975. *Abies* maximum.

Ly-724. Saint-Léger 972, IV, 170-180 5860 ± 180

Peat from 170 to 180cm depth. Coll with "Couteau" drill and subm 1972. Same pollen as the previous sample but from another profile.

Ly-1138. Saint-Léger 973, 660-675 8400 ± 220

Gyttja from 660 to 675cm depth. Coll with "Hiller" drill and subm 1973. Pollen diagram shows Boreal increase of forest of supramediterranean oak.

Ly-1139. Saint-Léger 973, 685-700 9330 ± 430

Gyttja from 685 to 700cm depth. Coll with "Hiller" drill and subm 1973. Pollen diagram shows extension of *Betula, Quercus* and *Corylus.*

Ly-963. Saint-Léger 973, 745-758 12,520 ± 360

Gyttja from 745 to 758cm depth. Coll by "Hiller" drill and subm 1973. Pollen diagram shows a 1st increase of *Pinus.* 1/2 sample diluted.

General Comment (JL de B): all dates agree with pollen diagrams. Thin layer of sediments prevents accuracy at Bölling and Alleröd levels and makes interpretation of Ly-963 fairly difficult.

Le Forest 972 series, Saint-Etienne en Dévoluy, Hautes Alpes

Peat from 3 levels in boring in Le Forest peat bog near Saint-Etienne en Dévoluy, Hautes-Alpes (44° 38′ N, 5° 57′ E). Coll 1972 and subm 1974 by J L Beaulieu.

Ly-1144. Le Forest 972, 65-70 5100 ± 150

From 65 to 70cm depth, decline of *Abies.*

Ly-1143. Le Forest 972, 120-125 7570 ± 190

From 120 to 125cm depth, above beginning of *Abies.*

Ly-1142. Le Forest 972, 140 8440 ± 320

From 140cm depth, under beginning of *Abies.*

General Comment (JL de B): confirms previous date from 130 to 140cm depth in same boring: Ly-782: 8310 ± 180 (R, 1975, v 17, p 10) for beginning of *Abies* at site. Seems to contradict 2 dates on same site (Wegmüller, 1975) giving ca 5000 for same pollen event.

La Selle di Carnino series, Ponte di Nava, Prov di Coni, Italy

Peat from several levels in 2 borings in a small peat bog at alt 2090m at La Selle di Carnino near Ponte di Nova, Prov Coni, Italy (44° 9′ N, 7° 41′ E). Coll 1973 and subm 1974 by J L de Beaulieu. Valley is close to Les Merveilles Valley. Layer of coarse colluvium caused by collapse of a nearby cliff occurs between 1.80 and 2.10m depth. Measurements were taken to date underlying tardiglacial sediment and Holocene overlying sediment.

Ly-1203. Le Selle di Carnino, 50-55 550 ± 140

From 50 to 55cm depth, coll with "Smith" drill. Pollen diagram shows *Abies* maximum at upper level.

Ly-1204. Le Selle di Carnino, 105-110 **990 ± 250**

From 105 to 110cm depth, coll with "Smith" drill. Preponderance of *Abies*. 1/3 sample diluted.

Ly-1140. La Selle di Carnino, 175-180 **6960 ± 160**

From 175 to 180cm depth, overlying colluvial layer, coll with "Couteau" drill.

Ly-962. La Selle di Carnino, 210-216 **9610 ± 170**

From 210 to 216cm depth, underlying colluvial layer, coll with "Couteau" drill.

Ly-1141. La Selle di Carnino, 218-226 **10,330 ± 210**

From 218 to 226cm depth, coll with "Couteau" drill.

General Comment (JL de B): both 1st dates indicate peat growth was faster since last millennium although it was fairly slow before. Collapse might be at end of Pre-Boreal period if no erosion of sediments younger than Ly-962 is assumed.

Sabion series, Tende, Alpes Maritimes

Gyttja from lower part of boring in Sabion peat bog at Tende, Alpes Maritimes (48° 8′ N, 7° 28′ E). Coll and subm 1974 by J L de Beaulieu. Two measurements made to locate cold phase which appears in sediments but not in pollen diagram.

Ly-1145. Sabion 240-248 **10,380 ± 400**

From 240 to 248cm depth, above cold sediments. 1/3 sample diluted.

Ly-1146. Sabion 250-255 **9340 ± 450**

From 250 to 255cm depth, under cold sediments. 1/3 sample diluted.

General Comment (JL de B): both dates are inverted according to stratigraphic order but in the 2σ range. Cold climate should then be located at beginning of Pre-Boreal (ca 10,000). Pollution of layers remains a possibility.

Ly-1284. Le Col Bas B 75, 455-460,
Le Lauzet, Alpes de Haute Provence **9750 ± 200**

Clayey peat from 455 to 460m depth in peaty part of small, high-alt lake, ca 2050m, at Le Col Bas near Le Lauzet, Alpes de Haute Provence (44° 23′ N, 6° 48′ E). Coll and subm 1976 by J L de Beaulieu. At this level, pollen diagram shows increase of *Pinus* after Late Dryas and before supposed decrease in Pre-Boreal phase. *Comment* (JL de B): agrees with expected date. Date confirms that decrease of arboreal pollen occurred in Pre-Boreal.

Col des Lauzes series, Freissinières, Hautes Alpes

Sample from several levels in Col des Lauzes peat bog near Freissinières, Hautes-Alpes (44° 46′ N, 6° 15′ E). Coll with "Smith" drill and subm 1975 by J L de Beaulieu.

Ly-1234. Col des Lauzes 775, 45-50 2980 ± 130

Peat from 45 to 50cm depth. Increase of *Larix* due to deforestation.

Ly-1279. Col des Lauzes 775, 190-195 5680 ± 170

Peat from 190 to 195cm depth. Great increase of *Abies*.

Ly-1280. Col des Lauzes 775, 280-285 7510 ± 150

Peat from 280 to 285cm depth. Slight appearance of *Abies*.

Ly-1281. Col des Lauzes 775, 372.5-377.5 9860 ± 200

Peaty clay from 372.5 to 377.5cm depth. Maximum and preponderance of *Betula*.

Ly-1282. Col des Lauzes, 382-387 10,870 ± 330

Clayey gyttja from 382 to 387cm depth. 1/2 sample diluted. End of 2nd extension of *Juniperus* and of steppe species.

Ly-1333. Col des Lauzes 775, 387-392 11,160 ± 320

Clayey gyttja from 387 to 392cm depth. 2 5/3 sample diluted. Middle of 2nd extension of *Juniperus* and of steppe species.

Ly-1283. Col des Lauzes 775, 392.5-397.5 11,800 ± 340

Clayey gyttja from 392.5 to 397.5cm depth. 2/3 sample diluted. Beginning of 2nd extension of *Juniperus* and of steppe species.

Ly-1334. Col des Lauzes 775, 403-410 11,730 ± 200

Clayey gyttja from 403 to 410cm depth. Middle part of level corresponding to *Pinus* maximum.

Ly-1209. Col des Lauzes 775, 415-420 13,060 ± 270

Clay from 415 to 420cm depth. End of increasing curve of *Pinus*.

Ly-1210. Col des Lauzes 775, 424-428 13,750 ± 450

Clay from 424 to 428cm depth. 1/2 sample diluted, 1st maximum of *Juniperus* extension.

General Comment (JL de B): dates from peaty layers agree with date from pollen analyses. In clay, dates could be ca 300 or 400 yr too old compared with other dates of region. Ly-1283, which has a large statistical margin, is much older for unknown reasons.

Ly-1245. Lac de l'Huile I, Tende Alpes Maritimes 7520 ± 210

Clay with many vegetal remains from 20 to 40cm depth in basal sediments of small, high-alt lake, 2281m, Lac de l'Huile, near Saint Dalmas de Tende, in Les Merveilles valley, Alpes Maritimes (44° 3′ N, 7° 26′ E). Coll and subm 1975 by J L de Beaulieu. Slightly lower alt than Les Merveilles lakes, above. This lake seems permanent. Level underlies a light gray clayey layer which seems to mark end of periglacial influences in region. Expected age: Boreal. *Comment* (JL de B): pollen analysis suggests very slow deposition of sediment. Date may correspond to average value of a long period. Organic sedimentation probably began at Pre-Boreal, as at Lac Mouton, below.

Lac Mouton 875 series, Tende, Alpes Maritimes

Samples from several levels of boring in basal sediments of high-alt lake, 2266m, Lac Mouton, near Tende, in Les Merveilles valley, Alpes Maritimes (44° 4′ N, 7° 27′ E). Coll and subm 1975 by J L de Beaulieu.

Ly-1247. Lac Mouton 875, 70 3000 ± 160

Fragment of wood from 70cm depth embedded in sediments. May date large deforestation phase.

Ly-1248. Lac Mouton 875, 115-120 8220 ± 200

Peaty clay from 115 to 120cm depth. *Abies* beginning.

Ly-1249. Lac Mouton 875, 125-130 7930 ± 170

Peaty clay from 125 to 130cm depth, just before beginning of *Abies*.

Ly-1246. Lac Mouton 875, base 9340 ± 240

Peaty clay from base of boring.

General Comment (JL de B): all dates agree with age forseen by palynologic data and as compared with Lac Long-Inferieur series, below. 8000-8100 BP is more likely for beginning of *Abies* than Ly-1240 and -1239. Sedimentation in lake probably began before Pre-Boreal phase (Ly-1246) because an older layer, according to pollen diagram (Late Dryas) was found at base of nearby boring in same lake.

Lac Long Inférieur 875 series, Tende, Alpes Maritimes

Sample from boring in sediments of high-alt lake, Lac Long Inferieur, near Tende, in Les Merveilles valley (44° 4.5′ N, 7° 27.5′ E). Coll and subm 1975 by J L de Beaulieu. All samples come from same boring (875-S4), except Ly-1238, from nearby boring (875-S5) to check Ly-1208.

Ly-1244. Lac Long Inférieur 875, 40-45 2660 ± 190

Peaty silt from 40 to 45cm depth, cereal pollen maximum. 2/3 sample diluted.

Ly-1243. Lac Long Inférieur 875, 60-65 3740 ± 160

Peaty silt from 60 to 65cm depth, beginning of *Plantago*.

Ly-1242. Lac Long Inférieur 875, 80 4770 ± 300

Peat from 80cm depth, beginning of *Fagus*; relatively large error due to counting uncertainty (evaporation of benzene sample).

Ly-1241. Lac Long Inférieur 875, 100-105 5670 ± 170

Peat from 100 to 105cm depth, beginning of large increase of *Abies*.

Ly-1240. Lac Long Inférieur 875, 130-135 8730 ± 220

Peaty silt from 130 to 135cm depth, beginning of *Abies*.

Ly-1239. Lac Long Inférieur 875, 140-145 9330 ± 220

Peat from 140 to 145cm depth, just before beginning of *Abies*.

Ly-1238. Lac Long Inférieur 875, 285-294 10,310 ± 230

Peaty silt from 285 to 294cm depth, in boring in central part of lake. Increase of *Betula*.

Ly-1208. Lac Long Inférieur 875, G 11,270 ± 230

Peat from 212 to 217cm depth, same level as Ly-1238, according to pollen diagrams.

Ly-1207. Lac Long Inférieur 875, F 10,430 ± 210

Peaty silt from 217 to 225cm depth, large decrease of NAP (non-arboreal pollen).

Ly-1206. Lac Long Inférieur 875, E 10,970 ± 210

Peaty silt from 225 to 235cm, beginning of decrease of NAP.

Ly-1205. Lac Long Inférieur 875, D 12,040 ± 370

Peaty silt from 235 to 245cm depth, end of *Pinus* maximum. 2/3 sample diluted.

Ly-1237. Lac Long Inférieur 875, C 12,170 ± 280

Peaty silt from 245 to 255cm depth, middle of *Pinus* maximum.

Ly-1236. Lac Long Inférieur 875, B 12,510 ± 370

Slightly peaty silt from 255 to 255cm depth. Beginning of *Pinus* maximum. 2/3 sample diluted.

Ly-1235. Lac Long Inférieur 875, A 13,460 ± 410

Slightly peaty silt from 266 to 278cm depth, increasing curve of *Pinus*. 2/3 sample diluted.

General Comment (JL de B): measurements taken to establish chronology of several pollen diagrams in sediments of this lake, important because it is at outlet of Les Merveilles valley. All results, except Ly-1208, are coherent and indicate fairly constant sedimentation rate, ca 20cm/millennium. However Ly-1240 and -1239 are 1000 yr too old, for unknown reason. A Louvain lab measurement on sample from another boring and correlated by pollen with these 2 last values, is more consistent: Ly-517: 7410 ± 120 (de Beaulieu, 1974). On the other hand, comparison between Ly-1238 and -1208 shows that the latter is obviously out of general trend of data, and remains questionable. Relatively great age, probably beginning of Bölling, of deepest layer indicates a glacier retreat very early in Tardiglacial (Würm IV) even at this high alt. Also, all earliest dates, from Ly-1207, are a little older than climatic phase suggested by pollen data; they only fit using a 2σ strastistical range but always in the same direction, which seems to correlate with low organic content of samples. It is simpler, but questionable, to assume presence of older carbonaceous material in sediments;; up to now, discrepancy between dates and pollen results could be more satisfactorily explained but studies are being made on other profiles (de Beaulieu and Evin, 1977).

C. Samples from Holocene fluvial, periglacial, and glacial sediments

Ly-1106. Tourette-Levens, Alpes Maritimes **Modern $\Delta^{14}C = 4.6\% \pm 2.6$**

Bone from thick Late Quaternary sediments, discovered during road building at Tourette-Levens, Alpes Maritimes (43° 47′ N, 7° 17′ E). Coll 1975 by F Irr and subm 1975 by C Guérin, Geol Dept, Univ Lyon. Fauna may be either Holocene or Late Würm. *Comment* (CG): despite its relative depth, bone is very recent.

Grand'Maison series, Vaujany, Isère

Wood from peat in upper alluvium of Eau d'Olle R, at alt 1560m, Grand'Maison dam, near Vaujany, Isère (45° 12′ N, 5° 7′ E). Coll and subm 1975 by Division Geol, Electricité de France, Paris.

Ly-1013. Grand'Maison no. 1 **1390 ± 220**

Ly-1014. Grand'Maison no. 2 **2410 ± 130**

General Comment (EDF): considering apparent age of wood when buried, both dates confirm each other and show that alluvial filling of Eau d'Olle R valley is relatively recent.

Ly-1010. Foce del Fiume Fortore, Serracapribla, Prov di Foggia, Italia **4450 ± 130**

Shells (*Helix*) from dune on edge of coastal plain, 2.5km from sea, at mouth of Fortore R, near Serracapribla, Prov Foggia, Italy (41° 54′ N, 15° 26′ E). Coll 1974 by G Dai Pra and subm 1974 by G Magri. *Comment* (GM): despite uncertainty of original ^{14}C value, dates gives Holocene age to deposits which crop out on coastal plain (Kelletat, 1974).

Ly-1310. Ponte del Torrente Correntino, Carpino, Prov di Foggia, Italia **2120 ± 180**

Charcoal from fluvial sediment 2m deep on S side of Varano lake, 200m W of bridge of Correntino torrent, near Carpino, in Gargano headland, Pov Foggia, Italy (41° 52′ N, 15° 50′ E). Coll 1975 by C Carrara and G Dai Pra and subm by C Magri. Sample coll in sandy silt and brown clay containing lithic industry and overlying Würmian alluvial deposits (Mancini & Palma di Cesnola, 1967). *Comment* (GM): date confirms expected Holocene age of top sediments.

Ly-1056. La Maison Blanche, Fontenay sur Loing, Loiret **1830 ± 300**

Wood embedded in clay from 1m depth in alluvial valley of Loing R, at La Maison Blanche, near Fontenay sur Loing, Loiret (48° 20′ N, 2° 46′ E). Coll and subm 1974 by J Allain, Dir Antiquités Préhist Centre, Bourges. *Comment* (JA): much younger than position of clay indicates, overlying basal gravels in valley.

Ly-1176. Vaux, Saint-Victor de Cessieu, Isère **1170 ± 130**

Charcoal embedded in clay of paleosol overlain by drift-stones which may represent moraine at Vaux near Saint Victor de Cessieu, Isère (45° 32′ N, 5° 25′ E). Coll and subm 1974 by G Monjuvent, Inst Dolomieu, Univ Grenoble. *Comment (*GM): confirms another date from another sample from same site: Gif-3286: 890 ± 70 (unpub). Interglacial or interstadial date was expected, and it is difficult to explain presence of recent charcoal under moraine-like material. Either a wide landslide or an artificial earthwork may be assumed but not proven on the grounds that stratigraphic contacts seem normal.

Ly-1054. Vanvay, Côte d'Or **4710 ± 300**

Small fragments of charred pine resin found scattered between 1.25 to 1.50m depth in Holocene sediment at Vanvey, Côte d'Or (47° 50′ N, 4° 43′ E). Coll and subm by J J Puissegur. Sediment seems to be formed from underlying cryoclastic slope-sand. *Comment* (JJP): Atlantic age, concurring with ecol data of assoc malacologic fauna (Puisségur, 1976).

Ly-1311. Les Menuires, Saint-Martin de Belleville, Savoie **4010 ± 160**

Wood from 1m depth in small peat-bog downstream from Thorens Glacier at Les Menuires, near Saint-Martin de Belleville, Savoie (45° 22′ N, 6° 30′ E) (Vivian, 1975). Coll and subm 1976 by R Vivian, Inst Géog Alpine, Univ Grenoble. *Comment* (RV): agrees with previous date, Ly-891: 4470 ± 150 (R, 1976, v 18, p 64) from same Les Belleville valley. Confirms presence of ancient arboreal vegetation in valley at high alt. Vegetation was probably fairly extensive, judging from, > 50cm dia of tree trunk.

Ly-1299. Le Terrieu, Valflaunès, Hérault **Modern** **$\Delta\,^{14}C = 1.6 \pm 1.6\%$**

Fragment of tree trunk (*Quercus*), found uprooted in alluvium from side of Le Terrieu R at foot l'Hortus Mt, near Valfaunès, Hérault (43° 47′ N, 3° 51′ E). Coll and subm 1975 by M Archambault, Inst Etudes Ligériennes, Univ Orléans. *Comment* (MA): proves recent age for fossilization of wood, which means terrace or assoc erosion glacis cannot be dated.

Ly-763. La Couronne, Alba la Romaine, Ardèche **290 ± 110**

Wood from 0.40m depth in colluvium of erosion glacis at lowest part of Valvignière depression at La Couronne, near Alba La Romaine, Ardèche (44° 31′ N, 4° 34′ E). Coll and subm 1972 by M Archambault. *Comment* (MA): indicates wood was embedded in recent landslide and cannot be used for dating all erosional landforms.

Ly-1300. Cebette, La Roche Saint-Secret, Drôme **540 ± 350**

Fragment of charred wood embedded in sandy, clayey gravel sediments from bedded "grèze", partly overlying low terrace of Le Lez R at Cébette near La Roche Saint-Secret, Drôme (44° 27′ N, 6° 1′ E). Coll and subm 1976 by M Archambault. Very diluted: 0.7/3 sample. *Comment* (MA): date of end of Tardiglacial (Late Würm) was expected. Date proves that material older than grèze can be redeposited.

Ly-1183. Lavars, Isère **Modern** **Δ ¹⁴C = −2.1% ± 1.4**

Wood from detrital filling of a small thalweg cut in lacustrian sands of Würmian ancient lake of Le Trièves near Lavars, Isère (44° 51′ N, 5° 40′ E). Coll and subm 1975 by M Archambault. The wood may either date filling which might be recent or mark a Late Würm stadial during which erosion of lacustrina sediments began. *Comment* (MA): date only proves that thalweg filling is recent.

Ly-1032. Chabulière, Percy, Isère **2710 ± 230**

Charcoal from mudflow, 20m above and 200m beyond moraine, between Chabulière and Les Blancs, near Percy, Isère (44° 48′ N, 5° 38′ E). Coll and subm 1974 by M Archambault. *Comment* (MA): landslide is contemporaneous with beginning of Iron age.

Darne series, Chichilianne, Isère

Wood from 2 levels in fluvio-glacial cone of ancient glacier of Donnière, dug by Darne-Orbannes R near Chichilianne, Isère (44° 50′ E). Coll and subm 1975 by M Archambault.

Ly-1202. Darne No. 2 **7700 ± 180**

Wood from a tufa overlapping cone.

Ly-1201. Darne No. 1 **7940 ± 190**

Wood from clayey level with calcareous gravels 2m below tufa, presumably in youngest part of cone. Expected age: Würm III or IV.

General Comment (MA): Ly-1201 proves that wood is not contemporaneous with cone and is in statistical range of Ly-1202 which, as expected, dates tufa as recent.

Ly-1298. Luc en Diois, Drôme **10,350 ± 240**

Wood rooted in clayey layer of left side of La Drôme R near Luc en Diois, Drôme (44° 37′ N, 5° 27′ E). Coll and subm 1975 by M Archambault. *Comment* (MA): dates low terrace of la Drôme R and assoc erosion glacies, to beginning of Postglacial. Another measurement from similar site 20km downstream gave a similar age, Gif-2218: 11,150 ± 250 (R, 1974, v 16, p 67).

D. Samples from Würmian glacial, periglacial, and lacustrine sediments

Les Cèdres series, Salignac, Alpes de Haute Provence

Fragments of wood embedded in silty fluviatile sands overlying Würmian terrace of La Durance R at Les Cèdres near Salignac, Alpes de Hautes Provence (44° 15′ N, 5° 58′ E). Coll and subm 1975 by J L de Beaulieu and J Tiercelin. Samples found in 2 neighboring secs.

Ly-1290. Les Cèdres de Salignac 2 **13,800 ± 250**

From 1.65 to 2m depth in clayey sandy level. Pollen analysis shows preponderance of *Hippophar thammoïdes,* indicating settlement of pioneer vegetation on Würmian terrace.

Ly-1289. Les Cèdres de Salignac 1 **14,230 ± 290**

Wood found rooted in gray clayey level, from 4.15 to 4.45m depth. Pollen analysis shows dominance of *Pinus sylvestris,* indicating settlement of forest.

General Comment (JL de B): both dates are in statistical range. Bölling interstadial suggested by pollen analyses is unlikely; it is more probably pre-Bölling. Dates confirm early inception of arboreal vegetation in region.

Le Villard series, La Baume, Hautes Alpes

Wood from 2 tree trunks rooted in clayey layers, interstatified in gravelled formations at Le Villard near La Balme, Hautes Alpes (44° 34′ N, 5° 41′ E). Coll 1967 and subm 1973 by M Archambault. Both samples were counted with 10ml benzene and 1ml scintillating toluene in specially shielded spectrometer.

Ly-873. Le Villard No. 9 **40,300 ± 1100**

Ly-874. Le Villard No. 9bis **42,900 ± 900**

General Comment (MA): values are in statistical range. They confirm two previous dates, Gif-1138: ⩾ 35,000, and I-5022: 37,000 ± 2900 Archambault, 1969) and a new one: GrN-7574: 46,400 +2100, −1600 (unpub). These formations might be Würm II, which means a recent age for intersecting glacis.

Achenheim series, Bas Rhin

Charcoal from top of lehm layer, called "Le Grand Lehm noir", interstratified in Hurst loess quarry at Achenheim, Bas Rhin (48° 34′ N, 7° 37′ E). Coll and subm 1972 and 1973 by A Thevenin, Dir Antiquités Prehist, Alsace. No assoc industry. Level may correspond either to Riss-Würm interglacial (Wernert, 1957) or to Early interstadial (Bordes, 1960; Thevenin, 1973; 1976) which seems more likely.

Ly-761. Achenheim 1 **$36,700\,^{+2200}_{-1700}$**

Normal treatment and counting with 3ml benzene.

Ly-1276. Achenheim 2 **> 43,500**

Very careful treatment and counting with 3/4 sample and 1/4 dead benzene in 10ml benzene.

General Comment (AT): Ly-761 suggested Würm II/III interstadial which might be possible, but Ly-1276 shows more careful treatment eliminated contamination more effectively and samples may be as old as Würm I/II interstadial or even older.

E. Samples from marine and lagoonal sediments

Sant Agata di Militello series, Provincia di Messina, Italia

Charcoal from fluvial sands at 2 sites near Sant Agata di Militello, Prov Messina, Italy (38° 2′ N, 14° 10′ E). Coll 1974 by D Robillard and subm 1975 by G Duée, Univ Lille.

Ly-1051. Torrecandele DD70 **1400 ± 130**

Ly-1052. Santa Anna DD163 **380 ± 110**

General Comment (DR): much younger than expected. Date shows very recent stream channel brought charcoal and redeposited fluvial sands overlying terrace (Robillard, 1975).

Lac Retba series, Sénégal

Samples from 2 places on Retba lakeside, 28km NE of Dakar, Sénégal (14° 50′ N, 17° 13′ W). Subm by P Elouard, Dept Geol, Univ Lyon.

Modern

Ly-1278. Lac Retba WS 51 **Δ ^{14}C = +5.4% + 3.0**

Vermetius adansoni Daudin from S side of lake encased in calcareous vesicular crust, forming nodular concretions, lying at base of lake, under 3m water, at alt −5m (bsl). Coll 1975 by L Hebrard and subm 1975. *Vermetus adansoni* live on marine littoral in intertidal zone before waves, in very aerated conditions. Their geol position thus indicates real marine episode for region but at a level lower than actual sea level. This occurred either at beginning of Nouakchottian, when sea level rose, ca 7000, or during a short fluctuation Post-Nouakchottian, ca 4000. High ^{14}C count of old shells may ensue from isotopic exchange between carbonates of surface of shells and bicarbonates of lake water, enriched by considerable evaporation. Because shells were too thin, usual pretreatment was impossible. *Comment* (PE): influence of bomb radiocarbon is evident and obviously does not agree with paleoecol data of Lake Retba, which was a gulf when *Vermetus adansoni* were living, and is now highly saline lake. Date demonstrates difficulty of radiocarbon dating thin, unburied shells.

Modern

Ly-1274. Lac Retba WS 51 **Δ ^{14}C = −1.7% + 1.6**

Sandy clay with montmorillonite and large amount of organic matter from NW side of lake. Coll and subm 1976. Level is overlain by sandy terrace with marine shells. *Comment* (PE): As clay could not have been redeposited, overlying shells must be secondary deposit from offshore bars previously dated ca 1000: see 6 Ly dates (R, 1976, v 18, p 68). Such redeposition is probably due to heavy storm of present lake, because layer consists solely of lightest shells of ancient offshore bar.

Ly-1275. Lac Tanma, WS 55, Sénégal **5410 ± 170**

Radiorotula orbiculus Blainv from W side of Tanma lake, 45km NW Dakar, Sénégal (14° 54′ N, 17° 5′ W). Coll and subm 1976 by P Elouard.

Samples coll in layer with sea urchins indicating fully marine conditions which may be attributed to Nouakchottien, ca 5500 in Sénégal and Mauritania. *Comment* (PE): agrees with attribution, confirms previous measurement: Ly-890: 2630 ± 110 (R, 1976, v 18, p 68) from overlying layer which contains *Arca senilis* L, marking coastal marine or lagoonal conditions of end of Nouakchottien. Level with *Echinides* indicates fully open gulf at maximum of transgression.

Sondage du delta du fleuve Sénégal series, Sénégal

Clayey peat from 2 borings in N delta of Sénégal R near Debi, Sénégal. Coll 1970 by M. Audibert and subm 1976 by J Monteillet, Inst Fondamental d'Afrique Noire, Dakar. Peat layers embedded in sandy clayey layers with shells presumably Tchadian, 11,000 to 7000 = Early Holocene. Overlying clay and clayey sand seem to be late Tchadian. Underlying sands with flakes of mica and red dune-sand may represent base of Tchadian and Ogolian, end of Würm in Europe, respectively.

Ly-1269. Sondage Eudoxie FL 1 **8870 ± 240**

From 25m depth, −23m, in Eudoxie Fl 1 boring at Debi (16° 30′ N, 16° 17′ W).

Ly-1270. Sondage Lea Fl 2 **8450 ± 220**

From 22.5m depth, −20.5m, in Lea Fl 2 boring 4km NW Debi (16° 34° N, 17° 10′ W).

General Comment (JM): dates confirm Early Holocene attribution (Monteillet & Evin, 1977), and agree with data of Ogolian sea level rise and with data on humidity of climate in Sahara (Elouard, 1973).

F. Samples from miscellaneous origins

Ly-1103. Tarfaya, Morocco **1100 ± 120**

Camel's jaw bone from Neolithic site at Tarfaya, Morocco (27° 56′ N, 12° 58′ W). Coll 1974 by N Petit-Maire and subm 1975 by J Bouchud, Inst Paleontol Humaine, Paris. Camel presumably disappeared from Africa from Paleolithic to Roman periods. *Comment* (JB): dates proves that bone cannot belong to Neolithic layer in which it was buried; paleontol problem about camel's possible existence during Neolithic is not solved.

Le Trou des Cervidés series, Gex, Ain

Bones found on heap of rocks at base of deep limestone have, "Le Trou des Cervidés", open on side of Le Mont Rond near Gex, Ain (46° 20′ N, 6° 1′ E) at alt 1500m. Coll 1952 by E Pellaton and subm 1974 by L Chaix, Dept Anthropol, Univ Geneva. Measurements part of contribution to general review of all fauna found in such a condition in W Switzerland.

Ly-1186. Le Trou des Cervidés Cerf **3700 ± 140**

Bones of deer.

Ly-1187. Le Trou des Cervidés Elan **4180 ± 140**

Bones of elk.

General Comment (LC): both dates are almost in statistical range and indicate that fauna found inside grotto (Revillod, 1953) is fairly homogeneous: animals fell into cave at end of Late Neolithic period

Ly-1185. Gouffre de la Dent d'Oche, Novel, Haute Savoie **6800 ± 170**

Bones from base of limestone cave open in SE side of La Dent d'Oche Mt, near Novel Haute-Savoie (46° 21′ N, 4° 24′ E). Coll 1973 by P Dardilly and subm 1974 by F Baud, Mus Hist Nat, Geneva. Six skeletons of *Ursus arctos* L were found in grotto. One, lying near entrance, is recent (Baud, 1975); the 5 others, lying further inside, are ancient and more recent date, was suggested because of preservation. *Comment* (FB): dates prove age was underestimated and bears used grotto as hibernation shelter for a long time.

Zawiyah series, Lybie

Calcium carbonates from Quaternary fixed dunes at Zawiyah, Lybia (32° 40′ N, 12° 44′ E). Coll and subm 1974 by A Legall, SOGREAH soc, Grenoble.

Ly-923. Zawiyah encroutement **5540 ± 250**

Calcic crust from some interdunal depressions. More probable age range, with ^{14}C original value = 80% NBS: 3790 ± 290. 1/2 sample diluted.

Ly-924. Zawiyah nodule **4690 ± 110**

Calcareous nodules from same depth, inside dunes. More probable age range, with ^{14}C original value = 80% NBS: 2920 ± 130.

General Comment (AL): both dates seem to indicate that calcic crust and nodules are contemporaneous, or subjected to same isotopic exchange. This approx age suggests former presence of ground water near present soil.

II. ARCHAEOLOGIC SAMPLES

A. Historic period

Ly-1291. Viremont, Jura **840 ± 140**

Wood from 2.5m depth in morainic sediments at Viremont, Jura (46° 26′ N, 5° 38′ E). Coll 1973 and subm 1975 by M Jacquemin, Moirans en Montagne, Jura. Wood is presumably from base of ancient well probably from Bronze age. *Comment* (MJ): younger than expected but possible because hollowed-out trees remained in use as water collector at base of well from Metal ages or Roman periods, such as well of salt fountain of Saint-Père lès Vezelay, Yonne. Date assoc wood with Middle age habitation.

Ly-1301. Princay, Vienne **1170 ± 140**

Human bone from peculiar sarcophagus found near church of Princay, Vienne (46° 18′ N, 0° 17′ E). Coll 1974 by M Delaroche, Loudun and subm 1975 by B Guillet, Centre Pédol, Vandoeuvre lès Nancy. At 3km from Princay is the presumed Merovingian necropolis of Dercé, but sarcophagus may also come from Carolingian or Capetian time. *Comment* (BG): skeleton may be either from beginning of Carolingian time, AD 780, or from end of Merovingian, as expected.

Ly-1157. La Grave, Hautes Alpes **1280 ± 150**

Human bones from 4 isolated graves near La Grave village, Hautes Alpes (45° 3′ N, 6° 18′ E) in high valley of La Romanche R, at alt 1500m. Coll, subm, and treated in radiocarbon lab by J P Depardon, Dept Geol, Univ Lyon. No assoc industry nor documentation of graves, which may date from ca AD 400 to 1600. *Comment* (JP D): graves are of Early Middle age.

Ly-1224. Les Fous, Izieux, Ain **1310 ± 150**

Human bones from isolated grave at 0.6m depth at Les Fous near Izieux, Ain (45° 39′ N, 5° 38′ E). Coll and subm 1975 by M Dunand and R Vilain, Dept Geol, Univ Lyon. Type of grave is called "Burgonde", probably Early Middle age, but graves might have been re-used later. *Comment* (MD): agrees with expected age for this type of grave. A possible 2nd use could only have occurred shortly after grave was dug.

Ly-1223. Géligneux, Murs et Géligneux, Ain **1350 ± 120**

Human bones from isolated grave from 1.20m depth at Géligneux, Ain (45° 39′ N, 5° 39′ E). Coll 1975 by A Juillar and subm 1975 by R Vilain. This "Burgonde" grave (Morel & Demetz, 1961) presumably belonged to former Early Middle age cemetery. *Comment* (RV): date agrees with expected age and with neighboring site, Les Fous d'Izieux, above.

Ly-1133. Jonqueirolle, Bollène, Vaucluse **1610 ± 130**

Charcoal from Layer 2 in Kiln 743 A in Jonqueirolle site near Bollène (44° 16′ N, 5° 45′ E). Layer is refuse portion of potter's workshop containing hardly known and poorly dated pottery, assumed by typology to date from Early Middle age. Site was occupied from Roman to end of Middle age. Archaeomagnetic date, made by Thellier's method, cannot be considered because kiln was turned around by bull-dozer. It indicated either middle of 1st Century AD or between AD 500 to 700. *Comment* (JT): considering a double standard deviation, ± 260, real date, ca 500, seems more possible and will be determined precisely by typology and thermoluminescence measurement.

Kanaris series, Oasis du Fayoum, Egypte

Charcoal or charred wood from boiler room and frigidarium of Greco-Roman bath at Karanis, Fayoum oasis, Egypt (29° 19′ N, 30° 50′

E). Coll and subm 1975 by G Castel, Inst Français Archéol Orientale, Cairo. The 3 samples presumably represent building period, lintel from frigidarium and last occupation, charcoal from boiler room, of site (El Nassery *et al,* 1976).

Ly-1268. Karanis Linteau **1340 ± 230**

From lintel of frigidarium niche. 2/3 sample diluted.

Ly-1266. Karanis Charbon de Bois **2110 ± 210**

From hearth in boiler room, upper layer, 9/10 sample diluted.

Ly-1267. Karanis Charbon de Bois **2690 ± 140**

Same place as above.

General Comment (GC): Ly-1268, lintel, corresponds to late repair of building, when it had not been used as frigidarium for a long time. One sample from boiler room indicates last occupation of bath, the other proves that some very old wood might have been used as combustible material, as previously assumed in Les Kellia Qouçur Isa site (see 2 Ly results: R, 1971, v 13, p 55).

Ly-1023. Pont de Tourenne C4, Capdenac le Haut, Lot **1780 ± 230**

Wood from mass of various Gallo-Romain remains, buried in ancient terrace in le Pont de Tourenne quarter, Part C4 in Capdenac le Haut site, Lot (44° 35′ N, 2° 4′ E). Coll 1973 and subm by A Sors, Figeac Lot. 1/3 sample diluted. Capdenac le Haut was presumably important Gallic camp besieged by Caesar in 52 BC during Roman conquest, and remained important fortress till end of Middle ages (Sors, 1971). *Comment* (AS): considering large statistical range, real date may be in last century BC.

B. Iron and Bronze ages period

Ly-1024. Ibos No. 3 **2500 ± 160**

Charcoal from sepulture of base of Moulin de Géline tumulus near Ibos, Hautes Pyrenées (43° 14′ N, 0° 11′ W) on Ger plateau. Coll 1964 and subm 1974 by R Coquerel, Tarbes. Assoc with industry that resembles late Bronze age, ca 2850, compared with Salies de Bearn site, dated ca 3100 (Ly-246 and -247: R, 1966, v 8, p 253, and Gif-394: R, 1970, v 12, p 241). Dated also to solve sampling problem that appeared after 2 previous measurements: Ly-660 and -661 (R, 1975, v 17, p 17) 1/3 sample diluted. *Comment* (RC): date is younger than expected and shows that Hallstatt civilization may have been delayed on Ger plateau. Date is close to Ly-660: 2460 ± 180, from sepulture in NE flank of tumulus, and proves that Ly-661: 2200 ± 260, origin of which was doubtful, came from another sepulture at top of tumulus assoc with La Tène II industry that also has some delayed character.

La Pièce au Loup series, Saint-Marcel, Saône et Loire

Charcoal from 2 places in La Saône riverside site, La Pièce au Loup, near Saint-Marcel, Saône et Loire (46° 46′ N, 4° 52′ E). Coll and subm

1975 by L Bonnamour, Mus Denon, Châlon sur Saône (Bonnamour, 1974).

Ly-1028. La Pièce au Loup III **2320 ± 190**

From Sq F9 and F10 at base of Hallstatt level, Layer III. 1/3 sample diluted. *Comment* (LB): much more recent than expected, ca 2550, generally assumed age for Hallstatt civilization. Date older than 2550 is possible because of contamination by outer, overlying Late Bronze age layer, while Gallo-Roman one, more consistent with date, lies 2m above.

Ly-1029. La Pièce au Loup I **2790 ± 120**

From Sq M13 at top of Hallstatt level, Layer I. *Comment* (LB): date indicates Late Bronze age and therefore possibility of redeposit from underlying sediments as suggested by mixing of archaeol material.

Ly-1229. Le Tumcher de Salival, Haraucourt sur Seille, Moselle **3240 ± 380**

Charcoal from filling of Tumulus 4 in Protohistoric necropolis Moyenvic at Le Tumcher de Salival, near Haraucourt sur Seille, Moselle (48° 49′ N, 6° 35′ E). Coll and subm 1974 by J M Prignon, Villers lès Nancy. Assoc with pottery industry attributed to Hallstatt period. *Comment* (JMP): date does not agree with expected age and involves redeposit of Bronze age material when tumulus was constructed.

Ly-1180. Bliesbrück, Moselle **2580 ± 210**

Charcoal from 1m depth in Layer 3, Pit A, Sand site at Bliesbrück, Moselle (49° 8′ N, 7° 11′ E). Coll 1973 and subm 1975 by C Guillaume, Dir antiquités préhist, Lorraine, Nancy. Assoc with Late Hallstatt industry. *Comment* (CG): almost agrees with expected age, indicates rather Middle Hallstatt. No other dates exists for this civilization in region.

Ly-1179. Dieue, Meuse **2340 ± 160**

Charcoal from 0.55m depth in Pit 3 of open-air site, Le Boular, at Dieue, Meuse (49° 4′ N, 5° 26′ E). Coll and subm 1975 by C Guillaume. Assoc with a Middle Hallstatt industry. *Comment* (CG): younger than it should be according to assoc industry.

Ly-1018. Rosheim, Bas-Rhin **2700 ± 120**

Charcoal from shallow hearth dug in loess, found in Helmbacher quarry at Rosheim, Bas-Rhin (48° 25′ N, 7° 26′ E). Coll 1973 by J Sainty and subm 1974 by A Thévenin, Dir Antiquités Préhist, Alsace. Assoc with graphitic ceramics of Early Hallstatt (Sainty *et al*, 1974). *Comment* (AT): agrees with generally accepted age of industry.

Ly-1017. Mundolsheim 1-73, Bas-Rhin **2500 ± 150**

Charcoal from shallow hearth discovered in the foundation of Montbert house at Mundolsheim, Bas-Rhin (48° 38′ N, 7° 42′ E). Coll 1973 by C Jeunesse and subm 1974 by A Thevenin. Assoc with graphitic ceramics of Early Hallstatt (Sainty *et al,* 1974). 1/3 sample diluted. *Comment*

(AT): date, ca 2700, similar to Ly-1018, was expected and can only be deduced by assuming a double standard deviation.

Les Rives de Thorey series, Saint-Germain du Plain, Saône et Loire

Charcoal from Sq B 91 in La Saône riverside site, Les Rives, at Le Thorey near Saint-Germain du Plain, Saône et Loire (46° 42′ N, 4° 57′ E). Coll and subm 1974 by L Bonnamour. Layer lies at top of filling of kiln assoc with Late Bronze IIIb industry (Bonnamour, 1973).

Ly-1026. Les Rives de Thorey, No. 1 — 2780 ± 230

2/3 sample diluted.

Ly-1027. Les Rives de Thorey, No. 2 — 2770 ± 260

1/2 sample diluted.

General Comment (LB): average of both values: Ly-1026/27: 2780 ± 170. Agrees with generally admitted age of industry.

Ly-1230. Puy Saint-André, Busséol, Puy de Dôme — 2780 ± 130

Bones from bottom of ancient hut at Le Puy Saint André, near Busséol, Puy de Dôme (45° 42′ N, 3° 6′ E). Coll 1975 and subm 1976 by L Tixier, Tourzel, Puy de Dôme. Assoc with ceramic industry of transition Late Bronze. Early Hallstatt period (Daugas & Tixier, 1975). *Comment* (LT): agrees with expected age from other region. There is no date from that period in Auvergne.

Ly-1098. Cheval d'Auvernier, Auvernier, Canton de Neuchatel, Suisse — 3190 ± 200

Horse bone found under 0.3m lacustrian chalk in Auvernier bay, in Neuchatel lake, Switzerland. Coll during underwater excavations 1972 and subm 1974 by B Arnold, Service Cantonal d'Archéol, Neuchatel. Bone belonged to almost complete skeleton lying across late palisade of coastal sta N Auvernier, of Late Bronze age, Habitat 2, according to Gerbach (Egloff, 1972). No stratigraphic connection with archaeol level could be made because of erosion of sediments. *Comment* (BA): dendrochronol correction tables pub in Ralph *et al* (1976) give: LYON-1098: 1290-1760 BC+, which involves 400 yr between horse and habitat. Such a topographic position can only be explained by chance (Arnold, 1977).

Ly-1053. Abri de la Gourgue d'Asque, Asque, Hautes Pyrénées — 3800 ± 200

Bones from single layer of La Gourgue d'Asque shelter near Asque, Hautes Pyrénées (43° 1′ N, 0° 15′ E). Coll and subm 1974 by A Clot, Bordère sur Echez, Hautes Pyrénées. Archeol level is a triple sepulture assoc with type of decorated pottery also found on Ger plateau and in Landes region, and is generally attributed to Hallstatt period, ca 2700. However, same pottery is found in Asque region in Tumulus Lescar No. VI and Tumulus Sauvagnon No. II, dated Gif-2515: 3840 ± 80 and Gif-2516: 3720 ± 80 respectively (unpub).

C. Neolithic period

Ly-1188. Dolmen du Riffat I, Thédirac, Lot 4090 ± 130

Human bone from earth of clandestine excavations in open-air dolmen, Le Riffat No. 1 near Thédirac, Lot (44° 35′ N, 1° 19′ E). Coll and subm 1974 by J M Grafeille, D Cavallier, and V Vanel, Lab ERS Catus, Lot. Assoc with a Chalcolithic industry and close to an urn grave. *Comment* (JMG): corresponds closely to ages generally obtained for industry in region; see, eg, La Bertrandoune dolmen: Ly-1220, below, or les Grèzes dolmen at Souillac: Ly-895: 3910 ± 100 (R, 1976, v 18, p 73) (Clottes, 1976) or Les Grèzes dolmen at Souillac: Ly-895: 3910 ± 100 (R, 1976, v 18, p 73).

Ly-1220. Dolmen de La Bertrandoune, Prayssac, Lot 4170 ± 120

Human bones from lowest part of archaeol level in funerary room of La Bertrandoune dolmen at Prayssac, Lot (44° 31′ N, 1° 12′ E). Coll 1975 by F Rouzaud and subm 1975 by J. Clottes, Dir Antiquités préhist Midi-Pyrénées, Foix. Assoc with a Chalcolithic industry. *Comment* (JC): agrees with expected age and other results from dolmens containing same industry in region: Le Riffat dolmen: Ly-1188, above, and Les Grèzes de Souillac: Ly-895: 3910 ± 100 (R, 1976, v 18, p 73) (Clottes, 1976). All dates confirm a large chronologic difference between dolmens of Quercy and these from Atlantic coast.

Ly-1105. Tumulus BI, Chenon, Charente 5540 ± 140

Human bones from funerary room T in Tumulus BI at Chenon, Charente (45° 57′ N, 0° 13′ E). Coll 1972 and subm 1974 by D Gauron, Angoulème. Room contains homogeneous material of Late Chalcolithic, Artenac civilization: expected age: 3900 to 4200. *Comment* (DG): much older than all other values for Artenac civilization. Date may, however, correspond with age of building of tumulus, Middle Neolithic. Whole sample possibly came from ancient bone material that remained in middle of Chalcolithic material of 2nd usage.

Ly-1195. Chambre 2 Tumulus E, Bougon, Deux Sèvres 4700 ± 140

Human bones from 2nd funerary rm of Tumulus E in Megalithic necropolis "Les Tumulus", near Bougon, Deux Sèvres (46° 21′ N, 0° 11′ E). Coll 1973 and subm 1975 by J P Mohen, Mus Antiquités, Saint-Germain en Laye. The 1st funerary rm of Tumulus E was previously dated, Ly-966: 5800 ± 230 (R, 1976, v 18, p 74), which gives a Late Neolithic age (Mohen, 1973). Dated to check this value, which is oldest for that type of monument. *Comment* (JPM): date is much younger than expected and similar to those from nearby Tumulus F, Ly-967 and -968: ca 4550. It corresponds to Late Neolithic. It is known that Funerary Rm 2 of Tumulus E had been visited at this time but it was thought that during this 2nd visit, bones from former construction time remained *in situ*. On the contrary, date proves that a new burial was made.

Stations cotières du Lac de Clairvaux series

Samples from several coastal stas in N part of Clairvaux lake at Clairvaux, Jura (46° 40′ N, 5° 46′ E). Coll and subm by P Petrequin, Dir antiquités Préhist, Besançon (Pétrequin, 1974).

Ly-1154. Clairvaux, Sta La Motte aux Magnins, Level V, CT 97 4950 ± 140

Wood, coll 1973 and subm 1974. Expected age: ca 5000.

Ly-1153. Clairvaux, Sta II bis, Delta 8, cordon 4430 ± 150

Charcoal, coll and subm 1974. Expected age: 4500 to 5000.

Ly-1152. Clairvaux, Sta II bis, Pile No. 1474 4650 ± 130

Fragment of pile dwelling. Coll and subm 1974. Expected age: 4500 to 5000.

Ly-1151. Clairvaux, Sta II bis, Pile No. 456 5520 ± 150

Fragment of pile foundation. Coll and subm 1974. Expected age: 4500 to 5000.

Ly-1058. Clairvaux, Sta III, Delta 2, Level IIb 4620 ± 130

Charcoal, coll and subm 1974. Expected age: 3700 to 4000.

Ly-1059. Clairvaux, Sta III, Delta 2, Level IIe 4780 ± 130

Charcoal, coll and subm 1974. Expected age: ca 4300.

Ly-1155. Clairvaux, Sta VII, sondage 4340 ± 140

Fragment of pole and board from peaty layer. Coll and subm 1975. Expected age: ca 4800.

General Comment: some dates, approx same as ages expected in 1974-1975, are now too recent or too old after new archaeol correlations. However some measurements made to check previous dates (see another Clairvaux series: R, 1975, v 17, p 19-20) confirm them. Discrepancy with new expected values is too great and cannot be explained by usual causes in coastal stas such as: re-use, apparent age of wood redeposits (Boisaubert *et al*, 1974).

Ly-1296. Mundolsheim, RU 74, Bas Rhin 5200 ± 300

Some thin pieces of charcoal from a hole, 1.8m deep, in loess, Junkergaten site at Mundolsheim (48° 38′ N, 7° 42′ E). Coll 1974 by J Rapp and subm by A Thévenin. Assoc with Late Rubané pottery. Very diluted: 0.7/3 sample. *Comment* (AT): despite relatively large statistical margin, date agrees perfectly with expected age: ca 5000. Some older dates were obtained for 1st phase of Rubané, see Dachstein: Ly-1295, and Evendorf: Ly-1181, below.

Ly-1295. Dachstein, 74 E4 RU, Bas Rhin 6280 ± 320

Charcoal from pit dug in loess, 1.5m deep, in Vonesch quarry, at Dachstein, Bas Rhin (48° 34′ N, 7° 32′ E). Coll 1974 by J Sainty and subm 1975 by A Thévenin; 1/2 sample diluted. *Comment* (AT): correct value for Early Rubané; see Reichtett, Ly-865: 5940 ± 140 (R, 1976, v 18, p 76).

Ly-1171. Pincevent, Sta 64, Sepulture 184, La Grande Paroisse, Seine et Marne 3580 ± 140

Human bones from a triple sepulture, 70cm deep, Layer II, Magdalenian site, Pincevent, near La Grande Paroisse, Seine et Marne (48° 23′ N, 2° 53′ E). Coll 1974 and subm 1975 by C Girard, Lab Technol, Mus Homme, Paris. No material assoc with 3 skeletons that, according to their positions, seem to belong to Seine-Oise-Marne (S O M) civilization (Girard & Leclerc, 1977). Neolithic *sensu lato*: between Neolithic and Bronze age. *Comment* (CG): younger than usual range of S O M dates, between 4400 and 3650. However this value is almost same as date of collective S O M sepulture of Guiry en Vexin, Gif-3329: 3640 ± 100 (unpub in Radiocarbon) and those of La Chaussée Tirancourt, 3 dates: Gif-3350-3700 (R, 1971, v 13, p 222).

Ly-1057. Le Suc, Arlempdes, Haute Loire 5980 ± 150

Very black carbonaceous earth from hearth, 2m deep, in underbasalt rock shelter at Le Suc, near Arlempdes, Haute Loire (44° 51′ N, 3° 55′ E). Coll and subm 1974 by A Cremillieux, Le Monastier sur Gazeille, Haute Loire. Site is wide slope at base of a cliff. Hearth only contains fauna but no archaeol remains; it lies under Late and Middle Neolithic layers. *Comment* (AC): date probably marks oldest Neolithic known in high valley of La Loire R. All other measurements in region, eg, Ly-164: 3670 ± 130 (R, 1971, v 13, p 59) from La Baume Loire, or Ly-49: 4750 ± 300 (R, 1969, v 11, p 115) from Le Rond du Lévrier, are more recent (Cremillieux, 1975).

Ly-1181. Evendorf, Kirchnaumen, Moselle 6050 ± 200

Charcoal from 0.8m depth in hearth at base of pit in Dolem site at Evendorf, near Kirchnaumen, Moselle (45° 25′ N, 6° 34′ E). Coll by M Michels and subm 1975 by C Guillaume; assoc with Rubané industry. Site seems to be 1st Neolithic habitat in Lorraine. *Comment* (CG): agrees with other results on Rubané industry; see Dachstein: Ly-1295, above, and Reichstett, Ly-865: 5940 ± 140 (R, 1976, v 18, p 76).

Lino series, Peru

Samples from 3 villages of a Preceramic people, near Lino, Peru (11° 54′ S, 77° 6′ W). Coll and subm 1975 by F Engel, Centre d'Investigation Zones Arides, Univ Agraire Peru, Lima. Villages consisted of huts with only some wood foundations and refuse remaining. Expected age from typologie criteria was 6000 to 10,500.

Ly-1034. Lino 11b XI-81, Unité K, Layer 2 6010 ± 260

Marine shells from ashy layer.

Ly-1035. Lino 11b XI-81, Unité B, Layer 2 **7750 ± 160**

Charcoal from refuse filling a hut.

Ly-1036. Lino 11b XI-81, Unité F, Layer 2 **8560 ± 170**

Charcoal from refuse filling a hut.

General Comment (FE): 3 samples from same site gave ages in 1500 range. Thus site was occupied several times between long periods of disuse.

D. Mesolithic and Epipaleolithic periods

Ly-1222. L'Adreyt de La Baume d'Arlempdes, Arlempdes, Haute-Loire **2500 ± 130**

Very thin pieces of charcoal from layer with geometric industry without ceramics in basaltic rock shelter, La Baume, at Greycenet near Arlempdes, Haute Loire (44° 52′ N, 3° 55′ E). Coll and subm 1975 by A Crémillieux. Level lies below Bronze and Neolithic layer from which it is separated by gravel layer (Crémillieux, 1974). Assoc industry could be Tardenoisian which may be Early, and expected age is a little greater than Ly-1057 from Le Suc d'Arlempdes, above. *Comment* (AC): too recent date proves that charcoal from Bronze age layer or younger fell down through upper layers, as frequently occurred in this type of site, see, eg, Ly-452: 3950 ± 120 for Paleolithic layer of La Baume Loire II site (R, 1973, v. 15, p 147).

Ly-1198. Botiqueria del Moros, Mazaleon, Provincia de Teruel, Spain **7550 ± 200**

Charcoal from lowest level of Botiqueria del Moros site near Mazaleon, Prov Teruel Spain (41° 3′ N, 0° 5′ E). Coll 1974 and subm 1975 by I Barandiaran, Dept Arqueol, Univ La Laguna, Spain. Level corresponds to 1st occupation of site and contains Epipaleolithic industry with geometrics attributed to Tardenoisian, Sauveterrian, or Castelnovian civilization. It may be correlated with "Cocina I" horizon in Spanish Levant. In upper level of site is industry with evolved geometric and the 1st appearance of Cardial ceramics. *Comment* (IB): date as expected. It is close to Castelnovian value obtained from Chateauneuf lès Martigues, see eg, Ly-448: 7270 ± 220 (R, 1973, v 15, p 527) and close to values of Sauveterrian at Montclus site, Ly-308: 7760 ± 260 (R, 1971, v 13, p 42) (Barandarian, 1976).

Ly-1189. La Passagère, Méaudre, Isère **8790 ± 190**

Bones from Layer 2 of La Passagère grotto, Epipaleolithic site at Méaudre, Isère (45° 9′ N, 5° 33′ E). Coll and subm 1974 by P Bintz, Inst Dolomieu, Univ Grenoble. Assoc with Magdalenian-type industry with burins and Azilian points and with a fauna containing reindeer. Expected age: 9500. *Comment* (BP): younger than expected, date may be compared with previous result from nearby grotto, Grotte Colomb, industry of which is similar and contemporaneous, Ly-430: 8960 ± 420 (R, 1973, v 15, p 147). Last result was doubtful according to Magdalenian character of industry. It now appears, not only from similarity of both dates but also from palynologic, sedimentologic, and faunal date, that chronology of Late Paleolithic civilization in region must be revised and may involve survival of Magdalenian groups up to beginning of postglacial period.

Saint-Thibaud de Couz series, Savoie

Bones from 2 upper levels of La Grotte Jean Pierre I site at Saint-Thibaud de Couz, Savoie (45° 40′ N, 5° 50′ E). Coll and subm by P Bintz. Many dates and description were pub in previous date list (R, 1975, v 17, p 24).

Ly-1309. Saint-Thibaud de Couz JP I, Layer 1 3790 ± 260

Some bones from Layer 1; no assoc industry. Subm 1976. Pollen diagram indicates large decrease of tree and fern pollen due to intentional deforestation. Sedimentology shows deterioration of climatic conditions, colder and dryer, following climatic optimum attributed to Atlantic period. 1/3 sample diluted. *Comment* (PB): date indicates Sub-Boreal, agrees with sedimentologic and palynologic data.

Ly-1190. Saint-Thibaud de Couz JP I, Layer 5 10,620 ± 210

Bones from Layer 5 where pollen diagram shows short cold phase in Pre-Boreal which can be assimilated to Piottino phase. Subm 1974. *Comment* (PB): for unknown reason date agrees neither with palynologic attribution, Piottino: 950 to 10,000, nor with 2 previous dates from nearest overlying and underlying levels, Ly-428: 9050 ± 260 for Layer 5A, and Ly-596: 10,750 ± 300 for Layer 6.

Abri du Mannlefelsen I series, Oberlarg, Haut-Rhin

Charcoal from 2 levels in Mannlefelsen I rock shelter at Oberlarg, Haut-Rhin (47° 27′ N, 7° 14′ E). Coll by J Sainty and subm by A Thévenin. Site now shows up to 8m sediment and contains Epipaleolithic and Mesolithic industry, probably with a continuous stratigraphy from end of Würm IV to Atlantic period. Lowest and highest layers were previously dated by 2 labs, Layer S: Ny: 10,220 ± 330 (unpub) and Layer G: Gif-2634: 5140 ± 140 (Thévenin, 1976). The following dates concern layers excavated during a deep bore-hole.

Ly-1016. Oberlarg JK Y20 7860 ± 280

From 3.42m depth in Sq Y 20 at top of Layer K. Coll 1973 and subm 1974. Assoc with Middle Mesolithic microlithic industry. Pollen diagram suggests end of Boreal. Charcoal sample was very small, diluted 2/3.

Ly-1015. Oberlarg KL W3 7810 ± 170

From 3.42m depth in Sq W3 at base of Layer K. Coll 1973 and subm 1974. Same industry and pollen as Ly-1016.

Ly-1297. Oberlarg P X3 **8230 ± 300**

From 4.6m depth in Sq X3 of Layer P and base of Layer Q, Early Mesolithic. Coll and subm 1975. Pollen diagrams indicate Pre-Boreal—Boreal transition in Layer Q. Another date in Layer Q, Gif-2387: 9030 ± 160 (unpub). Because charcoal was in very fragile pieces, one complete treatment with pyrophosphate could not be made; some humic pollution might remain in sample. Very diluted: 0.8/3 sample.

General Comment (AT): Ly-1015 and -1016 attribute a precise date to Layer K. Average is 7830 ± 130, agreeing with industry, pollen and other values. Ly-1297 is too young compared with Gif-2387, but falls well within range of expected date, considering large statistical deviation.

Rochedane series, Villars sous Danjoux, Doubs

Bones from 3 levels in rock shelter Rochedane at Villars sous Danjoux, Doubs (47° 21′ N, 6° 46′ E). Coll by J Sainty and subm by A Thévenin. This large rock shelter contains 3.5m sediment divided into 10 main levels, including industries probably belonging to Azilian or Mesolithic periods. Analyses indicate End of Würm IV — postglacial transition: Alleröd, Late Dryas, and Pre-Boreal, but precise attribution for different levels remains difficult. One of upper levels, A4, was previously dated, Gif-2530: 9210 ± 120 (Thévenin & Sainty, 1976).

Ly-1194. Rochedane 75 B G3 **10,730 ± 190**

From 1.60m depth in Layer B, Sq G3. Coll and subm 1975. Assoc with rich industry probably belonging to Azilian with engraved pebbles. The climatic phase seems to be Late Dryas or Pre-Boreal.

Ly-1192. Rochedane 74 C'I A3 **11,090 ± 200**

From 2.07m depth in Layer C'I, Sq A3. Coll 1974 and subm 1975. Assoc with industry similar to that of Layer B. Climatic phase seems to be Late Dryas. Both Layers B and C'I are almost inserted into one another.

Ly-1193. Rochedane 74 DI A3 **11,060 ± 470**

From 2.22m depth in Layer DI, Sq A3. Coll 1974 and subm 1975. Assoc with poor industry which may be Azilian or Late Magdalenian. Climatic phase is Alleröd and fauna marks last appearance of reindeer. Absence of arctic species of micromammals excludes attribution to Early or Middle Dryas. 1/3 sample diluted.

General Comment (AT): Ly-1193 agrees with expected age and indicates Alleröd despite large statistical range.

Ly-1175. Abri de la Tête du Chien,
La Madeleine, Penne, Tarn **10,110 ± 440**

Bones from 1m depth in single level of small shelter, La tête du Chien, at La Madeleine, near Penne, Tarn (44° 5′ N, 1° 43′ E). Coll and subm 1974 by H Bessac, La Fau near Montauban. 1/3 sample diluted. Assoc with Azilian industry. *Comment* (HB): agrees with expected age for this industry in region, between Magdalenian VI, eg, La grotte de Venus, Ly-1108, below, and Sauveterrian, eg, La grotte des Fieux at Miers, Lot, Gif-1807: 9450 ± 190 (R, 1974, v 16, p 26).

E. End of Late Paleolithic period

Ly-1099. Rislisberghöhle, Oensingen, Kanton Solothurn, Switzerland **11,860 ± 230**

Bones from Level II, Grid 33 in Rislisberghöhle site near Oensingen, Solothurn Canton, Switzerland (47° 19′ N, 7° 42′ E). Coll and subm 1973 by J H Barr and H R Stampfli, Kantonsarchäologie, Solothur. Assoc with Late Magdalenian industry. Accompanying fauna is that of cold climate. *Comment* (JHB): date agrees very closely with date of B-2316: 12,060 ± 130 (unpub in Radiocarbon) for Swiss Magdalenian open sta of Moosbühl, where occupation lasted from shortly before end of Bölling until beginning of Dryas II (Barr, 1975).

Ly-1108. Sanuv kout, Hostim, Beroun, Czechoslovakia **12,420 ± 470**

Horse bones from 105 to 160cm depth in Sq 143 E81 of camping site at Sanuv Kout in Berounka R valley, near Hostim, Prov Beroun, Czechoslovakia (49° 57′ N, 14° 7′ E). Coll 1968 and subm 1974 by S Vencl, Inst d'Archéol Praha. Previous date of charcoal from upper level was obviously polluted or redeposited, Bln-495: 2005 ± 80 (R, 1970, v 12, p 405). *Comment* (SV): date agrees with expected age of industry, Late Magdalenian, contemporaneous with Stages IV or V of French Magdalenian.

Gönnersdorf series, Neuwied, Rheinland West Germany

Small fragments of bones, mainly horse ribs, from open air habitat at Gönnersdorf near Neuwied, West Germany (50° 27′ N, 7° 19′ E). Coll 1972 by G Bosinski, Univ Köhln and subm 1975 by F Polin, Mus hist nat, Paris. Measurements made to check Ly-768: 12,380 ± 230 (R, 1975, v 17, p 25) and to determine contemporaneity of soil of habitat and of underlying pits (Bosinski and Fischer, 1974) (Poplin, 1976).

Ly-1172. Gönnersdorf No. 2 **12,660 ± 370**

Sample from all the habitat soil, diluted 2/3.

Ly-1173. Gönnersdorf No. 3 **11,100 ± 650**

Sample from pits at base of habitat soil. Very diluted, 0.9/3.

General Comment (GB & FP): Ly-1172 and -768 are compatible. Ly-1173 is clearly more recent but obtained from small amount of bone which entails a large statistical margin; date cannot be used to determine length of site occupation.

Ly-1109. Grotte de Venus, La Madeleine, Penne, Tarn **11,180 ± 300**

Bones from 1.5m depth under cryoclastic fall of rock at entrance of shelter Grotte de Venus, at La Madeleine, near Penne, Tarn (44° 5′ N, 1° 43′ E). Coll and subm 1974 by H Bessac. Sample diluted 1/2. Assoc with Late Magdalenian (VI_2) industry (Sonneville-Bordes, 1960). *Comment* (HB): agrees with expected age for this industry in region. May be compared with Le Trou des Forges at Bruniquel, Tarn et Garonne, BM-302: 11,750 ± 300 and BM-303: 11,110 ± 160 (R, 1969, v 11, p 283).

Ly-1200. Pech-Merle, Cabrerets, Lot 11,460 ± 390

Charcoal in dust form adhering to pieces of clay from small depressions at surface of Upper Paleolithic ground, 15cm deep and at top of Layer II in Pech-Merle cave near Cabrerets, Lot (44° 30′ N, 0° 34′ E). Coll and subm 1974 by M Lorblanchet, Thémines, Lot. Very crumbly sample which has not permitted basic pretreatment to eliminate any possible humus. Sample diluted 1/2. A few reindeer bones were found with charcoal but flint implements are not typical. Cave contains rock paintings of 2 main periods, probably Upper Perigordian to Solutrean and Magdalenian. However, dated layer may correspond to occupation different from time of execution of paintings. Blocking of primitive entrance by cone of debris is also unknown (Lorblanchet, 1976). *Comment* (ML): date must be considered minimum but could be correct, non-polluted sample, and in this case, it seems to reveal relatively late occupation and blocking of cave, *ie*, a long time after execution of paintings. It may be comparable to Gif-1697: 10,830 ± 200 (R, 1974, v 16, p 26), from nearby Upper Magdalenian cave Sainte-Eulalie.

Grottes de Caubeta series, Bagnères de Bigorre, Hautes-Pyrénées

Bones from 2 ancient grottoes destroyed by quarry at Caubeta, near Bagnères de Bigorre, Hautes-Pyrénées (43° 4′ N, 0° 10′ E). Bones were preserved in Mus Bagnères de Bigorre since end of ancient excavation. Subm 1974 by A Clot, Bordères, Hautes-Pyrénées. Assoc with industry presumably Late Magdalenian, V or VI.

Ly-1107. Grotte d'Aurensan inférieure 13,910 ± 230

From middle layer, coll 1869 by E and C. L. Frossard (Frossard & Frossard, 1870).

Iy-1055. Grotte Diogène 14,280 ± 300

From unknown layer, coll 1930 by M Quéruel (Rousseau, 1932).

General Comment (AC): both dates are in statistical range. They are older than expected, industry attributed to Late Magdalenian (Breuil, 1950). They may correspond more closely to Middle Magdalenian, III or IV, compared with sites of region, eg, 3 Ly dates between 14,180 and 13,510 in Duruthy site (R, 1976, v 18, p 79) or Ly-846: 13,810 ± 740 (R, 1975, v 17, p 23) in Le Fontanet grotto, or lastly Gif-2943: 12,760 ± 170 (unpub) in Saint-Jean de Vergès.

Ly-1182. Le Flageolet II, no. 4, Bézenac, Dordogne 14,250 ± 400

Bones from Layer IX in Le Flageolet rock shelter at Bésenac, Dordogne (44° 49′ N, 1° 6′ E). Coll and subm 1976 by J P Rigaud, Dir

Antiquités Préhist Aquitaine, Bordeaux. Two previous dates for same layer were, for top, Ly-917: 14,110 ± 690, and for the base, Ly-918: 15,250 ± 320 (R, 1976, v 18, p 80). Both dates seemed too old for assoc industry, attributed to Late Magdalenian, with regard to typologic characteristics. *Comment* (JPR): date confirms both previous values and suggests Middle Magdalenian attribution, which is not in disagreement with paleontologic or sedimentologic date (Rigaud, 1976).

Ly-1191. Rigney, Doubs **14,940 ± 500**

Bone, cerival vertebra, (*Coelodonta antiquitatis*) from base of Rigney grotto at Rigney, Doubs (47° 21′ N, 6° 8″ E). Coll 1952 by A Glory and subm 1975 by C Guérin, Geol Dept, Univ Lyon. Sample diluted 1/3. Fauna is represented only by 1 skull of wooly rhinoceros and some reindeer bones (Théobald & Szymaneck, 1963). Assoc industry is badly defined Magdalenian, but certainly not Late Magdalenian. Engravings in grotto compare with those from Arlay or La Garenne sites (Glory, 1961). *Comment* (CG): agrees with attribution of industry to Early or Middle Magdalenian and with dates from Arlay; see 2 Ly dates ca 15,500 (R, 1973, v 15, p 518) and La Garenne series, below. Apart from paleontologic site Esclauzure, Corrèze, Ly-361: 14,540 ± 300 (R, 1973, v 15, p 150), Rigney site is most recent where *Coelodonta antiquitatis* has been found in W Europe and skull from this fauna is most recent known (Guérin, 1976).

F. Beginning of Late Paleolithic and Middle Paleolithic periods

La Garenne series Saint-Marcel, Indre

Bones from 3 layers in 2 superimposed but stratigraphically connected sites of La Garenne near Saint-Marcel, Indre (46° 36′ N, 1° 30′ E). Coll 1955 to 1974 and subm 1974 by J Allain, Dir Antiquités Préhist, Centre, Bourges. Numerous measurements were taken from site for 20 yr by 4 labs, using charcoal of charred bones. Results are between ca 8000 and 16,000. Assoc industry: "à navettes Magdalenian" is special type of which contemporaneity with classic Magdalenian industries is not well defined. It may be of 2nd part of Magdalenian period. No site with a similar industry has been well dated.

Ly-1125. La Garenne Grand Abri K I A 2 **15,330 ± 950**

From deep layer in Le Grand Abri site corresponding to Upper level of "à Navettes Magdalenian". Bad conservation of organic matter. 1/6 samples diluted.

Ly-1126. La Garenne Grand Abri B 2 **15,560 ± 580**

From lower level in Grand Abri corresponding to Middle level of "à Navettes Magdalenian". Sample diluted 2/3.

Ly-1127. La Garenne Abri Blanchard B 5 **14,080 ± 350**

From single layer in Abri Blanchard, corresponding to Lower level of "à Navettes Magdalenian". Sample diluted 2/3.

General Comment (JA): as with other series from site, these 3 dates are unsatisfactory and in wrong stratigraphic order. Previous dates form 3 groups: 1) ca 9000 L-399 D (R, 1959, v 1, p 23) is obviously wrong because Ly present dates prove that bones in site are neither polluted nor redeposited; 2) 3 dates from 3 labs, ca 11,000 from burnt bones; 3) 2 isolated dates ca 13,000 and 15,900 (Chicago dates, unpub in Radiocarbon). Three present dates are closer than 3rd group but only Ly-1127 from Layer B5 in Abri Blanchard seems to agree with typologic and palynologic date.

L'Abri Fritsch series, Les Roches, Pouligny Saint-Pierre, Indre

Burnt bones, Ly-1001, and unburnt bones from several levels in Abri Fritsch at Les Roches, near Pouligny Saint-Pierre, Indre (46° 40′ N, 1° 0′ E). Coll 1973 and subm 1974 by J Allain (Allain & Fritsch, 1967).

Ly-1121. Abri Fritsch, 3a **17,130 ± 550**

Bones from Layer 3a assoc with Magdalenian 1 industry with raclettes, Upper Badegoulian. 2/3 sample diluted.

Ly-1122. Abri Fritsch, 4 **16,530 ± 550**

Bones from Layer 4 assoc with Magdalenian 1 industry with raclettes, Upper Badegoulian. Sample diluted 2/3.

Ly-1001. Abri Fritsch 5b IN_2 **14,960 ± 380**

Burnt bones treated as carbonaceous earth from Layer 5b, $SqIN_2$ Assoc with Late Badegoulian industry without raclettes. Presence of rootlets. *Comment* (JA): date is obviously at least 2000 yr too recent: pollution by recent carbon is certain.

Ly-1123. Abri Fritsch 5b **17,280 ± 350**

Bones from same level as Ly-1001, assoc with same industry.

Ly-1124. Abri Fritsch 6 **17,980 ± 350**

Bones from Layer 6, assoc with Magdalenian O industry, Lower Badegoulian. Attributed to Lascaux interstadial.

General Comment (JA): Ly-1001 must be discarded as polluted. Ly-1121 and -1122 should be in reverse order, but are within statistical margin. Apart from this, all dates agree, are in range of expected ages, correspond to typologic data and fit with previous date from lower Layer 8, GrN-5499: 19,280 ± 230 (R, 1972, v 14, p 57). It thus appears that Early Magdalenian in region is contemporaneous with some Solutrean industries, eg, at Parpallo in Spain, Birm-521: 17,900 ± 340 (R, 1975, v 17, p 273), or maybe at La Grotte Chabot in SE France, Ly-699: 17,770 ± 400 (R, 1975, v 17, p 27).

F. Beginning of Late Paleolithic and Middle Paleolithic periods

Ly-1150. Peyrehaute, Mejanne le Clap, Gard **21,700 ± 1500**

Bones from upper layer of filling of gallery in Peyrehaute Grotto, near Mejanne le Clap, Gard (44° 16′ N, 4° 23′ E). Coll and subm 1974 by X Gutherz, Dir Antiquités Préhist, Languedoc-Roussillon, Montpellier, and A Bonnet, Nimes. Assoc with reindeer and horse fauna and not well-defined industry (Mazauric, 1904). *Comment* (AB): date suggests attribution of industry to Late Aurignacian and cold phase indicated by fauna seems to belong to end of Würm III. Date may be compared with results from La Salpètrière site, eg, Ly-942: 20,630 ± 770 and Ly-943: 21,760 ± 490, for Levels 30A and 30E, presumably Late Aurignacian (R, 1976, v 18, p 81).

Ly-991. La Lâouza, Sanilhac et Sagriès, Gard 10,000 ± 480

Bones from Layer 2 in La Laouza rock shelter near Sanilhac, Gard (43° 56′ N, 4° 34′ E). Coll and subm 1973 by F Bazile, Vauvert, Gard. Sample diluted 1/2. Assoc industry: Early Aurignacian. *Comment* (FB): bones from layer 2 in La Lâouza rock shelter near Sanilhac, Gard (43° 56′ N, 4° 34′ E). Coll and subm 1973 by F Bazile, Vauvert, Gard, Sample diluted 1/2. Assoc industry: Early Aurignacian. *Comment* (FB): contamination by recent bones seems impossible because all bones seem to have same fossilized aspect, but date is obviously much too young.

Ly-1102. Bacho-Kiro, Dryanovski Monastyr, Dryanovo, Gabrove, Bulgaria 29,150 ± 950

Bone from Layer 7/6a from Bacho-Kiro grotto at Dryanovski monastary, near Dryanonvo, Prov Gabrovo, Bulgaria (42° 40′ N, 25° 27′ E) (Garrod, 1939). Coll 1972 and subm 1974 by J K Kozłowski, Inst archéol, Univ Krakow, Poland. Recent excavation revealed 6 Aurignacian levels and dated level is 5th from base. Aurignacian series lies between Mousterian-Levallois series and Late Paleolithic, Tardigravetian, level (Kozłowski, 1975). *Comment* (JKK): date agrees with expected age and indicates that more recent typical Balkan Aurignacian took place in Krinides Interstadial II with regard to series obtained at Tanaghi Philippon, Thessalia (Wijmstra, 1969).

Ly-1104. Camiac et Saint-Denis, Gironde $35{,}100^{+2000}_{-1500}$

Bones from basal layer of open-air site. Camiac, at Camiac et Saint-Denis, Gironde (44° 47′ N, 0° 16′ W). Coll and subm 1974, by M Lenoir and F Prat, Inst Quaternaire, Univ Bordeaux. *Comment* (ML): although poor, assoc industry may be atrributed to Middle Paleolithic or to very early Upper Paleolithic. Layer might have been formed in Würm II/III interstadial. Date agrees with data of fauna, industry, and sedimentology of site (Lenoir, 1976).

Grotte de la Baume series, Echenoz la Meline, Haute Saône

Bones from 2 levels in La Baume Grotto near Echenoz la Méline, Haute Saône (47° 36′ N, 6° 7′ E). Coll and subm 1972 by M Campy Lab Géol, Univ Besançon. Assoc with probably Early Würm fauna and Mousterian industry (Campy, 1973).

Ly-550. Echenoz No. 1 **24,180 +840 −630**

From Level II. Coll 1971, 5/6 sample diluted.

Ly-772. Echenoz No. 2 **≥32,000**

From Level III, coll 1972.

General Comment (MC): although upper level seems to have finite age, it seems more likely that this date is too young. Sample could be polluted for unknown reason. According to type of industry, archaïc character of fauna, and sedimentology of all layers in site, an unlimited age as Ly-772, is more suitable.

III. HYDROGEOLOGIC SAMPLES

Fes series, Morocco

Water samples from springs and wells in several aquifers in Saïs plain near Fes, Morocco (34° 10′ N, 5° 0′ W). Coll 1972 by Dir Hydraulique, Royaume Maroc, Rabat, and subm 1972 by A Marcé, Bur recherches Géol Min, Orléans. This basin is mainly constituted by 2 aquifers separated by slightly permeable formation. Lower aquifer, Lias dolomitic limestones, contains artesian confined ground water coll by borings; upper aquifer, Plio-Quaternary lacustrian limestones, contains unconfined ground water.

Sample		Localization	Dilution: % of sample	$\delta^{13}C$ ‰ PDB ± 0.1	^{14}C % modern
Ly-709.	Fes 532,830	cold spring: 42/15	100.0	−15.1	85.6 ± 1.5
Ly-710.	Fes 534,950	cold spring: 48/15	100.0	−16.0	83.2 ± 2.1
Ly-711.	Fes 520,100	hot spring: 105/15	83.3	—	8.7 ± 0.9
Ly-712.	Fes 537,850	boring: 152/15	100.0	−14.0	51.1 ± 1.1
Ly-713.	Fes 538,964	boring: 290/15	100.0	−17.5	79.1 ± 1.4
Ly-714.	Fes 536,700	boring: 515/15	100.0	−15.3	81.1 ± 1.3
Ly-715.	Fes 541,800	boring: 1225/15	66.7	−15.5	5.2 ± 0.9
Ly-716.	Fes 547,653	hot spring: 1845/15	100.0	−17.2	50.3 ± 1.2
Ly-717.	Fes 541,200	boring: 2060/15	100.0	−16.3	72.3 ± 1.5
Ly-718.	Fes 540,250	boring: 2168/15	100.0	−14.0	57.5 ± 1.3

General Comment (AM): ^{14}C contents from borings indicating recent waters show important renewal of Lias ground water, except low ^{14}C content of Ly-715, which, agrees with other data and confirms presence of a confined ground water in special region of basin. ^{14}C values from cold springs prove that water probably also comes from Lias aquifer. ^{14}C values from hot springs may be due to long transfer time of waters of same origin as Ly-715. ^{13}C values show no isotopic exchange occurred between limestones and bicarbonates of waters (Marcé, 1975).

Tangiers series, Morocco

Water from several wells in Charf el Akab aquifer, near Tangiers, Morocco (35° 5′ N, 5° 50′ W). Coll 1972 by Dir Hydraulique, Royaume Maroc, Rabat, and subm 1972 by A Marcé, Bur recherches Géol Min, Orléans. Mio-Pliocene closed basin of Charf el Akab has aquifer layers mainly constituted by calcarenites and sandstones. No dilution of samples.

Sample		Alt (asl)	$\delta^{13}C$ ‰ PDB ± 0.05	^{14}C % Modern
Ly-728.	Oued Mharhar	—	−13.26	122.9 ± 1.6
Ly-730.	22/1	16.0m	—	19.1 ± 0.6
Ly-732.	23/1	16.0	−16.74	54.3 ± 0.9
Ly-734.	24/1	16.5	−17.13	46.1 ± 0.9
Ly-736.	31/1	25.75	−11.36	17.2 ± 0.6
Ly-738.	324/1	31.0	−11.21	10.2 ± 0.5
Ly-739.	325/1	19.5	−18.55	60.3 ± 1.0
Ly-740.	511/1	24.0	−21.23	83.7 ± 1.2
Ly-741.	512/1	27.5	−15.8	65.8 ± 1.0

General Comment (AM): highest ^{14}C values indicate recent waters supply aquifer, total volume of which is ca 500 10^6 M3 (Marcé, 1975).

Beni Mellal series, Morocco

Water from springs and wells in several aquifers of Oumer Rbia R basin near Beni Mellal, Morocco (32° 36′ N, 6° 25′ W). Coll 1972 by Dir Hydroulique, Royaume Maroc, Rabat, and subm 1972, by A Marcé. Waters from springs of Oum er Rbia R are its main supply when it comes into Tadla basin where it is used for irrigation. In Tadla basin, there are phreatic ground waters in surficial formations and confined gound water in Turonian limestones. Only diluted sample, Ly-742: 1/2 sample.

Sample		Localization	$\delta^{13}C$ ‰ PDB ± 0.05	^{14}C % Modern
Ly-742.	Beni Mellal 147/30	Spring of Oum er Rbia R	−15.94	65.2 ± 1.9
Ly-743.	Beni Mellal 516/30	Spring of Oum er Rbia R	−22.04	71.2 ± 1.1
Ly-744.	Beni Mellal 2324/36	Boring in phreatic GW	−14.94	76.1 ± 1.7
Ly-745.	Beni Mellal 332/36	Boring in phreatic GW	−18.19	61.8 ± 1.0
Ly-746.	Beni Mellal 2400/36	Boring in phreatic GW	−18.01	54.7 ± 1.0
Ly-747.	Beni Mellal 642/36	Boring in Turonian GW	−15.61	45.5 ± 0.9
Ly-748.	Beni Mellal 705/36	Boring in Turonian GW	−14.98	70.9 ± 1.1

General Comment (AM): agrees with other analyses, comparison between values from springs and those from borings facilitates their distinction in Tadla basin. No drainage occurred from Turonian gound water to phreatic system (Marcé, 1975).

ADDENDUM

Dilution of previously published samples. The following numbers indicate % dilution of sample with respect to total amount of gas or benzene counted in detectors. All other samples were not diluted.

Ly- 16:94.7	Ly-255:21.4	Ly-391:83.9	Ly-516:43.3	Ly-624:67.6	Ly-753:50.0
20:87.9	263:66.7	392:28.2	517:39.8	632:29.2	756:66.7
21:87.6	264:34.1	395:32.8	518:28.2	634:83.3	770:58.1
23:60.0	265:33.4	396:20.9	526:88.9	640:83.3	780:66.7
51:87.5	269:91.6	397:37.8	531:43.5	646:63.6	788:46.9
53:90.7	270:53.6	400:35.3	534:56.2	648:39.4	798:77.2
63:14.5	279:81.6	403:47.3	549:60.4	649:87.3	793:66.7
66:94.0	280:75.6	409:35.0	550:83.3	651:47.4	801:43.3
71:87.3	283:52.7	410:64.2	556:83.3	454:56.2	812:66.7
91:77.3	284:64.3	411:51.3	558:58.3	655:11.0	846:28.6
92:38.6	285:63.0	414:31.9	560:69.6	656: 2.7	847:66.5
124:64.8	287:73.0	417:85.3	562:83.1	656:38.8	848:50.8
125:21.9	289:37.7	418:37.3	564:66.7	658:90.7	858:66.7
126.42.2	291:87.0	419:79.7	574:58.3	660:57.7	889:66.7
153:81.1	298:93.9	420:75.0	586:66.0	661:37.8	904:33.3
155:42.5	300:95.3	428:76.0	589:38.4	662:77.5	915:86.9
178:29.5	301:64.4	429:76.0	590:19.9	663:83.3	916:85.3
184:92.0	306:66.4	430:87.5	591:26.6	671:23.7	917:65.9
193:56.4	307:38.4	439:16.3	592:19.9	672:52.9	927:36.1
194:76.8	308:49.8	454:50.0	594:68.7	676:62.7	953:31.9
196:88.0	310:41.3	456:50.0	596:83.3	677:58.4	954:76.6
197:16.6	315:44.1	458:78.6	597:49.0	679:32.7	955:70.5
198:43.0	318:87.6	475:84.2	598:19.9	680:83.3	956:66.7
199:39.3	319:89.3	490:68.9	600:29.6	685:66.7	957:66.7
211:93.2	321:30.7	492:75.1	602:85.6	692:73.2	958:17.0
213:67.9	327:58.5	500:39.2	604:39.8	695:71.9	961:40.3
215:36.6	336:38.2	501:24.8	607:27.5	697:57.7	964:45.2
216:75.7	347:33.5	502:33.3	608:66.7	700:23.6	965:50.0
234:49.3	348:87.5	505:76.6	609:65.5	702:39.6	966:66.7
236:42.5	362:31.5	507:40.0	610:83.3	703:83.2	967:66.7
238:88.9	371:52.2	508:37.1	611:66.7	704:29.1	968:66.7
240:90.9	376:87.8	509:29.9	612:91.7	705:70.9	970:33.3
243:93.6	379:62.7	510:54.9	620:30.0	707:42.2	974:50.0
244:83.3	384:62.5	512:25.9	621:39.4	722:72.8	977:92.9
248:56.2	388:83.9	514:45.3	622:59.8	727:83.3	979:50.0
249:57.3	389:57.8	515:46.1	623:18.7	752:66.7	

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NUCLEAR SCIENCE AND TECHNOLOGY FACILITY RADIOCARBON DATES I

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The Radiocarbon Laboratory began operation in mid-1972, using benzene synthesis. The equipment for the laboratory was obtained under a National Science Foundation Grant*. Basic equipment consists of a benzene synthesizer (Alford Instrument Co) and a liquid scintillation counter (Picker-Nuclear 220). The equipment is essentially identical with that of Noakes and Brandau (1971). Counting efficiency and background rates are also similar; ca 70% efficiency with a 4 to 5cpm background for 5ml benzene samples. Benzene synthesis is standard with sample combustion in pure oxygen under reduced pressure. The original synthesis system has been modified to permit simultaneous processing of more than one sample.

Dates are based on 0.95 of the activity of National Bureau of Standards oxalic acid and the Libby half-life for ^{14}C. Counting techniques and data analysis procedures are similar to those described by Polach (1969) with the exception that Tamers' (1965) bottles are used. $\delta^{13}C$ values are currently based on data reported in Radiocarbon. Dates for various types of samples have been averaged and the standard deviation calculated. Recent acquisition of a mass spectrometer and a qualified operator will permit use of measured $\delta^{13}C$ values.

Samples dated thus far have been primarily wood or charcoal, although some peat samples have been dated. Pretreatment of wood and charcoal is a standard acid-alkali procedure, using 2% HCl and 2% NaOH at elevated temperature. Peat is initially suspended in water, sieved, and then subjected to treatment with acid and alkali at ambient or slightly elevated temperatures. Contaminating materials such as rootlets and pebbles are mechanically removed.

As a result of limited personnel, the laboratory has functioned well below capacity since completion of the equipment installation, and preliminary testing in early 1973. Dating has been done by the authors with the assistance of graduate and undergraduate students. Dates obtained on previously dated wood and charcoal specimens are shown in Table 1, and demonstrate that the dates obtained by the laboratory are in good agreement with the original dates.

* National Science Foundation Grant SG-28297, "Specialized Equipment for Radiocarbon Dating Facility."

TABLE 1
Interlaboratory Sample Dates*

NSTF sample no.	NSTF date	Original sample no.	Original dating lab	Original date
NSTF-2	1515 ± 290**	GX-2072	Geochron	1655 ± 80
NSTF-3	1759 ± 176	GX-2142	Geochron	1695 ± 90
NSTF-23	10,188 ± 396	SI-1329	Smithsonian	9835 ± 90
NSTF-53	6846 ± 187	BGS-120	Brock Univ	6800 ± 120

* Radiocarbon years BP
** Minimum sample size

The sample site descriptions provided for early samples were less than complete. As a result, the archaeologist submitting the sample and his affiliation are noted in the following list.

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I. ARCHAEOLOGIC SAMPLES

A. Mexico

NSTF-5. Arrinitas-la **$\delta^{14}C = -81.5‰$** **685 ± 85**
$\Delta = -81.7‰$ *$\delta^{13}C = -25.1 \pm 1.29‰$*

Charcoal from Arrinitas, Mound A, Sq A, Level 7, Lot 7 (22° 29′ N, 105° 39′ W). Subm by S Scott, State Univ New York at Buffalo.

NSTF-9. Arrinitas-lg **$\delta^{14}C = -128.9‰$** **1108 ± 62**
$\Delta = -128.8‰$ *$\delta^{13}C = -25.1 \pm 1.29‰$*

Charcoal from Arrinitas, Mound A, Sq A, Level 8, 3.5 from NW stake in SE quad (22° 29′ N, 105° 39′ W). Subm by S Scott.

NSTF-7. Tecicallo-la **$\delta^{14}C = -110.95‰$** **946 ± 60**
$\Delta = -111.13‰$ *$\delta^{13}C = -24.9 \pm 1.78‰$*

Charcoal from Tecicallo, Mound Feature A, Level 5 (22° 28′ N, 105° 39′ W). Subm by S Scott.

NSTF-6. Tecicallo **< 200**
Modern

Charcoal from Tecicallo, Mound A, Feature A, Level 4 (22° 28′ N, 105° 39′ W). Subm by S Scott.

B. New York

NSTF-11R. Witch's Walk $\delta^{14}C = -183.60‰$ **819 ± 91**
$\Delta = -183.77‰$ $\delta^{13}C = -24.9 \pm 1.78‰$

Charcoal from Witch's Walk Iroquois site, Sq 25 W, 15 E, Feature 1 (42° 6′ 18″ N, 78° 50′ 25″ W). Subm by J Schock, State Univ New York at Buffalo.

NSTF-13R. Lawrence $\delta^{14}C = -127.42‰$ **1097 ± 65**
$\Delta = -127.60‰$ $\delta^{13}C = -24.9 \pm 1.78‰$

Charcoal from Lawrence Iroquois site, Feature 8 (42° 14′ 32″ N, 79° 08′ 13″ W). Assoc with pottery and triangular points. Subm by J Schock.

NSTF-14. Falcone $\delta^{14}C = -72.19‰$ **604 ± 109**
$\Delta = -72.37‰$ $\delta^{13}C = -24.9 \pm 1.78‰$

Charcoal from Falcone Iroquois site, Feature 8 (42° 14′ 54″ N, 79° 15′ 42″ W). Round pit with flint content. Assoc with flint and pottery. Subm by J Schock.

NSTF-15. Falcone $\delta^{14}C = -88.53‰$ **746 ± 57**
$\Delta = -88.71‰$ $\delta^{13}C = -24.9 \pm 1.78‰$

Charcoal from Falcone Iroquois site, Feature 7 (42° 14′ 54″ N, 79° 15′ 42″ W). Top level from pit with high sherd and flint content. Reddened soil above top level. Assoc with pottery and flint. Sub by J Schock.

NSTF-18. Ellington $\delta^{14}C = -74.31‰$ **622 ± 107**
$\Delta = -74.49‰$ $\delta^{13}C = -24.9 \pm 1.78‰$

Charcoal from Ellington Iroquois site (42° 8′ 16″ N, 79° 6′ 16″ W). From near base of depression with much midden material. Subm by J Schock.

NSTF-19C. Rhinehart $\delta^{14}C = -109.87‰$ **932 ± 56**
$\Delta = -110.05‰$ $\delta^{13}C = -24.9 \pm 1.78‰$

Charcoal, NSTF 16, 17, and 19 combined. Samples from Rhinehart Iroquois site (42° 14′ 21″ N, 79° 07′ 37″ W). From base of earthring Trench B. Assoc with pottery and flint. Subm by J Schock.

C. Pennsylvania

NSTF-47. Swainville $\delta^{14}C = -223.42‰$ **2030 ± 98**
$\Delta = -223.27‰$ $\delta^{13}C = -25.1 \pm 1.29‰$

Wood from Swainville site (42° 4′ N, 80° 11′ W). Pit in sandy gravel. Sample from lens overlain with small sec of humus and balance sand. Sample depth, 0.46m. Slightly damp soil (seasonal fluctuation) pH 5.4. Subm by W Englebrecht, State Univ New York at Buffalo.

NSTF-48. Swainville $\delta^{14}C = -200.17‰$ **1793 ± 90**
$\Delta = -200.01‰$ $\delta^{13}C = -25.1 \pm 1.29‰$

Wood from Swainville site (NSTF-47). Sample depth, 0.64 to 0.88m. Subm by W Englebrecht.

II. GEOLOGIC SAMPLES

A. New York

NSTF-24. Huff Island **< 200**
Modern

Fibrous peat from 90 to 100cm depth. Subm by L C Marsh, State Univ New York at Oswego.

NSTF-25. Huff Island $\delta^{14}C = -461.64‰$ **4933 ± 550**
$\Delta = -458.84‰$ $\delta^{13}C = -27.6 \pm 2.24‰$

Peat with wood from 220 to 230cm depth. Subm by L C Marsh.

NSTF-27. Huff Island $\delta^{14}C = -508.9‰$ **5672 ± 337**
$\Delta = -506.35‰$ $\delta^{13}C = -27.6 \pm 2.24‰$

Peat with some marl and shells from 420 to 430cm depth. Subm by L C Marsh.

NSTF-29. Jordan Station $\delta^{14}C = -182.76‰$ **1580 ± 128**
$\Delta = -178.51‰$ $\delta^{13}C = -27.6 \pm 2.24‰$

Peat from 240 to 250cm depth. Subm by L C Marsh.

NSTF-32. Buck Pond $\delta^{14}C = -149.11‰$ **1255 ± 58**
$\Delta = -144.69‰$ $\delta^{13}C = -27.6 \pm 2.24‰$

Peat from 245 to 255cm depth. Subm by L C Marsh.

NSTF-38. Port Bay $\delta^{14}C = -630.6‰$ **7959 ± 110**
$\Delta = -628.7‰$ $\delta^{13}C = -27.6 \pm 2.24‰$

Fibrous peat from 90 to 100cm depth. Date appears too old. Subm by L C Marsh.

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NANCY NATURAL RADIOCARBON MEASUREMENTS IV

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This list includes results of measurements made during 1973-1974 and 1975 in the Natural Radiocarbon Laboratory of the Centre de Recherches Radiogéologiques de Nancy (CRR).

Laboratory procedures and techniques are the same as reported in Hassko *et al* (1974) where the sample is synthesized to benzene and counted for 24 hours. Radiocarbon ages are calculated using ^{14}C half-life of 5568 years; 95% activity of NBS oxalic acid is used as the modern standard. The counting errors are expressed at 1 σ confidence level. ADIBC* dates are corrected according to the MASCA correction curve.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC AND HISTORIC SAMPLES

A. Peru

Chilca program series

Samples are from different prehistoric villages, in Chilca basin, central coast of Peru. Coll by Frederic Engel, Dir Mission archeol française au Pérou and Inst Antropol y agric Precolombina, Univ Nac Agraria, Lima, Peru.

Samples were dated to a) establish prehistoric population maps, b) contribute to the establishment of climatic curves particularly by dating the appearance of diagnostic elements, c) differentiate the pre-agricultural from Neolithic populations, and d) date prototypical villages of different periods.

1. Pre-agricultural sites

5630 ± 70
Ny-231. Chilca, V 3230 **4490 BC***

Wood charcoal from prehistoric village, Loma Huarangal, 12 b-VII 9160, Level 200, alt 350m (12° 25′ 30″ S, 76° 39′ 35″ W). *Comment* (FE): because of presence of Mesodesmas with tegument, village seems to belong to Pre-agricultural period. Estimated age: 10,000 to 5500 BP. Coll 1973 by F Engel and B Ojeda.

3460 ± 70
Ny-356. Chilca, V 2850 **1920-1950 BC***

Shells assoc with detritus stuck to floor of hut from prehistoric village Loma de Paloma 12 b-VII 4027, alt 300m (12° 25′ 00″ S, 76° 44′ 00″ W). *Comment* (FE): dates appearance of stone wall on central coast of Peru. Estimated age: 6500 BP. Coll 1973 by F Engel.

* Centre de Pédologie Biologique, Nancy-Vandoeuvre.

Ny-242. Chilca, V 3247 **6030 ± 180**
4990 BC*

Vegetal material and fiber mat fragments surrounding a corpse buried in detritus covering the huts of village of late Pre-agricultural period, from Village 12 b-VII 613, Loma de Paloma, Tomb 12, Level 400, alt 250m (12° 25′ 50″ S, 75° 45′ 00″ W). *Comment* (FE): dates of 2nd village of 3 superimposed villages at this site. Estimated age: 6000 to 6500 BP. Coll 1973 by F Engel and B Ojeda.

Ny-243. Chilca, V 3248 **6510 ± 180**
5360 BC*

Vegetal material and fragments of small cord surrounding a corpse from village Loma de Paloma 12 b-VII 613, Level 500, alt 250m, Tomb 11, dug from deepest bed of detritus downward, village of late Pre-agricultural (12° 25′ 00″ S, 76° 45′ 00″ W). *Comment* (FE): dates 3rd and oldest of 3 superimposed villages at this site. Coll 1973 by F Engel and B Ojeda. Estimated age: 6000 to 6500 BP.

2. Sites of Neolithic III or Preceramic

Ny-224. Chilca, V 2832 **4070 ± 90**
2690-2800 BC*

Shells from village Loma de Los Cardos (Jaboncillo), 12 b-VII 6501, Level 100 (12° 30′ 31″ S, 76° 38′ 39″W). *Comment* (FE): sample gathered from interior of detritus covering vestiges of huts. By appearance, it does not seem to be related to Pre-agricultural, but to beginning of Neolithic II or late Pre-maize. Date establishes relation to Pre-agricultural or Neolithic I village. Preceramic with haricot and cotton. Estimated age: 4500 to 4000 BP. Coll 1973 by F. Engel.

Ny-230. Chilca, V 2829 **4120 ± 80**
2850 BC*

Wood charcoal from village Loma de Los Cardos, 12 b-VII 6510, alt 500m (12° 33′ 00″ S, 76° 37′ 38″ W). *Comment* (FE): see Ny-224. Coll 1973 by F. Engel.

3. Sites with ceramics of Neolithic IV, V and beginning of Chalcolithic

Ny-227. Chilca, V 3232 **3340 ± 80**
1690-1710 BC*

Shells from village Loma de Huarangal 12 b-VII 8570, Level 100, alt 375m (12° 30′ 30″ S, 76° 39′ 40″ W). *Comment* (FE): sample gathered from interior of bed of detritus covering ruins of stony small houses. Dates appearance of maize and ceramics in lower central Andes. Estimated age: 3500 to 3300 BP. Coll 1973 by F Engel and B Ojeda.

Ny-229. Chilca, V 2828 **2530 ± 60**
790 BC*

Shells from village Loma de Camotillo 12 b-VII 945, Level 1, alt 675m (12° 30′ 31″ S, 76° 39′ 40″ W). *Comment* (FE): gathered material from layer within embankment of a culture terrace. Dates ceramics and architecture of village. Ceramic seems to belong to Chavin society. Estimated age: 2800 to 2500 BP. Coll 1973 by F Engel.

2130 ± 70
Ny-228. Chilca, V 2809 **210-360 BC***

Shells from village Loma de Paloma 12 b-VII 6048, Level 400, alt 250m (12° 25′ 45″ S, 76° 44′ 40″ W). *Comment* (FE): shells gathered from interior of pile of ash and detritus covering house walls, silos and well. Dates pre-Columbian well assoc to Lapa Lapa ceramic produced from 2200 to 1800 BC. Coll 1969 by F Engel.

Chillon program series

1. Pre-agricultural sites

7500 ± 110
Ny-235. Montaro basin, V 3272 **5550 BC**

Wood charcoal from prehistoric grotto Yanamachay 10 c-XII 1, Level 600, alt 4.40m (11° 03′ 00″ S, 76° 21′ 20″ W). *Comment* (FE): 6th, last and deepest bed found during stratigraphic excavation, typical of groups before altithermal, dates lithic material. Estimated age: < 7500 BP. Coll 1973 by F Engel and B Ojeda.

5580 ± 80
Ny-237. Montaro basin, V 3276 **4470 BC***

Wood charcoal from prehistoric grotto Cuchimachay, 10 c-IX 1, Level 300, alt 4.25m (10° 55′ 15″ S, 76° 21′ 38″ W). *Comment* (FE): 3rd to last bed and oldest found during stratigraphic excavation. Age seems to be late Pre-agricultural of Paloma type. Dates human occupation. Coll 1973 by F Engel and B Ojeda.

2. Sites with ceramics of Neolithic IV or V

3420 ± 60
Ny-234. Montaro basin, V 3269 **1770-1850 BC***

Wood charcoal from village Curuqaqa, 10 c-IX 4, Level 100, alt 4.24m (10° 55′ 20″ S, 76° 20′ 15″ W). *Comment* (FE): 1st bed with detritus found under sediments of recent surface. Dates occupation of grotto with walls ornamented with painting. Estimated age: 3500 to 3000 BP. Coll by F Engel and B Ojeda.

3260 ± 60
Ny-233. Montaro basin, V 3268 **1600-1640 BC***

Wood charcoal from village Cajocancha 1, 10 c-XII 2, Level 100, alt 4.60m (11° 04′ 37″ S, 76° 23′ 08″ W). *Comment*: see Ny-234. Dates ceramic period of village. Estimate age: 3500 to 3000 BP. Coll by F Engel and B Ojeda.

870 ± 80
Ny-358. Southern deserts program, V 3549 **AD 1090**

Fragments of reed from mouth of Rio Ica (Eneolithic sites) Village, 15 b-VII 40, Level 200, alt 20m (14° 52′ 00″ S, 75° 33′ 34″ W). *Comment* (FE): sample from within sand cover of beach eolian sediments. Dates raft 7m long with balancing-pole decorated with multicolored cotton amulets and with "spondyles", the only presently known pre-Columbian raft. Estimated age: 700 to 500 BP. Coll 1974 by F Engel.

Bandurria Huahco series

Wood charcoal from Km 127 of Panamericana main rd. Coll 1973 by Rosa Fung, Univ Nac Major San Marcos, Lima, Peru. Dated to determine age of site containing feminine statuettes of unfired clay. Agriculture without maize was already established.

4480 ± 70
Ny-244. Bandurria, V 3277 **3240-3330 BC***

Sample from Lado (E), Level 4. Estimated age: 5500 to 3500 BP.

4320 ± 90
Ny-245. Bandurria, V 3278 **3010-3110 BC***

Sample from Lado opuesto (W) Level 3. Estimated age: 5500 to 3500 BP.

4530 ± 80
Ny-246. Bandurria, V 3279 **3350 BC***

Sample from Hallazgo 18.

B. France

490 ± 60
Ny-223. Nany **AD 1410**

Trunk of oak tree, old water pipe. Depth 4.50m (48° 41′ 34″ N, 6° 11′ 17″ E). Coll by J Florentin and R Jaegy, ENSG, Nancy.

870 ± 80
Ny-336. Avioth **AD 1090**

Fragment of linden tree from statue ND Avioth, Meuse. *Comment*: agrees with assumed antiquity of this renewed statue for pilgrimage of Avioth. Coll by cure d'Avioth, 55, Montmedy.

310 ± 50
Ny-354. Arnaville **AD 1590-1510**

Fragment of oak from ancient water mill. Coll by R Jacques, Arnaville—Pagny/Moselle.

1580 ± 80
Ny-353. Joinville **AD 400**

Human bones. Coll by Martin Fac Pharmacie, Nancy.

C. Africa

1980 ± 60
Ny-357. Ifan **AD 20**

Carbonized wood fragments and charcoal near Megalithic monument (Cromlech), Tikene Boussoura, arr Kounpentoum, depth 1.05m. Coll by Ifan, Dakar.

II. HYDROGEOLOGIC SAMPLES

Carbonates extracted from fossil water from Tarabulus dist, Libyan Arab Republic. Coll by GEFLI and GERSAR Soc, Nîmes, France.

Ny-214. Chameau mort aquifer **15,380 ± 440**

Sample from well drilled in Jurassic at Jawsh (31° 57′ N, 11° 43′ E). Depth of sampled aquifer from 110 to 140m.

Ny-208. Jawsh Takbal aquifer **18,600 ± 30**

Sample from well drilled in middle Jurasic at Tiji (32° 56′ N, 11° 23′ E). Depth of sampled aquifer from 62 to 70m.

Gefara and coastal belt first aquifer series

Ny-205. Zawiyah drilling **4400 ± 90**

From Quaternary deposit, Az Zawiyah (32° 48′ N, 12° 41′ E). Depth of sampled aquifer, 64m.

Ny-201. BP 1/21 **21,740 ± 440**

From Triasic, Wadi al Hiram (32° 23′ N, 13° 05′ E). Depth of aquifer 130m.

Ny-213. T3 **23,400 ± 240**

From Triassic, SW al Aziziyah (32° 18′ N, 11° 53′ E). Depth of aquifer 92 to 174m.

Ny-211. T 11 **17,570 ± 250**

From Triassic, S al Aziziyah (32° 21′ N, 13° 02′ E). Depth of aquifer 136 to 155m.

Gefara and coastal belt deep aquifer series

Ny-206. DW Nasiria **15,820 ± 350**

From Miocene, NW Aziziyah (32° 38′ N, 12° 47′ E). Depth of aquifer from 265 to 310m.

Ny-209. T 10 **18,780 ± 270**

From Miocene, Bin Gashir (32° 40′ N, 13° 17′ E). Depth of aquifer 486 to 546m.

Ny-207. T 2 **$19{,}330\ {}^{+\,1450}_{-\,1230}$**

From Miocene, S az Aziziyah (32° 37′ N, 12° 41′ E). Depth of aquifer 371 to 391m.

Ny-210. N° 7 **21,480 ± 370**

From Cretaceous, Sidi Mesri (32° 52′ N, 13° 12′ E). Depth of aquifer from 445 to 450m.

Ny-203. T 4 **$15{,}230\ {}^{+\,470}_{-\,540}$**

From Cretaceous, S Zliten (32° 20′ N, 14° 35′ E). Depth of aquifer from 235 to 265m.

Ny-238. DW 7 **12,770 ± ±180**

From Cretaceous, Wadi ar Ramil (32° 36′ N, 13° 35′ E). Depth of aquifer from 200 to 300m.

General Comment: only one "young" age (Ny-205) was encountered. Although for last 3000 yr, climatic conditions of Sahara have remained relatively similar to those prevailing today, it is known from botanical research that a major pluvial period occurred between 3000 and 7000 yr ago. All other samples have apparent ages between 12,000 and 24,000 yr (Ny-201, 202, 206-214) samples between 17,000 and 22,000 yr clearly predominant. This category can be linked to paleoclimatologic events relatively well known on North-African scale.

REFERENCE

Hassko, B, Guillet, B, Jaegy, R, and Coppens, R, 1974, Nancy natural radiocarbon measurements III : Radiocarbon, v 16, p 118-130.

[RADIOCARBON, VOL. 20, No. 1, 1978, P. 68-78]

UNIVERSITY OF ROME CARBON-14 DATES XV

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This list includes ages measured from August 1974 to May 1976 using the benzene scintillation method. All archaeologic and geologic samples except Sahara Libico series, come from Italian territory. These datings were carried out partly with the liquid scintillation counter previously described (Alessio *et al*, 1973) and partly with a new liquid scintillation counter (Alessio *et al*, 1976b). Vials, 4.5ml in volume, described in Alessio *et al*, 1973. Mixture consists of 3.5ml of benzene from sample and 1ml of commercial liquid scintillator NE 216. The characteristics of new counter are: background 2.90 cpm and figure of merit $\frac{E^2}{B} = 2000$.

Charcoal and wood samples underwent standard pretreatment by boiling with 5 to 10% HCl; α-labelled samples were given additional leaching with 0.2 N NaOH.

The counting rate of approx half the samples was corrected based on the $^{13}C/^{12}C$ ratio, mass-spectrometrically measured on CO_2 obtained in combustion line set up after Broecker *et al* (1959), according to previously described procedure (Alessio *et al*, 1969). As in dating with the CO_2 proportional counter, the modern standard is the same wood grown near Rome from 1949 to 1953, the activity of which is repeatedly checked with 95% of the activity of NBS oxalic acid and measurements are found coincident within 1σ. Errors quoted are 1σ statistical error. Ages were calculated using the Libby half-life of 5568 ± 30 yr, with 1950 as the standard year of reference.

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SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC AND HISTORIC SAMPLES

A. Italy

R-1073. Cavallo della Basilica di S Marco **450 ± 50**
$\delta^{13}C = -23.8‰$

Charred wood fragments from left hind paw of 1 of 4 gold-plated copper horses removed for restoration from loggia of S Marco Cathedral, Venice. Coll 1973 and subm 1974 by late A Rusconi, Proto Procuratoria di S Marco. *Comment*: dated to solve controversy about Greek or Roman origin of monument. Date does not settle question, but may indicate charred wood is remains of fire used in restoration or gilding work during Renaissance. Network of scratches apparently scattered at random to decrease surface reflectivity might be attributed to an artist contemporary to Ghiberti, as this technique was probably unknown in antiquity (Vittori and Mestitz, 1975).

Gran Carro, Lago di Bolsena series

In 1974, stratigraphic excavations in $2m^2$ area divided into 4 equal quadrangles, were made by A Fioravanti, E Loret and A Guidi, Gruppi Archeol Italia, for Sopr Etruria Meridionale, Rome, in undisturbed basal sediments of Bolsena crater lake, water depth 3.80m, near E shore at Gran Carro, prov Viterbo, Latium (42° 35′ 23″ N, 11° 59′ 44″ E). Darkened wood and charcoal coll and subm 1974, from depths up to 35cm below lake bottom, are assoc with abundant Villanovan, *Tarquiniae* and *Visentum* phases, pottery; sterile layer not reached (A Fioravanti, oral commun).

R-1120α. Gran Carro 2 **2740 ± 50**
$\delta^{13}C = -25.7‰$

Darkened wood fragments from Quad I, 5cm depth below base of lake.

R-1121. Gran Carro 3 **3470 ± 80**

Darkened wood fragments from Quad I, 10cm depth. *Comment*: sample too small to undergo .2N NaOH leaching.

R-1122α. Gran Carro 4-5 **2710 ± 50**
$\delta^{13}C = -26.2‰$

Darkened wood fragments, from Quad II, 10cm depth.

R-1123α. Gran Carro 7 **2860 ± 50**
$\delta^{13}C = -25.9‰$

Darkened wood fragments from Quad II, Layer 1, 15cm depth.

R-1124α. Gran Carro 12 **2850 ± 50**
$\delta^{13}C = -28.0‰$

Darkened wood fragments and charcoal from Quad III, Layer 1, 20cm depth.

R-1125α. Gran Carro 15 **3040 ± 50**

Darkened wood fragments and charcoal from Quad III, Layer 2, 25cm depth.

R-1126α. Gran Carro 16 **3030 ± 50**
$\delta^{13}C = -25.0‰$

Darkened wood fragments and charcoal from Quad IV, Layer 1, 30cm depth.

R-1127α. Gran Carro 19 **2850 ± 50**
$\delta^{13}C = -26.3‰$

Darkened and partly charred wood fragments from Quad IV, Layer 2, 35cm depth.

General Comment: R-1120-1127, except R-1121, ranging from 8th to mid-12th centuries BC, are to our present knowledge, judged too old for assoc Villanovan pottery (Fioravanti, oral commun). Another date available for Gran Carro R-859α (R, 1975, v 17, p 320). Prehistoric settlements of nearby small Mezzano crater lake were dated (R, 1975, v 17, p 316-319), among others discovered in Central Italy lakes.

Navi romane, Porto di Claudio, series

During construction of Leonardo da Vinci airport in 1957, keels of 6 Roman merchant ships were found at 3.5m depth below surface in entrance area of Roman port of Emperor Claudius at Fiumicino, Rome (41° 46′ N, 12° 15′ E). All keels were embedded at same depth in sandy sediments rich in mollusk shells (Scrinari, 1961). Wood from keels id by M Follieri, Ist Bot, Univ Rome, coll 1957 and subm 1975 by V Scrinari, Sopr Antichità, Ostia.

R-1128α. Porto di Claudio 1 **2020 ± 50**

Wood fragment (*Quercus* sp deciduous group) from keel of Ship 1, *Barca del Pescatore*.

R-1129α. Porto di Claudio 2 **1780 ± 50**
$\delta^{13}C = -28.0‰$

Wood fragment (*Picea or Larix*) from keel of Ship 2, *Oneraria minore*.

R-1130α. Porto di Claudio 3 **1790 ± 50**

Wood fragment (*Quercus* sp deciduous group) from keel of Ship 3, *Oneraria minore fatiscente*.

R-1131α. Porto di Claudio 4 **1820 ± 50**
$\delta^{13}C = -26.3‰$

Wood fragment (*Quercus* sp deciduous group) from keel of Ship 4, *Oneraria maggiore*.

R-1132α. Porto di Claudio 5 **1830 ± 50**
$\delta^{13}C = -24.9‰$

Wood fragment (*Quercus* sp deciduous group) from Ship 5, *Oneraria caudata*.

R-1133α. Porto di Claudio 6 **1750 ± 50**
$\delta^{13}C = -27.6‰$

Wood fragment (*Quercus* sp deciduous group) from keel of Ship 6, *Bordata di Oneraria*.

General Comment: R-1128α *Barca del Pescatore* date (70 ± 50 BC) is of Roman republican age: probably old wood reused for ship restoring.

R-1129α-1132α dates, ranging between 1st and 2nd centuries AD, agree with building time (42 to 54 or 66 AD) of Emperor Claudius port.

R-1134. Antemurale, Roma **2230 ± 50**
$\delta^{13}C = -27.4‰$

R-1134α. Antemurale, Roma **1990 ± 50**
$\delta^{13}C = -26.9‰$

Wood fragments (*Abies* sp) id by M Follieri, from rampart belonging to remains of structure of large republican Roman villa found during underground excavation work in SW area of Piazza della Repubblica, Rome. Coll 1973 and subm 1975 by V Scrinari. Rampart found at 6.5m depth at ground water level in contact with a travertine ashlar and remains of a gray pozzolana with tuff fragments mortar from rough-cast foundation. *Comment*: ^{14}C date agrees with archaeol age.

Pontile romano, fiume Tevere series

In 1974 in Tiber R bed, at 1 to 1.5m water depth, a concrete wharf with large embedded piles and a palisade between wharf and right bank were found downstream of Magliana bridge, Rome, by C Mocchegiani Carpano, Soprin Archeol, Rome. Wood id by R D'Alessandro, Ist Bot, Univ Rome; coll and subm by C Mocchegiani Carpano.

R-1111α. Pontile 1 **1780 ± 120**
$\delta^{13}C = -26.3‰$

Well-preserved wood (*Quercus* sp, deciduous group) from wharf pile, sec 30 × 20cm.

R-1112α. Pontile 2 **1760 ± 120**

Well-preserved wood (*Quercus* sp, deciduous group) from wharf board, 2cm thick.

R-1113α. Pontile 3 **2020 ± 100**

Well-preserved wood (*Quercus* sp, deciduous group) from wharf pile, sec 30 × 20cm.

R-1114α. Palizzata 4 **2150 ± 110**

Slightly darkened wood (*Quercus* sp, deciduous group) from palisade pile, sec 20 × 20cm.

General Comment: ^{14}C dates confirm Roman epoch, suggesting use of wharf for some centuries.

Toppo Daguzzo series

Charcoal from prehistoric settlement at Toppo Daguzzo near Comm Rapolla, prov Potenza, Lucania (41° 00′ 00″ N, 15° 43′ 38″ E). Coll 1972 and subm 1974 by M Cipolloni, Ist Paletnol, Univ Rome. Stratigraphic sec exposes one of most complete sequences so far known in SE Italy for Middle and Late Bronze age, Apennines and Subapennines culture, respectively (Cipolloni, 1977).

R-1090. Toppo Daguzzo DB5 **2920 ± 50**

Charcoal from Balk B, Layer 5 with pottery of Apennines culture.

R-1091α. Toppo Daguzzo III A-B6 **3340 ± 50**
$\delta^{13}C = -24.5‰$

Charcoal from Sec III, Sq AB, Level 6 with pottery of Subapennines culture.

General Comment: R-1090 -1091α dates disagree, inexplicably inverted with respect to corresponding cultures.

R-807β. Capo di Ponte, via S Bartolomeo, 70-1 **440 ± 50**
$\delta^{13}C = -28.8‰$

R-807α. Capo di Ponte, via S Bartolomeo, 70-1 **360 ± 220**

Peat from 1.70m depth, underlying level with prehistoric remains, S Bartolomeo St, Capo di Ponte, Valcamonica, prov Brescia, Lombardy. Coll 1969 and subm 1970 by E Anati. *Comment*: R-807α was given 5% HCl pretreatment and additional leaching with .2N NaOH; R-807β fraction insoluble in above .2N NaOH leaching. Sample, expected to be Neolithic, is recent; reworking is possible.

Grotticella Incudine series

Impaired wood fragments, supposedly remains of Late Bronze structure from deposit inside Incudine small cave 6km NE Edolo prov Brescia, Lombardy (46° 13′ 07″ N, 10° 21′ 48″ E). Coll 1969 and subm 1970 by E Anati. WW I trench-work discovered cave which collapsed afterwards and was rediscovered in 1969.

R-809α. Incudine 70-3 **<150**

Impaired wood fragment from Incudine small cave deposit.

R-810α. Incudine 70-4 **<150**
$\delta^{13}C = -26.2‰$

Impaired wood and other fragments from Incudine small cave deposit.

General Comment: recent, see also R-810α, proportional counting age (R, 1976, v 18, p 322).

B. Sardinia

Ossi series

Two stone huts, A and B, of Nuragic age (Alessio *et al*, 1969) found during 1967 excavations carried out by M L Ferrarese Ceruti at Sa Mandra 'e sa Giua near Ossi, ca 11km S Sassari (40° 40′ 35″ N, 8° 37′ 03″ E). Charcoal from Huts A and B and from open space E. Coll and subm 1969 by M L Ferrarese Ceruti.

R-1092α. Ossi 1 **2740 ± 50**

Charcoal from Hut B, lower cultural Layer II.

R-1093α. Ossi 2 **2690 ± 50**
$\delta^{13}C = -25.1‰$

Charcoal from crumbling in Open Space E before Hut A.

R-1094α. Ossi 3 **3050 ± 50**
$\delta^{13}C = -23.5‰$

Charcoal from sole cultural layer in Open Space E before Hut A.

R-1095α. Ossi 4 **2590 ± 50**

Charcoal from crumbling inside Hut A entrance.

R-1096. Ossi 5 **2810 ± 50**
$\delta^{13}C = -23.7‰$

Charcoal from crumbling inside Hut A.

R-1097. Ossi 6 **2800 ± 50**

Charcoal from Hut A, upper cultural Layer I.

R-1098. Ossi 7 **2670 ± 50**
$\delta^{13}C = -24.7‰$

Charcoal from Hut A, older cultural Layer II.

General Comment: Hut A believed to be newer as partly built on ash and charcoal lens on floor of Hut B; ^{14}C dates do not reveal this difference; besides, date complex is slightly older than previous ones (R, 1969, v 11, p 491) but still somewhat younger than expected.

C. Africa

Uadi Ti-n-Tohra, Sahara Libico, series

In 1971-72 Italian Archaeol Mission in Sahara Libico, Ist Paleontol, Univ Rome, Head S M Puglisi, made excavations in both N and E shelter deposits 300m apart at Uadi Ti-n-Tohra, Uadi Auis's affluent, Tadrart-Acacus sandstone massif Sahara Libico (25° 00′ N, 10° 20′ E). N shelter deposit, ca 2m thick up to rocky soil, revealed 2 archaeol horizons separated by thick sterile layer. Upper horizon, Layers I-II, Bovidian complex or series, dotted pottery and stone industry with large tools; lower horizon, Layer IV-V, dotted wavy line pottery and microlithic stone industry. E shelter deposit, ca 1.70m thick up to rocky soil, showed, Layers I to IV, sole archaeol horizon with dotted wavy line pottery and abundant stone industry; animal bone remains also present (Barich, 1976). Rock paintings and engravings, peculiar rock incision called "paired holes" (Mori, 1961), and sepulchral monuments of various kinds (Barich, 1976) were found nearby, indicating successive settlements of different prehistoric peoples. Charcoal and bovine excrement from both N and E shelters coll and subm 1972 by B Barich, Ist Paletnol, Univ Rome, who carried out excavations.

N shelter

R-1028. Ti-n-Tohra Ia **5600 ± 50**

Bovine excrement from Layer I, Level a with series dotted pottery, Bovidian phase.

R-1029. Ti-n-Tohra Ib **5260 ± 130**

Bovine excrement from Layer I, Level b with series dotted pottery, Bovidian phase.

R-1030. Ti-n-Tohra Ic **5360 ± 120**

Bovine excrement from Layer I, Level c with series dotted pottery, Bovidian phase.

R-1031α. Ti-n-Tohra II **5940 ± 50**
$\delta^{13}C = -27.0‰$

Charcoal from Layer II with series dotted pottery, Bovidian phase.

R-1032. Ti-n-Tohra V **7080 ± 60**
$\delta^{13}C = -24.5‰$

Charcoal from Layer V with dotted wavy line pottery.

E Shelter

R-1033α. Ti-n-Tohra C4 **8400 ± 60**
$\delta^{13}C = -25.1‰$

Charcoal inside Hut 4, Level II with dotted wavy line pottery.

R-1034α. Ti-n-Tohra C5 **7990 ± 70**

Charcoal inside Hut 5, Level II, with dotted wavy line pottery.

R-1035α. Ti-n-Tohra IV **8650 ± 70**
$\delta^{13}C = -24.1‰$

Charcoal from upper part of Level IV with dotted wavy line pottery.

R-1036α. Ti-n-Tohra IV **9080 ± 70**
$\delta^{13}C = -25.2‰$

Charcoal from lower part of Level IV with dotted wavy line pottery.

General Comment: ^{14}C dates range from late 8th to late 4th millennium BC, with gap through 7th millennium BC between 2 cultures: area may have been temporarily abandoned owing to unfavorable climatic conditions (Bonadonna, 1976; Geyh and Jäkel, 1974, 1975; Rognon, 1975). R-1036 is oldest date now available for Acacus Massif. Date sequences for pottery cultures of other settlements in same climatic area in Acacus Massif measured by both American and Italian (Pi, unpub) labs (Mori, 1968) as well as Tibesti and Sahara-Sudan, by both French and German labs (Camps, 1974). All above chronologies indicate settlement between 8th and 3rd millennium BC, suggesting mid-2nd millennium BC as beginning of desert environment.

II. GEOLOGIC SAMPLES

Italy

Torbiere d'Iseo series

Peat from Holocene peat bogs S Iseo lake, prov Brescia, Lombardy (45° 39′ 00″ N, 10° 02′ E). Coll 1969 and subm 1970 by E Anati. Samples from drilling core every 50cm from surface up to Würmian level, 4m depth. Peats were given only 5% HCl pretreatment, being completely soluble in .2N NaOH; sample from 2m depth: too small for dating.

R-812. Iseo 70-6 **740 ± 50**
$\delta^{13}C = -28.6‰$

Peat from 0.5 to 1m depth.

R-813. Iseo 70-7 **3340 ± 70**

Peat from 1 to 1.5m depth.

R-815. Iseo 70-9 **4240 ± 60**
$\delta^{13}C = -28.4‰$

Peat from 2 to 2.5m depth.

R-816. Iseo 70-10 **4580 ± 50**
$\delta^{13}C = -29.0‰$

Peat from 2.5 to 3m depth.

R-817. Iseo 70-11 **5390 ± 70**
$\delta^{13}C = -28.2‰$

R-818. Iseo 70-12 **7190 ± 60**

Peat from 3.5 to 4m depth.

General Comment: dates requested in support of pollen analysis as well as stratigraphic studies for Valcamonica Holocene paleoenvironment reconstruction. R-811 to -818 dates consistent with stratigraphy but systematically somewhat younger than pollen analysis data and 2 ^{14}C ages for nearby similar Tonale peat bogs (Horowitz, 1975): samples probably contaminated by recent vegetation. Iseo peat bog, unlike Tonale bogs, are under 1m water at S edge of lake.

Lago di Tenno series

Well-preserved wood from trunks *in situ* at base of Tenno Lake, 4.5km N Tenno, prov Trento, Trentino (45° 56′ N, 10° 46′ E) at +570m. Lake No. 3 in "Catasto laghi del Trentino". Coll 1970 by Gruppo Sommozzatori Riva del Garda and subm 1975 by F Pedrotti, Ist Bot, Univ Camerino, who id wood.

R-1107α. Lago di Tenno 1 **920 ± 50**
$\delta^{13}C = -26.0‰$

Well-preserved wood (*Fagus silvatica* L) from Trunk 1 *in situ* in basal sediments, water depth 24m.

R-1108α. Lago di Tenno 8 **1420 ± 50**

$\delta^{13}C = -26.1‰$

Well-preserved wood (*Fagus silvatica* L) from Trunk 8 *in situ* in basal sediments, water depth 19m.

R-1109α. Lago di Tenno 13 **1000 ± 50**

$\delta^{13}C = -28.0‰$

Well-preserved wood (*Fagus silvatica* L) from Trunk 13 *in situ* in basal sediments, water depth 19m.

R-1110α. Lago di Tenno 32 **810 ± 50**

$\delta^{13}C = -25.8‰$

Well-preserved wood (*Ostrya carpinifolia*) from Trunk 32 *in situ* in basal sediments, water depth 18m.

General Comment: R-1107 to -1110 dates, agreeing with previous ones (R, 1973, v 15, p 385; R, 1975, v. 17, p. 323-324), conclude detailed chronology of Tenno submerged forest. 12 trunks have been dated, and do not disagree with traditional belief that Tenno Lake basin was formed by landslide ca AD 1400.

Aeroporto Leonardo da Vinci, Fiumicino series

In 1968, for enlargement of Leonardo da Vinci airport, Ministero Lavori Pub entrusted R Mortari, Ist Geol & Paleont, Univ Rome, with geol and geotech studies in recent sediments at Bonifica di Porto NE Fiumicino (41° 50′ N, 12° 16′ E). 15 drillings in present 3rd strip area revealed brackish lagoon formation from 35 to 60m thick; from surface downwards: Levels 1-3 clayey sediments, average thickness ca 20m, with interbedded peaty layer, 4m depth, and several horizons with both wood and vegetable remains, and mollusk shell accumulations; Levels 4 and 5, from 20 to 40-60m depth, silty-clayey sediments resting on fluvial sands and gravels. Stratigraphic sequence also recognized by penetration tests (Mortari, 1975a b). Wood and clays from Core P3-S5 (41° 50′ 03.3″ N, 12° 16′ 01″ E) coll 1968 and subm 1974 by R Mortari.

R-887. Aeroporto P3-S5 I **4760 ± 60**

$\delta^{13}C = -28.4‰$

Blackish clay rich in very small and microscopic vegetable remains (C = 13%), freed from larger wood fragments, Core 5, Level I, 4m depth.

R-887Aα. Aeroporto P3-S5 I **4640 ± 80**

$\delta^{13}C = -29.0‰$

Darkened wood fragments from blackish clay, R-887.

R-888. Aeroporto P3-S5 II **7730 ± 80**

$\delta^{13}C = -28.1‰$

Blackish clay rich in very small and microscopic vegetable remains (C = 5.2%), freed from larger wood fragments, Core 5, Level II, 9.20m depth.

R-888Aα. Aeroporto P3-S5 II **7660 ± 80**
$\delta^{13}C = -24.7‰$

Darkened wood fragments from blackish clay, R-888.

R-889. Aeroporto P3-S5 II **7770 ± 60**
$\delta^{13}C = -26.8‰$

Blackish clay rich in very small and microscopic vegetal remains and freed from larger wood fragments, Core 5, Level II, 9.35m depth.

R-889Aα. Aeroporto P3-S5 II **7670 ± 70**
$\delta^{13}C = -26.4‰$

Darkened wood fragments from blackish clay, R-889.

R-890. Aeroporto P3-S5 II **7930 ± 70**
$\delta^{13}C = -28.0‰$

Grayish clay with scarce vegetable remains (C = 1.2%) from Core 5, Level II, 9.5m depth.

General Comment: dates consistent with stratigraphy indicate Holocene age. Further datings are in progress for Latium to attempt correlation of Holocene sequences id by geotech test and provide data on recent sea-level variations (Mortari, 1972, 1975a, 1975b).

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UNIVERSITY OF ROME CARBON-14 DATES XVI

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This list includes dates measured from July 1975 to December 1976 with CO_2 proportional counters. All archaeologic and geologic samples except for Turkey and Sistan series come from Italian territory. Laboratory equipment, largely unchanged but expanded and technically improved, has been previously described (Alessio *et al*, 1970b, 1976).

Charcoal and wood samples received standard pretreatment by boiling with 5 to 10% HCl; α-labeled samples were given additional leaching with .2N NaOH.

The activity of our modern standard, wood grown near Rome between 1949 and 1953, is checked repeatedly with 95% activity of NBS oxalic acid and measurements agree within 1σ. For each sample of CO_2, except for two, the counting rate was corrected according to mass-spectrometrically measured $^{13}C/^{12}C$ ratio as described previously (Alessio *et al*, 1969). Dates are reported in conventional radiocarbon years, using the Libby half-life of 5568 ± 30 yr, with 1950 as the standard year of reference. When requested, MASCA corrected dates (Ralph *et al*, 1973) are reported.

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SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC AND HISTORIC SAMPLES

A. Italy

Riparo di Romagnano III series

In 1968-69 agric and quarry work uncovered some prehistoric settlements at Loc, Comm Romagnano, along right side of Adige Valley, on alluvial cone of Rio Bondone near its junction with Adige R, 10km S Trento, Trentino-Alto Adige. At top of Bondone cone (46° 00′ 26″ N, 11° 06′ 23″ E) at +210m, relict edge of Romagnano III shelter deposit was excavated 1970—Iron, Bronze and Neolithic levels, by R Perini, Mus Sci Nat, Trento (Perini, 1971), and 1971-73—Epipaleolithic levels, with Tardenoisian and Sauveterrian complexes, by G Bartolomei and A Broglio, Ist Geol, Paleont, & Paleont Umana, Univ Ferrara (Broglio, 1971, 1973a, 1976; Bartolomei *et al*, 1972). On debris bottom of deposit, average thickness ca 8m, Layers AF-AE of limestone rubble underlie, AD, Bondone alluvial sands and gravels with superimposed, AC, eaolian paleosol; upper Layers, AB, AA, T to A, until top, mainly crumbled limestone rubble and blocks. Epipaleolithic fauna complex confirms transition from scarcely forested mt environment to progressively woodier one with rise of broad-leaved tree forest and migration of periglacial fauna towards higher Alpine zones. Paletnol and paleont studies as well as pollen and sediment analyses are in progress. Charcoal from Layers I2 and T4 coll and subm 1970 by R Perini, and from Layers AA to AF coll and subm 1971-73 by G Bartolomei and A Broglio, id by M Follieri, Ist Bot, Univ Rome: *Pinus* sp dominant together with *Quercus* sp deciduous group.

1970 excavations

R-767. Romagnano III 1, I2 **2600 ± 140**
$\delta^{13}C = -25.0‰$

Charcoal from Layer I2 in ash and carbonaceuos earth lens, probably hearth. Final Bronze age. Luco culture, recent phase apparently ending in 8th century BC. *Comment*: ^{14}C date agrees.

R-768. Romagnano III 2 **3000 ± 50**
$\delta^{13}C = -25.0‰$

Charcoal from N landslide. Hearth and pottery of Final Bronze age, Luco culture ancient phase attributable to 11th and 10th centuries BC as coeval to Ha A of Reinecke (Frei, 1955; Perini, 1970). *Comment*: ^{14}C dates agrees.

R-769. Romagnano III 3, P1 **3720 ± 50**
$\delta^{13}C = -24.9‰$

Charcoal from Layer P1, in No. 1 inhumation burial of Early Bronze necropolis. *Comment*: see R-770α.

R-770α. Romagnano III 4-7, P2-3 **3630 ± 50**
$\delta^{13}C = -24.4‰$

Charcoal from Layer P2-3, in No. 4 and 5 inhumation burials of Early Bronze necropolis. *Comment*: necropolis, containing remains of 31 children and 9 adults mainly in inhumation burials, is attributed to Polada-A culture, local facies, synchronizable to Bz A1 of Reinecke (Perini, 1973, 1975). R-769 and -770 dates agree, being within chronologic range of above culture.

R-775. Romagnano III 12, R4 **4810 ± 50**
$\delta^{13}C = -25.2‰$

Charcoal from Layer R4, inside hearth with scarce Upper Neolithic pottery. *Comment*: ^{14}C date agrees with Po plain Upper Neolithic; no comparisons available.

R-776. Romagnano III 13-14, T1 **5560 ± 50**
$\delta^{13}C = -25.1‰$

Charcoal from Layer T1, near and inside hearth, Middle Neolithic, Square-mouthed pottery culture, middle phase. *Comment*: see R-779.

R-777α. Romagnano III 15, T1 **5530 ± 50**
$\delta^{13}C = -25.5‰$

Charcoal from Layer T1, under R-776 hearth. *Comment*: see R-779α.

R-779α. Romagnano III 17, T2 **5470 ± 50**
$\delta^{13}C = -26.0‰$

Charcoal from Layer T2, Middle Neolithic, at Hearth I level with Square-mouthed pottery culture, middle phase. *Comment*: R-776, -777α, and -779α ages acceptable for Square-mouthed pots, middle phase, also in comparison to numerous available ^{14}C dates of Fimon-Molino Casarotto settlement, 1st half 4th millennium BC, belonging to late ancient phase of same culture (R, 1974, v 16, p 358-361) (Bagolini *et al*, 1973). Comparable dates for other sites: Grotta Aisone, R-95 (R, 1965, v 7, p 213); Arene Candide, P-27 (Tongiorgi *et al*, 1959) and R-103 (R, 1966, v 8, p 402); Rivoli "spiazzo", middle phase, Birm-103 (R, 1970, v 12, p 396).

R-781. Romagnano III 19-20, T4 **5810 ± 50**
$\delta^{13}C = -25.7‰$

R-781α. Romagnano III 19-20, T4 **6060 ± 50**

Charcoal from Layer T4, Cut 1 under Hearth I and Cut 2 on floor remains. Industry of Tardenoisian local tradition assoc with Lower Neolithic impressed pottery, some of Fiorano type (Bagolini, 1971; Bagolini and Biagi, 1975). *Comment*: R-781α date agrees, see also R-1136.

1971-1973 excavations

R-1136. Romagnano III AA1-2 **6480 ± 50**
$\delta^{13}C = -26.9‰$

Charcoal from Layer AA1-2. Coll 1971. Industry of Tardenoisian local tradition assoc with Lower Neolithic impressed pottery as in Layer T4, see R-781α above. *Comment*: R-1136 date confirms supposed age of pottery appearing in Po plain and Adige valley.

R-1137. Romagnano III AB1-2 **7850 ± 60**
$\delta^{13}C = -27.2‰$

Charcoal from Layer AB1-2. Coll 1972. Epipaleolithic: Tardenoisian industry similar to "Castelnovian" characterized by trapezes, rhomboids, and denticulate scrapers on blade. *Comment*: see R-1138.

R-1138. Romagnano III AB3 **8140 ± 80**
$\delta^{13}C = -25.4‰$

Charcoal from Layer AB3. Coll 1971-73. Final Sauveterrian, or Episauveterrian phase industry with trapezes and assoc elements belonging to both overlying Tardenoisian and underlying Sauveterrian recent phase industries. *Comment*: R-1137 and -1138 dates too old in comparison with available ones for S France similar sequence in which Tardenoisian elements appear 1st half of 7th millennium BC, see: Rouffignac, GrN-2289 (R, 1972, v 14, p 58); Chateauneuf, Ly-438, and La Baume de Montclus, Ly-542 (R, 1973, v 15, p 526-527); and with Vatte di Zambana series, Adige valley (R, 1969, v 11, p 483-484) where Tardenoisian elements appear ca 2nd half same millennium. Wrong sampling may be inferred; R-1137 and -1138 partly coll from deposit zone where layer id was very difficult.

R-1139. Romagnano III AC1 **8220 ± 80**
$\delta^{13}C = -26.7‰$

R-1140. Romagnano III AC2 **8560 ± 70**
$\delta^{13}C = -26.3‰$

R-1141. Romagnano III AC3 **8590 ± 90**
$\delta^{13}C = -25.6‰$

Charcoal from Layer AC1-3, Sauveterrian industry complex, recent phase, mainly characterized by bilaterally-backed and oblique-truncated both bladelets and short points, latter "triangles de Montclus".

R-1142. Romagnano III AC4 **8740 ± 90**
$\delta^{13}C = -26.0‰$

R-1143α. Romagnano III AC5-6 **9090 ± 90**
$\delta^{13}C = -25.7‰$

R-1144α. Romagnano III AC7 **9100 ± 90**
$\delta^{13}C = -25.6‰$

R-1145. Romagnano III AC8-9 **9200 ± 60**
$\delta^{13}C = -26.1‰$

R-1145α. Romagnano III AC8-9 **9200 ± 60**
$\delta^{13}C = -25.9‰$

Charcoal from Layer AC4-9. Sauveterrian industry complex, middle phase, mainly characterized by small double-side-backed elongated points voluntary broken at base, small elongated backed points normally truncated, crescents, trapezoidal segments, and triangles.

R-1146Aα. Romagnano III AE1-4 **9580 ± 250**
$\delta^{13}C = -25.5‰$

R-1146α. Romagnano III AE1-5 **9420 ± 60**
$\delta^{13}C = -25.6‰$

R-1146B. Romagnano III AE **9490 ± 80**
$\delta^{13}C = -26.6‰$

R-1147. Romagnano III AF **9830 ± 90**

$\delta^{13}C = -27.9‰$

Charcoal from Layers AE1-5 and AF, Sauveterrian industry complex, ancient phase, mainly characterized by double-side-backed and double-truncated bladelets, small backed and normally truncated short points, nearly isosceles triangles trilaterally retouched, crescents, trapezoidal segments, and short triangles.

General Comment on Sauveterrian complexes: R-1139 to -1141 dates from 8600 to 8200 BP confirm assumption (Broglio, 1973b) that Sauveterrian industry complex, recent phase, is older at Romagnano III than at Vatte di Zambana (R, 1969, v 11, p 482-484). Therefore, on the whole, Val d'Adige Sauveterrian, recent phase, ca 6000 BC, agrees with S France complexes, see: Rouffignac 4a, GrN-2913 (R, 1972, v 14, p 59); Montclus 21F and 22, Ly-305 to 308 (R, 1971, v 13, p 62); Gramari C3A and C3B, Gif-752, 753 (R, 1971, v 13, p 219); Salzet, Gif-443 (R, 1970, v 12, p 423). R-1142-1145 ages, from ca 9260 to 8700 BP, *ie*, ca 7000 BC, refer to Sauveterrian complex, middle phase. R-1146 and -1147 ages, from ca 9900 to 9400 BP, place ancient phase of same complex in 1st half of 8th millennium BC, oldest dates so far available for Sauveterrian industries. Comparison with S France Sauveterrian same phase: Rouffignac 4b, 4e, 5a, and 5b, GrN-2895, 2880, 5513 and 5514, respectively (R, 1972, v 14, p 59); Fieux, Gif-1807 (R, 1974, v 16, p 26); Gramari C4, Gif-754 (R, 1971, v 13, p 219); Culoz E, Ly-286 (R, 1971, v 13, p 58).

Riparo di Pradestel series

In 1973 prehistoric deposit under small shelter, covered with large debris cone, was found by quarry work at Ischia Podetti, right side of Adige Valley, 6km N Trento, Trentino-Alto Adige (46° 07′ 07″ N, 11° 04′ 55″ E) at +225m. Excavations in deposit of detrital material, 15m above quarry plain, made in 1975 by G Bartolomei, A Broglio, and B Bagolini, latter of Mus Tridentino Sci Nat, Trento (Ist It P P, 1976), revealed Epipaleolithic or Mesolithic industries of Adige Valley sequence: Upper Layers A and B, Tardenoisian industry with trapezes together with pottery; C to E1, Tardenoisian industry complexes; E3-4 to M, Sauveterrian industries. Charcoal from Layers D, H, and L coll 1975 and subm 1976 by G Bartolomei, A Broglio, and B Bagolini.

R-1148. Pradestel D1-3 **6870 ± 50**

$\delta^{13}C = -26.5‰$

Charcoal from Layer D1-3, Tardenoisian industry characterized by trapezes, rhomboids, and denticulate scrapers on blade.

R-1149. Pradestel H-H2 **8200 ± 50**

$\delta^{13}C = -25.4‰$

Charcoal from Layer H-1-2, Sauveterrian industry.

R-1150. Pradestel L1 **8240 ± 200**

Charcoal from Layer L1, Sauveterrian industry.

R-1151. Pradestel L-7-8 **9320 ± 50**
$\delta^{13}C = -26.3‰$

Charcoal from Layer L7-7ab-8, Sauveterrian industry.

General Comment: R-1148 age agrees with middle level of Tardenoisian complex and suggests comparison with "Covoloni del Broion" R-892 date, see below; also agrees with dates available for "Castelnovian", the most similar Tardenoisian complex of Mediterranean France for > a millennium ca 5000 BC, see: Chateauneuf 7 and 8, Ly-447, 624, 448, and 438; Montclus, 8, 14, and 16, Ly-494, 495, 496, and 542 (R, 1973, v 15, p 526-527). Other similar dates for S France Tardenoisian industries: Rouffignac 3 and 2, GrN-2289 and 5512 (R, 1972, v 14, p 58-59). Range of R-1149-1151 dates, from ca 9370 to 8250 BP, is large for Pradestel Sauveterrian and could result longer after dating E3-4 and M Layers. At present, Pradestel dates fall inside Sauveterrian Romagnano III series; see above also for comparison with ages of S France Sauveterrian.

R-892. Grottina dei Covoloni del Broion **6930 ± 60**
$\delta^{13}C = -26.0‰$

"Grottina dei Covoloni del Broion" is small niche in rear of Covoloni shelter in limestone wall of Broion, Berici Mts, at La Vallà, Lumignano, Comm Longare, prov Vicenza, Veneto (45° 27′ 58″ N, 11° 35′ 22″ E) at ca +120m. In 1973-74 and 1976 Fondazione Ligabue, Venice, with Ist Geol, Paleont & Paleont Umana, Univ Ferrara, carried out excavations (Ligabue, 1973) in deposit formed by cyclic stalagmitic levels overlying clastic and aeolian-colluvial sediments, with limestone rubble at base. Cultural horizons revealed in upper Layers 3-4, Eneolithic or Bronze age with numerous human skeleton remains; Layer 6, Tardenoisian industry complex with trapezes, part of Epipaleolithic sequence; 7 to 7c, very scarce Sauveterrian industries attributable to Final Upper Paleolithic. Industry and pollen analyses as well as paleont and paleoanthropol studies in progress (Cattani, 1977). Charcoal from Layer 6, Sqs 2-5, 12-13, coll 1974 and subm 1976 by A Guerreschi, Ist Geol, Paleont & Paleont Umana, Univ Ferrara. *Comment*: R-892 date agrees, suggests intermediate age of trapeze Epipaleolithic industries, and is strictly comparable to R-1148 of Pradestel shelter, above.

Grotta Benussi series

From 1965 to 1972 Comm Grotte "E Boegan", Soc Alpina Giulie, Sez CAI Trieste, excavated Benussi cave deposit, on W slope of Sedlen Mt, a Cenomanian limestone hill NNW S Pelagio village, Comm Duino-Aurisina, prov Trieste, Venezia Giulia (45° 46′ 36″ N, 13° 41′ 34″ E) at ca +250m. Cave No. 4163 VG in "Catasto Grotte della Venezia Giulia". Deposit, average thickness ca 2m, contains Epipaleolithic levels with Sauveterrian and Tardenoisian industries, scarce Neolithic remains, Final Bronze and Middle Ages horizons (Andreolotti and Gerdol, 1973). Epipaleolithic fauna, Cuts 3 to 6, comprises large mammals, food refuse; bird, fish and marine mollusk shell remains also present (Riedel, 1976).

Charcoal and charred bones from Epipaleolithic levels coll 1972 and subm 1973 by S Andreolotti and R Gerdol, Comm Grotte "E Boegan".

R-1043. Benussi 3 **7050 ± 60**
$\delta^{13}C = -25.0‰$

Charcoal from Cut 3, 15cm thick. Epipaleolithic, Tardenoisian phase with prevailing trapezes and rhomboids, almost absent bilaterally backed tools.

R-1042. Benussi 3-4 **7230 ± 140**
$\delta^{13}C = -23.9‰$

Charred animal bones from Cuts 3-4.

R-1044. Benussi 4 **7620 ± 150**
$\delta^{13}C = -24.3‰$

Charcoal from Cut 4, 15cm thick. Epipaleolithic, final Sauveterrian or Episauveterrian phase with trapezes.

R-1045. Benussi 5 **8380 ± 60**
$\delta^{13}C = -24.1‰$

Charcoal from Cut 5, 15cm thick. Epipaleolithic, final-recent Sauveterrian phase as in Cut 6.

R-1045A. Benussi 5-6 **8650 ± 70**
$\delta^{13}C = -24.0‰$

Charred bones and charcoal from Cuts 5-6. Epipaleolithic, final-recent Sauveterrian phase with hypermicrolithic and microlithic bilaterally or unilaterally retouched points along with truncated-and-backed bladelets, points, and scarce trapezes (Broglio, 1971).

General Comment: R-1043, Tardenoisian horizon, and R-1044, Episauveterrian complex, dates substantially agree with available ones for S France settlements and Vatte di Zambana, Adige Valley; *cf* R-1138, Romagnano III, above. R-1145 and -1145A dates approx for recent Sauveterrian phase at Romagnano III and S France, though in latter, trapezes are absent; *cf* R-1139-1141, Romagnano III *General Comment*, above.

Grotta dei Ciclami series

From 1959 to 1964 and in 1972 Comm Grotte "E Boegan, Soc Alpina Giulie, CAI Trieste, excavated Ciclami cave deposit, on S slope of Orsano Mt, 1km E Comm Monrupino, prov Trieste, Venezia Giulia (45° 42′ 24″ N, 13° 49′ 08″ E) at +324m. Cave No. 2433 VG in "Catasto Grotte della Venezia Giulia" (Legnani & Stradi, 1963; Legnani, 1967). First excavations 1925 by R Battaglia (1927, 1958-59). Deposit, ca 4m thick, reveals Epipaleolithic, Neolithic, Eneolithic Bronze and Iron age cultural Horizons. Fauna remains show large wild mammals in Epipaleolithic levels and domestic ones prevailing from Neolithic level upwards (Riedel, 1968). Charcoal from Cuts 4, 6, and 9 coll 1962 by F Stradi and F Legnani, Comm Grotte "E Boegan", and from Cut 8b coll 1972 and subm 1973 by S Andreolotti and R Gerdol.

R-1037. Ciclami 4 **4160 ± 50**
$\delta^{13}C = -24.7‰$

Charcoal from Cut 4, 50cm thick. Early Bronze, decorated pottery of Ljubljana style. *Comment*: date only comparable with Layer 5 of Mitreo cave, Ljubljana culture, ca 300 yr younger.

R-1038. Ciclami 6 **6290 ± 130**
$\delta^{13}C = -24.5‰$

Charcoal from Cut 6, 50cm thick. Upper Neolithic, scarce pottery of Brijuni-Skocian type (Barfield, 1971). *Comment*: date too old, if compared with available ones for Square-mouthed pot culture in N Italy at least partly coeval. See Romagnano III R-779α, above.

R-1040α. Ciclami 8b **6300 ± 60**
$\delta^{13}C = -25.0‰$

Charcoal from Cut 8b, 10cm thick. Middle Neolithic, Vlasca type pottery (Barfield, 1971). *Comment*: date comparable with available ones for Fiorano culture type pottery in N and Central Italy believed approx coeval. See Ripabianca di Monterado, R-598α and -599α (R, 1970, v 12, p 602-603) and Grotta dell'Orso di Sarteano, R-676 (R, 1973, v 15, p 168).

R-1041α. Ciclami 9 **8260 ± 60**
$\delta^{13}C = -24.4‰$

Charcoal from Cut 9, 30cm thick. Epipaleolithic with scarce and hardly significant trapezeless industry. *Comment*: date acceptable, similar to available ones for Sauveterrian industry, recent phase, at Romagnano III and at Grotta Benussi, see above, R-1139-1141, and R-1045, 1045A, respectively.

Grotta del Mitreo series

In 1965 excavations made by Soc Alpina Giulie (Andreolotti *et al*, 1966) uncovered remains of Mithra's temple in late Roman epoch upper layer of Mitreo cave deposit, ca 0.5km SE S Giovanni al Timavo, Comm Duino-Aurisina, prov Trieste, Venezia Giulia (45° 47′ 00″ N, 13° 31′ 20″ E) at ca +50m. Cave No. 4204 VG in "Catasto speleologico della Venezia Giulia" (Marini, 1965). In 1971-72 Centro Antichità Adriatiche, Head, G Stacul, dug trench, 5 × 3m wide, in W side. Through sec, over 4m deep, 8 stratigraphic layers with 4 main cultural horizons were id (Stacul, 1971-72, 1973, 1976). Charcoal from Layers 4, 5, and 8 coll 1971 and subm 1972 by G Stacul.

R-902. Mitreo 4 **3820 ± 50**
$\delta^{13}C = -28.1‰$

Charcoal from basal level of Layer 4, ca 1m thick. *Comment*: all levels of Layer 4 contain similar industries. Upper levels yielded vases comparable to frequent ones in lowest cultural horizon of Castelliere Marchesetti deposit near Slivia, Trieste, dated 3430 ± 50 (R, 1973, v 15, p 166) (Stacul, 1972).

R-903α. Mitreo 5 **3720 ± 50**

$\delta^{13}C = -24.7‰$

Charcoal from Layer 5, ca 70cm thick, with decorated pottery of Ljubljana style, Ig II phase, between Eneolithic and Bronze age (P Korošec and J Korošec, 1969).

R-904. Mitreo 8 **5770 ± 60**

$\delta^{13}C = -25.8‰$

R-904α. Mitreo 8 **5770 ± 50**

$\delta^{13}C = -26.1‰$

Charcoal from lowest cultural Layer 8, average thickness 80cm, and partly overlying rocky soil. Pottery infilled with red paste of Danilo culture style (J Korošec, 1959, 1964).

General Comment: previous archaeol excavations in other caves of Trieste Karst revealed same industry series as Mitreo cave (Radmilli, 1974). R-902 and -903α dates generally agree with expected ones for Ig II phase, Ljubljana culture, judged coeval to final Remedello and early Polada cultures (Korošec & Korošec, 1969), with influences of bell-beaker pottery style (Korošec, 1967) and typologic affinities with Dalmatia Hvar culture (Novak, 1955). Also R-904α date seems to agree with Danilo culture dated by comparison with others, 5300 to 4000 BC (Thomas, 1967; Alexander, 1972; Gimbutas, 1970, 1974). MASCA corrected dates can be used for this cultural comparison.

R-886α. Duomo di Monza **460 ± 50**

$\delta^{13}C = -27.3‰$

Slightly damaged and worm-eaten wood fragment found 1941 inside marble sarcophagus of Queen Theodolinda, now behind small neogothic altar in left apsis Teodolinda chapel, cathedral of Monza, prov Milan, Lombardy (Merati, 1962). Wood, in cathedral store since 1941, subm 1975 by A Merati and L Pozzo, Monza. *Comment*: sample carefully chosen, portion pulverized by worms was discarded. In January 1941 all founds in sarcophagus were recovered including objects of Longobard style and impaired wood fragments possibly from 2 coffins into which mortal remains of Queen Theodolinda, presumably dead AD 628, and her husband King Agilulph, formerly interred, were transferred AD 1308 to be put into marble sarcophagus, according to necrological calendar of Monza cathedral (Frisi, 1794; Merati, 1975). R-886α ^{14}C age and MASCA corrected date, AD 390 to 440, slightly later.

R-1105. Buca dei Ladri **>28,000**

Collagen of animal bones from bone breccia sticking to vault of bottom chamber of Ladri cavity, an interstratum cave, ca 130m deep to bottom lake, downhill ca 34m below entrance, on limestone S slope of Pisano Mt near Agnano, Comm S Giuliano Terme, prov Pisa, Tuscany (43° 44′ 15″ N, 10° 28′ 30″ E) at +40m. Coll 1973 by G P Pianucci and subm 1975 by A M Radmilli, Ist Antropol & Paleont Umana, Univ Pisa. Cave bottom partly covered with debris cone overlying crumbled limestone blocks with bones from breccia comprising *Cervus* prevailing over *Bos, Equus, Lepus Vulpes,* and *Martes martes,* latter confirming cold climate phase, and bird remains; 4 implements attributable to Upper Paleolithic industry also found. *Comment*: ^{14}C date a) refutes inferred correlation between bone breccia and industry; b) gives minimum age only for bone breccia and, thus, for similar ones of Pisano Mt; c) refutes correlation with basal deposit in nearby Leone cave containing Epipaleolithic industry. If bone breccias of Pisano Mt are coeval, they might belong to an old Würmian phase.

R-878. Fossacesia 1, B-IV, 9-10 **5430 ± 120**
$\delta^{13}C = -25.8‰$

Charcoal and carbonaceous earth from Hut 1, Sec B, Sq IV, Cuts 9-10, of Neolithic village of Fossacesia near Chieti, Abruzzo (42° 12′ 20″ N, 14° 29′ 18″ E). Coll 1971 by G Cremonesi, Ist Paletnol, Univ Lecce, and subm 1971 by A M Radmilli. Sample from brown clay level mottled by ashes and charcoal and containing scarce potsherds. *Comment*: archaeol materials in Hut 1, various cuts, belong to final phase of Ripoli culture showing some influences of Diana culture, a handle of Serra d'Alto type also present (Cremonesi, 1973). ^{14}C date agrees with age of Sec B, Cut 1 of same Hut, Fi-30, 5420 ± 210 (R, 1973, v 15, p 484), both believed too old for final phase of Ripoli culture and its relations with others. Available dates for Ripoli culture at Ripoli village: R-665 and -664 (R, 1971, v 13, p 397); Fi-31 (R, 1973, v 15, p 848); Pi (unpub), 5100 ± 120 (Cremonesi, 1965). Besides, Grotta dei Piccioni, Ripoli horizon, with Lagozza and Diana types, Pi-49 (R, 1961, v 3, p 100-101 (Cremonesi, 1976).

Taurisano series

In 1964 construction uncovered prehistoric settlement underlying ground of surrounding plain at Pietra L'aia, ca 0.5km NW Comm Taurisano, prov Lecce, Apulia (39° 57′ 34″ N, 18° 12′ 31″ E), originally probably shelter deposit in marine calcareous tufa "carparo" local formation, which crumbled afterwards. Excavations 1964 made by late L Cardini and P Cassoli, Ist It Paleont Umana, Roma, for Sopr Antichità Puglie, Taranto (Cardini & Biddittu, 1967). Trench, $9m^2$ wide and ca 4.2m deep, revealed under vegetal soil and terra rossa reworked layer, ca 1.5m thick, archaeol deposit, average thickness ca 2.7m: Cuts, 10cm thick, 1 to 23, "terra bruna" mixed with carparo fragments containing Epigravettian industry and abundant animal charred bones and teeths, some uncharred, mainly *Equus caballus, Equus hydruntinus, Bos,* and *Cervus*; Cuts 24 to 27, mainly carparo blocks with little reddish earth, Epigravettian industry and scarce charred bone remains belonging to same fauna as Cuts 1-23, in any case insufficient for dating. Bones and charred bones from

Cuts 4 to 22 coll 1964 by P Cassoli and subm 1973 by A Bietti, Ist It Paleont Umana.

R-1061. Taurisano Tl 4-5 **15,500 ± 150**
$\delta^{13}C = -21.7‰$

Charred animal bones and small amount of collagen of uncharred bones from Cuts 4 and 5.

R-1062. Taurisano Tl 6-9 **16,050 ± 160**
$\delta^{13}C = -21.7‰$

Charred animal bones and small amount of collagen of uncharred bones from Cuts 6 to 9.

R-1063. Taurisano Tl 10-12 **15,600 ± 120**
$\delta^{13}C = -22.5‰$

Charred animal bones and small amount of collagen of uncharred bones from Cuts 10 to 12.

R-1064. Taurisano Tl 18-22 **16,000 ± 150**
$\delta^{13}C = -23.0‰$

Charred animal bones and small amount of collagen of uncharred bones from Cuts 18 to 22.

General Comment: charcoal from charred bones was extracted by boiling with 15% HCl and collagen from uncharred bones by method already described (Alessio *et al*, 1976). In 1964 G Laplace analyzed Taurisano Epigravettian industry attributing Cuts 1 to 5 to Final Epigravettian and 6 to 23 to Ancient Epigravettian, owing to presence of "à cran" tools (Laplace, 1964, 1966). ^{14}C dates seem to disagree with Laplace analysis, showing no hiatus or discontinuity as suggested by above interpretation. Taurisano industry is being studied by A Bietti—a sharp typologic discontinuity seems to exist only between Cuts 1-23 and 24-27 complexes. Latter not dated for lack of bone remains.

A significant comparison exists with Layer 3 of Cipolliane caves C shelter for both industry of Evolute Epigravettian facies, similar to Taurisano ones, and ^{14}C dates: R-353, 15,000 ± 100, R-355, 15,250 ± 300, and R-356, 15,200 ± 100 (R, 1976, v 18, p 232-233) (Gambassini, 1970).

R-1152. Grotta dei Giganti 5-6, 9-10 **>39,000**
$\delta^{13}C = -26.3‰$

Charred animal bones from Cuts 5-6, lower Hearth F4, and 9-10, basal Hearth F5, in deposit of Giganti cave in limestone cliff along Ionian coast rd, ca 2km from lighthouse W Capo S Maria di Leuca, prov Lecce, Apulia (39° 47′ 23″ N, 18° 20′ 23″ E) (Blanc, 1959; De Lorentiis, 1959). Excavations made 1974-75 by E Segre, P Cassoli and M Piperno, Ist It Paleont Umana, Rome, revealed from surface 5 superimposed Hearths F1-F5 with interbedded terra rossa levels. Industry, fauna, and stratigraphic data confirm rather late facies of Mousterian in

Salento. Sample coll and subm 1975 by M Piperno. *Comment*: ^{14}C minimum age somewhat older than expected if compared with available dates for Upper and Final Mousterian in Broion cave, Veneto, Italy (Leonardi and Broglio, 1966; R, 1967, v 9, p 117) and at La Quina, France, GrN-2526 (R, 1963, v 5, p 165) and GrN-4494 and -4449 (R, 1967, v 9, p 111-112). See also, Haua Fteah, Libya, Debba culture, GrN-2550 (R, 1963, v 5, p 171) and GrN-1486 (R, 1967, v 9, p 120).

B. Sicily

Chiesa della Martorana, Palermo series

Wood taken 1972 from "cupola" and "Telaio di Ruggero" in S Maria dell'Ammiraglio or della Martorana church, Palermo, by R Calandra, Ist Storia Architettura, Univ Palermo, on behalf of B Lavagnini, Ist Siciliano Studi Bizantini e Neoellenici, Palermo, and subm through M Marabini, Ist Centrale Restauro, Rome. Dates essential for architectural and mosaic studies being done by E Kitzinger, Harvard Univ.

R-959. La Martorana 2, Telaio Ruggero **190 ± 50**
$\delta^{13}C = -25.7‰$

Well-preserved wood from "Telaio di Ruggero", ie, wooden frame fixed to mosaic representing King Roger II crowned by Christ. *Comment*: MASCA corrected date, AD 1630 to 1670-1770, slightly younger than expected as frame was used for mosaic displacement possibly connected with lengthening of former square church attributable to late 16th century.

R-960. La Martorana 1, Cupola **720 ± 100**
$\delta^{13}C = -26.6‰$

Impaired and strongly worm-eaten reddish wood fragment with a few plaster bits adhering from wooden frame at dome base. *Comment*: sample carefully chosen: outer surface removed and portion pulverized by worms discarded as much as possible. ^{14}C-conventional and MASCA-corrected date, 1130-1160 to 1325 AD, suggest frame coeval to church construction, AD 1143, by Georges of Antioch, Admiral of Roger II, as expected (B Lavagnino, written commun).

C. Sardinia

Grotta di Sa 'Ucca de su Tintirriòlu series

Charcoal from archaeol layers of deposit of Sa 'Ucca de su Tintirriòlu, karst cave 310m long, in Bonu Ighinu region, Comm Mara, prov Sassari (40° 27′ 13″ N, 8° 39′ 06″ E; 32TMK 707784) at +400m. Coll 1971 by R Loria, Sopr Antichità, Sassari and D H Trump, Univ Cambridge; subm 1971 by E Contu, Sopr Antichità, Sassari. Deposit revealed pottery of Roman epoch, Bronze age, Monteclaro culture, Eneolithic, S Michele culture, and Bonu Ighinu, newly attributed to Late Neolithic (Contu, 1970, 1971). Several vases of S Michele style with engravings of schematic woman figures, very rare for Sardinia Eneolithic, were found

(Loria, 1971; Loria and Trump, 1978). Human skeletons, animal bone remains and fresh-water and marine mollusk shells, food refuse, also present.

R-882. Sa 'Ucca de su Tintirriòlu 1 **5680 ± 160**
$\delta^{13}C = -23.3‰$

Charcoal, Sample 1, Layer 4, Trench C, at 80cm depth below cave soil. Pottery attributed to Late Neolithic, Bonu Ighinu culture first id in site. *Comment*: R-882 date, so far the only available one for above culture, acceptable, as it is likely to bridge gap between impressed pottery, presumably of 5th millennium BC, and S Michele culture at end of 4th century BC; one can argue on typological grounds for continuity of the 3 cultures, and so far S Michele being indigenous, can not have been intrusive from Aegean (D H Trump, written commun; Loria and Trump, 1978).

R-879. Sa 'Ucca de su Tintirriòlu 9 **4850 ± 50**
$\delta^{13}C = -24.0‰$

Charcoal, Sample 9, Layer 4, Trench F, at 35 to 40cm depth below cave soil and 35m from its entrance. Pottery of Bonu Ighinu culture. *Comment*: sample, assoc with abundant B I pottery, displaced, as ^{14}C date agrees with S Michele culture also represented in level only by several sherds believed accidentally introduced from above (D H Trump, written commun). See also R-884α above.

R-883α. Sa 'Ucca de su Tintirriòlu 2 **4930 ± 50**
$\delta^{13}C = -25.8‰$

Charcoal, Sample 2, Layer 4, Trench G, at 55 to 60cm depth below cave soil and 20m from its entrance. Eneolithic, pottery of S Michele culture. *Comment*: see R-884α below.

R-884α. Sa 'Ucca de su Tintirriòlu 8 **5090 ± 50**
$\delta^{13}C = -24.4‰$

Charcoal, Sample 8, Layer 5, Trench G, at 55 to 65cm depth below cave soil. Eneolithic, pottery of S Michele culture. *Comment*: R-879, -883α and -884α for S Michele culture remarkably consistent with each other and with available samples from same culture at Grotta del Guano, Oliena, see R-609-609α (R, 1971, v 13, p 399). According to D H Trump (written commun), start of S Michele culture by 3000 BC contradicts current beliefs, which will have to be readjusted.

R-885. Sa 'Ucca de su Tintirriòlu 15 **1890 ± 50**
$\delta^{13}C = -24.8‰$

Charcoal, Sample 15, Layer 1-b, Trench C-8, at 8 to 10cm depth below cave soil. Bronze age, pottery of Monte Claro culture. *Comment*: sample assoc with above culture displaced; Monte Claro judged probably pure in level but this is uncertain because of difficulty in defining limits of animal disturbance; date probably refers R-885 to scarce Roman sherds nearby (D H Trump, written commun). Monte Claro culture dated 1700 to 1800 BC at Acqua Calda cave, Cagliari, see R-677 (R, 1970, v 12, p 607).

General Comment: in conclusion, 3 further consistent dates are given for S Michele culture and 1st one for new Bonu Ighinu culture id in site.

Su foxi 'e s'abba series

In 1964 C Maxia, Ist Sci Antropol, Univ Cagliari, and his coworkers discovered Su foxi 'e s'abba cave at Lecorci, Comm Ulassai, Ogliastra, prov Nuoro (39° 48′ 50″ N, 9° 29′ 23″ E). Cave was id as votive place, probably an hypogean nuragic temple. In small cavity inside cave, votive pottery vases of nuragic type and 1 small wooden (*Quercus ilex*) vessel, the only one known for this time in Sardinia, were found. Charcoal from cave deposit and wood from small vessel coll and subm 1974 by C Maxia.

R-1074α. Su foxi 'e s'abba 1 **2910 ± 50**
$\delta^{13}C = -24.9‰$

Fairly well-preserved fragment sawed off bottom of small wooden vessel.

R-1065. Su foxi 'e s'abba 2 **2650 ± 50**
$\delta^{13}C = -25.4‰$

R-1065α. Su foxi 'e s'abba 2 **2670 ± 50**
$\delta^{13}C = -26.1‰$

Charcoal from cave deposit.

General Comment: dates agree with presumed age of nuragic hypogean rites, 1st millennium BC but before Carthaginian invasion, 500 BC. Other nuragic hypogean temple, so called "Tempio ipogeo di Santadi" in ASI or Pirosu cave dated: R-492α, 2680 ± 60 (R, 1970, v 12, p 606-607).

D. Turkey

Porta bella di S Sofia, Istanbul, series

Well-preserved wood (*Cedrus* sp), id by M Follieri, from back of wooden structure supporting bronze laminae of left shutter, 3.8m × 0.8m wide, S door of S Sophia, Istanbul, also called "clock door" or, according to old Byzantine sources, "porta bella" (beautiful door). Coll during restoration work and subm 1974 by L Vlad Borrelli, Ministero Beni Culturali e Ambientali, Rome.

R-1070. Porta bella 14 **1890 ± 50**
$\delta^{13}C = -23.9‰$

R-1070A. Porta bella 14 **1950 ± 50**
$\delta^{13}C = -22.5‰$

Wood fragments, Sample 14, from vertical frame supporting bronze lamina belonging to 1st oldest constructive phase. *Comment*: R-1070 pretreated with 5% HCl. MASCA corrected date, AD 50 to 110-130; R-1070A was given no pretreatment. MASCA corrected date AD 10 to 70.

R-1071. Porta bella 15 **1900 ± 50**
$\delta^{13}C = -21.6‰$

R-1071A. Porta bella 15 **1860 ± 50**
$\delta^{13}C = -22.5‰$

Wood fragments, Sample 15, from horizontal frame expected to belong to a 2nd newer constructive phase. *Comment*: R-1071 pretreated with 5% HCl; MASCA corrected date, AD 50 to 110-113. R-1071A was given no pretreatment; MASCA corrected date, AD 70 to 160. Unexpectedly, age and wood type resemble those of R-1070: 2 assumptions are possible, a) old wood of 1st construction phase was re-used; b) also R-1071 structure belongs to above phase; at any rate Sample 15 requires technical revision.

General Comment: according to scholars elements of at least 3 epochs form structures of 2 shutters of "porta bella": a) central oldest part of cedar wood covered with bronze laminae with cast frames, possibly of Hellenistic or, more probably, Roman age, or even from Constantinian Basilica, 2nd half 4th century AD; b) other cast bronze elements, same style as oldest ones, on wooden support, added during Justinian reconstruction; c) later interventions, 9th century AD, confirmed by imperial monograms and engraved dates. ^{14}C dates set oldest door construction between 1st and 2nd century AD, fairly consistent with decoration style attributable to mid-2nd century AD. Re-use of old wood might be inferred from unlikely door pertaining to Costantinian Basilica. Many ancient monuments were known to be despoiled to construct St Sophia (L Vlad Borrelli, written commun). For available dates for St Sophia see, SI-778-782 (R, 1973, v 15, p 399).

E. Iran

Shahr-i-Sokhta series

From 1967 to 1976 Italian Archaeol Mission of IsMEO in Iran, entrusted by G Tucci to M Tosi, excavated Shahr-i-Sokhta at Hilmand R ancient delta, Sistan, SE Iran near Afghan-Iranian border (30° 40′ N, 61° 25′ E) the largest, area ca 151ha, Chalcolithic—Bronze age proto-urban settlement of "Hilmand civilization" covering whole Indo-Iranian border, partly due to its favorable geog and ecol position. Its ruins form upper level, ca 7m thick, of tell, 12m above surrounding desert salt-clay plain and consist of superimposed bldg structures, mainly unbaked-clay brick walls; abundant charcoal, wood beams and collapsed wall bricks both burnt, suggest at least 2 destructive fires. Abundant pottery and other significant archaeol founds as well as animal bone remains indicate agric, cattle breeding, and trade mixed-economy of town throughout 3rd millennium BC; since 2nd millennium shifting Hilmand delta depopulated S Sistan, making it a desert. So far Shahr-i-Sokhta general cultural sequence for entire mound, comprises IV to I main periods subdivided into 0 to 10 phases, each with well defined structures and cultural characteristics. Shahr-i-Sokhta sequence can be compared with Periods III and IV of Mundigak, 2nd main center of Hilmand civilization in E Afghanistan (Tosi, 1969,1971-1974; Lamberg-Karlovsky and Tosi, 1973; Biscione, 1974). Large graveyard, area 21.3ha, was discovered 1972 in SW tell sec and excavations made between 1972-1976 (Piperno and Tosi, 1975). Charcoal and charred wood from different cultural phases coll 1967-69 and subm 1968-69 and 1972 by M Tosi, IsMEO, id by L Costantini, Ist Bot, Univ Rome. Preliminary H_2O boiling of samples detected abundant Cl^- and SO_4^{--}, and a little CO_3^{--}, *ie,* soluble clorides, sulphates and carbonates; subsequent 5% HCl treatment revealed further SO_4^{--}, absent Fe^{++} and Fe^{+++} or traces. Samples for which .2N NaOH test did not disclose humic material were given no alkaline leaching.

Period IV, 1969

A. Phase 0

R-901α. Shahr-i-Sokhta 83 **3540 ± 50**
$\delta^{13}C = -21.2‰$

Charcoal (*Populus, Tamarix, Haloxilon*) from Sec RWJ, Rm CXXI, Layer 2. In packed layer of sherds, salt crust. MASCA corrected date, 2110 to 1960 BC.

B. Phase 1

R-898. Shahr-i-Sokhta 77 **3680 ± 50**
$\delta^{13}C = -27.0‰$

Charcoal (*Populus* sp) from Sec 1PF1, Rm CXXIII, staircase, Layer 3. Randomly coll in fill of loose mud-bricks following destruction of Phase 1 bldg. MASCA corrected date, 2170 to 2110 BC.

R-900. Shahr-i-Sokhta 84 **3730 ± 50**
$\delta^{13}C = -25.7‰$

Charcoal (*Populus, Tamarix*) from Sec RWE, Rm CXX, Layer 4. Randomly coll in destruction layer of burnt bldg; brownish earth.

Periods IV-III. Between Phases 1 and 3, 1969

R-899α. Shahr-i-Sokhta 73 **3800 ± 50**
$\delta^{13}C = -26.3‰$

Charcoal (*Tamarix* sp) from Sec 3PF4-2PFS, Rm CXXXIII, Layer 5. Coll on top of 1st floor occurring below structures of Phase 1 Burnt Bldg and destroyed by its foundation, brownish earth; uncertain attribution between Phases 1 and 3.

Period II

A. Phase 5, 1968

R-637A. Shahr-i-Sokhta 16 **4000 ± 50**
$\delta^{13}C = -26.6‰$

Charcoal (*Tamarix*) from Sec XIG, Rms XXI, XXII, Cut 5. In fire-bowl of latest benched square-hearth. MASCA corrected date, 2630 to 2550 BC.

B. Between Phases 5 and 6, 1967-1968

R-623. Shahr-i-Sokhta 2 **4050 ± 50**
$\delta^{13}C = -26.3‰$

Charcoal (*Populus* sp & *Tamarix* sp) from Sec RYL, Rm C, Cut 4. Coll 1968 inside fire-bowl of benched hearth.

R-626. Shahr-i-Sokhta 9 **3890 ± 50**
$\delta^{13}C = -25.1‰$

Charcoal (*Tamarix*) from Sec RYL, Rm CIV, Cut 12. Coll 1968 inside fire-bowl of square-benched hearth. MASCA corrected date, 2560 to 2210 BC.

R-628. Shahr-i-Sokhta 13 **4000 ± 50**
$\delta^{13}C = -26.0‰$

Charcoal (*Tamarix*) from Sec RYL, Rm CIV, Cut 15. Coll 1968 in small brick platform.

R-627. Shahr-i-Sokhta 10 **4020 ± 50**
$\delta^{13}C = -23.9‰$

Charcoal (*Tamarix*) and uncharred wood (*Tamarix* sp) from Sec RYL, Rm CI, Cut 13. Coll 1968 inside hole in floor close to burned stone-cutter hoard.

R-405α. Shahr-i-Sokhta II **3960 ± 50**
$\delta^{13}C = -25.9‰$

Charcoal (*Populus, Tamarix*) from Sec XID, Cut 2. Coll 1967 in E residential zone.

R-404α. Shahr-i-Sokhta I **4100 ± 50**
$\delta^{13}C = -25.8‰$

Charcoal (*Populus, Tamarix*) from Sec XID, Cut 3 W. Coll 1967 in E residential zone.

C. Phase 6, 1968

R-634α. Shahr-i-Sokhta 13bis **3900 ± 50**
$\delta^{13}C = -26.1‰$

R-634. Shahr-i-Sokhta 13bis **4050 ± 50**
$\delta^{13}C = -25.8‰$

Charcoal (*Tamarix*) from Sec XIB, Rm XVIII, Cut 10. In side-slot of Kiln. R-634α MASCA corrected date, 2570 to 2340 BC.

R-632. Shahr-i-Sokhta 23 **4100 ± 50**
$\delta^{13}C = -26.0‰$

Charcoal (*Tamarix*) from Sec XIG-H, Rm XX, Cut 15. Randomly coll above earliest floor of courtyard in House of stairs.

D. Phase 7

R-641. Shahr-i-Sokhta 27 **4000 ± 50**
$\delta^{13}C = -25.0‰$

Charred (*Populus, Tamarix*) wood from Sec XIE-XDY, Rm LXIX, Cuts 3-6. Fragments from roof beam burnt and partly collapsed inside room.

Periods II-I, between Phases 7 and 8, 1968

R-638. Shahr-i-Sokhta 26 **4150 ± 50**
$\delta^{13}C = -26.1‰$

Charcoal (*Populus, Tamarix*) from Sec XIG, Rms XXI-XXII, Cuts 16-17. Fill partly produced by establishment of earliest bldg of House of stairs. MASCA corrected date, 2940 to 2700 BC.

Period I, Phases 8 and 9, 1968

R-633α. Shahr-i-Sokhta 30 **4170 ± 50**
$\delta^{13}C = -25.6‰$

Charcoal (*Populus, Tamarix*) from Sec XIG-H, Rm XX, Cut 20. Cluster charcoal in Period I fill on top of great bone-pit. MASCA corrected date, 2960 to 2850 BC.

R-629. Shahr-i-Sokhta 24 **4200 ± 50**
$\delta^{13}C = -25.4‰$

Charcoal (*Populus, Tamarix*) from Sec RYL, Rm CIV, Cut 28. Randomly spread below main N-S wall within thinly stratified silt. MASCA corrected date 2940 to 2700 BC.

Uncertain attribution, 1967

R-424. Shahr-i-Sokhta III **3920 ± 50**
$\delta^{13}C = -25.3‰$

Charcoal (*Tamarix*) from Sec To, 4. Test Trench, Cut 5, on E slope of site, possibly related to Phase 5.

R-425. Shahr-i-Sokhta IV **3950 ± 50**
$\delta^{13}C = -26.4‰$

Charcoal (*Tamarix*) from Sec To, 4. Test Trench, Cut 6, on E slope of site, possibly related to Phase 5.

General Comment: ^{14}C date complex suggests for Shahr-i-Sokhta, Periods I to IV, Phases 9 to 0, time span from 4250 to 3500 BP; MASCA corrected dates from 2970-2880 to 2110-1960 BC in agreement with whole cultural sequence and with scarce available dates for comparable cultural horizons of Chalcolithic and Bronze sites in S Turkmenian SSR and Quetta and Indus valleys, Baluchistan, W Pakistan. Following comparisons are possible: Shahr-i-Sokhta Period IV, Phase 1, R-898, -900, with Namazga VI cultural horizon dated at Namazga Tepe, S Turkmenian, Kopet-Dag Mt N margin, LE-665 (R, 1970, v 12, p 142) (Romanova *et al*, 1972; Bovington *et al*, 1977). S S, Period III, Phases 3 and 4, with Namazga V dated at Altyn Tepe, S Turkmenian, Kopet-Dag Mt N margin, Bln-716-717 (R, 1970, v 12, p 17-18) (Bovington *et al*, 1977); also dates available for Rud-i-Biyaban Tepe, Sistan, ca 30km SE Shahr-i-Sokhta, can be related, Tunc-21-27 (R, 1973, v 15, p 593-594) (Bovington *et al*, 1977). S S, Period II, between Phases 5 and 6, R-637A, 623-26-27-28, 404α, 432 and 434α, seems, on most significant comparisons, connected with Namazga IV (Biscione, 1974; Tosi, 1973) dated at Altyn Tepe, LE-664, -769 (R, 1970, v 12, p 142; R, 1972, v 14, p 351) (Romanova *et al*, 1972) and at Uleg Tepe, S Turkmenian, Kopet-Dag Mt lower lands, Bln-714-715 (R, 1970, v 12, p 419) (Bovington *et al*, 1977). Finally S S Period I, between Phases 8 and 9, R-629, can be compared with both Damb-Sadaat I and II, Mian Gundai, Quetta Valley, N Baluchistan, L-180B, C, E (Broecker *et al*, 1956) and P-522-523 (R, 1963, v 5, p 94), and Kot Diji, Indus Valley, W Pakistan, P-196 (R, 1959, v 1, p 54) (Bovington *et al*, 1977). Dated series for Shahr-i-Sokhta has been made by Pennsylvania lab (R, 1977, v 19, p 204-207).

II. GEOLOGIC SAMPLES

A. Italy

Conca di Forni series

Peat, wood, and other vegetable remains from 2 Quaternary lacustrine basins cropping out in Conca di Forni, left side Tagliamento R high valley, prov Udine, Carnia. Coll and subm 1973 by B Martinis, Ist Geol, Univ Milano.

R-1057α. Forni di Sotto 1 **9850 ± 80**

$\delta^{13}C = -25.0‰$

Darkened wood fragment, diam 5cm, 20cm long, from gray-bluish clayey lacustrine level rich in vegetable remains exposed in left bank of Tagliamento R immediately S Comm Forni di Sotto, prov Udine (46° 23′ 29″ N, 12° 42′ 08″ E) at +695m, at base of deposit, ca 30m thick, mainly formed by interbedded clayey and sandy lacustrine sediments and coarse fluvial gravels in upper layers up to top. *Comment*: 5% HCl pretreatment disclosed abundant Fe^{++}, Fe^{+++}, and SO_4^{--}. ^{14}C Holocene age supports formation of barrier-lacustrine basin by postglacial landslide following ice tension release and fall from steep walls bounding Conca di Forni eastwards.

R-1058. Forni di Sopra, Pian del Moro 2 **1270 ± 50**
$\delta^{13}C = -29.0‰$

R-1058α. Forni di Sopra, Pian del Moro 2 **980 ± 50**
$\delta^{13}C = -28.6‰$

Peaty level, 3m thick, embedded in upper part of small lacustrine sequence cropping out in Pian del Moro incision near Comm Forni di Sopra, left side Tagliamento R, prov Udine (46° 24′ 51″ N, 12° 34′ 51″ E) at +995m, and resting on strongly cemented conglomerate of uncertain age widely cropping out in region. *Comment*: 5% HCl disclosed abundant Fe^{++} and Fe^{+++}.

R-1059α. Forni de Sopra, Pian del Moro 6 **>40,000**
$\delta^{13}C = -27.2‰$

Partly humified vegetable remains in grayish clay level, 4.5m thick, lower part of R-1058, above, lacustrine sequence, near basal conglomerate. *Comment*: 5% HCl pretreatment disclosed abundant Fe^{++}, Fe^{+++}, S^{--}, SO_4^{--}, and CO_3^{--}.

General Comment: R-1058α dates final phase of lake basin filling at ca 1000 BP; R-1059α minimum age excludes recent Würmian age for basal conglomerate.

Firenze series

Following dates contribute to paleogeog of Arno R plain. Project, in progress by both Ist Bot and Ist Geol Applicata, Univ Firenze, provides correlations among secs exposed in several gravel quarries by bot, palynol, and sedimentol studies.

R-1135α. Viale Talenti, Firenze **4870 ± 50**
$\delta^{13}C = -27.2‰$

Wood (*Quercus* sp) id by G Ciuffi, Ist Bot, Univ Firenze, fragments of transported trunks, diam 30 to 40cm, 4m long, from coarse sand layer interbedded with pebble and sand, 6.5m below surface, recovered during excavations near Viale Talenti, Arno R left bank, Firenze W suburbs, Tuscany (43° 47′ 00″ N, 11° 11′ 38″ E). Coll and subm 1975 by C Bini, Ist Geol Applicata, Univ Firenze. *Comment*: 5% HCl pretreatment disclosed abundant Fe^{++} and Fe^{+++} and abundant humic acids extracted by subsequent .2N NaOH leaching.

R-999α. Isolotto, Firenze 1 **4000 ± 50**
$\delta^{13}C = -26.1‰$

R-1000α. Isolotto, Firenze 2 **3960 ± 50**
$\delta^{13}C = -26.2‰$

Wood (*Quercus* sp) id by G Ciuffi, fragments of 2 large trunks coll 1970 and subm 1974 by G Ciuffi and E Francini Corti, Ist Bot, Univ Firenze. In 1970 after removal of upper layer of deposit, average thickness ca 2m, in Mr Cubattoli gravel quarry, left bank of Arno R, ca 4km downstream from Firenze, Isolotto suburbs (43° 47′ 03″ N, 11° 12′ 07″ E) several dozens trunks, max diam 80cm, 5m long, probably transported, were found in pebbly-gravelly layer, and generally so well-preserved as to be used in antique restoring. *Comment*: see R-1135α.

General Comment: 1st dates for Arno plain, of which detailed stratigraphy is known mainly through wells drilled for hydrogeol purposes (Capecchi *et al*, 1975). Trunks in coarse sediments show sedimentation from powerfully transporting waters. All samples for both stratigraphic position and field observations belong to 2 mature and meandering phases of Arno flow regime (Bini, oral commun); R-1135α, according to stratigraphic position, dates older event.

R-1020. Cetara **>40,000**

$\delta^{13}C = -24.1‰$

R-1020α. Cetara **>40,000**

$\delta^{13}C = -24.1‰$

R-1020β. Cetara **32,300 ± 1100**

$\delta^{13}C = -24.1‰$

Charred wood small fragments from basal level of humified layer, 1m thick, underlying pumices and overlying calcareous breccia in sec at Km 44 of State Rd 163, Amalfitana, ca 1km SW Cetara, prov Salerno, Campania (40° 38′ 23″ N, 14° 41′ 38″ E). Coll and subm by P Di Girolamo, Ist Min, Univ Napoli. Sec exposes from top: humified layer, 1.5m thick, pumices, 40cm thick, of unknown origin, overlying humified layer, 1m thick, resting on dubitatively Würm calcareous breccia. *Comment*: R-1020 was given only 5% HCl pretreatment; R-1020β, humic fraction (< 37%) extracted by additional leaching with .2N NaOH and precipitated again with dilute HCl, clearly contaminated; R-1020α, wood fraction insoluble in above .2N NaOH leaching. Cetara charred wood belongs to event >40,000: no further geol data available.

R-1056. Vallone di Acqualonga **16,520 ± 130**

$\delta^{13}C = -25.9‰$

Humic acids from humified layer directly overlying Campanian Ignimbrite and underlying Mt Somma-Vesuvius volcano pumices in Vallone di Acqualonga sec at ca Km 69 of State Rd 7bis, Terra di Lavoro, prov Avellino, Campania (40° 54′ 45″ N, 14° 39′ 48″ E). Coll and subm 1974 by P Di Girolamo. Sec exposes from top: upper humified level, Mt Somma-Vesuvius pumices of presumably Plinian age overlying pumice layer attributed to Mt Somma old eruption and sampled humified layer, latter resting on Campanian Ignimbrite, gray facies (Di Girolamo, 1968). *Comment*: sample was pretreated with 8N HCl; humic acids extracted with .2N NaOH and precipitated again with dilute HCl. R-1056 is acceptable for pyroclasts of ancient Mt Somma eruption and agrees with field and petrographic data. For lab dating project of Mt Somma-Vesuvius volcano activity in progress, see, R-715α (R, 1973, v 15, p 171) and R-935 to -940 (R, 1974, v 16, p 364-366).

Macchialonga, Fossiata series

Well-preserved wood, fragments of 2 small subfossil trunks, diam 5 to 10cm, 1m long, (*Abies alba* Mill) id by C Ciampi, recovered at 1.45m depth from surface soil, in sand layer overlying granite gravel and pebbles at bottom of small old lacustrine basin, area ca 700m², at present filled by marshy silty-clayey sediments ca 1.4m thick, at Macchialonga, S slope of Pettinascura Mt, edge of Fossiata State forest, Sila Grande, prov Cosenza, Calabria (43° 58′ 07″ N, 19° 06′ 23″ E) at +1525m. Coll 1972 by E Ferrarini and subm 1973 by R Corti and C Ciampi, Ist Bot Agraria e Forestale, Univ Firenze. Pollen analysis of overlying filling sediments by E Ferrarini (written commun) shows: 3 to 15cm depth, *Pinus laricio* and *Fagus silvatica*, as present local vegetation; 15 to 90cm depth, *Abies alba* assoc to *Pinus laricio* and *Fagus* in amount varying with depth; 90 to 120, *Abies alba* prevailing on *Pinus*, no *Fagus*; 120 to 145, *Pinus* prevailing on *Abies* and *Fagus*. Comparable pollen analyses made nearby by Ferrarini and Padula (1969).

R-957. Macchialonga 1 **1150 ± 50**
$\delta^{13}C = -24.3‰$

Wood, fragment of small subfossil trunk. *Comment*: test with .2N NaOH did not disclose humic acids.

R-958. Macchialonga 2 **1080 ± 50**
$\delta^{13}C = -25.5‰$

Wood, fragment of small subfossil trunk. *Comment*: see R-957.

General Comment: ^{14}C dates restrict to last millennium forest vegetational variations found in pollen analysis, possibly also caused by man.

B. Ischia Island

Arso series

R-1003α. Arso 1 **560 ± 50**
$\delta^{13}C = -24.5‰$

Charcoal in paleosol underlying Arso lava flow, S Michele, on right crossrd upwards Via G B Vico (40° 43′ 25″ N, 13° 57′ 12″ E). Coll and subm 1973 by M Fornaseri, Ist Geochimica, Univ Roma. *Comment*: MASCA corrected date, 1340 to 1400 AD.

R-1004. Arso 2 **450 ± 50**
$\delta^{13}C = -25.7‰$

Charcoal in paleosol underlying Arso lava flow in foundation work sec, right side S Antuono to S Michele rd, near Civic No. 52 (40° 43′ 23″ N, 13° 56′ 55″ E). Coll and subm 1973 by M Fornaseri. *Comment*: test with .2N NaOH did not disclose humic materials. MASCA corrected date, AD 1410 to 1440.

General Comment: according to historic sources, Arso lava flow erupted AD 1302 from S wall of Costa del Lenzuolo, 800m SE Fondo Ferraro. R-1003α date agrees within errors; R-1004 seems too young.

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TRONDHEIM NATURAL RADIOCARBON MEASUREMENTS VIII

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INTRODUCTION

Most dates in this list were obtained between 1972 and 1976. Treatment of samples has remained essentially the same as described previously (R, 1975, p 364).

Several experiments concerning shielding and counter background have been performed (Nydal *et al*, 1975; Gulliksen & Nydal, 1976). The capacity of our iron shield has been doubled from three to six chambers, two new guard counters, GM4 and GM5, have been installed, and three new counters, nos. 7, 8 and 9, added to the three already operating. Data for the counters with present shielding are:

Counter no.	Effective vol (L)	Background (cpm)	Recent standard net count (cpm)
2	1.5	0.70	19.3
5	0.9	0.90	11.5
6	0.6	0.45	7.5
7	1.2	0.70	15.3
8	0.36	0.28	4.8
9	1.6	0.75	21.8

Counter 9 is used for both tritium and ^{14}C measurements. The backgrounds appearing in the table are not the lowest values obtained during shielding experiments. More research is needed before we decide upon a final shielding.

Ages are calculated by applying the Libby value 5570 ± 30 years for the ^{14}C half-life, and using 95% of NBS oxalic acid activity as contemporary standard referring to AD 1950. Errors quoted ($\pm 1\sigma$) include counting uncertainties for sample, standard, and background. $\delta^{13}C$ values reported are relative to PDB, and corrections for deviations from 0‰ relative PDB are applied for shell samples.

For dates that can be corrected according to the dendrochronologic calibration table given by Ralph *et al*, 1973, the corrected range is given and denoted MASCA age. Uncertainty in half-life 5730 ± 40 yr is included in the calibrated range.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Norway

1. Late Weichselian and Holocene samples

Mona at Mysen series

Shells of Boreo-Arctic fauna from glaciomarine clay within foreset sec of Mona ice-front delta at Mysen (59° 32′ N, 11° 22′ E). T-1020 coll and subm 1970 by Olaf Holtedahl and Björn G Andersen, Dept Geol, Univ Bergen; T-1382 coll and subm 1972 by B G Andersen. *Comment* (BGA): clay lies conformably with foreset beds of sand and gravel, and wedges out towards the ice-contact side. Date indicates that Mona delta is of Younger Dryas age. Thus, the Ra moraine must represent earlier phases of Younger Dryas period, not agreeing with date, 10,080 ± 160 BP on *Portlandia arctica* clay from within Ra moraine near Sarpsborg.

T-1020. Mona 1 **10,430 ± 160**
$\delta^{13}C = -0.5‰$

T-1382. Mona 2 **10,670 ± 270**
$\delta^{13}C = -2.0‰$

Yrkje series

From sediment core in basin at +38m in Yrkje, Tysvær, Rogaland (59° 23′ N, 5° 40′ E). Stratigraphy from base (7.5m): bed of silt below bed of gyttja-rich silty clay (bed 2), both .1m thick and deposited in fresh water; then .65m thick bed of silty clay (bed 3), basal part deposited in fresh water, and upper .5m in salt water. Overlain by gyttja with decreasing content of silty clay upwards. Coll and subm 1970 by Karl Anundsen, Dept Geol, Univ Trondheim. *Comment* (KA): series dates marine transgression at +38m to 10,500 BP. Basin again isolated from sea at ca 9500 BP. This is 1st demonstration of a marine transgression in Younger Dryas-Pre-Boreal in Norway (Anundsen, 1977a).

T-993. Yrkje I **11,530 ± 140**

Gyttja-rich silty clay from base of Bed 2 at depth 7.35 to 7.40m.

T-1040. Yrkje III **10,540 ± 170**

Organic substances in silty clay from base of Bed 3 at depth 7.27 to 7.31m.

T-994. Yrkje V **9580 ± 120**

Organic content in silty clay from top of Bed 3 at depth 6.66 to 6.72m.

Borgöy series

From +25m at Borgöy, Tysvær, Rogaland (59° 20′ N, 5° 38′ E), outside terminal moraines of Younger Dryas age. Clay bed at depth ca 2m below .25 to .30m thick ground moraine and boulders, overlain by clay bed, littoral sand and gravel, and gyttja. Coll 1947 by H Olsen, Zool Mus, Univ Bergen; subm 1973 to 1975 by K Anundsen.

T-1621. Borgöy I **12,830 ± 150**
$\delta^{13}C = -16.4‰$

Bones of Greenland right whale (*Balaena mysticetus* L) from top of clay bed at depth ca 2m. *Comment* (KA): reservoir corrected age 12,380 ± 150 BP (apparent res. age 450 yr) dates glacier advance in inner part of Boknfjord-Nedstrandsfjord area within Older Dryas Chronozone. Agrees with glacial advance during Older Dryas Stadial in Bergen dist further N (Mangerud, 1970; Anundsen, 1972, 1977a,b).

T-2005. Borgöy II **4340 ± 110**

Gyttja from depth .7m in contact zone between littoral sediment and gyttja. *Comment* (KA): if this sample dates littoral sand and gravel, sea level was at +24m ca 4300 yr ago. MASCA age: 3120 ± 200 BC.

T-1883. Nedstrand IV **12,420 ± 100**
$\delta^{13}C = -17.0‰$

Bones of Greenland right whale (*Balaena mysticetus* L) from depth ca 2m on top of 20m marine clay at Hinderåvåg, Tysvær, Rogaland (59° 20′ N, 5° 47′ E). Above clay is ca .3m littoral sand and gravel. Loc at +22m outside terminal moraines of Younger Dryas age. Coll 1950 by H Olsen; subm 1974 by K Anundsen. *Comment* (KA): reservoir corrected age 11,970 ± 100 BP (apparent res. age 450 yr) indicates that Older Dryas glacial advance at Borgöy did not reach Hinderåvåg further E. Contamination from younger humic acids suspected (Anundsen, 1972; 1977b).

T-1620. Nedstrand V **11,630 ± 100**
$\delta^{13}C = +2.0‰$

Marine shells (*Balanus balanoides, Mya truncata, Chlamys* (*Pecten*) *islandicus*) from upper part of clay overlain by .5m silt and clay and .5m ground moraine. Loc at +10m, 3 to 4km outside terminal moraines of younger Dryas in Nedstrand, Tysvær, Rogaland (59° 20′ N, 5° 52′ E). Coll 1968 and subm 1973 by K Anundsen. *Comment* (KA): glacier was in early phase of Younger Dryas at a more advanced position than the pronounced Younger Dryas moraines in the area (Anundsen, 1972; 1977b).

Blomvåg series

Littoral sediments rich in shells, wood, and bones, below till at ca +20m at Blomvåg cemetery, Öygarden, Hordaland (60° 32′ N, 4° 93′ E). Previously dated to 12,200 ± 350 and 12,700 ± 350 (T-138, -139; R, 1960, v 2, p 88). Coll 1942 by Knut Fægri and Isak Undås; subm 1974 by Jan Mangerud, Dept Geol, Univ Bergen. *Comment* (JM): Blomvåg beds deposited during Bölling Chronozone (Mangerud, in press) as defined by Mangerud *et al* (1974). Shell-dates are corrected for apparent age of 410 yr (Mangerud, 1972b), while bone-dates are uncorrected, and entire apparent age must therefore be subtracted for latter, found to be 440 yr (Mangerud, 1972b; Mangerud *et al*, 1974; Mangerud & Gulliksen, 1975; Mangerud, in press).

T-1696. Blomvåg 3 **12,570 ± 180**
$\delta^{13}C = -1.7‰$

Marine shells (mainly *Modiolus modiolus*) from deepest shell-bearing layer, .15m above base of sediments at depth 2.95 to 3.05m.

T-1697. Blomvåg 4 **12,570 ± 150**
$\delta^{13}C = -1.4‰$

Marine shells (mainly *Modiolus modiolus*) from .9m below till at depth 2.45 to 2.50m.

T-1882. Blomvåg 5 **12,430 ± 90**
$\delta^{13}C = -1.1‰$

Marine shells (*Mytilus edulis*) from plant-bearing bed in upper part of sequence.

T-1898. Blomvåg 6 **260 ± 100**

Herbs, probably grass, from same mus sample as T-1882. *Comment* (JM): sample contaminated from either field work in 1942, or alternatively in lab. MASCA age: AD 1610 ± 160.

T-1899/1. Blomvåg 7 **12,550 ± 100**
$\delta^{13}C = -16.6‰$

From top of littoral sediments, whale bones partly penetrating into till. *Lab comment*: bone brushed and washed, treated with 40% HCl under vacuum overnight. Residue washed and dissolved in 50% HCl. Solution evaporated to dryness and burned.

T-1899/2. Blomvåg 7 **12,360 ± 80**
$\delta^{13}C = -17.4‰$

Lab comment: collagen separated by EDTA-treatment as described by Olsson *et al* (1974).

Ågotnes series

Marine shells from sequence of marine sediments at +10m outside Younger Dryas endmoraines at Ågotnes (Sotra), Fjell, Hordaland (60° 25′ N, 5° 1′ E). Coll 1970; subm 1971 and 1973 by J Mangerud. *Comment* (JM): dates prove that Younger Dryas ice-advance did not reach site (Mangerud, in press; Aarseth & Mangerud, 1974).

T-1023. Ågotnes 1 **12,250 ± 150**
$\delta^{13}C = +1.5‰$

Mya truncata, Balanus sp from base of brown gyttja bed, depth ca 4m.

T-1574. Ågotnes 2 **10,260 ± 180**
$\delta^{13}C = -0.2‰$

Balanus balanus, Hiatella arctica, Mya truncata, Astarte elliptica from greenish gray silt, depth ca 2.5m.

Sandviken series

From marine clay below 2 beds of till at +8 to 10m in Sandviken, Bergen (60° 25′ N, 5° 20′ E). Previously dated to 12,470 ± 150 (T-750; R, 1972, v 14, p 23; Mangerud, 1970). Coll 1968 and subm 1970/74 by J Mangerud. *Comment* (JM): clay is of Alleröd age (Mangerud, in press), and not of Bölling age as previously concluded (Mangerud, 1970; 1972a; in press; R, 1972, v 14, p 418-451).

T-1024. Sandviken 2 **(a) 12,070 ± 180**
(b) 11,570 ± 160
$\delta^{13}C = -3.1‰$

Outer (a) and inner (b) fraction of carbonate cover on pebbles, depth ca 6m.

T-1809. Sandviken 3 **12,090 ± 120**
$\delta^{13}C = +1.3‰$

Marine shells, *Chlamys islandica, Mya truncata, Astarte elliptica, Balanus balanus,* depth ca 6m. *Comment* (JM): same sample as T-750.

T-1810. Sandviken 4 **11,940 ± 100**
$\delta^{13}C = +0.8‰$

Marine shells, *Chlamys islandica, Mya truncata, Astarte elliptica, Hiatella arctica,* depth ca 4 to 6m.

Fensfjorden series

Marine shell fragments from area around Fensfjorden, dating glacial readvance in area, and ice-free period prior to it. Coll and subm 1971 to 1975 by Inge Aarseth, Dept Geol, Univ Bergen. *Comment* (IA): dates T-1168, T-2106 indicate approaching glacier (Aarseth & Mangerud, 1974). T-1606, -1607, and -2107 date very early (Bölling/Older Dryas) deglaciation of area. Dates are, except for T-2107, which is ca 500 yr too old, agreeing well with established stratigraphy in Bergen area (Mangerud, 1970).

T-1168. Fonnes **10,770 ± 140**

From depth 2.5m below surface in glaciomarine clay overlain by till at +7m in Fonnes, Austrheim, Hordaland (60° 48′ N, 4° 58′ E). Sec between 2 moraine ridges, 1km apart.

T-1606. Mongstad 1 **12,020 ± 120**
$\delta^{13}C = -0.8‰$

From glaciomarine sediments overridden by ice. Loc at +12 to 13m at Mongstad, Lindås, Hordaland (60° 49′ N, 5° 2′ E), 2km proximal to Herdla Moraines. *Mya truncata, Balanus, Macoma* from small crack in bedrock below 2.5m of consolidated silty clay with dropstones.

T-1607. Mongstad 2 **11,810 ± 120**
$\delta^{13}C = -1.1‰$

Mya truncata, Hiatella, Chlamys, Astarte sp from clay 1.5m above bedrock, overlain by 1m clayey till.

T-2107. Austrheim 1 **12,460 ± 100**
$\delta^{13}C = -1.2‰$

From glaciomarine sediments in sec at +2 to 2.5m at Austrheim, Hordaland (60° 46′ N, 4° 55′ E), 200m distal to Herdla moraines, deposited in shallow sea (25 to 30m) during glacial readvance in Younger Dryas. *Mytilus edulis* from depth 1.3m in lowermost part of .5m thick shell layer overlain by .3m bed of glaciomarine silt and .5m soil profile. Below shell bed is .6m silts, sand and gravels.

T-2106. Austrheim 2 **10,620 ± 170**
$\delta^{13}C = -1.4‰$

Mya truncata from depth .8m, in lowermost part of silt bed overlaying shell bed.

Björnafjorden series

Marine shell fragments from area around Björnafjorden, dating glacial readvance in area, and also ice-free period prior to it. Coll 1969 and 1970; subm 1969 and 1970 by I Aarseth.

T-847. Lunde **10,570 ± 100**

From depth 3m in glaciomarine clay overlain by 2m thick till, at +42m in zone of large moraines at Lunde, Rysnes, Hordaland (60° 03′ N, 5° 89′ E). *Comment* (IA): date agrees with view that Herdla Moraines reached their terminal position in Late Younger Dryas (Aarseth & Mangerud, 1974).

T-983. Ölve **11,230 ± 180**
$\delta^{13}C = -0.1‰$

From brook cutting through a clayey till, sec at +15m at Ölve, Kvinnherad, Hordaland (60° N, 5° 46′ E). *Comment* (IA): dates ice-free period prior to glacial readvance (of order of min 25km) (Aarseth & Mangerud, 1974).

T-984. Nordtveit **11,320 ± 180**
$\delta^{13}C = -1.9‰$

From depth 2m in clayey till at +35m at Nordtveit, Fusa, Hordaland (60° 06′ N, 5° 44′ E). *Comment* (IA): dates ice-free period prior to glacial readvance (Aarseth & Mangerud, 1974).

T-1169. Vinnesleira **2660 ± 120**

Gyttja from 27m deep core in clay at Vinnesleira, Fusa, Hordaland (60° 9′ N, 5° 36′ E), dating isolation contact. Lower 20m deposited as glaciomarine clay in Alleröd/Younger Dryas during Holocene uplift. Coll and subm 1971 by Inge Aarseth, Univ Bergen. *Comment* (IA): date shows that marine sedimentation ended at Vinnes (Aarseth & Mangerud, 1974). MASCA age: 900 ± 120 BC.

T-1171. Fitjar trench, marine shells **12,860 ± 250**
$\delta^{13}C = -0.5‰$

Chlamys islandicus, Macoma calcarea, Mytilus edulis from depth 1.5m in dark gray fossiliferous clay till at +16 to +20m in Fitjar, Hordaland (59° 50′ N, 5° 30′ E). Till, exposed in 235m long trench, containing broken shells and small angular pebbles intercalated with small sandy granule deposits, overlain by outwash of gravel to cobble size with boulder inclusions. Coll and subm 1971 by A N Genes, Univ Bergen. *Comment* (ANG): date indicates Fitjar substage moraine is of older Dryas age (Genes, 1977; Mangerud, 1970).

T-1172. Fitjar trench, wood **1200 ± 110**

Wood in same position as T-1171. *Comment* (ANG): anomolous date, solifluction or contamination negates date. MASCA age: AD 780 ± 130.

(a) outer fraction 10,690 ± 130
$\delta^{13}C = -0.5‰$

T-1371. Bortveit tunnel **(b) inner fraction 10,600 ± 140**
$\delta^{13}C = -0.5‰$

Marine shells (*Mya truncata, Hiatella arctica, Chlamys islandicus*) from depth .5m in 1m-thick layer of bluish-gray, stoney clay directly on bedrock, at +35m in Stord, Hordaland (53° 80′ N, 5° 13′ E). Coll 1972 by A N Genes; subm 1972 by A N Genes and H Holtedahl, Univ Bergen. *Comment* (ANG): dessication or rapid drainage presumed to allow for seeming preconsolidation, does not suggest Younger Dryas ice movement having reached Stord I.

T-1593. Sandosen, Jondal 1 **6740 ± 200**

Lacustrine organogenic sediments consisting of allochthonous plant remains, resting on bouldery gravel and overlain by ca 3m-thick sand deposit at +935m in S end of lake Dravdalsvatn, Sandosen, Ullensvang, Hordaland (60° 14′ N, 6° 26′ E). Coll 1972 and subm by Tore Torske, Norges geol undersøkelse, Trondheim. *Comment* (TT): supposedly dates period when nearby present glacier Folgefonna, or, at least, its N part, did not exist.

Omnsbreen glacier series

Plant remains and gravel with organogenic remains, uncovered during recession of the Omnsbreen glacier at +1515m, Ulvik, Hordaland (60° 39′ N, 7° 29′ E). Coll 1972 by Reidar Elven, subm 1973 by Rolf Y Berg, Bot Garden, Univ Oslo. *Comment* (RYB): material dates, as expected, time immediately before AD 1600 to 1700 glaciation; probably covered by perennial snowbanks at onset of this glaciation (Elven, 1974).

T-1485. Omnsbreen N3-169 **550 ± 100**

MASCA age: AD 1345 ± 85.

T-1486. Omnsbreen N7-449 **(a) 440 ± 120** **(b) 2930 ± 160**

NaOH-soluble fraction (a) and insoluble fraction (b) of gravel with abundant organic remains. *Comment* (RYB): (b)-fraction contaminated by carbon from gravel. MASCA age: (a) AD 1480 ± 120; (b) 1210 ± 270 BC.

T-1578. Omnsbreen N7-462 **430 ± 120**

Silene acaulis. MASCA age: AD 1490 ± 120.

T-1579. Omnsbreen N7-463 **430 ± 100**

Silene acaulis. MASCA age: AD 1485 ± 105.

T-793. Rebnis Li **8140 ± 310**

Sandy dy from bog at +560m between 2 lateral moraines in valley side of Mökrisdalen, Luster, Sogn og Fjordane (61° 31′ N, 7° 37′ E). Coll from lowermost organogenic layer, 7.15m below surface, with Livingstone samples. Coll 1968 and subm 1969 by T O Vorren. *Comment* (TOV): date is minimum of Gaupne Stadial, later dated to 9500 to 9800 BP (Vorren, 1970; 1973).

Haukelandsvatnes series, Hordaland

Peat and silty gyttja from Li at +75m, Haukedalsvatnet, Arna, Hordaland (60° 22′ N, 5° 28′ W). Samples from core in Holocene delta in front of alluvial fan, providing data about propagation of delta and frequency of landslides or floods on alluvial fan. Some samples also date pollen zone boundaries. Coll 1972 and subm 1973 by Kåre Skår and Jan Mangerud, Univ Bergen.

T-1490. KS-1 **4440 ± 80**

Peat from depth 1.84 to 1.73m below surface. MASCA age: 3230 ± 120 BC.

T-1491. KS-2 **8960 ± 220**

Silty gyttja from depth 11.45 to 11.50m. *Comment* (JM): dates *Corylus* rise; result agrees with other dates of this pollen-boundary in Hordaland.

T-1492. KS-3 **6560 ± 100**

Silty gyttja from depth 8.26 to 8.42m. *Comment* (JM): boundary between bottomset and foreset.

T-1749. KS-5 **7430 ± 110**

Silty gyttja from depth 10.37 to 10.45m. *Comment* (JM): dates *Alnus* rise; a few hundred yr younger than expected from dates nearer coast.

T-1750. KS-6 **6040 ± 140**

Silty gyttja from depth 3m; top of foreset beds. MASCA age: 4925 ± 215 BC.

Kroken series

Holocene organogenic sediments from regrown basin at +125m at Kroken, Luster, Sogn og Fjordane (61° 21′ N, 7° 23′ E), dating deglaciation events, shoreline displacement and vegetational development. Coll with piston sampler and subm 1970 by Tore O Vorren, Tromsö Univ.

T-1050. Kroken 1 **10,520 ± 450**

Silty dy from depth 6.01 to 6.05m below surface. *Comment* (TOV): date is minimum for deglaciation of Inner Lusterfjord area.

T-1107. Kroken 2 **9100 ± 200**

Fine detritus dy from depth 5.84 to 5.88m. *Comment* (TOV): dates end of unfavorable climatic period.

T-1106. Kroken 3 **8550 ± 170**

Fine detritus dy from depth 5.05 to 5.11m. *Comment* (TOV): dates 1st rise of *Pinus*.

T-1105. Kroken 4 **8550 ± 110**

Fine detritus dy from depth 4.93 to 4.98m. *Comment* (TOV): dates rational and empirical limit of *Alnus* (probably *A glutinosa*).

T-1605. Karihola 1/73 **12,090 ± 100**
$\delta^{13}C = -0.1‰$

Shells (*Chlamys isl*) from depth 1m in roadcut with 2m sandy till overlain by ca .5m bog at +5m at Karihola, Kristiansund, Möre og Romsdal (63° 7′ N, 7° 42′ E). Coll 1973 and subm 1974 by Roar Kræmer, Dept Geol, Univ Bergen. *Comment* (RK): date indicates that older Dryas ice-advance passed the NW coast of Norway, leaving its terminus outside.

Flöytmyr series

Sphagnum peat from Flöytmyr at +192m, Bærum, Akershus (59° 59′ N, 10° 37′ E). Series provides age of various pollen-analytic horizons concerning Post-Weichselian (Flandrian) development of vegetation, climate, and agric within Oslo area. Coll 1976 by Ulf and Eva Hafsten; subm 1976 by U Hafsten, Dept Bot, Univ Trondheim. *Comment* (UH): dates agree with supposed age (Hafsten, 1956; Nydal, 1970).

T-2319. Flöytmyr 3 **2540 ± 90**

Dates initial spruce (*Picea abies*) pollen maximum occurring below beginning of continuous spruce curve. Depth 1.10 to 1.15m. MASCA age: 690 ± 180 BC.

T-2320. Flöytmyr 4 **2020 ± 110**

Dates beginning of continuous spruce (*Picea abies*) pollen curve, *viz* final establishment of spruce forest within area. Dept .70 to .75m. MASCA age: 155 ± 225 BC.

Våletjern series

Fine detritus gyttja, providing age of various pollen-analytic horizons concerning Post-Weichselian development of vegetation, climate, and agric within Lake Mjösa region, from Våletjern at +216m, Stange, Hedmark (60° 42′ N, 11° 13′ E). Coll 1974 to 1976 by Ulf and Dag Hafsten, Univ Trondheim; subm 1975 and 1976 by Ulf Hafsten. *Comment* (UH): dates agree with supposed age (Hafsten, 1956; 1958; 1975), T-2411 slightly older than expected.

T-2186. Våletjern 1 **8490 ± 130**

Dates immigration and spread of elm (*Ulmus*). Depth 5 to 5.1m.

T-2187. Våletjern 2 **6170 ± 150**

Dates immigration and spread of lime (*Tilia*). Dept 3.7 to 3.8m. MASCA age: 5105 ± 175 BC.

T-2411. Våletjern 3 **4070 ± 120**

Dates end of Megathermal lime (*Tilia*) maximum, assumed to represent start of late Post-Weichselian climatic decline. Depth 1.85 to 1.95m. MASCA age: 2745 ± 195 BC.

T-2318. Våletjern 4 **2620 ± 70**

Dates very abrupt and extensive immigration and expansion of spruce (*Picea abies*.) Depth 1 to 1.1m. MASCA age: 850 ± 60 BC.

Forradal series

Peat from 2 blanket bog profiles and 1 sloping fen profile in Forradal moorland complex in Nord-Tröndelag (63° 37′ N, 11° 33′-41′ E). Series dates Post-Weichselian expansion and development of alder (*cf Alnus incana*) and spruce (*Picea abies*) and formation of blanket bogs. Coll and subm 1971 to 1972 by Ulf Hafsten and Thyra Solem, Univ Trondheim (Hafsten & Solem, 1976).

Blanket bog near Salthammervold, ca +485m

T-1520. Depth .075 to .125m **1230 ± 70**

Comment (UH): *Eriophorum/Calluna* peat dating spruce expansion. MASCA age: AD 750 ± 100.

T-1693. Depth .25 to .30m **4110 ± 90**

Comment (UH): *Eriophorum/Calluna* peat dating transition from optimal (Megathermal) to late warmth (Katathermal) period. MASCA age: 2780 ± 170 BC.

T-1521. Depth .30 to .35m **4840 ± 90**

Comment (UH): *Eriophorum/Calluna* peat dating decline of alder or transition to temporal period with a drier and somewhat colder type of climate during late Megathermal time. MASCA age: 3650 ± 90 BC.

T-1522. Depth .65 to .70m **7630 ± 70**

Comment (UH): *Sphagnum/Eriophorum* peat dating alder expansion at transition from early to middle Megathermal period.

T-1523. Depth .975 to 1.025m **8350 ± 100**

Comment (UH): birch-wood peat dating start of blanket bog formation and base of organic deposits.

Blanket bog near Roknesbustaden, ca +403m

T-1692. Depth .175 to .225m **5080 ± 90**

Comment (UH): Eriophorum peat dating decline of alder or transition to temporal period with drier and somewhat colder climate during late Megathermal time. MASCA age: 3875 ± 125 BC.

T-1526. Depth .675 to .725m **7270 ± 120**

Comment (UH): *Carex* peat dating oldest of the 2 alder maxima occurring in area.

Sloping fen near Heståa River, ca +404m

T-1691. Depth .85 to .90m **3960 ± 80**

Comment (UH): *Carex/Eriophorum* peat dating youngest of the 2 alder maxima occurring in area. MASCA age: 2570 ± 230 BC.

T-1524. Depth 1.0 to 1.05m **4360 ± 90**

Comment (UH): *Carex/Eriophorum* peat dating temporal period with drier and somewhat colder climate during late Megathermal time. MASCA age: 3145 ± 175 BC.

T-1525. Depth 1.30 to 1.35m **5980 ± 70**

Comment (UH): unspecified peat dating oldest of the 2 alder maxima occurring in area. MASCA age: 4875 ± 145 BC.

Frosta series

Peat and gyttja from 5 different lakes and bogs on Frosta peninsula in Nord-Tröndelag (63° 33′-37′ N, 10° 40′-52′ E). Series dates various (pollen-analytic and stratigraphic) horizons of Post-Weichselian development of vegetation and climate, agric history and sea-level changes. Coll and subm 1970 to 1971 by Julie Lillealter and Ulf Hafsten (Lillealter, 1972; Tallantire, 1973).

Logtunmyr, ca +27m (63° 34′ N, 10° 42′ E)

T-1132. Depth .75m **1880 ± 70**

Comment (UH): highly humified *Sphagnum/Ericales* peat dating a transient desiccation layer coinciding with 1st appearance of agric indicators in profile. MASCA age: AD 95 ± 65.

T-1131. Depth .95m **2760 ± 50**

Comment (UH): minerotrophic rich-fen peat dating transient rise in groundwater level (*viz* distinct alder peak), supposed to designate late Post-Weichselian climatic deterioration. MASCA age: 1000 ± 100 BC.

T-1130. Depth 1.57m **4030 ± 110**

Comment (UH): minerotrophic rich-fen peat from base of profile indicating age of isolation of basin from sea and latest phase of Megathermal elm maximum. MASCA age: 2700 ± 210 BC.

Lianvatn, +43m (63° 36′ N, 10° 46′ E)

T-1133. Depth 10.45m **5950 ± 100**

Comment (UH): very compressed, sandy brackish-water fine detritus gyttja, containing abundant *Hystrix,* indicating age of isolation of basin from sea. MASCA age: 4840 ± 180 BC.

Asklundvatn, +88.5m (63° 35′ N, 10° 43′ E)

T-1137. Depth 4.80m **1000 ± 60**

Comment (UH): fine detritus dy dating youngest of 2 Iron age *Cerealea* maxima and local spruce expansion. MASCA age: AD 975 ± 65.

T-1136. Depth 6.55m **1600 ± 80**

Comment (UH): fine detritus dy dating a transient local stand of spruce prior to final spruce expansion within area. MASCA age: AD 375 ± 105.

T-1135. Depth 8.10m **3010 ± 120**

Comment (UH): fine detritus gyttja dating local decline of elm and probably 1st appearance of agric indicators on Frosta (documented also by a seed find of *Chenopodium album*). MASCA age: 1305 ± 195 BC.

T-1177. Depth 8.745 to 8.805m **6550 ± 120**

Comment (UH): fine detritus gyttja dating local alder expansion and regional (?) halt in early Megathermal hazel expansion.

T-1134. Depth 9.15m **8640 ± 230**

Comment (UH): fine detritus gyttja from base of profile indicating age of pine immigration and isolation of basin from sea.

Brekkmyr, ca +168m (63° 36′ N, 10° 47′ E)

T-1139. Depth 5.80m **7060 ± 130**

Comment (UH): *Sphagnum fuscum* peat dating early Megathermal alder and local hazel expansion.

T-1138. Depth 9.10m **8770 ± 200**

Comment (UH): *Sphagnum/Carex* peat from base of profile indicating age of isolation of basin from sea.

Stavsjö series

Gyttja from sediment core with 6.25m gyttja above .45m glacial sediments. Sampled in bed at deepest point of Lake Stavsjö at +246m, Ringsaker, Hedmark (60° 49′ N, 10° 50′ E). Coll 1973 and subm 1974 by Per B Christiansen, Limnologisk Inst, Univ Oslo.

T-1769. Stavsjö 1 **2510 ± 210**

Depth 2.1m. *Comment* (PBC): dates rise in sedimentary chlorophyll, and parameters Fe and Mn indicates marked change in lake at this time. MASCA age: 675 ± 255 BC.

T-1770. Stavsjö 2 **6430 ± 250**

Depth 5.75m. *Comment* (PBC): dates marked fall in sedimentary chlorophyll.

Tunsbergdalen series

Plant fragments interbedded in postglacial deltaic sediments at +500m in Tunsbergdalen, Luster, Sogn og Fjordane (61° 30′ N, 7° 11′ E), dated to study rate and chronology of sedimentation. Coll 1974 by Jim Bogen, Geog Inst, Univ Oslo; subm 1975 by Kjell Nordseth, Geog Inst, Univ Oslo. *Comment* (KN): dates agree well with delta sedimentation model.

T-1884. Luster 1 **3380 ± 190**

Depth 6m. MASCA age: 1800 ± 290 BC.

T-1886. Luster 2 **1070 ± 130**

Depth 8m. MASCA age: AD 885 ± 155.

T-1944. Nordre Svartvatn **6110 ± 100**

Trunk of pine from mud 16m below original lake level at +390m in Nordre Svartvatn, Grane, Nordland (65° 43′ N, 13° 29′ E). Coll 1975 by Torbjörn Tuven, Mosjöen; subm 1975 by Nordland county forest office, Mosjöen. MASCA age: 5085 ± 155 BC.

Nordland series, Northern Norway

Shells from glaciomarine sediments in Salten and Narvik area in Nordland. Coll and subm by Björn G Andersen, Univ Bergen, 1971-72, except for T-633, which was coll by G W Holmes and subm by B G A in 1966.

T-1372. Bodö, Salten **10,930 ± 200**
$\delta^{13}C = -1.4‰$

Portlandia arctica from Bodö clay pit (67° 17′ N, 14° 24′ E). *Comment* (BGA): previously dated to 10,550 ± 250 (T-246). Clay deposited when ice front was at Bodö.

T-1158. Valnesfjordvann, Salten **9870 ± 120**
$\delta^{13}C = -1.5‰$

From clay with *Bathyarca glaciales* exposed in roadcut at Valnesfjordvann (67° 18′ N, 15° 12′ E). *Comment* (BGA): clay deposited when ice front had retreated at least 35km E of Bodö.

T-1154. Finneid end moraine **9570 ± 150**
$\delta^{13}C = -0.5‰$

Mainly *Hiatella arctica* from laminated clay below bouldery till bed at the crest at S end of Fenneid end moraine (67° 14′ N, 15° 27′ E). *Comment* (BGA): clay deposited when ice front was at, or close to end moraine, prior to a small glacial oscillation.

T-633. Misvaer, Salten **9490 ± 220**

Mainly *Macoma calcarea* from silty foreset beds in ice-contact outwash delta at Misvær end moraine (67° 7′ N, 15° E). *Comment* (BGA): shells date end moraine.

T-1157. Straumen, Salten **9380 ± 200**
$\delta^{13}C = -1.2‰$

From clay with *Yoldiella lenticula* at Straumen (67° 20′ N, 15° 32′ E). *Comment* (BGA): very bouldery upper part of clay probably corresponds with end moraine at Straumen.

T-1155. Rombak end moraine, E of Narvik **9300 ± 120**
$\delta^{13}C = -1.5‰$

From *Boreo-Arctic* fauna from laminated silt and clay below bouldery till bed at crest at S end of Rombak end moraine (68° 26′ N, 17° 44′ E). Marine beds exposed in road cut. *Comment* (BGA): beds deposited when ice front was located at, or close to, end moraine, prior to a small glacial oscillation.

(a) 9500 ± 130
$\delta^{13}C = +0.7‰$

T-1373. Narvik end moraine **(b) 9450 ± 180**
$\delta^{13}C = -0.1‰$

Outer fraction (a) and inner fraction (b) from *Boreo-Arctic* fauna in clay on proximal slope of Narvik end moraine ridge (68° 27′ N, 17° 26′ E). *Comment* (BGA): clay probably deposited during melting phase following Narvik glacial event.

T-1159. Håkvik, SW of Narvik **8400 ± 120**
$\delta^{13}C = -9.7‰$

Mainly *Macoma calcarea* and *Bathyarca glacialis* in sec of stratified sand, silt and clay at Håkvik (68° 24′ N, 17° 17′ E). *Comment* (BGA): sec was correlated with end moraine at Håkvik, and 9500 to 10,000 yr BP was suggested. Sample must have been contaminated, also indicated by abnormal $\delta^{13}C$ value.

(a) 10,020 ± 130
$\delta^{13}C = -0.3‰$

T-1374. Bjerkvik NE of Narvik **(b) 10,100 ± 190**
$\delta^{13}C = -2.6‰$

Outer fraction (a) and inner fraction (b) from Boreo-Arctic fauna in laminated silt-clay at oldest end moraine NE of Bjerkvik church (68° 33′

N, 17° 35′ E). *Comment* (BGA): marine sec overlain by bouldery till, and most likely slightly older than end moraine, which is younger than Tromsö-Lyngen moraines.

T-1881. Nedrevatn **9290 ± 200**
$\delta^{13}C = -1.1‰$

Shell fragments (*Macoma calcarea, Balanus* sp) from depth 2 to 7m in silt and silty clay beneath and within an ice-front ridge of resedimented marine deposits at ca +85m at N end of Nedrevatn, Strofjord, Troms (69° 22′ N, 20° 18′ E). Coll 1970-1974 and subm 1974 by Geoffrey D Corner, Univ Tromsö. *Comment* (GDC): pre-dates a glacier advance in Late Pre-Boreal time; correlates probably with late Stordal event in Troms and other glacial events in Norway 9200 to 9300 yr BP (Andersen, 1968, 1975; Corner (ms in preparation).

B. Spitsbergen

Bellsund series

From Calypsostranda, Spitsbergen (77° 30′ N, 14° 30′ E), samples coll to date glaciation and postglacial emergence in area. Coll and subm 1974 by Otto Salvigsen, Norsk Polarinstitutt, Oslo. (Shytt *et al,* 1968).

T-1829. Calypsostranda 1 **9400 ± 120**
$\delta^{13}C = -18.8‰$

Jawbone of whale at +10m partly buried in coarse gravel.

T-1830. Calypsostranda 2 **10,310 ± 200**
$\delta^{13}C = +1.3‰$

Shell (*Mya truncata*) from sand and gravel at +29m in rivercutting in marine terrace at +32m. *Comment* (OS): area probably ice-free in Younger Dryas; marked rate of uplift.

T-1699. Freemansundet **8570 ± 110**

Driftwood from marine terrace at +44m at S coast of Barentsöya, Svalbard (78° 20′ N, 21° 30′ E). Coll 1973 and subm 1974 by T S Winsnes, Norsk Polarinstitutt, Oslo. *Comment* (TSW): agrees well with land-uplift curves from Wilhelmsöya and S-most area of Edgeöya (Shytt *et al,* 1968).

Damesmorena series

From marine moraine deposits in Damesmorena, Spitsbergen (77° 52′ N, 16° 30′ E), to date maximum age of great surge of glacier Paulabreen, Van Mijenfjord, and moraine deposits from it. Coll 1975 and subm 1976 by Öystein Haga, Univ Oslo, and Norsk Polarinistitutt.

T-2088. Damesmorena 1 **990 ± 60**

Driftwood at +18m from big log partly buried at inner edge of Damesmorena. MASCA age: AD 985 ± 65.

T-2089. Damesmorena 2 **4090 ± 80**

$\delta^{13}C = -15.8‰$

Whale-bone from depth 1 m at +20m. MASCA age: 2760 ± 160 BC.

T-2090. Damesmorena 3 **3960 ± 100**

$\delta^{13}C = +0.4‰$

Shell from depth .2m at +30m. MASCA age: 2575 ± 245 BC.

II. ARCHAEOLOGIC SAMPLES

A. Norway

1. Settlement sites

Torsröd series

Charcoal assoc with brittle-burned stones from depth 0.3 to 0.4m in ca 1m wide pits in sandy soil. Presumably late Mesolithic dwelling site at +28.5m at Rorsröd, Stavern, Vestfold (59° 0′ N, 10° 2′ E). Coll 1972 and subm 1973 by Einar Östmo, Univ Oslo (Östmo, 1975).

T-1493. Pit 3 **2550 ± 60**

Comment (EÖ): date too young. MASCA age: 775 ± 65 BC.

T-1425. Pit 4 **5350 ± 70**

Comment (EÖ): date supports archaeol and geol information, indicating late Mesolithic age (Östmo, 1975). MASCA age: 4220 ± 150 BC.

Mohalsen series

Charcoal from site Mohalsen IV at +84m, Mohalsen, Vega, Nordland (11° 50′ N, 65° 38′ E). Coll 1974 by Kristian Pettersen and Kurt Alterskjær, DKNVS Mus, Univ Trondheim; subm by Fredrik Gaustad, DKNVS, Univ Trondheim. *Comment* (FG): dates agree well with geol and archaeol data.

T-1807. Mohalsen 1 **9350 ± 270**

Salix, Quercus sp from fireplace, depth .35m.

T-1808. Mohalsen 2 **8440 ± 190**

Quercus sp from charcoal concentration, depth .32m.

T-1873. Rognlien houseground **4600 ± 130**

Charcoal coll during re-examination of trench for wall of Neolithic houseground at +21m, excavated in 1957-1958 by Anne Stine Ingstad, from Rognlien, Porsgrunn, Telemark (59° 4′ N, 9° 48′ E). Coll and subm 1974 by Egil Mikkelsen, Univ Mus Nat Antiquities, Oslo. *Comment* (EM): agrees well with T-133, 4700 ± 120 BP from same houseground (R, 1960, v 2, p 93), and oldest Neolithic pottery found in Rognlien may be of same age (Ingstad, 1970; Mikkelsen, 1975a). MASCA age: 3395 ± 205 BC.

Törkop series

Hazelnuts and charcoal from Mesolithic settlement site at +72m in Törkop, Voll, Halden, Ostfold (59° 6′ N, 11° 26′ E). Finds: flint tools, stone artifacts and animal bones. Coll and subm 1974 and 1975 by E Mikkelsen (1975b).

T-1872. Törkop 1 **8180 ± 170**

Hazelnuts from find-bearing layer, depth .90 to 1.3m. *Comment* (EM): agrees with archaeol material.

T-2134. Törkop 2 **8790 ± 100**

Charcoal from find-bearing cultural layer, depth 1.9 to 2.28m. *Comment* (EM): date slightly older than expected from artifact assemblage.

T-2135. Törkop 3 **3060 ± 60**

Charcoal assoc with flint, hazelnuts, and coarse pottery sherds, depth 1.1 to 1.3m. *Comment* (EM): date far too young, must date pottery, which may be of Bronze age type. Possibly from secondary cremation grave. MASCA age: 1385 ± 115 BC.

T-2194. Törkop 4 **8590 ± 140**

Hazelnuts from find-bearing cultural layer, depth 1.9m. *Comment* (EM): artifact assemblages do not contradict date.

Holeheia series

Charcoal from stone age site at +7m at Holeheia, Bore, Klepp, Rogaland (58° 30′ N, 4° 50′ E). Coll and subm 1962 to 1974 by A Skjølsvold. *Comment* (AS): 6 samples were dated from this site, with average date of 2520 yr BC. One sample dates to early Bronze age, 1460 BC. Although ^{14}C dates obtained suggest occupations in early part of middle Neolithic and in early Bronze age (R, 1964, v 6, p 288), bulk of archaeol material seems to date from late part of middle Neolithic, indicating 3 different occupations at site.

T-587. Holeheia III **4470 ± 120**

From firepit at base of cultural layer, dates oldest occupation of site. MASCA age: 3205 ± 175 BC.

T-588. Holeheia IV **4490 ± 120**

From another firepit at base of cultural layer. MASCA age: 3300 ± 150 BC.

T-1782. Holeheia V **4400 ± 130**

From Sq 4c, depth .1 to .2m, in cultural layer. MASCA age: 3170 ± 200 BC.

T-1783. Holeheia VI **3410 ± 120**

From Sq 7b, depth .2 to .3m, in cultural layer. MASCA age: 1850 ± 210 BC.

Slettabö/Stokkaland series

Charcoal from settlement site at +6m in Slettabö, Stokkaland, Ogna (58° 31′ N, 4° 55′ E), Rogaland. Coll and subm 1963 to 1974 by Arne Skjölsvold, Univ Oldsaksamling, Oslo. *Comment* (AS): 4 cultural layers were found in site; they reflect different settlement phases from Stone and Bronze age (R, 1972, v 14, p 440).

T-457. Slettabö 1 **2850 ± 100**

Assoc with brittleburnt stones of hearth sunken into sterile subsoil in Sq 8. MASCA age: 1095 ± 175 BC.

T-560. Slettabö 2 **4780 ± 130**

From ash and carbon underlying Layer III in Sq 1a. MASCA age: 3560 ± 170 BC.

T-561. Slettabö 3 **4650 ± 100**

From depth 0 to .15m in Sq 0d. MASCA age: 3440 ± 170 BC.

T-562. Slettabö 4 **2900 ± 100**

From depth .15 to .17m, in Layer I, Sq 1h. MASCA age: 1200 ± 190 BC.

T-1779. Slettabö 5 **4640 ± 130**

From depth 1.2m, Layer III, Sq 6q. MASCA age: 3420 ± 200 BC.

T-1780. Slettabö 6 **4470 ± 120**

From depth 1.2m, Layer III, Sq 3q. MASCA age: 3205 ± 175 BC.

T-1803. Slettabö 7 **4820 ± 180**

From depth 1.2m, Layer III, Sq 0n. MASCA age: 3585 ± 195 BC.

Oddernes church series

Charcoal from various pits in settlement-complex around Oddernes church, Kristiansand, Vest-Agder (58° 10′ N, 2° 45′ E). T-1498 and -1499 coll 1960 and 1961 by Elizabeth Skjelsvik, Univ Oslo; T-1410 and -1411 coll 1972 by Anne Aure, Univ Oslo; subm 1972 and 1973 by Anne Aure.

T-1410. Pit 78A, No. 6 **1840 ± 70**

From depth .9m in rectangular fireplace at +20m, 0.5m below pit with no finds. *Comment* (AA): date is within span of 3 pits containing charcoal. MASCA age: AD 130 ± 70.

T-1411. Pit 241, No. 31 **1670 ± 80**

From depth .2m in firepit at +20m with brittle stones and 2 sherds of pottery, 1 decorated. *Comment* (AA): date as expected, corresponds with other pits dated by pottery (Böe, 1931). MASCA age: AD 290 ± 110.

T-1498. Pit 4 **1750 ± 70**

From depth .7m in oven pit at +15m, with brittle stones and 70 sherds belonging to 6 to 7 pots of different types, some fingertip decorated.

Comment (AA): pottery with fingertip decoration should not predate AD 300 in Norway (Böe, 1931, p 159). MASCA age: AD 230 ± 90.

T-1499. Pit 18 **1740 ± 70**

From depth .28m in pit at +15m, with brittle stones, burned bones and a piece of bronze. *Comment* (AA): date as expected. MASCA age: AD 230 ± 90.

Oddernes houseground series

Charcoal from walls and a fireplace in 3 housegrounds at +20m in Oddnernes prestegård, Kristiansand, Vest-Agder (58° 9′ N, 8° 15° E). Coll 1972; subm 1972 and 1973 by Perry Rolfsen, Univ Mus Nat Antiquities, Oslo. *Comment* (PR): archaeol material scanty and difficult to date, dates slightly older than expected (Rolfsen, 1976).

T-1407. Oddernestuft No. 1/1 **1820 ± 80**

Depth .55m. MASCA age: AD 160 ± 90.

T-1548. Oddernestuft No. 1/3 **1900 ± 60**

From fireplace at depth .6m. MASCA age: AD 80 ± 60.

T-1549. Oddernestuft No. 2/1 **2010 ± 70**

Depth .5m. MASCA age: 65 ± 125 BC.

T-1550. Oddernestuft No. 4/1 **1850 ± 70**

Depth .6m. MASCA age: AD 130 ± 70.

Skarg houseground series

Charcoal from 4 out of 12 fireplaces in houseground at +532m in Skarg, Tveiten, Bykle, Aust-Agder (59° 9′ N, 7° 43′ E). Coll 1973 and 1974; subm 1974 by P Rolfsen. *Comment* (PR): dates agree with archaeol material (Rolfsen, 1977).

T-1675. Skargtuft No. 1/1 **1090 ± 70**

Depth .25m. MASCA age: AD 890 ± 90.

T-1758. Skargtuft No. 1/2 **1300 ± 80**

Depth .25m. MASCA age: AD 690 ± 100.

T-1759. Skargtuft No. 1/3 **990 ± 190**

Depth .4m. MASCA age: AD 980 ± 210.

T-1760. Skargtuft No. 1/4 **1070 ± 80**

Depth .45m. MASCA age: AD 905 ± 105.

Sandöya series, Sund

Charcoal from houseground belonging to Late Iron age settlement on Sandöya I. near Risöya, Sund, Hordaland (60° 10′ N, 5° E) (R, 1975, v 17, p 379). Coll 1973 and subm 1974 by Bente Magnus, Hist Mus, Univ Bergen.

T-1591. Sandöya 1, 1x/1y, lag IV **1310 ± 80**

From depth .4m in bottom layer of hearth within wall foundations. *Comment* (BM): date agrees with find material (Magnus, 1974). MASCA age: AD 665 ± 95.

T-1592. Sandöya 2, 1x/3y, lag III **1540 ± 110**

From depth .3 to .35m near foundation wall. *Comment* (BM): date too old according to find material. MASCA age: AD 440 ± 150.

T-1836. Volsvika, Fjörtoft **1490 ± 110**

Peat from depth 1m assoc with asbestos ceramics, dating transition from meadow to heath in Volsvika, Fjörtoft, Haram, Möre og Romsdal (62° 43′ N, 6° 23′ E). Coll 1968 by P E Kaland, Bot Mus, Bergen; subm 1974 by Bergljot Solberg, Hist Mus, Bergen. *Comment* (BS): date as expected. MASCA age: AD 495 ± 125.

S Kvalöy series

Charcoal from assumed Late Iron age site at +5m at Tussöy, Tromsö, Troms (69° 39′ N, 17° 26′ E). Site is close to burial place with clear pagan traits. Coll and subm 1972 by Kari Stören, Univ Tromsö. *Comment* (KS): dates older than expected, difference in age between them probably due to 2 building phases.

T-1402. Bö 1 **1120 ± 110**

Depth .52m in hearth with blackburned stones in SW end of site. MASCA age: AD 850 ± 150.

T-1403. Bö 2 **1430 ± 80**

From depth .64m between hearth and wall. MASCA age: AD 545 ± 95.

Hoset deserted farm series

Charcoal and 1 peat sample (T-1587) from deserted farm area at +320m to +350m at Hoset, Stjördal, Nord-Tröndelag (63° 24′ N, 11° 11′ E), relating to different traces of settlement and samples activities, eg, ancient fields, iron production site, houses, graves. Area also analyzed for pollen. Coll 1971 to 1974 by O Farbregd, H Salvesen and K P Buhaug; subm 1971 to 1975 by O Farbregd, DKNVS Mus, Univ Trondheim (Salvesen, 1975a,b).

T-1170. Barrow C 24 **1660 ± 220**

From scanty cremation layer at depth .5m below surface under cairn ca 3.5 × 2.5m wide, .3m high. *Comment* (OF): date corresponds well with this type of grave, scantily furnished. MASCA age: AD 320 ± 250.

T-1682. Phosphate concentration West 1 **380 ± 100**

From charcoal concentration, at depth .05m, overlying unexplained stone construction. *Comment* (OF): date is *ante quem* for construction. MASCA age: AD 1510 ± 100.

T-1583. Phosphate concentration West 2 **850 ± 70**

From charred piece of wood from humus layer at depth .05 to .07m in assumed old field. *Comment* (OF): field not worked after deposition of sample; proved by continuity of many separate charcoal bits. MASCA age: AD 1125 ± 95.

T-1584. Phosphate concentration West 3 **1420 ± 80**

From depth .5m below surface at base of charcoal (cooking ?) pit containing earth, stones, and charcoal. MASCA age: AD 555 ± 95.

T-1683. Phosphate concentration West 4 **1430 ± 70**

Charcoal close to T-1584, with different, twisted structure. *Comment* (OF): consistency of T-1584 and -1683 contradict hypothesis that wood of markedly different age was used for fuel in pit. MASCA age: AD 550 ± 90.

T-1585. Slag Heap 1 **1840 ± 80**

Charcoal (*Pinus*) from base of slag heap below ca .5m slag. *Comment* (OF): age remarkably high, corresponding well with others from same site, and also with recent research results from other iron production sites in S Norway. MASCA age: AD 135 ± 75.

T-1685. Slag Heap 2 **1930 ± 80**

Charcoal (*Pinus*) .2m above base of slag heap below ca .6m slag. MASCA age: AD 20 ± 120.

T-1586. Slag Heap 3 **1860 ± 110**

Charcoal (*Pinus*) from upper layer of slag heap below ca .3m slag. *Comment* (OF): date indicates that time span of iron production was relatively short. MASCA age: AD 120 ± 100.

T-1684. Slag Heap 4 **1620 ± 70**

Charcoal from outer parts of tree (*Pinus*) from bottom of slag heap below ca .6m slag. Distance 3 to 4m from Samples T-1585, -1586, and -1685. *Comment* (OF): date markedly younger than other 3 from same slag heap. Coming from bottom layer, it suggets short use of site. Since all samples are pine, most of other fuel may have been old when used for ore melting. MASCA age: AD 350 ± 90.

T-1925. Barrow C 22 **1250 ± 90**

From earth filling of 9m wide and .5m high barrow. *Comment* (OF): obviously brought here during building of monument. MASCA age: AD 735 ± 115.

T-1926. Cairn **1330 ± 80**

From cremation layer in a cairn 4 × 2.5m wide, also containing calcinated bones, pieces of bone comb and iron fragments. MASCA age: AD 650 ± 80.

2. Bog iron industries

Mösstrand series, Telemark

Charcoal from iron extraction sites at +925 to +950m at Mösstrand, Vinje, Telemark (59° 50′ N, 8° 10′ E). Coll 1973 and 1974 by Univ Mus Nat Antiquities, Oslo; subm 1973 to 1975 by Irmelin Martens, Univ Mus Nat Ant, Oslo. *Comment* (IM): dates agree with archeol data. Chronology of sites and furnace types in Mösstrand are now firmly established by these and earlier dates (R, 1975, v 17, p 386).

T-1642. Nystaul 31/51 No. 4/1 **1010 ± 70**

Depth ca .2m, on original surface underlying slag heap. MASCA age: AD 965 ± 75.

T-1751. Nystaul 31/51 No. 4/2 **940 ± 80**

Depth .35m, close to furnace. *Comment* (IM): on this site was found piece of 10th century bronze brooch. MASCA age: AD 1045 ± 95.

T-1752. Nystaul 31/51 No. 5/1 **1070 ± 70**

Depth .4 to .5m on original surface underlying slag heap. MASCA age: AD 910 ± 90.

T-1643. Nystaul 31/51 No. 6/1 **910 ± 70**

Depth .4 to .5m on original surface underlying a slag heap. MASCA age: AD 1080 ± 100.

T-2042. Nystaul 31/51 No. 6/2 **1090 ± 50**

Depth .25 to .35m in slag pit close to furnace. MASCA age: AD 890 ± 70.

T-1644. Nystaul 31/51 No. 7/1 **1290 ± 110**

Depth ca .1m on original surface underlying slag heap. MASCA age: AD 695 ± 125.

T-1753. Nystaul 31/51 No. 7/2 **960 ± 80**

Depth ca .1m from charcoal layer below turf. MASCA age: AD 1015 ± 85.

T-1891. S Hovden 35/47 No. 5/1 **850 ± 90**

Depth ca .15m on original surface underlying slag heap. MASCA age: AD 1120 ± 100.

T-1892. S Hovden 35/47 No. 5/2 **1000 ± 90**

Depth .2 to .25m close to bottom of clay furnace. MASCA age: AD 965 ± 105.

T-1645. S Hovden 35/47 No. 13/1 **1430 ± 110**

Depth ca .4m on original surface underlying slag heap. MASCA age: AD 550 ± 120.

T-1646. S Hovden 35/47 No. 13/2 **1190 ± 110**

Depth ca .2m in stone lined bowl furnace. MASCA age: AD 785 ± 135.

T-2041. S Hovden 35/47 No. 13/3 **1300 ± 60**

Depth ca .35m in furnace. MASCA age: AD 680 ± 80.

T-1647. S Hovden 35/47 No. 14/1 **1420 ± 110**

Depth ca .15m on original surface underlying slag heap. MASCA age: AD 555 ± 115.

T-1754. S Hovden 35/47 No. 14/2 **1420 ± 80**

Depth .25 to .3m in stone lined bowl furnace. MASCA age: AD 555 ± 95.

T-1927. Holen, bog iron **700 ± 110**

Charcoal from depth .4m in melting furnace at +570m at Brustölhaugen, Holen, Bykle, Aust-Agder (59° 8′ N, 7° 17′ E). Coll and subm 1974 by P Rolfsen. *Comment* (PR): date younger than expected (Rolfsen, 1977). MASCA age: AD 1255 ± 105.

3. Hunting constructions and localities

Reindeer pitfall series

Samples from pitfalls at different localities in E Norway, to study their construction and practical use. Coll 1972 to 1975 by E K Barth and Jon Vingelen; subm 1973 to 1976 by E K Barth, Norsk Skogbruksmus, Elverum.

T-1711. Fremre Bråkdalshö 1 **730 ± 70**

Wood from pointed pole in base of rectangular, stone-sided pitfall at +1480m at Fremre Bråkdalshö, Sel, Oppland (61° 55′ N, 9° 36′ E). Depth .2m below basal surface. *Comment* (EKB): pole perhaps for impaling animal; date agrees with pitfall at same alt, 2km SE, dated to 670 ± 60 BP, T-885 (R, 1972, v 14, p 447). MASCA age: AD 1245 ± 65.

T-1935. Fremre Bråkdalshö 2 **750 ± 200**

Last remains of wood from covering frame work on top of stone sided rectangular pit, depth .2 to .55m below basal surface at +1420m in Rondane, Sel, Oppland (61° 53′ N, 9° 37′ E). *Comment* (EKB): agrees well with another pitfall 2km N at approx same alt (T-1711). MASCA age: AD 1205 ± 185.

T-1608. Heimare Veslefjell **140 ± 60**

Wood from .08m thick pole in bottom of rectangular stone-sided reindeer pitfall at +1130m at Heimare, Veslefjell, Brennhaug, Oppland (61° 57′ N, 9° 21′ E). Depth .3m below basal surface. *Comment* (EKB): pole perhaps for impaling animal; pitfall situated close to habitated area, thus expected younger than the others. MASCA age: younger than AD 1640.

T-1572. Lille Ula 2 **320 ± 70**

Charcoal from last remnants of burned poles from wall construction in oval-shaped pitfall at ±1020m in Lille Ula, Sel, Oppland (61° 51′ N, 9° 40′ E). Depth .2m below basal surface. *Comment* (EKB): date agrees with 360 ± 90 BP from same pitfall, T-1420 (R, 1975, v 17, p 391) and with charcoal from depth .3m dated by Gif-sur-Yvette Lab, France, to 370 ± 80 BP. MASCA age: AD 1535 ± 95.

T-1880. Tolga östfjell **1160 ± 70**

Wood from remnants of construction in very wet boggy soil at base of oval-shaped pitfall at +780m in Trangdalen, Tolga, Hedmark (62° 19′ N, 11° 24′ E). Depth .6 to .7m below surface. *Comment* (EKB): one of ca 100 pitfalls within 3km distance in birch wood, *ie,* lower than other pits of same type (Barth, 1974). MASCA age: AD 805 ± 105.

T-2155. Gravskaret **990 ± 50**

Last remains of wood from covering frame work on top of stone-sided rectangular pit, depth .15m below basal surface at +1482m in Gravskaret, Alvdal, Hedmark (61° 57′ N, 10° 10′ E). *Comment* (EKB): one of oldest known dates for pitfalls of this type (R, 1975, v 17, p 391). MASCA age: AD 985 ± 55.

T-2210. Illmanndalen **720 ± 50**

Humus and wood from last remains of frame work on top of stone-sided rectangular pit, depth .4m below basal surface at +1270m in Illmanndalen, Sel, Oppland (61° 53″ N, 9° 49′ E). *Comment* (EKB): pitfalls in Rondane seem not to have been in use after the Black Death.

T-2154. Breisjöen **640 ± 50**

Humus from distinct layer in stone-sided oval pit, depth .5 to .58m below basal surface at +950m in Alvdal, Hedmark (61° 58′ N, 10° 15′ E). MASCA age: AD 1300 ± 60.

T-1879. Ledsageren/Hirkjölen **340 ± 60**

Wood from .2 to .3m-thick logs horizontally bonded together in rectangular shape, forming elk (*Alces alces*) pit fall at +730m at Ledsageren, Stor-Elvdal, Hedmark (61° 45′ N, 10° 38′ E). Depth .1m below surface; pit filled with boggy soil and wake. *Comment* (EKB): 1st dating of elk pitfalls in Norway (Barth, 1974). MASCA age: AD 1520 ± 90.

T-1804. Fåset I **710 ± 90**

Charcoal (pine) from depth 2.5m in 1 out of ca 500 elk (*Alces alces*) pitfalls at Fåset, Tynset, Hedmark (62° 16′ N, 10° 40′ E). Coll and subm 1974 by Ivar Streitlien, Tynset. MASCA age: AD 1260 ± 80.

T-715. Lesja animal trap **1230 ± 80**

Wood (*Pinus*) from wooden structure in animal pit at +950m in Svartdalen, Lesja, Oppland (62° 16′ N, 8° 50′ E). Coll 1968 by Öystein

Mölmen, Eidsvoll; subm 1968 by Norsk Skogbruksmus, Elverum. *Comment* (NS): date as expected. MASCA age: AD 750 ± 100.

T-2136. Lomseggen **1350 ± 60**

Wood (*Salix*) from drift fence directing deer toward hunter's hiding-place at +2000m in Skjåk, Oppland (61° 49′ N, 8° 17′ E). Coll and subm 1976 by Ö Mölmen. *Comment* (ÖM): date reasonably agrees with estimated age. MASCA age: AD 630 ± 60.

4. Miscellaneous archaeologic samples

Small oval mounds series

Small oval mounds of earth heaped up by windfalls are widespread and commonly known, similar formations covering pits or layers may be man-made, perhaps simple graves. Charcoal from mounds in Nes, Sunndal, and Engdal, Aure, Möre og Romsdal (63° 11′ N, 8° 45′ E). Coll 1973 and 1974; subm 1974 by O Farbregd. *Comment* (OF): dates refer 2 such formations to period characterized by simple cremations graves and scarcity of finds. This strengthens hypothesis that some mounds may be graves (Farbregd, 1975).

T-1805. Nes **2560 ± 100**

From mound at +20m, .7m below surface. MASCA age: 715 ± 185 BC.

T-1806. Engdal **1750 ± 70**

From mound at +100m, ca .2m below surface. MASCA age: AD 230 ± 90.

Bog platform series

In recent years a series of similar finds were made in bogs in Tröndelag area, *viz*, round wooden platforms 1.5 to 6m wide, made of split logs. Wooden tools like spades, forks, troughs and strange cruciform objects were found in connection with the platform. Function and age of these constructions were unknown. Excavations gradually offered evidence that they were bottoms of a special kind of tar kiln. Written records and current ethnographic evidence confirm this explanation. Samples, except T-1680, are wood from outer part of platform, probably *Pinus*. Coll 1972 and 1973; subm 1972 to 1974 by O Farbregd.

T-1496. Glåmen **900 ± 110**

From ca 1.6m wide platform, preserved in bottom of ca .5m deep bog at +90m in Glåmen, Halsa, Möre og Romsdal (63° 07′ N, 8° 20′ E). *Comment* (OF): date older than others in series. May indicate that platforms, although most widely used in post-Reformation period, may be older (Farbregd, 1973, 1976; Hafsten, 1974; Dybdahl, 1976). MASCA age: AD 1085 ± 125.

T-1497. Lund **310 ± 70**

From ca 1.8m wide platform at depth .6m in bog at +30m in Lund, Meldal, Sör-Tröndelag (63° 31′ N, 9° 45′ E). MASCA age: AD 1540 ± 100.

T-1581. Haset Platform 4 **270 ± 70**

From ca 1.7m wide platform at depth .5m in bog Raudmyra at ca +220m in Haset, Malvik, Sör-Tröndelag (63° 24′ N, 10° 41′ E). MASCA age: AD 1560 ± 90.

T-1582. Haset Platform 6 **180 ± 100**

From ca 2m wide platform at depth .2m in bog Raudmyra. MASCA age: younger than AD 1520.

T-1679. Litlsaetertjörna 1 **280 ± 70**

From ca 5m wide, large platform at depth ca .6m in bog at +320m at Litlsætertjörna, Stjördal, Nord-Tröndelag (63° 32′ N, 10° 59′ E). MASCA age: AD 1555 ± 95.

T-1680. Litlsaetertjörna 2 **200 ± 70**

Wood from young tree, from handle of fork found under platform dated by T-1679. *Comment* (OF): in satisfactory agreement with T-1679. MASCA age: AD 1660 ± 140.

T-1681. Litlsaetertjörna 3 **410 ± 100**

From ca .2m wide platform at depth ca 1m in bog at Litlsætertjörna. MASCA age: AD 1500 ± 110.

Antler mattock-heads series

Elk (*Alces alces*) and deer antlers from bogs in E Norway. Different pieces were selected for dating and compared with pollen- and typologic dating to strengthen chronologic framework on Norwegian finds of antler mattock-heads (Brögger, 1938; Mikkelsen & Höeg, 1977). Subm 1975 by Egil Mikkelsen, Univ Mus Natl Antiquities, Oslo. *Comment* (EM): dates agree very well with pollen analysis.

T-2130. Östen, Gran **7300 ± 100**

Elk antler mattock-head from bog at ca +245m in Östen, Gran, Oppland (60° 29′ N, 10° 29′ E). Coll in 19th century and brought to Univ Mus Nat Antiquities, Oslo 1889.

T-2131. Viul **7690 ± 90**

Deer antler from depth 2 to 3m in bog at +120 to 145m in Viul, Ringerike, Buskerud (60° 12′ N, 10° 20′ E). Coll 1891 or 1893 by unknown collector. Other finds: deer antler mattock-head, crania of deer and fish-bones.

T-2132. Lunden **2970 ± 70**

Elk antler mattock-head from marsh-soil near pond found during plowing in Lunden, Ringsaker, Hedmark (60° 57′ N, 10° 47′ E). Coll 1957 by Freddy Löje-Jensen, Veldre. MASCA age: 1275 ± 125 BC.

T-2133. Alstad **3000 ± 80**

Elk antler mattock-head probably from bog, found in 19th century and brought to Univ Mus Nat Antiquities in 1868, from Alstad, Östre Toten, Oppland (60° 41′ N, 10° 50′ E). MASCA age: 1315 ± 145 BC.

Hov elk antler series

Elk (*Alces alces*) antler in light silt and mud at +250m from Hov, Löten, Hedmark (60° 49′ N, 11° 21′ E). T-513 coll 1965 by Gunnar Söberg, Löten. T-1824 coll 1974 by Johan Skårholen, Löten; subm 1965 and 1974 by Norsk Skogbruksmus, Elverum (Henningsmoen, 1975).

T-513. Hov 1 **8060 ± 160**

Depth 1.70m.

T-1824. Hov 2 **8520 ± 140**

Depth 1.85m.

Urnes series

Wood from Urnes stave church, built ca AD 1150 at Urnes, Luster, Sogn og Fjordane (61° 18′ N, 7° 19′ E). Coll 1974 by Hans Granum, Dept Bldg Tech, Univ Trondheim; subm 1974 by H Granum and Håkon Christie, The Central Office of Historic Monuments, Oslo. *Comment* (HC): dates older than expected.

T-1776. Urnes 1 **980 ± 70**

From N end of W nave raft beam. MASCA age: AD 995 ± 75.

T-1777. Urnes 6 **1120 ± 110**

From NE post in chancel, used in an older building. MASCA age: AD 850 ± 150.

T-1778. Urnes 9 **1010 ± 70**

From roof boarding, in nave. MASCA age: AD 965 ± 75.

Lom series

Wood from walls of church, recycled when present church was built ca AD 1180 at Lom, Oppland (61° 50′ N, 8° 34′ E). Coll 1973 and subm 1974 by H Christie. *Comment* (HC): dates older than expected.

T-1843. Lom 1 **1210 ± 80**

From beam on which posts of earlier church rested. MASCA age: AD 765 ± 115.

T-1845. Lom 10 **1350 ± 120**

From post belonging to earlier church. MASCA age: AD 625 ± 135.

T-1984. Lom 3 **1130 ± 70**

Same as for T-1845. MASCA age: AD 835 ± 105.

T-1985. Lom 4 **1220 ± 130**

Same as for T-1845. MASCA age: AD 765 ± 145.

T-1986. Lom 7 **1220 ± 80**

Same as for T-1845. MASCA age: AD 750 ± 100.

T-2052. Haukåsmyra **1140 ± 80**

Wood from dugout canoe from depth 2m found during ditching of marsh, previously a pond, at +370m in Åsvang, Stange, Hedmark (60° 43′ N, 11° 24′ E). Coll 1974 by Nikolai Sjöli, Stange; subm 1975 by Norsk Skogbruksmuseum. *Comment* (NS): date considerably younger than indicated by pollen analysis. MASCA age: AD 835 ± 105.

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ERRATUM

In our previous date list, Trondheim VII (R, 1975, v 17, p 377) the date for T-1452 should be corrected from 600 ± 120 BP to 2420 ± 140 (470 BC).

[RADIOCARBON, VOL. 20, NO. 1, 1978, P. 134-138]

UNIVERSITY OF MIAMI RADIOCARBON DATES XI

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The following dates are a partial list of geologic samples dated since December 1976. The method used is described by (Stipp *et al*, 1976). Ages were calculated using a half-life of 5568 years. Errors reported are one standard deviation and include only the counting errors on the unknown sample, background and modern standard. There have been no corrections made on these dates. Sample descriptions and comments were written, based on information supplied by the submitters.

SAMPLE DESCRIPTIONS

A. United States

North Captiva Island Series

Shell samples hand coll along E-W transect on North Captiva I., Florida (26° 32′ to 36′ N, 82° 10′ to 15′ W). Coll from ca 0.5m below island surface. Dated to establish method of barrier island formation. Coll and subm 1977 by T Missimer, Cape Coral, Florida and C Snively, Univ Miami.

UM-1069. 1a **104.0 ± 0.9% modern**

UM-1070a. 1b **3825 ± 105**

UM-1070b. 1b **2450 ± 80**

Duplicate run of UM-1070a.

UM-1071. 2 **1400 ± 75**

UM-1072. 3 **1850 ± 75**

UM-1073. 4 **920 ± 85**

UM-1074. 9 **435 ± 65**

UM-1075. 10 **1730 ± 85**

Everglades Tree Island series

Peat from piston core in Everglades tree-island, small *Persea* type, in Conservation Area I, Everglades, Florida (26° 26′ 55″ N, 80° 17′ 10″ W). Continuation of study on tree-island formation (R, 1976, v. 18, p 375; v 19, p 121-122). Coll and subm 1976 by D Piepgras.

General Comment (DP): this core was taken 9.6km N of Core 20 (R, 1976, v 19, p 121-122) on same island. Results support floating island theory and indicate that subsequent island growth is affected by Everglades drainage patterns (Davis, 1943). Core 20 showed no reversals.

UM-1106. 70cm **290 ± 80**

Wood.

UM-1107. 81 to 91cm **410 ± 70**

UM-1108. 141 to 147cm **1300 ± 135**

UM-1109. 150 to 156cm **1710 ± 110**

UM-1110. 158 to 164cm **1260 ± 70**

UM-1111. 175 to 181cm **1900 ± 85**

UM-1112. 183 to 187cm **2620 ± 115**

UM-1113. 189 to 195cm **1805 ± 60**

UM-1114. 195 to 200cm **1850 ± 95**

UM-1115. 200 to 206cm **2295 ± 60**

UM-1116. 206 to 213cm **2330 ± 70**

UM-1117. 213 to 219cm **2660 ± 80**

UM-1118. 219 to 225cm **2420 ± 65**

UM-1119. 225 to 231cm **2735 ± 75**

Calcrete series

Calcrete, cryptocrystalline carbonate crusts, 2 to 2.5cm thick, resulting from soil-forming processes (Read, 1976), were sampled from Key Largo (25° 08′ N, 80° 21′ W) and Big Pine Key (24° 39′ N, 81° 21′ W), Florida. Crusts separated into laminae 1 to 4.5mm thick. Dated to show that crust forms by orderly deposition of $CaCO_3$ precipitate from overlying soil layer. Coll and subm 1977 by D Robbin, USGS, Fisher I. Sta, Miami Beach, Florida.

UM-1079. Key Largo Crust **400 ± 70**
Lamina 1 to 1.5mm.

UM-1080. Key Largo Crust **1450 ± 65**
Lamina 2 to 3mm.

UM-1081. Key Largo Crust **3100 ± 80**
Lamina 2 to 4mm.

UM-1082. Key Largo Crust **4930 ± 115**
Lamina 2 to 4mm.

UM-1083. Key Largo Crust **18,190 ± 225**
Grain stone underlying laminated crust.

UM-1084. Key Largo Crust **1685 ± 80**
Total thickness of laminae without grain stone.

UM-1076. Big Pine Key Crust **260 ± 70**
Lamina 2 to 4mm.

UM-1077. Big Pine Key Crust **7890 ± 70**

Lamina 3 to 4mm.

UM-1078. Big Pine Key Crust **7900 ± 190**

Duplicate run of UM-1077.

South Florida coral reef series

Coral reef accumulation rates in S Florida were studied by dating coral samples (Shinn *et al*, 1977) from cores taken from Bahia Honda Reef (24° 34′ N, 81° 20′ W), Carysfort Reef (25° 13′ N, 80° 12′ W), Long Reef (25° 27′ N, 80° 07′ W), and Pulaski Reef (24° 42′ N, 82° 47′ W). Samples were also obtained from dredge site near Bal Harbor (25° 54′ N, 80° 06′ W) and a sewer trench off Virginia Key (25° 44′ N, 80° 07′ W). Depths reported are from mean sea level. Coll and subm 1975 to 1976 by E Shinn, USGS, Fisher I. Sta, Miami Beach, Florida.

UM-998A. Bahia Honda #1 **6440 ± 100**

Montastrea, 12m.

UM-998. Bahia Honda **6170 ± 80**

Duplicate run of UM-998A.

UM-999. Bahia Honda #1 **7160 ± 85**

Montastrea, 13.4m.

UM-1000. Bahia Honda #1 $\mathbf{37{,}480^{+1300}_{-1500}}$

Pleistocene coral, 17.1m.

UM-1001. Bahia Honda #2 **4735 ± 85**

Colpophyllia, 10.7m.

UM-1002. Carysfort Reef #1 **4570 ± 85**

Montastrea, 5.8m.

UM-1003. Carysfort Reef #1 **5250 ± 95**

Montastrea, 9.1m.

UM-1004. Long Reef **5630 ± 120**

Montastrea, 8.2m.

UM-1005. Bal Harbor **6300 ± 120**

Siderastrea, 16.1m.

UM-1006. Pulaski Reef **5865 ± 90**

Montastrea, 11.3m.

UM-1007. Pulaski Reef **6595 ± 115**

Montastrea, 13.4m.

UM-1008. Pulaski Reef **7165 ± 90**

Diploria, 14.9m.

UM-1014. Virginia Key **4930 ± 70**

Montastrea Cavernosa, 9.8m.

Aquifer Recharge series

Recharge source studies made for sandstone Tamiami Formation underlying Lee and Hendry Co, Florida. The sandstone aquifer is separated from water table aquifer of limestone Caloosahatchee Formation by impermeable green clay layer. Water samples coll from each aquifer encased wells over 42.6km extent. $SrCO_3$ was precipitated from water in field. Coll and subm 1977 by T O'Donnell, USGS, Ft Myers, Florida and D Gibbs, U Miami. *Comment* (TD): samples from sandstone aquifer coll in interval between casing depth and well depth. Water table aquifer samples coll at depths given.

UM-1057. He-529 **14,500 ± 180**

(26° 33′ 10″ N, 81° 25′ 09″ W). Casing depth: 41.15m. Well depth: 47.24m.

UM-1058. He-554 **108.3 ± 1.0% modern**

(26° 33′ 10″ N, 81° 25′ 09″ W), 3.35m.

UM-1059. L-2215 **20,230 ± 280**

(26° 31′ 27″ N, 81° 35′ 16″ W). Casing depth: 30.18m. Well depth: 40.54m.

UM-1061. L-730 **2200 ± 75**

(26° 31′ 27″ N, 81° 35′ 16″ W), 5.79m.

UM-1060. L-2184 **18,840 ± 370**

(26° 32′ 51″ N, 81° 50′ 17″ W). Casing depth: 22.86m. Well depth: 34.14m.

UM-1062. L-1994 **11,710 ± 125**

(26° 32′ 51″ N, 81° 45′ 28″ W). Casing depth: 21.34m. Well depth: 38.10m.

Blanco Trough series

Benthos gravity core (W7605B-9-GC) recovered from Blanco Trough (44° 17′ N, 129° 39′ W) in 3300m water. Dates sedimentation and metal accumulation rates. Coll 1976 by B W Selk, Oregon State Univ, Corvallis, Oregon; subm 1977 by B W Selk and K Rudolph, Univ Miami.

UM-1052. 1 to 9cm **14,495 ± 230**

UM-1053. 12 to 18cm **17,200 ± 140**

UM-1054. 24 to 32cm **18,415 ± 325**

UM-1055. 38 to 46cm **24,245 ± 300**

UM-1056. 51 to 59cm **$33,725^{+940}_{-1060}$**

B. Black Sea

Black Sea series

Piston core (P6507-12) from abyssal plain of Black Sea (43° 49′ 48″ N, 35° 31′ 12″ E). Dated to correlate with oxygen isotope record from core. Coll 1965 by RSMAS, Miami; subm 1977 by J Southam and M Boehm, RSMAS, Miami.

UM-1064. 53 to 69cm **15,815 ± 450**

UM-1065. 145 to 153cm **12,190 ± 145**

UM-1066. 163 to 172cm **16,600 ± 400**

UM-1068. 645 to 655cm **>34,600**

C. Belize

Carrie Bow series

Coral from core taken near Carrie Bow Cay, Belize (16° 50′ N, 88° 05′ W). Dated to study reef accumulation rates. Depth from top of core. Coll and subm by E Shinn.

UM-1009. Carrie Bow #2 **5625 ± 85**

Montastrea, depth 5.80m.

UM-1010. Carrie Bow #2 **6165 ± 90**

Porites, depth 8.20m.

UM-1011. Carrie Bow #2 **6140 ± 90**

Porites, depth 11.0m.

UM-1012. Carrie Bow #2 **7175 ± 100**

Porites, depth 17.70m.

UM-1013. Carrie Bow #4 **6960 ± 110**

Montastrea, depth 15.50m.

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[RADIOCARBON, VOL. 20, No. 1, 1978, P. 139-156]

US GEOLOGICAL SURVEY RADIOCARBON DATES XIII

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This list contains the results of some measurements made between 1965 and 1973. Samples are counted in the form of acetylene gas, as previously, and ages computed on the basis of the Libby half-life, 5568 ± 30 years. The dates have not been corrected for fractionation by a $\delta^{13}C$ measurement. The error listed, always larger than the one-sigma statistical counting error commonly used, takes into account possible fractionation in the laboratory and in nature and the variability experienced with replicate samples. We wish to thank Charles Oman for his technical assistance.

Unless otherwise stated, collectors of all samples are members of the US Geological Survey.

A. Eastern United States

W-2304. East Canaan, Connecticut **>38,000**

Organic nodules composed of partially decomposed wood, alt 252m, exposed in forest beds at East Canaan Delta, 0.3km NNW of intersection of Rte 44 and Canaan Valley Rd, East Canaan (42° 01.0′ N, 73° 16.6′ W), Connecticut. Coll 1968 by J T Leftwich, L B Smith, W S Newman, J H Hartshorn; subm by G W Holmes. *Comment* (GW): age is anomalously old for these glacial-deltaic sediments which should date ca 13,000 BP. The organic material is allochthonous, possibly brought in from older deposits, as was noted for similar dates from this area: 28,000 ± 1000 and >33,000, W-2043, -2174 (R, 1970, v 12, p 319).

Wononpakook Lake series, Connecticut

Samples from swamp, E of Wononpakook Lake (41° 56.3′ N, 73° 27.9′ W), Connecticut. Coll 1968 by Cornelia Cameron; subm by G W Holmes.

W-2401. **3980 ± 250**

Fresh peat, depth 368cm, underlain by clayey peat.

W-2398. **8480 ± 300**

Peaty clay, depth 762cm, underlain by "glacial" clay. *Comment* (GWH): represents earliest organic deposition after "glacial" lake clay.

Burlington series, Vermont

Wood and shells from blue-gray silt and clay unit, depth 4m, drainage trench, Lund Home, Burlington (44° 27′ 30″ N, 73° 12′ 30″ W), Vermont. Coll 1968 and subm by A S Hunt and W P Wagner, Univ Vermont, Burlington, Vermont.

W-2309. **10,950 ± 300**

Wood.

W-2311. **11,420 ± 350**

Pelecypods.

General Comment (ASH & WPW): ages are comparable to other Champlain Sea dates.

W-2128. Hemenway Landing, Massachusetts **>40,000**

Carbonized wood chips, depth 24.6m, at contact of gray clayey silt overlying light gray sand, Hemenway Landing (41° 49′ 19″ N, 69° 57′ 55″ W), Massachusetts. Coll 1967 and subm by J E Cotton. *Comment* (JEC): minimum date for end of fluvial sequence and beginning of lacustrine sequence.

Kittatinny Mountain series, New Jersey

Carbonaceous samples coll from a peat bog, depression in main ridge, Kittatinny Mt, Sussex Co (41° 14′ 08″ N, 74° 42′ 10″ W), New Jersey were dated to allow regional correlation of its pollen stratigraphy (Sirkin & Minard, 1972).

W-2236. **7800 ± 650**

Brown reed and sedge peat intermixed with organic muck, depth 5.1 to 5.4m in bog. Coll and subm 1968 by J P Minard.

W-2562. **12,300 ± 300**

Gyttja, depth 5.5 to 5.75m, at contact with clay. Coll 1970 by L A Sirkin and subm by J P Minard.

General Comment (LAS & JPM): dates are consistent with sample from 3m depth, 6260 ± 300, W-2200 (R, 1970, v 12, p 320). Sedimentation in bog probably begun sometime between 15,000 and 18,300 yr ago as deglaciation of area began.

W-2307. Shackleford Banks, North Carolina **< 200**

Peat overlying stained sand zones, Shackleford Banks beach at high-tide mark, ocean side (34° 39′ 30″ N, 76° 34′ 25″ W), North Carolina. Coll 1968 and subm by P J Godfrey, Natl Park Service, Beaufort, North Carolina. *Comment* (PJG): site represents ancient position of a fresh-water, wooded swamp when Outer Banks were farther from the mainland than they are today.

W-2344. Augusta, Kentucky **> 40,000**

Wood in till exposed on Rte 8 near Augusta (38° 46′ 18.2″ N, 83° 59′ 14.4″ W), Kentucky. Coll and subm 1969 by W F Outerbridge. *Comment* (WFO): till has long been considered Illinoian (McFarlan, 1943, p 127), but rock in this cut and wood were so fresh, to the extent that termites were invading, that I thought it might be younger.

W-2320. Tailbace Canal, Alabama **>37,000**

Lignitized wood in gravelly sand at base of Quaternary alluvium, depth 12m, near head of Tailbace Canal, Ellmore Co (32° 35′ N, 86° 31′

30″ W), Alabama. Coll 1968 by John Winefordner and Clayton Gore, both of Alabama Power Co, Alabama; subm by L C Conant. *Comment* (LCC): minimum date for extensive flood plain of Alabama R. Flood plain from which this sample came is lowest of a succession of some half dozen or more terraces that reach at least 120m higher. Date suggests that some low terraces of river system may be Tertiary.

Atlantic continental shelf series

Dolomite samples from Atlantic Ocean. Subm 1969 by J C Hathaway.

W-2323. **>40,000**

Depth 400m, Lydonia Canyon (40° 24.5′ N, 67° 39.1′ W). Coll 1968 by J C Hathaway, using DSRV Alvin.

W-2322. **>40,000**

Depth 180m, dredged from wall of Hudson Canyon (39° 30.0′ N, 72° 15.0′ W). Coll 1968 by Capt Henry W Climm, of fishing vessel, *Capn Bill IV*.

W-2416. **>33,000**

Complete re-run of W-2322.

General Comment (JCH): these dolomites are not genetically related to aragonite of 20,400 ± 800, W-2170 (R, 1970, v 12, p 319) as previously thought. Microfauna in sample indicate cold water environment. Stratigraphic position suggests post Tertiary age.

B. Central United States

W-2305. Long Lake, South Dakota **9220 ± 300**

Pelecypods from collapsed outwash deposited over stagnation moraine (Clayton, 1962), E side of State Hwy 101, 8.6km N of Long Lake (45° 51′ 09″ N, 99° 12′ 15″ W), South Dakota. Coll 1968 by C M Christensen, J K Hawley, and K C Christensen; subm by C M Christensen, South Dakota Geol Survey, Vermillion, South Dakota. *Comment* (CMC): date compares favorably with several dates from stagnation drift on Coteau du Missouri in North Dakota, 9000 ± 300 and 9870 ± 290, W-1019, -954 (R, 1964, v 6, p 46) and further substantiates theory that stagnant ice was still melting as late 9000 BP.

W-2388. East Stump Lake, North Dakota **920 ± 200**

Wood fragments, depth 9 to 11m near contact between lacustrine sediments and glacial till, N end East Stump Lake, Nelson Co (47° 54′ 47″ N, 98° 23′ 25″ W), North Dakota. Coll 1969 by J S Downey; subm by Q F Paulson. *Comment* (QFP): date probably indicates beginning of latest period of deposition in lake basin. Possibly date represents end of extremely arid period when lake received little, if any, overland flow or ground-water discharge.

W-2450. Ward, North Dakota **28,340 ± 1000**

Wood fragments recovered from drill cuttings, depth 93m, base of glaciofluvial deposits in buried bedrock channel, Ward Co, North Dakota. Coll 1969 by M O Lindvig; subm by Q F Paulson. *Comment* (QFP): glacial drift in channel was probably part of interglacial drainage system.

W-2386. Nederlo Creek, Wisconsin **1130 ± 200**

Birch log protruding from stream bank at water level, underlying 2.4m topsoil, Nederlo Creek, Crawford Co (43° 21′ 33″ N, 90° 54′ 36″ W), Wisconsin. Coll and subm 1969 by S M Hindall. *Comment* (SMH): log was found under 0.6m light (modern) silt of loessial origin and 1.8m darker, clayey silt of Holocene age. Lighter material essentially represents upland sheet erosion, probably within last 100+ yr or during time of extensive soil cropping without conservation practices. Darker material represents post-Pleistocene deposits from combined prairie-woodland environment that was indigenous to area prior to cultivation.

W-2357. Slab City, Wisconsin **12,200 ± 350**

Spruce log overlain by 3.6m till in borrow pit, 0.8km SW of Slab City, Shawano Co (44° 43′ N, 88° 27′ W), Wisconsin. Coll 1964 and subm by R F Black, Univ Wisconsin, Madison, Wisconsin. *Comment* (RFB): this Two Creeks material near outer margin of Valderian ice compares with others from area (Black & Rubin, 1967-68) and 11,560 ± 350, W-2015 (R, 1970, v 12, p 323) and 12,410 ± 100, WIS-347 (R, 1970, v 12, p 342).

W-2370. Ruble, Iowa **> 30,000**

Wood, flattened in cross sec, in till exposed in a well, Ruble, Plymouth Co (42° 48′ 30″ N, 96° 24′ 30″ W), Iowa. Coll 1967 by Dennis Carlson, South Dakota Geol Survey, Vermillion, South Dakota; subm by F V Steece, SDGS. *Comment* (FVS): age indicates that enclosing till is pre-Farmdalian. Regional studies in SE South Dakota and adjacent parts of Iowa and Minnesota indicates that till is Illinoian (Steece, 1965). This date correlates well with date of > 35,000, W-1969 (R, 1969, v 11, p 212) which is from same surface till of Illinoian age. Area is adjacent to and continuous with a region mapped as Illinoian in South Dakota but separated by Big Sioux R.

C. Western United States

W-2289. Yellowstone Lake, Wyoming **10,360 ± 350**

Peaty clay, depth 85 to 104cm, NE side of pond, 0.8km of Trail Creek patrol cabin, SE arm of Yellowstone Lake, Yellowstone Natl Park (44° 18′ N, 110° 14′ W), Wyoming. Coll 1966 and subm by R G Baker. *Comment* (RGB): minimum date for period when Yellowstone Lake was 27m higher than present level (Baker, 1976; Spiker *et al*, 1977).

Hanford region series, Washington

Geol investigations were conducted in S-central Washington to resolve differing interpretations concerning faulting and tectonic movements (Bingham *et al*, 1970). Samples were coll and subm 1969 by J W Bingham.

W-2363. **11,950 ± 300**

Carbonaceous silt deposited as lens, 369m above MSL, backhoe trench, Smyrna Bench, N side of Saddle Mts, Grant Co (46° 49′ 40″ N, 119° 33′ 40″ W). *Comment* (JWB): provides limit for 2 events. Dated material occurs near bottom of loess filling large trough. Trough was probably caused by pulling apart of bounding caliche and fanglomerate during large block slide. Sliding probably occurred at end of or during last glaciofluvial flooding down Crab Creek. This indicates that trough, as well as many small cracks, was opened up a relatively short time before 12,000 BP and that glaciofluvial flooding ceased before that date. Second event is volcanic ash deposition, which occurred shortly after 12,000 BP. If ash is from Glacier Peak, date becomes critical because Glacier Peak ash has previously been considered to be 12,000 to 13,000 BP and to be within latest glaciofluvial flood episode.

W-2310. **>40,000**

Wood embedded in medium to coarse sand within a sequence of well-bedded sand and gravels, alt 192m, bulldozer trench, S side of Gable Mt, Hanford Works Reservation, Benton Co (46° 35′ 40″ N, 119° 29′ 25″ W). Coll by R E Brown of Battelle Northwest, Washington, and J W Bingham. *Comment* (JWB): unit dated is 2nd oldest of 4 exposed glaciofluvial units deposited by floodwater of Glacial Lake Missoula (Richmond *et al*, 1965), Upper 2 deposits were dated elsewhere at ca 20,000, and 13,500 to 12,000 BP.

W-2168. Newberry volcano, Oregon **1720 ± 250**

Wood underlying main pumice fall from Central Pumice Cone in Newberry Caldera, 40km S of Bend (43° 44′ N, 121° 14′ W), Oregon. Coll 1968 by Mike Higgins; subm by Arthur Grantz. *Comment* (AG): compares favorably with age, 2054 ± 230 (Peterson & Groh, 1965, p 11) from charcoal in ash inside caldera.

Corral Canyon series, California

Samples dated in attempt to arrive at a recurrence interval for land movement in Corral Canyon area (34° 00′ N, 118° 45′ W). Exact relations of each sample to possible movement is very complex and is detailed in Yerkes and Wentworth (1965), and Birkeland (1974, p 148). Samples coll 1965 and 1968 by P W Birkeland, Univ Colorado, Boulder, Colorado and C M Wentworth.

W-1634. **2950 ± 300**

Shells (*Mytilus californianus, septifer bifurcatus*) from silty sand, Trench 3.

W-1635. **2440 ± 500**

Carbonaceous clay along slip surface, 24m, NW wall of Trench 3.

W-1678. **3080 ± 250**

Soil from S end of Trench B, bottom of soil horizon in alluvial fan.

W-1637. **4050 ± 300**

Organic clay from top of same soil horizon, Trench B.

W-1645. **9330 ± 400**

Organic clay from base of same soil horizon, Trench B.

W-2328. **16,280 ± 400**

Small charcoal pieces in clay, 810m E of mouth of Corral Canyon, E-facing valley wall of Gully A.

General Comment: these dated fan deposits overlie marine terrace deposits (115,000 ± 15,000 to 154,000 ± 30,000 yr, Szabo & Rosholt, 1969). Dates fall into consistent pattern, although contamination by both modern and fossil carbon is suspected. Fan deposition probably began ca 10,000 to 20,000 BP.

Laguna Alta series, California

Peat samples 3.4m below surface of peat deposit that formed in pond on San Andreas fault, NW part of Laguna Alta, San Mateo Co, California.

W-2561. **2340 ± 250**

Peat (37° 39′ 38″ N, 122° 28′ 48″ W). Coll 1962 by M G Bonilla and G O Gates; subm by M G Bonilla.

W-2659. **2690 ± 250**

Peat (37° 39′ 33″ N, 122° 28′ 42″ W). Coll 1962 by M G Bonilla, D M Hopkins, Clyde Wahrhaftig and D S McCulloch; subm by M G Bonilla.

General Comment (MGB): Laguna Alta was, before urbanization, a pond along San Andreas fault, and was almost certainly formed by movement along the fault. Radiocarbon date is minimum for period during which this trace of the fault has been active.

Los Angeles damsite series, California

Three samples from N wall of damsite, Van Norman Reservoirs area, N San Fernando Valley (34° 17.75′ N, 118° 28.75′ W), California. Coll 1972 by M G Bonilla, R F Yerkes, and R H Campbell; subm by M G Bonilla.

W-2747. **9580 ± 300**

Organic matter, depth 3.6m, alt 333m, Unit 4.

W-2746. **10,000 ± 300**

Organic matter, 1.6m SSW of W2747, Unit 4.

General Comment (MGB): dates indicate that wet plant-promoting environment persisted at least 8000 yr.

W-2745. **>40,000**

Wood, depth 9.3m, alt 327m, Unit 9.

General Comment (MGB): dates are consistent with ages inferred from fossil molar of *Paramylodon* sp and with other radiocarbon dates from (Yerkes *et al,* 1974). These dates were used to estimate the age of faulting at damsite. Surficial deposits locally cut by faults are correlated with units stratigraphically underlying Unit 4 and overlying Unit 9. Displacement probably occurred > 10,000 yr ago.

W-2336. Buena Vista Slough, California **31,000 ± 1000**

Fibrous wood from sequence of alluvial sand, silt, and clay, depth 18.6m, .48km NE of Sta 3168 + 00 of California Aqueduct, 4.8km S of Button Willow, 43km W of Bakersfield (35° 21′ 55″ N, 119° 28′ 12″ W), California. Coll 1969 by Neal Crawford, California Dept Water Resources; subm by B E Lofgren. *Comment* (BEL): good correlation with other radiocarbon dates in Tulare and Buena Vista lakebeds (Croft, 1968, p B155). Suggests depositional continuity between the 2 lake basins, certainly by stream gravels, and probably by pluvial lake clays.

Lake Bonneville series, Utah

Shells and lake sediment exposed in dragline excavation, 960m NE of Danger Cave, NE of Wendover (41° 00′ N, 114° 00″ W), W Utah (Jennings, 1957). Coll and subm 1969 by H J Bissell, Brigham Young Univ, Provo, Utah.

W-2332. **24,000 ± 600**

Gastropods from 0.3m mollusk bed, depth 2.1m, overlying silty clay unit of Provo Formation, Lake Bonneville Group (Bissell, 1963).

W-2335. **8850 ± 300**

Organic muck, depth 1.8m, underlain by W-2332, overlain by 1.2m lacustrine silt, and this by .45m alluvium and soil.

General Comment (HJB): gastropod bed is likely Provo Substage No. 1. A hiatus of some 15,000 yr is represented after accumulation of shell bed and organic muck.

W-2353. Big Cottonwood Canyon, Utah **770 ± 200**

Wood (*Pinus flexilis*), Lake Catherine Cirque of Big Cottonwood Canyon, Brighton quad (40° 35′ N, 111° 36′ W), Utah. Coll 1967 by Ted Arnow and Richard Van Horn; subm by Richard Van Horn. *Comment* (RV): date suggests limber pines grew in cirque during interstade between Temple Lake and historic glaciations (Richmond, 1962), the latter destroying pines on cirque floor but not those on rock ridges above ice. Date agrees with others from Rocky Mts which indicate interstade occurred ca AD 0 — 1400.

D. Alaska

W-2240. Emmikroak Creek, Alaska **>35,000**

Wood in beach deposits 9m above present level of Chukchi Sea, 1km E of Emmikroak Creek (68° 00′ N, 166° 00′ W), Alaska. Coll 1958 and subm by Reuben Kachadoorian. *Comment* (RK): minimum age for solifluction material that overlies beach deposits. Minimum age for last sea-level rise.

W-2288. Iliamna, Alaska **Modern**

Organic material in sand, depth 76cm, Augustine I. emerged beach deposit, 2.1km SSE of entrance to S lagoon, and 1.9 km N of S Augustine VABM sta, Cook Inlet (59° 21′ N, 153° 31′ 30″ W), Alaska. Coll and subm 1967 by R L Detterman. *Comment* (RLD): together with date, 2650 ± 250, W-2123 (R, 1970, v 12, p 330) gives maximum rate of uplift, 30 to 60cm/century, along W side of Cook Inlet. Modern age tends to confirm this rapid rate of uplift (Detterman & Reed, 1973).

Mt Michelson series, Alaska

Wood and peat samples from Mt Michelson quad, NE Alaska. Subm by R L Detterman.

W-2397. **6400 ± 250**

Peat and plant remains in highly organic layer overlying ice wedge from raised terace, 2.6km inland from Arctic coast, Marsh Creek (69° 57′ 30″ N, 144° 48′ 10″ W). Coll 1969 by R L Detterman. *Comment* (RLD): age represents beginning of Hypsithermal in N Alaska. The ice wedge is assumed a relic of Wisconsin glaciation, and not a result of more recent, minor advances in Brooks Range.

W-2508. **>28,000**

Wood from *Picea* log (id by R A Scott), Atlantic Richfield Prudhoe Bay State #1 well, depth 175 to 180m, 3km NW of mouth of Putuligayuk R (70° 19′ 30″ N, 148° 32′ W). Coll 1970 by Atlantic Richfield Company. *Comment* (RLD): this minimum age is 1st indication of possible Sangamon age spruce forest on North Slope of Alaska. Sample came from unconsolidated sand and gravel unit, believed to be an old fluvial deposit during a low sea-level stand.

W-2586. **>38,000**

Complete re-run of W-2508.

W-2590. **>39,000**

Wood from small log, depth 10.5m, tributary of Niguanak R, 27.5km SSW of Humphrey Point, Beaufort Sea, (70° 00′ N, 143° 00′ W). Coll 1970 by R L Detterman. *Comment* (RLD): confirms presence of spruce forest in N Alaska during Sangamon Interglaciation. Gravel at top of outcrop where sample was found is now considered Wisconsin outwash, and sands, silts, and gravel below are believed to be upper member of Gubik Formation. Date will help better define Gubik Formation and will make it a little older than originally defined (Black, 1964).

W-2917. Harlequin Lake, Alaska **9320 ± 350**

Marine pelecypods and barnacle shells atop ice-shove moraine, alt 54m, near SE shore of Harlequin Lake, 48km SE of Yakutat (59° 24′ N, 138° 57.5′ W), Alaska. Coll 1967 by S R Welty, US Bur Public Rds, Juneau, Alaska; subm by L A Yehle. *Comment* (LAY): dates part of interval of marine submergence during early Holocene time when land apparently was still glacio-isostatically depressed because of residual effect of ice load during last major Pleistocene glaciation. Later, sample and enclosing material were transported by ancestral Yakutat Glacier and deposited as a moraine.

W-2292. Skagway, Alaska **2880 ± 250**

Pelecypods from small pocket of shell accumulation on steep bedrock surface 9.6m above MSL, 0.5km NE of Yakutania Point, NW side of Skagway Harbor, Skagway (59° 27′ 15″ N, 135° 19′ 35″ W), Alaska. Coll 1968 by L A Yehle; subm by R W Lemke and L A Yehle. *Comment* (LAY): dates former sea level, controlled most likely by glacio-isostatic depression and rebound from Neoglacial ice load (Yehle & Lemke, 1972, p 17).

Haines series, Alaska

Pelecypod shells from Haines, Alaska. Subm by R W Lemke and L A Yehle.

General Comment (LAY): dates late Pleistocene and Holocene glacio-isostatic period of adjustment. Alt of deposit may be tectonically as well as glacio-isostatically controlled.

W-2291. **9940 ± 350**

Shells from floor of borrow pit, 10.5m above MSL, 0.5km S of junction of Sawmill Rd and Haines Hwy (59° 13′ 56″ N, 135° 28′ W). Coll 1968 by L A Yehle.

W-2293. **10,250 ± 350**

Shells, 12m below MSL, test hole 0.3km SW of junction of Sawmill Rd and Haines Hwy (59° 14′ 30″ N, 135° 28′ 30″ W). Coll 1967 by J A McConaghy.

W-2294. **11,020 ± 400**

Shells from construction site, 15m above MSL, along SW side Lutak Inlet, 5.6km NW of Haines (59° 17′ 10″ N, 135° 28′ 40″ W). Coll 1968 by L A Yehle (Lemke & Yehle, 1972, p 13).

Stikine delta region series, Alaska

Shells from Wrangell area, Alaska. Coll 1968 by L A Yehle; subm by R W Lemke and L A Yehle.

W-2326. **9700 ± 350**

Pelecypod shells, 19.5m above MSL, 0.8km SE of Point Highfield, S embankment, overlooking Wrangell Airport runway, 1.6km NNE of Wrangell (56° 29′ 05″ N, 132° 22′ 30″ W) (Lemke, 1974, p 23).

W-2327. **12,170 ± 400**

Barnacle fragments, 37.5m above MSL, N facing roadcut, Mitkof Hwy, S Mitkof I., 16.8km NW of Wrangell (56° 33′ 30″ N, 132° 37′ 30″ W).

General Comment (LAY): these 2 samples provide further evidence of shoreline displacement in SE Alaska during late Quaternary. Emergence of land was caused by glacio-isostatic rebound but total emergence was reduced by eustatic sea-level rise and tectonic sinking of Stikine delta. Other tectonic effects probably had an important influence. Comparison between W-2327 and -1738, 9970 ± 300 (R, 1967, v 9, p 523) from 8.4m above MSL, 3.2km to NE, gives a crude rate for net emergence of 1.34cm/yr. This rate appears reasonable. Present-day net emergence based on tidal gauge records is about the same at Juneau 200km to NW (Hicks & Shofnos, 1965).

Yakutat series, Alaska

Samples from 0.3m diamicton unit in intertidal zone of Lost R estuary at community of Lost R, 6.9km SE of Yakutat Airport (59° 27′ N, 139° 37′ W), Alaska. Coll 1966 and subm by L A Yehle.

W-2167. **500 ± 250**

Detrital Wood.

W-2598. **2180 ± 250**

Pelecypod shells.

General Comment (LAY): detrital wood (W-2167) is close in age, 560 ± 75, I-439 (R, 1966, v 8, p 163-164) to sheared off wood beneath major moraine 11.2km NW, near mouth of Yakutat Bay (Yehle, 1975, p 39). To account for mixing of materials of 2 different ages within same deposit, following sequence is suggested. Wood was plowed up by the glacier and, because land was glacio-isostatically depressed below present sea level, subsequent deglaciation and melting of glacier was accompanied by calving, floating, and occasional grounding of icebergs. During in-place melting, waves and tidal currents would have jostled and washed the bergs, resulting in spreading-out and mixing of englacial debris with soft underlying deposits, one part of which contained marine shells (W-2598).

Seward Peninsula series, Alaska

This study was made to establish time when certain forest and transition plants and animals reached their early Holocene limits in NW Alaska. Woods and sediments were coll from Seward Peninsula (SP) 1966-1970 by D M Hopkins; subm by D M Hopkins and C H Nelson. (McCulloch & Hopkins, 1966).

W-2810. **4290 ± 250**

Lacustrine sediments exposed in bank of intramorainal pond, near SE of Lopp Lagoon, W SP (65° 43′ 20″ N, 167° 27′ 30″ W). Exposure is within an end moraine of late Wisconsin glaciation, York Glaciation of Sainsbury, (Sainsbury, 1967a, b). *Comment* (DMH): sample unexpectedly young. Exposure was interpreted in field as consisting of pre-glacial lakebeds overlain by drift of York Glaciation, which Sainsbury shows took place before 10,900 yr ago. Locality is too far in front of mountains to suggest that it was overridden by drift of Neoglacial age. Probably exposure is cut through sediments in a kettle lake that was later covered by colluvium from a nearby morainal knob.

W-2808. **8080 ± 300**

Beaver-chewed log, NW side of mining cut at Mud Creek, near Candle, NE SP (65° 56′ 40″ N, 161° 59′ 00″ W).

W-2809. **8310 ± 300**

Stump rooted in buried turf, 3m above W-2808, same location.

General Comment (DMH): site lies W of present-day forest boundary and W of present limit of beaver. Both samples indicate evidence of warm climate from Mud Creek 10,000 to 8000 yr ago; date of 3600 ± 500, L-117F (Broecker *et al*, 1956, p 157) from same location is discredited.

W-2592. **8360 ± 300**

Stem of large willow shrubs, id by Virginia Page, in sedge peat filling ice-wedge pseudomorphs in bluffs on S shore of Lopp Lagoon, W SP (65° 40′ 20″ N, 167° 54′ 02″ W). *Comment* (DMH): records growth of large willow shrubs near Bering Strait, in region that now lacks shrubs of any kind.

W-2596. **8480 ± 300**

Birch log in fossil beaver dam from wave-cut bluff, mouth of Old Wound, N SP (66° 29′ 55″ N, 164° 46′ 30″ W). *Comment* (DMH): represents W-most fossil occurrence of birch during early Holocene warm period.

W-2619. **9190 ± 350**

Large log from bank of thaw lake, 8km SE of Northwest Corner, N SP (66° 31′ 31″ N, 164° 15′ 50″ W). *Comment* (DMH): sample coll at W-most occurrence of large freshwater mollusk, *Anodonta beringiana*, during early Holocene warm period.

W-2620. **9625 ± 350**

Large pieces of wood from thaw lake deposit on coast of N SP, between Cape Deceit and Rex Point (66° 04′ 00″ N, 163° 03′ 18″ W). *Comment* (DMH): probably represents W-most early Holocene fossil occurrence of *Populus*.

W-2804. **28,700 ± 1000**

Organic residue from loess exposed in wave-cut bluff at Northwest Corner Light, N SP (66° 34′ 54″ N, 164° 27′ 17″ W). *Comment* (DMH): older than expected and surprising in that it falls onto a period for which I had expected evidence of interstadial with sea level only slightly lower than at present, glaciers retracted, and aeolian activity reduced. Instead, this date indicates that intense aeolian activity on N SP-Kotzebue Sound area was not confined to late Wisconsin time but evidently persisted throughout Wisconsin cold cycle.

Devil Mt series, SP, Alaska

This study was made to establish tephrochronology of areas affected by ashfalls from Devil Mt (DMt). These upper Pleistocene ashfalls can be recognized widely in Kotzebue Sound. Col 1966 and 1970 and subm by D M Hopkins.

W-2800. **9350 ± 350**

Peaty material overlain by ashfall from S crater, from bluffs at SW shore of N DMt Lake (66° 23′ 36″ N, 164° 31′ 45″ W).

W-2802. **9410 ± 350**

Wood pieces, 0.6m below W-2800.

W-2803. **10,370 ± 500**

Peaty material, 0.9m below W-2802.

W-2801. **11,610 ± 500**

Peaty material, 0.6m below W-2803, underlain by ashfall from N crater, DMt.

General Comment (DMH): DMt Lake consists of 2 intersecting maars. S maar erupted after 9350 BP and N one erupted prior to 11,600 BP, but after 14,500, W-2806. Loess fall ended between time of deposition of W-2803 and -2802, ca 10,000 BP, but another sample, W-2805, indicated that 11,000 BP would be better estimate of end of loess fall.

W-2806. **14,490 ± 400**

Screen residue from lakebeds exposed in cut bank of Espenberg R (ER) (66° 31′ 50″ N, 164° 00′ 12″ W). *Comment* (DMH): age as expected. Sample was coll just below 1st appearance of DMt ash and thus provides close approx of date of ashfall.

W-2807. **25,390 ± 800**

Well-macerated peat, thought to be buried turf, involved in ice-wedge collapse in exposure on ER (66° 31′ 20″ N, 164° 00′ 20″ W).

Comment (DMH): sample unexpectedly old. In field ash layer was thought to be identical to ash layer of W-2806 and ice-wedge collapse was thought to have formed during early Holocene warm period. Redeposition of older peat seems improbable. Apparently, ash in this sect is probably identical with ash near Kougachuk Creek dated 42,000 yr.

W-2670. **>42,000**

Stems and roots of birch shrubs buried beneath fresh ashfall, exposed sea bluffs, 0.5km N of mouth of Kougachuk Creek, N SP (66° 15′ 54″ N, 163° 49′ 52″ W). *Comment* (DMH): sample is much older than anticipated. I had thought this ash layer was same as that of W-2806. Evidently, ash layer at Kougachuk Creek was erupted earlier and from another of numerous maars and cinder cones of area, most probably from South Killeak Lake. But an unresolved problem remains: why is there little or no loess above this ancient ash layer?

General Comment (DMH): there are 3 ash horizons representing 3 maar eruptions in Espenberg region during Wisconsin and Holocene time. Dates, taken together with studies of the freshwater mollusks, also show that post-glacial warming was felt earlier than previously thought. Mollusks reponded as early as 11,400 yr ago, although forest plants didn't begin to appear until ca 9800 yr ago.

Espenberg River series, SP, Alaska

This series was submitted to clarify age relationships among Quaternary deposits exposed along Espenberg R (ER), a sluggish stream that heads a short distance inland from a subdued slope evidently marking Pelukian (Sangamon) shoreline on N SP. The river crosses a plain underlain by Pelukian beach and lagoonal deposits, exposed at river level, mantled by medium sand, 2 or 3m thick, that was evidently deposited as coastal dunes, overlain in turn by ca 10m periglacial loess and fine sand that was deposited or redeposited in thaw lakes. Woods and sediments were coll and subm 1970 by D M Hopkins.

W-2805. **11,550 ± 350**

Small wood fragments, base of thaw lake deposit exposed in cut bank of ER (66° 30′ 42″ N, 164° 01′ 38″ W). *Comment* (DMH): was thought to be Holocene, but this age is plausible. Sample coll from base of thaw lake deposits that contain rich "post-glacial" biota and that accumulated after end of loess fall. Sediment underlain by ca 1m loess and then by ash dated elsewhere on Espenberg R as ca 14,500 yr (W-2806).

W-2883. **21,600 ± 600**

Organic material, screen-washed from thaw-lake sediments, cut bank ER (66° 31′ 21″ N, 164° 00′ 37″ W).

W-2879. **>27,000**

Organic material at base of thaw-lake sequence, artificial excavation in cut bank of ER (66° 30′ 01″ N, 164° 05′ 53″ W).

W-2880. **16,950 ± 500**

Organic debris, 0.5m below W-2879, top of silt unit, probably aeolian, containing lenses of sand and lenses and fragments of peat, representing fragments of buried turf.

General Comment (DMH): these 2 samples, W-2879 and -2880, appear to be transported, either in the field or during examination for micro-fossils.

W-2881. **> 36,000**

Fossil wood, thaw-lake sediments, cut bank ER (66° 30′ 38″ N, 164° 02′ 20″ W). *Comment* (DMH): high sand-silt content and lack of pumice suggest lake existed prior to last eruption at DMt Lake and during period of Pleistocene aeolian activity. But rich biota and presence of shrub-size twigs indicate lake is not contemporary with maximum cold period.

W-2882. **> 32,000**

Peat lumps, possibly buried turf, interbedded with silt and lenses of very fine sand, 1.8m below W-2881. *Comment* (DMH): depauperate flora suggest full-glacial conditions.

W-2878. **> 34,000**

Twigs in thin-bedded lacustrine silt interbedded with sand, containing distinctive Pelukian (Sangamon) fauna, cut bank of ER (66° 31′ 36″ N, 164° 00′ 12″ W).

W-2884. **> 31,000**

Screen residue, 2.4m below W-2806, at base of lake beds.

General Comment (DMH): series shows that some thaw lakes existed during early Wisconsin time, beyond range of radiocarbon dating and that others existed as recently as 11,500 BP (active thaw lakes still exist, away from river). Periglacial loess and fine sand has been deposited more or less continuously throughout Wisconsin Glaciation. Older 2 of 3 dated ash beds occur in some lake deposits. Medium sand of assumed coastal dunes is of early Wisconsin age, and beyond range of radiocarbon activity.

North Bering Sea series, Alaska

This study was made to establish transgressive history of region (Nelson, 1976; Nelson *et al,* 1973; 1974; Nelson & Creager, 1977). Shell samples, mainly shallow, burrowing and epifaunal species, from base of N Bering Sea were coll 1968-69 with box cores and subm by C H Nelson.

W-2682. **700 ± 250**

Shells (*Neptunea*) in coarse transgressive sand, overlain by clayey silt, water depth 42m, seaward side of isolated basin, 16km NNE of Singikpo Cape, central St Lawrence I. (63° 43.7′ N, 169° 54.2′ W).

W-2467. **700 ± 200**

Shell fragments (*Macoma calcerea*) in sand, overlain by 10cm fine sand, water depth 37.5m (63° 35.4′ N, 169° 58.4′ W).

W-2683. 740 ± 250

Infaunal shells (*Hyatella Arctica, Mya Truncata*) isolated in basal sands, overlain by 11cm undisturbed laminated sand, water depth 31m, 48km S of Cape Prince of Wales, 43km of Port Clarence (65° 11.2′ N, 167° 53.2′ W).

W-2462. 750 ± 200

Shells in silty sand, water depth 24.6m (64° 13.9′ N, 166° 14.9′ W).

W-2681. 770 ± 250

Shells at contact between "transgressive" and fine sand, water depth 50m, 78km SW of Cape Prince of Wales (65° 04.5′ N, 169° 17.7′ W).

W-2466. 980 ± 200

Shell fragments in muddy sandy silt, water depth 30.6m (64° 24.0′ N, 165° 35.0′ W).

W-2464. 1040 ± 200

Shell fragments in shell bed buried by fine sand, depth 42.6m (63° 41.0′ N, 170° 11.0′ W).

W-2684. 1400 ± 250

Rounded and abraded shells in basal pebbly clay layer, water depth 47m, 43km S of Cape Prince of Wales, 54km W of Port Clarence (65° 13.6′ N, 168° 06.6′ W).

General Comment (CHN): young dates suggest very limited or non-deposition of Holocene sediments in offshore regions.

W-2685. 1690 ± 250

Broken and rounded shells in beach gravel, water depth 30m, 27km N of Northwest Cape off W end of St Lawrence I (63° 58.5′ N, 171° 28.2′ W).

Norton Sound series, Alaska

Shell, wood, and peat samples from below sea floor, Norton Sound, Bering Sea were coll 1967-70 and subm by C H Nelson and D M Hopkins.

W-2301. 340 ± 200

Shells at water depth 25 to 32m, core depth 0 to 5cm, offshore at Nome (65° 00.5′ N, 168° 01.5′ W).

W-2325. 10,250 ± 350

Wood picked from drill cuttings, 0 to 420cm in core, water depth 20.4 to 18.6m, old outwash fan of Nome R, just E of Nome (64° 27.4′ N, 165° 25′ W).

W-2686. 10,120 ± 350

Reworked, subaerial fine peat, in Marine Yukon silts, core depth 19 to 23cm, water depth 18.7m, center of Norton Sound (63° 42.7′ N, 163° 03.2′ W).

W-2555. **10,500 ± 300**

Peat, core depth 33 to 40cm, water depth 20m, same core as W-2686. *General Comment* (DMH): indicates minimum rate of Holocene sedimentation 2cm/100 yr (Nelson *et al*, 1974, Nelson & Creager, 1977, Hopkins, 1973). Low rate of Holocene sedimentation in Norton Sound, but relatively high rate in Chukchi Sea suggests displacement and bypassing of Yukon sediment over Bering shelf.

W-2680. **1350 ± 500**

Mollusks, depth 40cm in sequence of Yukon silt, water depth 14m (63° 41.4′ N, 161° 11.6′ W).

W-2534. **>30,000**

Peat under Yukon silt, core depth 24cm, water depth 36.5m, 36.8km W of Point Spencer (65° 05.1′ N, 167° 43.4′ W).

W-2115. **>30,000**

Wood in alluvium, core depth 3.6 to 5.4m below sea floor, overlain by Holocene sand, water depth 13m (64° 31.3′ N, 165° 40.3′ W). *Comment* (CHN): upper Pleistocene stratigraphy related auriferous deposits.

W-2116. **>34,000**

Shells in marine nearshore sand, core depth 6.6 to 8.4m below sea floor, water depth 12.9m (64° 26.5′ N, 165° 06.6′ W).

E. Miscellaneous Samples

W-2287. Jarvis Island, Pacific **2530 ± 250**

Dolomitized lagoonal mud underlying gypsum-algal mat surficial layers on Jarvis I (01° 00′ N, 160° 00′ W), Pacific Ocean. Subm by S O Schlanger, Univ California, Riverside. *Comment* (SOS): 1st recent dolomite from Pacific.

W-2238. Monrovia, Liberia **6160 ± 600**

Clay with very abundant plant remains, within New Georgia Clay, depth 4.2 to 4.5m, near Monrovia (06° 22′ N, 10° 47′ W), Liberia. Coll 1967 and subm by L V Blade. *Comment* (LVB): deposit is probably estuarine lagoonal. Entire sequence of sediments is Quaternary (Blade, 1970, p 8).

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UNIVERSITY OF WISCONSIN RADIOCARBON DATES XV

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Procedures and equipment of the laboratory have been described in previous date lists. Except as otherwise indicated, wood, charcoal, and peat samples are pretreated with dilute NaOH and dilute H_3PO_4 before conversion to the counting gas methane, marls and lake cores are treated with acid only. Very calcareous materials are treated with HCl instead of H_3PO_4.

The dates reported have been calculated using 5568 as the half-life of ^{14}C, with 1950 as the reference year. The standard deviation quoted includes only the 1σ of the counting statistics of background, sample, and standard counts. Background methane is prepared from anthracite, standard methane from NBS oxalic acid. The activities of the dated samples for which $\delta^{13}C$ values are listed have been corrected to correspond to a $\delta^{13}C$ values of $-25‰$.

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I. ARCHAEOLOGIC SAMPLES

A. Iowa

Chan-ya-ta site (13BV1)

Charcoal from Chan-ya-ta site, Mill Creek culture in Buena Vista Co, Iowa (42°, 51′ N, 95° 18′ W), coll 1974 by J A Tiffany, Univ Iowa; subm by D A Baerreis. Dates from earlier excavation at site have been reported (R, 1975, v 17, p 125). Note correction of earlier site location.

WIS-893. Chan-ya-ta site (13BV1) **900 ± 60**
$\delta^{13}C = -25.6‰$

Sample 370A, Feature 9/ from floor of 1 of 2 small rectangular structures superimposed on each other in house depression.

WIS-895. Chan-ya-ta site (13BV1) **870 ± 55**
$\delta^{13}C = -25.1‰$

Sample 260A from floor of square structure in Feature 6/ house depression.

WIS-898. Chan-ya-ta site (13BV1) **735 ± 95**

$\delta^{13}C = -25.4‰$

Sample 360A, Feature 9/ from floor 1 of 2 small rectangular structures superimposed on each other in house depression. Sample was counted only once.

WIS-897. Chan-ya-ta site (13BV1) **820 ± 60**

$\delta^{13}C = -26.0‰$

Sample M-17, Feature 4/6, from hearth of E house superimposed by small diamond-shaped structure previously dated (WIS-671,-673,-685) between 890 to 995 BP.

WIS-892. Bultman site (13BV2) **770 ± 55**

$\delta^{13}C = -24.2‰$

Charcoal and charred bone from Bultman site in Buena Vista Co, Iowa (42° 54′ N, 95° 16′ W) coll 1974 by J A Tiffany and Dean Thompson, Luther College, Decorah; subm by D A Baerreis. Site is multicomponent fortified Mill Creek culture site on floodplain of Little Sioux R. Site was tested previously by Orr (1963) in the 1930's. Sample from Sq A-1, Level 5, 63.5 to 91.4cm below surface.

Glenwood series, State School site (13ML155)

Charcoal from Nebraska aspect, Central Plains earthlodge on loess ridge 985m N of Horse Creek, Mills Co, Glenwood, Iowa (41° 02′ 20″ N, 95° 43′ 46″ W). Earthlodge is 100m N of village group, Glenwood series, dated earlier (R, 1976, v 18, p 127-128). Coll 1975 by J A Hotopp, Univ Iowa, Iowa City; subm by D A Baerreis. Wood id by Dwight Bensend, Ames, Iowa.

WIS-877. State School site (13ML155) **690 ± 50**

$\delta^{13}C = -26.6‰$

Sample 408-P5-8 (*Ostyra* sp) from NE central support post of lodge, 43cm deep.

WIS-878. State School site (13ML155) **705 ± 50**

$\delta^{13}C = -26.3‰$

Sample 408-P18-19 (*Juglans nigra*) from wall post in NE corner of lodge, 39cm deep.

Glenwood series, McGee site (13ML145)

Charcoal coll June 1974 by J A Hotopp from earthlodge located on loess ridge 92m N of Brush Creek, tributary to Pony Creek, Glenwood, Mills Co, Iowa (41° 02′ 44″ N, 95° 46′ 56″ W). Earthlodge is somewhat isolated from village groups already dated, but ceramics place lodge in Nebraska aspect, Central Plains tradition. Samples id by Barbara Schulte, Ames, Iowa.

WIS-894. McGee site (13ML145) **700 ± 55**

$\delta^{13}C = -26.0‰$

Sample 344-26 (*Populus deltoides*) from post in cache pit in NW corner of earthlodge.

WIS-896. McGee site (13ML145) **770 ± 60**

$\delta^{13}C = -27.4‰$

Sample 344-24 (*Fraxinus americana*) from roof beam fragment in NW corner of earthlodge.

WIS-900. McGee site (13ML145) **755 ± 55**

$\delta^{13}C = -25.8‰$

Sample 344-29 (*Ulmus americana*) from S central floor of lodge.

Larsen site (13PM61)

Charcoal from 4 subterranean refuse-storage pits on Larsen site, Perry Reservoir, Plymouth Co, Iowa (42° 36′ 18″ N, 96° 24′ 21″ W) excavated in summer of 1974 by Dale Henning, Univ Nebraska, Lincoln; subm by Dale Henning. Site contained reputed late Great Oasis-Mill Creek material.

WIS-868. Larsen site (13PM61) **740 ± 60**

Catalog No. 573 from Feature 11, subterranean refuse-storage pit.

WIS-870. Larsen site (13PM61) **730 ± 50**

$\delta^{13}C = -25.8‰$

Catalog Nos 728 and 726 from Feature 15.

WIS-874. Larsen site (13PM61) **710 ± 55**

$\delta^{13}C = -24.7‰$

Catalog Nos 554 and 638 from Feature 10.

WIS-875. Larsen site (13PM61) **730 ± 60**

$\delta^{13}C = -25.4‰$

Sample Nos 633 and 512 from Feature 2.

WIS-876. Keystone site (13JK23) **1790 ± 60**

$\delta^{13}C = -26.1‰$

Charcoal from Levels 10, 11, 12 of Keystone rockshelter, Jackson Co, Iowa (42° 02′ N, 90° 51′ W). Coll October 1975 by D C Anderson, Univ Iowa; subm by D A Baerreis. Sample from transitional zone between Archaic and Woodland occupations, assoc with Archaic/Early Woodland artifacts.

Darr-Es-Shalom site (13PK149)

Charcoal from Darr-Es-Shalom site, Polk Co, Iowa (41° 44′ 5″ N, 93° 42′ 16″ W). Coll 1975 under direction of David Gradwohl, Iowa State Univ, Ames; subm by D A Baerreis. Samples represent 4 depositional units at Late Woodland site (Gradwohl & Osborn, 1973).

WIS-879. Darr-Es-Shalom site (13PK149) **840 ± 50**
$\delta^{13}C = -25.4‰$

Sample 58-A from Feature 58 in stratigraphic Unit 1.

WIS-899. Darr-Es-Shalom site (13PK149) **1575 ± 60**

Sample 55-A from Feature 55 assoc with depositional Unit 1.

WIS-902. Darr-Es-Shalom site (13PK149) **1605 ± 55**
$\delta^{13}C = -26.4‰$

Charcoal from Feature 12, acid treatment only.

WIS-904. Darr-Es-Shalom site (13PK149) **1605 ± 60**
$\delta^{13}C = -26.6‰$

Charcoal from depositional Unit 1, Feature 8, small basin-shaped feature which contained charcoal, clam shells, bone, and ash.

WIS-905. Darr-Es-Shalom site (13PK149) **2820 ± 65**
$\delta^{13}C = -23.1‰$

Sample 1130 from 2nd level of depositional Unit III, acid treatment only.

WIS-880. Darr-Es-Shalom site (13PK149) **3045 ± 65**
$\delta^{13}C = -25.7‰$

Sample 68-A from Feature 68 assoc with lowest depositional unit on site.

WIS-901. Darr-Es-Shalom site (13PK149) **3095 ± 65**
$\delta^{13}C = -25.4‰$

Sample 1335 from Unit IV, deepest unit of site.

WIS-906. River Bend site (13BN123) **940 ± 60**
$\delta^{13}C = -25.6‰$

Charcoal from River Bend site in Saylorville Reservoir, Boone Co, Iowa (42° 2° 18″ N, 93° 55′ 26″ W). Coll August 1974 under direction of D M Gradwohl; subm by D A Baerreis. Cultural horizon from which this charcoal was removed also produced grit-tempered cord marked, rocker stamped, dentate stamped and other pieces indicative of Middle Woodland occupation (Gradwohl & Osborn, 1973; 1976).

Sewer site (13CK405)

Excavations at Cherokee Sewer site, Cherokee Co, Iowa (42° 43′ 21″ N, 95° 34′ 24″ W) in 1976 under direction of Richard Shutler, Jr, Univ Iowa, Iowa City. Charcoal samples subm by D A Baerreis.

WIS-889. Sewer site (13CK405) **6080 ± 70**
$\delta^{13}C = -25.7‰$

Charcoal, Sample 45, from Horizon IA, Sq TT I-II, 13cm above and intruded into I from silt and sands.

WIS-891. Sewer site (13CK405) **7145 ± 75**
$\delta^{13}C = -25.2‰$

Sample 24 from Unit b of Horizon II, Trench I, Sq 55; may be from hearth.

WIS-882. Sewer site (13CK405) **7340 ± 75**
$\delta^{13}C = -24.5‰$

Sample from Sq 39, Horizon II, Trench I, top of Soil C.

WIS-886. Sewer site (13CK405) **7600 ± 80**
$\delta^{13}C = -25.0‰$

Charcoal and mud from Horizon II, Trench II, Sq I, Surface C, Feature 2.

WIS-888. Sewer site (13CK405) **7490 ± 80**

Charcoal and mud from Horizon II, Trench II, acid treatment only.

WIS-890. Sewer site (13CK405) **7770 ± 80**
$\delta^{13}C = -23.4‰$

Sample 52 from E wall of IIIb, between Horizon II and III.

B. Missouri

Cannon Reservoir series, Cannon Reservoir site (23RA136, 23RA224, and 23RA302A)

Charcoal from Cannon Reservoir, Ralls Co, Missouri (39° 31′ N, 91° 37′ 35″ W; 39° 33′ 38″ N, 91° 35′ 57″ W; and 39° 30′ 44″ N, 91° 38′ 59″ W) excavated under direction of D R Henning in August 1975. Subm by D A Baerreis.

WIS-850. Cannon Reservoir site (23RA224) **1150 ± 70**
$\delta^{13}C = -24.5‰$

Catalog No. 151 from Feature 18, basin-shaped pit. Feature contained reconstructable pottery vessel and some faunal remains.

WIS-858. Cannon Reservoir site (23RA136) **1055 ± 50**

Catalog No. 271 from Feature 11, Woodland basin-shaped pit which contained chert debitage.

WIS-859. Cannon Reservoir site (23RA224) **1060 ± 60**
$\delta^{13}C = -25.4‰$

Catalog No. 114 from Feature 9, steep-sided pit containing complete reconstructable pottery vessel and large amount of chert debitage. Occupation assigned to Middle-Late Woodland cultural period. Acid treatment only.

WIS-860. Cannon Reservoir site (23RA136) **1185 ± 60**
$\delta^{13}C = -25.5‰$

Catalog No. 336 from Feature 17, Woodland basin-shaped pit, stratigraphically superimposed over portion of Feature 11 and is therefore of more recent occupation.

WIS-861. Cannon Reservoir site (23RA136) 4110 ± 85
$\delta^{13}C = -25.0‰$

Catalog No. 268 from Feature 12, Archaic basin-shaped pit which contained relatively large amount of hematite/red ocher and manos with red stains suggesting pigment processing area. Only one long count on sample.

WIS-862. Cannon Reservoir site (23RA302A) 900 ± 50
$\delta^{13}C = -26.4‰$

Catalog No. 137 from Feature 2, vertical sided pit with expanded base.

Cannon Reservoir series, Rose Shinn site (23MN222)

Charcoal from Rose Shinn site, Monroe Co, Missouri (39° 31′ N, 91° 46′ 15″ W) coll 1976 under direction of D R Henning. Subm by D A Baerreis.

WIS-907. Rose Shinn site (23MN222) 845 ± 55
$\delta^{13}C = -25.0‰$

Catalog No. 31 from Feature 1, possible fire pit directly beneath plow zone.

WIS-910. Rose Shinn site (23MN222) 300 ± 50
$\delta^{13}C = -26.7‰$

Catalog No. 27 from large area of charred wood ca 20cm below surface.

C. Montana

Hagen site (24DW1)

Charcoal from Hagen site (Mulloy, 1942) Dawson Co, Montana (47° 03′ 00″ N, 104° 45′ 35″ W). Excavated 1933-1940 by O T Lewis. Subm by W R Wood, Univ Missouri. Hagen is late prehistoric, putative Crow site, previously undated. Ceramic assemblage is most closely related to that of Mandan-Hidatsa Knife River phase (AD 1675-1780); dates therefore appear to be too early.

WIS-863. Hagen site (24DW1) 490 ± 55
Outer 10 rings of charred log (*Juniperus* cf *scapulorum*).

WIS-864. Hagen site (24DW1) 780 ± 55
Charred log (*Juniperus* cf *scapulorum*).

WIS-865. Hagen site (24DW1) 775 ± 55
Charred log (*Juniperus* cf *scapulorum*).

WIS-914. Whiskey Hill site (24DW1001) 1555 ± 60
$\delta^{13}C = -24.8‰$

Charcoal and burned bone from Whiskey Hill site, Dawson Co, Montana (47° 32′ N, 104° 43′ W) coll 1973 by A M Johnson, Denver, Colorado; subm by D A Baerreis. Whiskey Hill is single component site containing both Besant projectile points and Woodland pottery.

D. Wisconsin

Diamond Bluff site (47PI2)

Charcoal from Diamond Bluff site, Pierce Co, Wisconsin (44° 38′ N, 92° 36′ W) was excavated by Univ Wisconsin-Milwaukee Summer Field School in Archaeol during summer of 1974 under direction of R A Alex, Archaeol Research Center, Ft. Meade, South Dakota, subm by D A Baerreis.

WIS-841. Diamond Bluff site (47PI2) 910 ± 55

Charcoal from 50 to 60cm deep, from Feature 1, large bell-shaped cache/refuse pit.

WIS-842. Diamond Bluff site (47PI2) 890 ± 55

Charcoal from Feature 1, 70 to 80cm deep.

WIS-846. Diamond Bluff site (47PI2) 955 ± 55

Sample from Feature 42, straight-walled cache/refuse pit from floor of pit house, 80 to 90cm deep.

WIS-849. Diamond Bluff site (47PI2) 790 ± 55

Sample from Feature 42, 100 to 110cm deep.

WIS-845. Diamond Bluff site 755 ± 55

Sample from Feature 42, 110 to 120cm deep.

II. GEOLOGIC SAMPLES

A. Massachusetts

WIS-796. North Pond site 9620 ± 95

Sediment cores were taken from North Pond, Berkshire Co, Massachusetts (42° 39′ 03″ N, 73° 03′ 12″ W) by means of modified Livingstone sampler. Samples coll Nov 1973 by T L Crisman and D R Whitehead, Indiana Univ, Bloomington, Indiana; subm by D R Whitehead. Sample dated was olive gyttja 3.27 to 3.37m deep.

B. Michigan

Pollen records of 3 lakes which lie along transect across forest-type ecotone in NW portion of Michigan's lower peninsula have been studied for late-Holocene climatic changes. Marion Lake, Charlevoix Co (45° 14′ N, 85° 15′ W), Northern Hardwoods region, is most N., Lake 27, Antrim Co (45° 04′ N, 84° 47′ W), is near boundary between N hardwoods and pine dominated forests to SE, and Jones Lake, Crawford Co (44° 46′ N, 84° 36′ W), most S, is inside pine forest area. Chronology of late-Holocene changes will be established by 3 radiocarbon dates on each 2m core. Samples coll with Livingstone core June 1975 by J C Bernabo, Brown Univ, Providence, Rhode Island; subm by Thompson Webb, III, Brown Univ.

WIS-884. Marion Lake **645 ± 55**
$\delta^{13}C = -31.8‰$

Lake sediment, 18 to 28cm sec of core, underlying *Ambrosia* rise. Dated to check for possible ancient carbonate contamination.

WIS-883. Marion Lake **1070 ± 60**
$\delta^{13}C = -32.0‰$

54 to 64cm of core, just below major rise in N hardwoods types (*Tsuga, Fagus, Acer*).

WIS-872. Marion Lake **3295 ± 60**

Bottom of core at 202 to 207cm.

WIS-881. Lake 27 **945 ± 60**
$\delta^{13}C = -21.4‰$

Lake sediment at 5 to 22cm, immediately below *Ambrosia* rise.

WIS-873. Lake 27 **1505 ± 55**
$\delta^{13}C = -22.6‰$

Gyttja at 42 to 60cm in core, just below rise in Northern hardwoods type.

WIS-869. Lake 27 **4140 ± 110**

Bottom of core, 170 to 176cm.

WIS-887. Jones Lake **1150 ± 60**
$\delta^{13}C = -31.8‰$

Lake sediment at 8 to 18cm, underlying *Ambrosia* rise.

WIS-885. Jones Lake **1465 ± 60**
$\delta^{13}C = -33.3‰$

Lake sediment at 48 to 56cm in core. Increase in pine (largely *Pinus strobus*) pollen, roughly correlated with increases in N hardwoods types at Marion Lake and pine at Lake 27.

WIS-871. Jones Lake **2155 ± 60**

Bottom of core at 142 to 149cm.

C. Nevada

Walker Lake site

Several lake cores were obtained in October 1975 from Walker Lake, Mineral Co, Nevada (38° 38′ N, 118° 43′ W, 38° 45′ N, 118° 45′ W, 38° 41′ N, 118° 44′ W). Lake sediments were mainly detrital clay with sulfides and $CaCO_3$ present: lengthy acid treatment was necessary. Coll by R Spencer and J Hainline; subm by L V Benson, Desert Research Inst, Reno, Nevada.

WIS-851. Walker Lake site **Modern**

0 to 10cm depth of Core B.

WIS-844. Walker Lake site **450 ± 50**
$\delta^{13}C = -27.0‰$

50 to 70cm depth of Core B.

WIS-847. Walker Lake site **1020 ± 60**
$\delta^{13}C = -27.4‰$

120 to 140 cm depth of Core B.

WIS-854. Walker Lake site **645 ± 55**
$\delta^{13}C = -30.0‰$

30 to 50cm depth of Core D.

WIS-853. Walker Lake site **985 ± 55**
$\delta^{13}C = -27.2‰$

80 to 100cm depth of Core D.

WIS-856. Walker Lake site **Modern**
0 to 10cm depth of Core E.

WIS-843. Walker Lake site **305 ± 50**
20 to 70cm depth of Core E.

WIS-838. Walker Lake site **315 ± 55**
70 to 90cm depth of Core E.

WIS-839. Walker Lake site **595 ± 55**
110 to 130cm depth of Core E.

WIS-840. Walker Lake site **840 ± 55**
150 to 170cm depth of Core E.

D. Pennsylvania

WIS-903. Criders Pond **15,210 ± 150**

680 to 750cm sec of lake sediment core coll 1971 by W A Watts, Univ Minnesota, from Criders Pond, N of Phillamon Run, 3.2km E of Scotland, Franklin Co, Pennsylvania (39° 57.5′ N, 77° 32.6′ W). Depth indicated is below water surface. Dates on upper depths of core reported earlier (R, 1977, v 19, p 133). Subm by A M Swain, Univ Wisconsin-Madison.

E. Rhode Island

Mashapaug and Pasacaco sites

Pollen records from Mashapaug and Pasacaco ponds, Washington Co, Rhode Island (41° 47′ N, 71° 26′ W, and 41° 31′ N, 71° 27′ W, respectively) are being studied in detail to examine changing land use patterns from Woodland culture times to present. Radiocarbon dates will be used to establish when prehistoric forest disturbances and cultivation began in S New England. Coll April 1976 by J C Bernabo; subm by Thompson Webb, III.

WIS-866. Mashapaug Pond **3820 ± 55**

Lake sediment, bottom of Livingstone core at 202 to 209cm. Date will be used to determine presettlement sedimentation rates.

WIS-867. Pasacaco Pond **1355 ± 60**

Lake sediment, bottom of Livingstone core at 186 to 194cm. Date will be used to establish presettlement sedimentation rate and determine time when prehistoric human related forest disturbances took place. Correction of this date for assumed carbon isotope fractionation of this sample, analogous to fractionation of WIS-908 and -909, yields date of 1280 ± 60.

WIS-909. Pasacaco Pond **825 ± 55**
$\delta^{13}C = -31.0‰$

Lake sediment, 136 to 144cm sec of core.

WIS-908. Pasacaco Pond **625 ± 55**
$\delta^{13}C = -30.1‰$

Lake sediment, base of historic herb pollen rise, 82 to 88cm sec of core.

F. Wisconsin

Kellner's Lake site

Core from S central portion of Kellner's Lake, Manitowoc Co, Wisconsin (44° 14′ N, 87° 51′ W) taken in 1.5m water with 5.1cm diam Livingstone piston sampler. Core consisted of 11.8m of organic sediments which rested on sand and gravel. Coll Nov 1975 and subm by R Goodwin and L J Maher, Jr, Univ Wisconsin-Madison. Lake lies on red drift of interlobate moraine between Green Bay and Lake Michigan glacial lobes.

WIS-857. Kellner's Lake site **13,970 ± 135**

Lowest organic sediment, 1135 to 1145cm below lake bottom in core.

WIS-855. Kellner's Lake site **10,220 ± 95**

Organic lake sediment 990 to 1002.5cm below lake bottom, core interval at which spruce pollen percentages decrease and pine pollen percentages increase.

WIS-848. Cold Spring Valley Creek site **1820 ± 60**
$\delta^{13}C = -28.4‰$

Sample from log (*Quercus* sp) at base of bank of Cold Spring Valley Creek, Monroe Co, Wisconsin (43° 52′ N, 90° 28′ W). Coll 1976 by W C Johnson; subm by W C Johnson and J C Knox, Univ Wisconsin-Madison. Log was short distance from one retrieved earlier and dated at 1920 ± 60, WIS-747 (R, 1976, v 18, p 136).

G. Northwest Territories

Long Lake site

Two sedge peat monoliths from NW corner Long Lake, 2km SE of SE end of Dubawnt Lake, Dist Keewatin, Northwest Territories (62° 38′

N, 101° 14′ W). Peat bank monolith 98cm thick, surrounds small drained pond; floor monolith 20cm thick from pond floor. Coll July 1975 and subm by P A Kay, Univ Utah, Salt Lake City.

WIS-818. Long Lake site **5550 ± 75**

Basal 2cm of bank monolith, overlay permafrost sand and pebbles. Pollen suggests forest-tundra vegetation.

WIS-852. Long Lake site **3745 ± 60**

$\delta^{13}C = -29.4‰$

36 to 38cm of bank monolith. Pollen indicates sharp reduction in sedge growth, rapid change from Boreal to Arctic vegetation. Date approx paleosols at Dubawnt Lake, WIS-12 (Bender *et al*, 1965) and WIS-52 (Bender *et al*, 1966) and widespread southward displacement of forest (Sorenson *et al*, 1971; Nichols, 1975).

WIS-815. Long Lake site **2980 ± 65**

Level 2 to 4cm of floor monolith. Pond drained shortly afterwards.

WIS-821. Long Lake site **5830 ± 75**

Basal 2cm of floor monolith, overlay permafrost sand and pebbles. Dates commencement of peat accumulation comparable to Ennadai Lake (Nichols, 1967). Pollen stratigraphy of floor monolith analogous to that of corresponding time in bank monolith.

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