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Radiocarbon

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1983

GEOSECS INDIAN OCEAN AND MEDITERRANEAN RADIOCARBON

MINZE STUIVER

Quaternary Isotope Laboratory, University of Washington, Seattle, Washington 98195

and

H G ÖSTLUND

Tritium Laboratory, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida 33149

This paper is the third of a series detailing the general features of ^{14}C distribution in the world oceans. In the preceding papers, we discussed the ^{14}C activities of Atlantic and Pacific Ocean waters (Stuiver and Östlund, 1980; Östlund and Stuiver, 1980). We now give an outline of the ^{14}C distribution of the Indian Ocean and profiles for one Mediterranean and three Red Sea stations.

This ^{14}C study was an integral part of the Geochemical Ocean·Section Study (GEOSECS) program which was designed to make an inventory of several chemical constituents in the oceans. Twenty-two hundred water samples were collected and CO_2 was extracted on board at 124 stations, of which 41 were in the Indian Ocean. The Indian Ocean study was the final seagoing phase of the GEOSECS program lasting from December 4, 1977 to April 24, 1978 (Craig and Turekian, 1980). The sampling covered the three major basins in detail (fig. 1). Sampling and measurement techniques were described previously (Östlund and Stuiver, 1980; Stuiver and Östlund, 1980).

Relatively few ^{14}C data are available for the Indian Ocean. Previous work includes profiles measured by Bien, Rakestraw, and Suess (1963; 1965), Linick (1978), and Delibrias (1980). Some earlier ^{14}C data from the Mediterranean Sea are available in papers by Broecker and Gerard (1969) and Östlund (1974).

The replacement times of abyssal waters (> 1500m depth) of the Atlantic, Pacific, and Indian Oceans can be calculated from the GEOSECS data. This calculation yields a 250-year replacement time for the deep waters of the Indian Ocean (Stuiver, Quay, and Östlund, 1983).

THE $\Delta^{14}C$ SCALE

The $\Delta^{14}C$ values are given relative to a standard (NBS oxalic acid), after normalization on a fixed $\delta^{13}C$ ratio of $-25‰$, according to the procedures given by Stuiver and Polach (1977). Appropriate corrections for the decay of the NBS ^{14}C standard were also made.

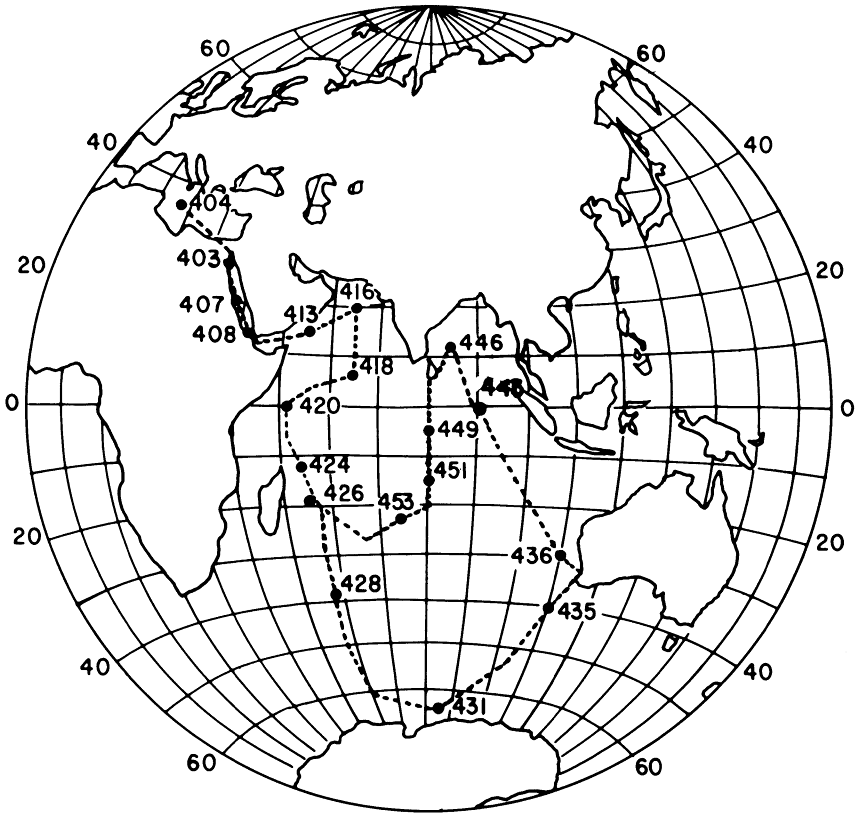

Fig 1. GEOSECS Indian Track 1977-78

EXPLANATION OF THE TABLES

All data on position, depths, hydrography, and total CO_2 were furnished by the GEOSECS Operations Group (now Physical and Chemical Ocean Data Facility) at Scripps Institution of Oceanography, which handled the logistics and operations on board the ship and serves as a temporary repository for all GEOSECS data. The following explains the column headings:

POSITION: Given in degrees and minutes. The ship frequently drifted during station time, so the position is defined to no better than ± a few minutes.

SAMPLE #: This is the operational sample number, in which the two last digits indicate the Gerard barrel number and the preceding digits, the cast number. The first on station 421 is sample no. 588; *ie*, cast # 5, Gerard # 88.

DEPTH M: Given in meters as calculated from density and pressure.

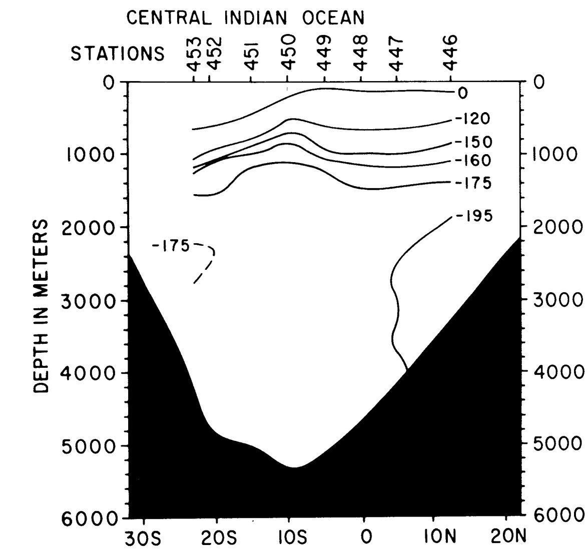

Fig 2. Central Indian Ocean; N-S section. Isolines are in $\Delta^{14}C$ units.

POT T DEG C: Potential temperature in degrees centigrade.
SAL‰: Salinity in unit g/kg sea water.
SIGMA THETA: Deviation from unity, in per mil, of the relative density in g/ml where ml has the old value of $1.000027 cm^3$.
TCO2 μM: The total amount of inorganic carbon in μ-moles per kg of sea water. All TCO2 data listed are still preliminary.
DC14‰: This is $\Delta^{14}C$ on the scale that was defined above. The accuracy is typically ± 4‰ and precision ± 3.5‰.
C14 LAB #: This colunm lists ML for the Miami Laboratory and QL for the Washington Laboratory with numbers referring to our laboratory journals.

THE SECTIONS

The track of the Indian Ocean GEOSECS expedition allows for the construction of vertical sections in the eastern and western Indian Ocean (pl 1 and 2), and of truncated vertical section of the Central Part (fig 2). Latitudes of each station are plotted along the abscissa.

The lack of deep convection in the northern Indian Ocean results in a pool of "old" water in the north with the lowest $\Delta^{14}C$ values in the Bay of Bengal (stations 445 and 446). The bay is a major nutrient source for the deep Indian Ocean (Broecker, Toggweiler, and Takahashi, 1980).

Figure 3 gives the ^{14}C distribution in the Northern Indian Ocean and the Red Sea. Here, the horizontal scale is proportional to the distance between the stations along the track.

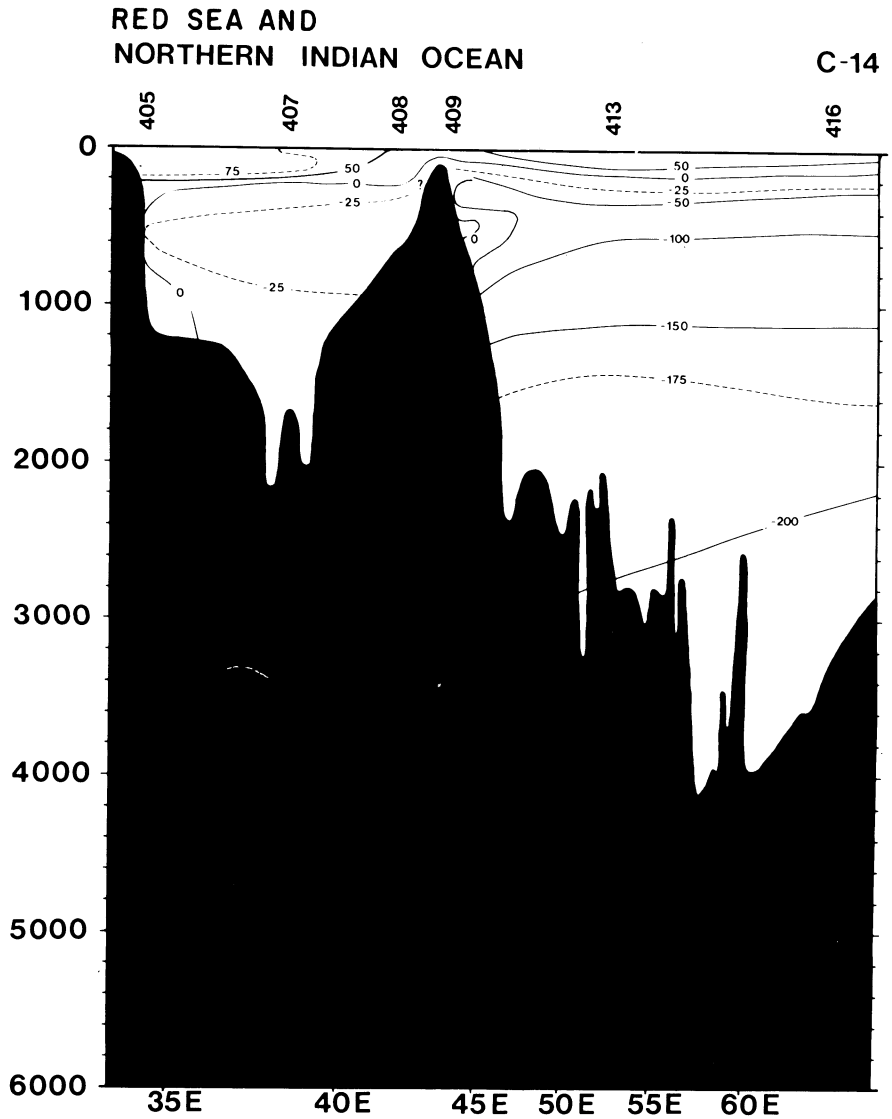

Fig 3. $\Delta^{14}C$ isolines for the Red Sea-Arabian Sea cruise track

Our previous research indicated strong latitudinal differences in the integrated amount of nuclear bomb carbon in, eg, the Atlantic Ocean (Stuiver, 1980). Bomb-produced ^{14}C was mostly encountered near the center of the large mid-latitude gyres, whereas the equatorial region had a lower ^{14}C inventory (Broecker, Peng, and Stuiver, 1978; Stuiver, Östlund,

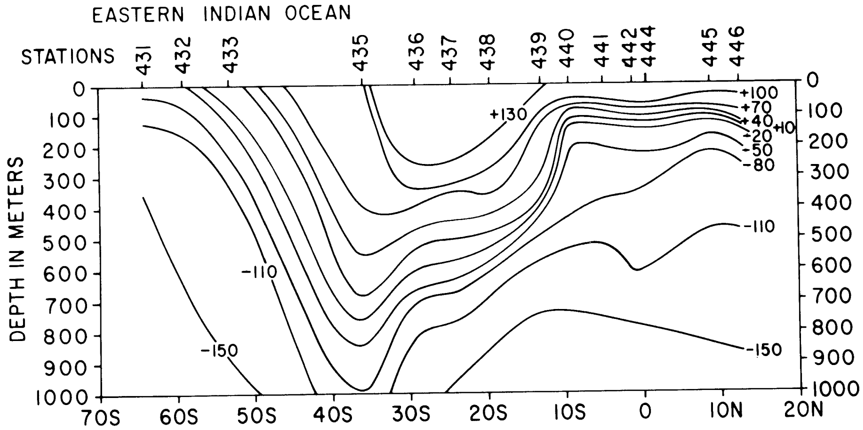

Fig 4. East Indian Ocean; N-S section of the upper 1000m. Isolines are in $\Delta^{14}C$ units.

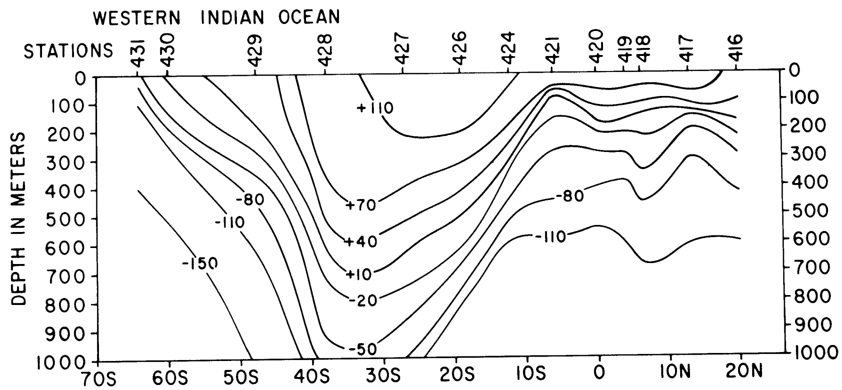

Fig 5. West Indian Ocean; N-S section of the upper 1000m. Isolines are in $\Delta^{14}C$ units.

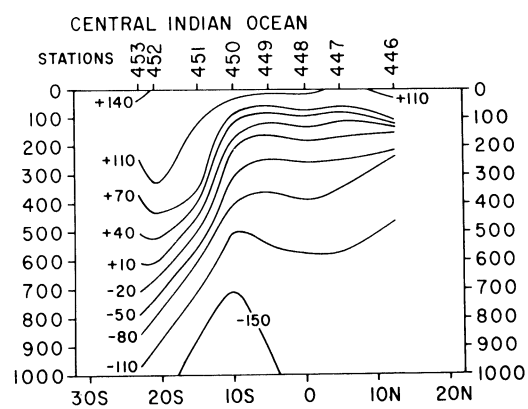

Fig 6. Central Indian Ocean; N-S section of upper 1000m. Isolines are in $\Delta^{14}C$ units.

and McConnaughey, 1981; Quay, Stuiver, and Broecker, in press). Due to the geographical restriction of the Northern Indian Ocean, a major mid-latitude gyre is absent in the north and, as a result, the amount of bomb ^{14}C at mid-depths (ca 1000m) is much less in the Northern Indian Ocean than in the southern portion. The penetration of bomb ^{14}C is especially deep between 40° to 50° S latitude, suggesting downward transport of bomb ^{14}C to at least 2000m depth. This part of the Indian Ocean appears to be an important region for direct transport of excess fossil fuel CO_2 from the surface into the deep waters of the world oceans.

Figures 4 to 6 give the ^{14}C distribution of the upper 1000m in more detail. The influence of the mid-latitude southern gyre on downward transport of ^{14}C is evident. The upwelling of water near the equator conforms with the patterns found for the Pacific and Atlantic Oceans.

The estimated ^{14}C bomb inventory in the east Atlantic is 74% of the inventory of the west Atlantic (Stuiver, 1980). Bomb ^{14}C appears also more abundantly in the west Pacific than in the east Pacific. For instance, the upper 1000m east-west Pacific Ocean section along 30° N has appreciably more ^{14}C in the west than in the east (pl 3, Östlund and Stuiver, 1980). For the Indian Ocean, the east-west $\Delta^{14}C$ gradient differs from the above pattern. Total integrated excess ^{14}C is higher in the east Indian Ocean where the maximum surface $\Delta^{14}C$ values near 25° S are ca 20‰ above those found in the west. A similar $\Delta^{14}C$ difference is encountered in the surface waters near the equator (figs 4 and 6).

Although an anticyclonic system of currents, similar to the corresponding system of the south Atlantic Ocean, prevails in the southern part of the Indian Ocean, it is subjected to greater annual variations (Sverdrup, Johnson, and Fleming, 1970). Particularly the currents in the northern part are strongly influenced by monsoons and change in seasons. During the southwest monsoon from April to October, strong upwelling takes place off the coast of Somali, causing vast areas of low surface temperature. Such western margin upwelling occurs only in the Indian Ocean, which may account for the reversed east-west bomb ^{14}C pattern.

The $\Delta^{14}C$ values of samples of the west Indian Ocean (0° to 30° S Lat) are extremely uniform from 2000 to 3500m depth. The average $\Delta^{14}C$ value of 20 samples collected for this body of water at stations 436 to 442 is −189.6‰, with a standard deviation around the mean of 2.4‰. The observed 2.4‰ variability in $\Delta^{14}C$ is even smaller than the 4‰ accuracy of each measurement.

The abyssal waters of the central and east basins are less uniform in ^{14}C activity. The change in average $\Delta^{14}C$ value of water below 1500m with latitude is nearly 7‰ per 10° latitude (see Stuiver, Quay, and Östlund, in press).

When crossing the 90° E ridge between the western and central basins (station 442 in the west and station 445 in the central part), abyssal waters change in $\Delta^{14}C$ level (*ie*, the waters between 2000 and 3500m at station 445 average −199.7‰ whereas those in the west basin, as discussed, average −189.6‰).

For a large series of measurements extending over a long period of time, a small number of anomalous results are often observed. In our opinion, the 4611m sample of station 435 is anomalously low in $\Delta^{14}C$ due to counting gas purity and dilution problems; the sample depths of samples QL-770, QL-2008, and QL-2009 of station 442 probably suffer from mislabeling.

ACKNOWLEDGMENTS

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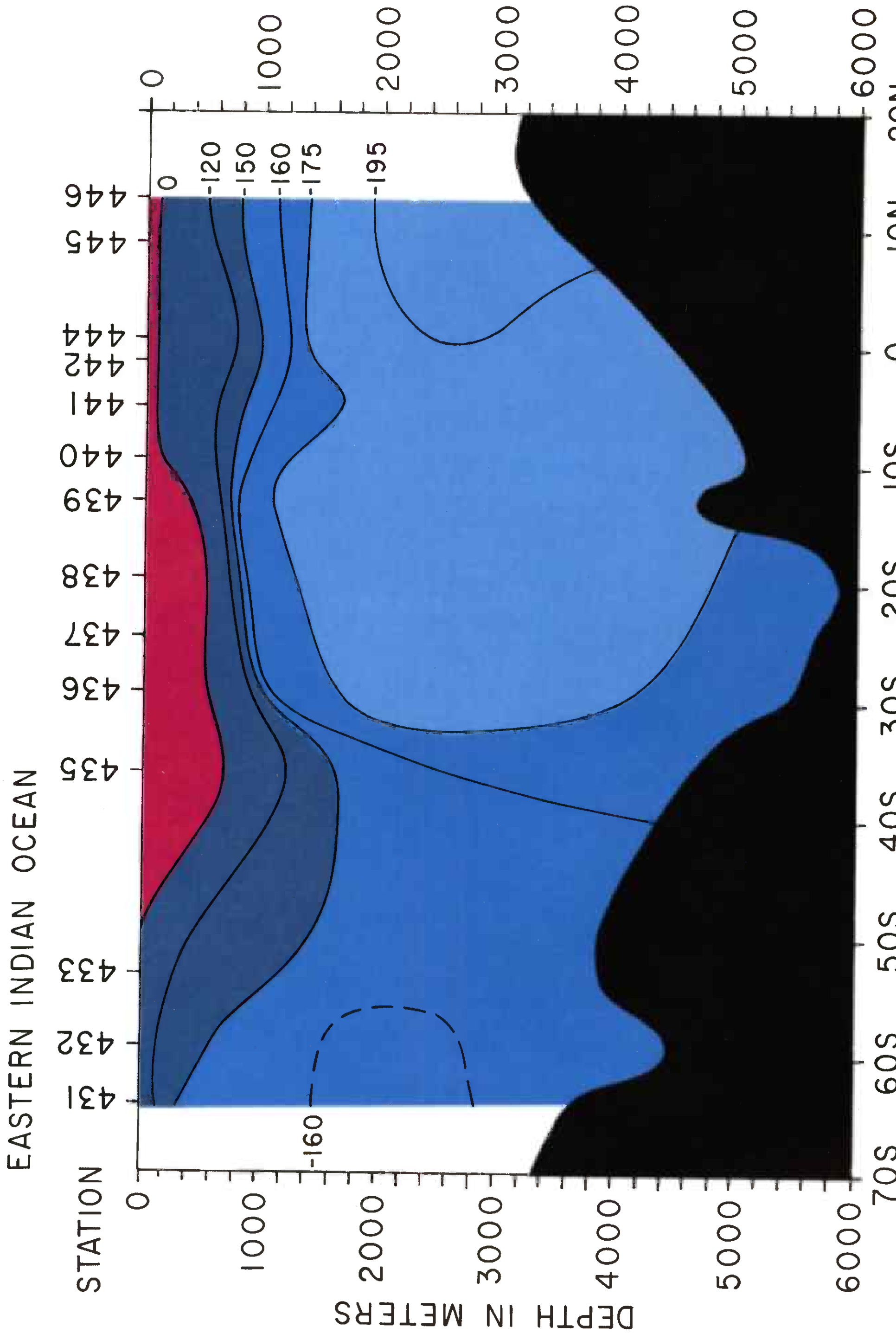

PLATE 1

East Indian Ocean; N-S section. Isolines are in $\Delta^{14}C$ units. The dashed isoline surrounds a region where $\Delta^{14}C$ is a couple of per mil above −160‰.

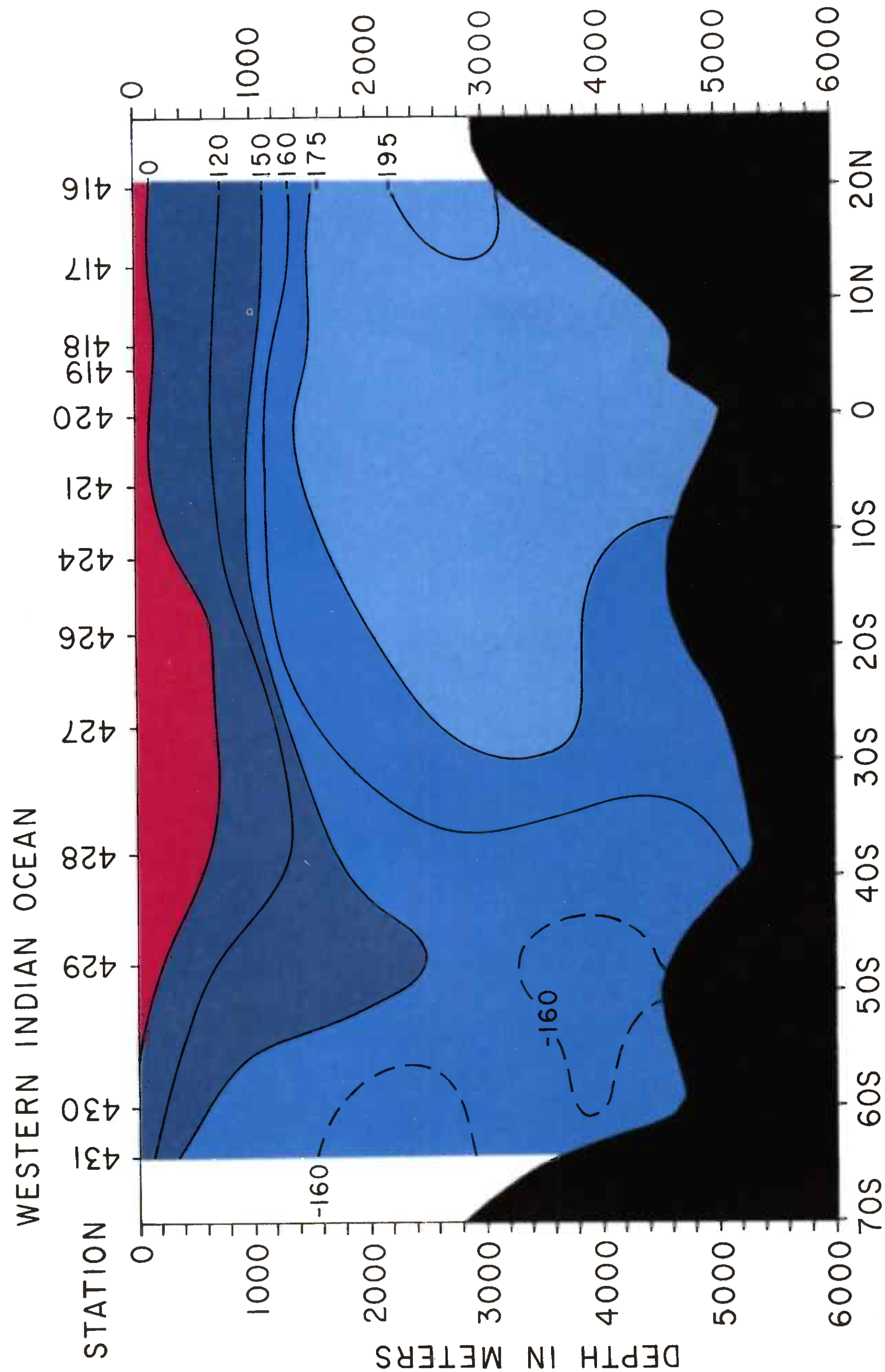

PLATE 2

West Indian Ocean; N-S section. Isolines are in $\Delta^{14}C$ units. The dashed isolines surround regions where $\Delta^{14}C$ is a couple of per mil above -160‰.

STATION 404 MEDITERRANEAN SEA

POSITION 35 36 N 17 15 E DATE 771209 BOTTOM 4051 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
335	5					44.2	QL 782
286	85	16.11	38.392	28.354	2263	92.1	QL 773
287	169	14.98	38.870	28.992	2315	80.1	QL 774
288	368	14.15	38.815	29.130	2335	38.6	QL 775
290	665	13.72	38.750	29.175	2332	-20.3	QL 776
291	1340	13.43	38.701	29.200	2323	-58.2	QL 777
292	1984	13.32	38.680	29.206	2323	-60.5	QL 778
293	2776	13.25	38.667	29.211	2323	-60.0	QL 779
294	3470	13.23	38.663	29.212	2329	-59.0	QL 780
295	3917	13.23	38.664	29.213	2334	-45.4	QL 781

STATION 405 RED SEA

POSITION 27 16 N 34 31 E DATE 771219 BOTTOM 1181 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
286	29	23.35	40.400	27.944	2100	98.9	ML2060
287	84	22.36	40.368	28.210	2120	88.8	ML2059
288	149	21.84	40.412	28.391	2136	84.2	ML2067
290	249	21.60	40.500	28.528	2176	35.1	ML2066
291	399	21.57	40.549	28.572	2190	-3.6	ML2065
292	548	21.57	40.583	28.599	2191	-30.9	ML2064
293	698	21.55	40.589	28.611	2187	-12.8	ML2063
294	847	21.49	40.587	28.624	2173	5.3	ML2062
295	996	21.42	40.583	28.642	2169	25.7	ML2061

STATION 407 — RED SEA

POSITION 19 55 N 38 29 E DATE 771222 BOTTOM 1665 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
386	20	27.26	39.363	25.961	2067	75.4	ML2083
387	70	26.30	39.606	26.442	2074	86.4	ML2082
388	119	23.04	40.207	27.888	2112	86.4	ML2081
390	179	22.02	40.409	28.329	2169	53.4	ML2079
391	242	21.85	40.518	28.452	2207	-0.7	ML2078
286	296	21.72	40.560	28.539	2221	-18.8	ML2077
287	445	21.64	40.593	28.586	2213	-33.8	ML2076
288	594	21.61	40.603	28.603	2199	-39.0	ML2075
290	794	21.58	40.607	28.614	2189	-25.3	ML2074
291	893	21.57	40.608	28.620	2186	-25.2	ML2073
292	1093	21.56	40.612	28.625	2182	-19.7	ML2072
293	1292	21.55	40.610	28.624	2175	-18.0	ML2070
294	1540	21.54	40.609	28.628	2176	-18.3	ML2069
295	1788	21.53	40.602	28.624		-13.4	ML2068*

STATION 408 — RED SEA

POSITION 14 42 N 42 10 E DATE 771224 BOTTOM 587 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
286	18	26.72	37.336	24.605		46.2	ML2092
287	57	26.62	37.455	24.725		40.8	ML2091
288	75	23.79	37.783	25.733	2141	36.5	ML2090
290	82	23.21	38.420	26.484	2166	34.5	ML2089
291	102	23.20	40.015	27.697	2132	72.3	ML2088
292	175	22.01	40.429	28.362	2180	27.2	ML2087
293	308	21.70	40.569	28.552	2212	-25.8	ML2086
294	436	21.66	40.595	28.584	2203	-41.2	ML2085
295	578	21.64	40.602	28.594	2202	-44.9	ML2084

STATION 409 GULF OF ADEN

POSITION 12 10 N 43 57 E DATE 771225 BOTTOM 580 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
286	18	26.77	36.355	23.848	2031	46.6	ML2101
287	53	23.11	35.761	24.504	2135	39.5	ML2100
288	147	16.31	35.639	26.195	2251	-34.6	ML2099
290	196	15.07	35.642	26.473	2253	-48.7	ML2098
291	246	14.84	35.804	26.665	2254	-54.3	ML2097
292	336	14.40	35.976	26.886	2263	-53.6	ML2096
293	412	17.77	37.241	27.068	2218	-14.1	ML2095
294	493	18.56	37.619	27.159	2204	2.9	ML2094
295	580	18.73	37.839	27.280		-2.5	ML2093*

STATION 413

POSITION 13 22 N 53 16 E DATE 771227 BOTTOM 2815 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	28	26.02	36.034	23.842	2037	72.0	ML2116
487	118	22.71	35.669	24.546	2115	49.6	ML2115
488	200	16.62	35.505	26.018	2239	-6.3	ML2114
490	302	13.94	35.515	26.628	2256	-47.7	ML2113
491	448	12.94	35.681	26.968	2286	-70.4	ML2112
286	593	11.85	35.669	27.173	2286	-102.9	ML2111
287	791	10.84	35.678	27.370	2301	-113.4	ML2110
288	988	9.00	35.458	27.513	2326	-136.0	ML2109
290	1235	6.56	35.182	27.662	2362	-164.0	ML2108
291	1580	4.44	34.973	27.756	2368	-183.1	ML2107
292	1876	3.17	34.867	27.799	2383	-189.9	ML2106
293	2171	2.41	34.807	27.817	2371	-196.8	ML2104
294	2468	1.97	34.775	27.827	2365	-195.0	ML2103
295	2715	1.70	34.762	27.834	2360	-198.3	ML2102

STATION 416 ARABIAN SEA

POSITION 19 46 N 64 37 E DATE 771231 BOTTOM 3209 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
395	40	26.24	36.482	24.110	2054	58.7	ML2137
394	120	20.39	36.026	25.461	2235	32.3	ML2136
393	186	17.89	35.937	26.042	2267	-8.7	ML2135
392	261	16.12	36.051	26.553	2283	-35.9	ML2134
391	301	15.05	35.941	26.715	2288	-59.6	ML2133
390	376	13.83	35.814	26.885	2293	-74.5	ML2130
594	475	12.74	35.734	27.049	2302	-90.4	ML2138
387	576	11.72	35.640	27.176	2306	-108.0	ML2129
386	823	9.92	35.504	27.399	2326	-127.5	ML2128
286	1008	8.59	35.385	27.526	2340	-147.8	ML2127
287	1271	6.82	35.199	27.642	2356	-157.9	ML2124
288	1534	5.22	35.047	27.725	2367	-172.9	ML2123
290	1797	3.89	34.924	27.774	2369	-193.1	ML2122
291	2060	2.96	34.845	27.799	2375	-193.4	ML2121
292	2323	2.36	34.801	27.817	2375	-201.0	ML2120
293	2588	1.94	34.772	27.826	2378	-204.2	ML2119
294	2858	1.67	34.755	27.834	2388	-200.3	ML2118
295	3140	1.48	34.744	27.838	2398	-188.6	ML2117

STATION 417

POSITION 12 58 N 64 29 E DATE 780102 BOTTOM 4117 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	40	26.60	36.407	23.944	2040	74.6	ML2157
487	99	22.25	36.056	24.970	2188	46.1	ML2156
488	174	16.16	35.617	26.217	2265	-47.1	ML2154
490	248	13.40	35.473	26.701	2274	-76.3	ML2153
491	398	11.71	35.415	27.004	2281	-91.5	ML2152
492	497	11.35	35.451	27.105	2282	-99.4	ML2151
493	647	10.41	35.411	27.241	2306	-115.5	ML2150
494	846	9.22	35.362	27.405	2320	-128.8	ML2149
495	1045	7.86	35.242	27.526	2329	-147.9	ML2148
286	1245	6.72	35.148	27.615	2337	-152.9	ML2147
287	1594	4.67	34.967	27.725	2354	-181.1	ML2146
288	1942	3.11	34.843	27.785	2361	-189.0	ML2145
290	2291	2.32	34.792	27.812	2361	-192.9	ML2144
291	2639	1.84	34.761	27.826	2361	-194.9	ML2143
292	2987	1.56	34.743	27.831	2365	-190.2	ML2142
293	3336	1.46	34.742	27.839	2357	-197.8	ML2141
294	3686	1.39	34.736	27.838	2345	-190.7	ML2140
295	4035	1.35	34.739	27.894	2367	-187.9	ML2139

STATION 418

POSITION 6 11 N 64 25 E DATE 780105 BOTTOM 4706 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
688	30	27.79	35.620	22.977	1993	75.1	ML2180
687	150	17.23	35.236	25.665	2182	6.8	ML2179
686	198	15.39	35.234	26.095	2195	-17.2	ML2178
586	299	12.93	35.182	26.583	2215	-38.9	ML2177
587	398	11.39	35.148	26.857	2237	-67.3	ML2176
588	497	10.73	35.148	26.978	2250	-93.5	ML2175
590	647	9.97	35.212	27.163	2291	-107.7	ML2174
591	797	8.89	35.174	27.313	2316	-125.4	ML2173
592	995	7.42	35.103	27.480	2333	-144.2	ML2172
593	1294	5.70	34.977	27.612	2336	-166.6	ML2171
594	1592	4.05	34.888	27.717	2342	-178.0	ML2170
595	1941	2.88	34.804	27.775	2344	-185.3	ML2169
286	2191	2.42	34.783	27.798	2349	-193.1	ML2168
287	2489	2.01	34.765	27.816	2349	-194.9	ML2167
288	2835	1.67	34.748	27.827	2345	-192.7	ML2166
290	3085	1.53	34.740	27.832	2338	-192.8	ML2165
291	3384	1.41	34.734	27.836	2340	-188.5	ML2163
292	3681	1.35	34.731	27.837	2338	-180.7	ML2161
293	4031	1.32	34.733	27.841	2342	-189.3	ML2160
294	4383	1.31	34.732	27.841	2341	-176.6	ML2159
295	4634	1.30	34.717	27.814	2339	-178.6	ML2158

STATION 419

POSITION 3 57 N 56 48 E DATE 780108 BOTTOM 4658 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	20	26.96	35.340	23.022	1981	94.8	ML2199
487	98	20.44	35.246	24.818	2085	50.0	ML2198
488	227	13.22	35.222	26.562	2207	-41.0	ML2197
490	406	10.05	35.027	27.005	2227	-88.2	ML2195
491	546	9.83	35.140	27.129	2264	-104.1	ML2194
492	756	8.33	35.081	27.325	2293	-131.7	ML2193
493	845	8.45	35.159	27.370	2301	-123.9	ML2192
494	1094	6.69	35.040	27.535	2320	-161.7	ML2191
495	1295	5.66	34.973	27.614	2334	-163.6	ML2190
286	1593	4.25	34.885	27.705	2333	-179.6	ML2189
287	1992	2.71	34.797	27.783	2344	-190.3	ML2188
288	2389	2.03	34.767	27.816	2338	-198.9	ML2187
290	2787	1.71	34.751	27.827	2335	-190.4	ML2186
291	3185	1.46	34.739	27.836	2325	-186.9	ML2185
292	3584	1.29	34.733	27.843	2320	-184.2	ML2184
293	3884	1.18	34.729	27.847	2323	-182.6	ML2183
294	4183	1.07	34.722	27.849	2314	-178.6	ML2182
295	4584	0.96	34.720	27.854	2307	-174.0	ML2181

STATION 420

POSITION 00 03 S 50 56 E DATE 780110 BOTTOM 5102 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
586	20	26.96	35.249	22.953	1995	93.1	ML2218
587	98	19.00	35.201	25.194	2106	49.1	ML2217
588	197	14.02	35.171	26.347	2172	-1.8	ML2216
590	296	11.80	35.078	26.725	2214	-53.7	ML2215
591	494	9.73	35.006	27.043	2255	-104.5	ML2214
592	714	8.90	35.094	27.248	2290	-124.2	ML2213
593	934	7.48	35.076	27.451	2325	-145.6	ML2212
594	1243	5.35	34.911	27.603	2333	-170.5	ML2211
595	1541	3.86	34.834	27.706	2338	-179.0	ML2210
386	1939	2.82	34.785	27.764	2341	-189.5	ML2209
387	2338	2.07	34.757	27.804	2343	-191.5	ML2208
388	2737	1.70	34.744	27.822	2339	-190.1	ML2207
390	3136	1.53	34.736	27.829	2335	-186.2	ML2206
391	3535	1.32	34.730	27.838	2330	-186.4	ML2205
392	3934	1.16	34.726	27.846	2327	-185.8	ML2204
393	4334	0.99	34.721	27.852	2315	-179.9	ML2203
394	4734	0.91	34.717	27.854	2312	-179.4	ML2201
395	5035	0.88	34.716	27.856	2310	-180.0	ML2200

STATION 421

POSITION 06 09 S 50 54 E DATE 780113 BOTTOM 4837 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
588	19	28.72	34.884	22.126	1956	94.7	ML2219
486	99	15.56	35.160	26.005	2160	2.9	ML2227
487	222	11.97	35.062	26.681	2177	-39.3	ML2226
490	346	10.56	34.950	26.853	2191	-66.2	ML2225
491	546	8.50	34.816	27.095	2233	-105.6	ML2224
492	795	7.08	34.842	27.324	2288	-145.2	ML2223
493	1095	5.70	34.856	27.516	2316	-155.9	ML2222
494	1394	4.14	34.792	27.644	2324	-173.5	ML2221
495	1694	3.13	34.764	27.720	2324	-181.4	ML2220
286	1957	2.52	34.758	27.769	2330	-189.0	ML2237
287	2256	2.12	34.753	27.798	2327	-191.9	ML2236
288	2555	1.79	34.747	27.818	2326	-190.9	ML2235
290	2854	1.61	34.742	27.827	2328	-189.4	ML2234
291	3153	1.49	34.738	27.832	2326	-192.0	ML2233
292	3451	1.39	34.734	27.836	2334	-185.2	ML2232
293	3852	1.21	34.728	27.844	2322	-183.8	ML2230
294	4300	0.94	34.720	27.855	2310	-172.3	ML2229
295	4752	0.84	34.716	27.858	2309	-171.4	ML2228

STATION 424

POSITION 12 18 S 53 41 E DATE 780116 BOTTOM 4676 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	19	28.95	35.016	22.158	1949	110.7	ML2255
487	97	23.50	34.973	23.758	2024	102.4	ML2254
488	205	15.42	35.401	26.214	2106	60.4	ML2253
490	270	12.98	35.224	26.604	2132	25.3	ML2252
491	343	11.01	34.985	26.802	2150	-17.9	ML2251
492	683	7.06	34.689	27.206	2233	-111.6	ML2250
493	843	6.06	34.738	27.378	2280	-135.4	ML2249
494	1043	5.19	34.750	27.494	2298	-155.1	ML2248
495	1392	3.81	34.715	27.616	2303	-163.6	ML2247
286	1745	2.83	34.728	27.719	2304	-174.8	ML2246
287	2043	2.22	34.736	27.776	2317	-181.4	ML2245
288	2422	1.87	34.743	27.809	2327	-184.0	ML2244
290	2721	1.69	34.741	27.821	2321	-176.7	ML2243
291	3138	1.46	34.736	27.834	2316	-182.7	ML2242
292	3566	1.27	34.728	27.840	2317	-170.3	ML2241
293	3884	1.10	34.723	27.847	2302	-176.8	ML2240
294	4281	0.87	34.716	27.856	2289	-175.1	ML2239
295	4581	0.79	34.600	27.804	2295	-175.1	ML2238

STATION 426

POSITION 18 54 S 54 47 E DATE 780120 BOTTOM 4737 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
386	19	27.95	35.094	22.532	1972	123.8	ML2273
387	69	26.14	35.058	23.063	1966	126.5	ML2272
390	172	22.12	35.177	24.342	2018	116.7	ML2271
391	296	16.94	35.423	25.878	2094	99.1	ML2270
392	544	10.80	34.938	26.804	2129	7.4	ML2269
393	843	6.72	34.562	27.153	2228	-116.4	ML2268
395	1191	4.37	34.647	27.506	2291	-162.4	ML2266
388	1437	3.52	34.661	27.602	2295	-166.6	ML2265
286	1692	2.79	34.680	27.685	2302	-165.9	ML2264
287	1941	2.36	34.704	27.740	2303	-177.8	ML2263
290	2192	2.08	34.725	27.778	2313	-178.8	ML2262
291	2491	1.86	34.733	27.802	2324	-185.5	ML2261
292	2792	1.69	34.736	27.817	2320	-178.6	ML2260
294	3689	1.21	34.726	27.842	2316	-174.7	ML2258
295	4137	0.92	34.719	27.855	2310	-169.1	ML2257
288	4585	0.67	34.711	27.864	2299	-167.4	ML2256

STATION 427

POSITION 27 04 S 56 58 E DATE 780130 BOTTOM 5169 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	5	25.59	35.239	23.374	1974	129.7	ML2295
487	129	19.07	35.484	25.397	2058	115.4	ML2294
488	183	16.96	35.516	25.948	2083	113.0	ML2293
490	367	13.41	35.285	26.564	2097	76.3	ML2292
491	542	11.73	35.066	26.729	2119	34.2	ML2291
492	717	10.13	34.863	26.862	2123	-12.1	ML2290
493	1096	5.01	34.439	27.268	2216	-107.7	ML2289
494	1349	3.45	34.513	27.491	2266	-148.5	ML2288
495	1747	2.57	34.659	27.686	2278	-166.5	ML2287
286	2068	2.21	34.721	27.765	2290	-163.5	ML2286
287	2470	1.91	34.740	27.804	2306	-174.8	ML2285
290	3224	1.39	34.730	27.834	2311	-178.1	ML2283
291	3595	1.12	34.724	27.846	2307	-179.5	ML2280
292	3984	0.88	34.718	27.857	2291	-165.8	ML2277
293	4333	0.69	34.713	27.865	2288	-165.4	ML2276
294	4700	0.56	34.708	27.868	2285	-161.5	ML2275
295	5066	0.51	34.706	27.870		-161.4	ML2274*

STATION 428

POSITION 37 46 S 57 38 E DATE 780202 BOTTOM 5383 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
386	9	18.44	35.340	25.448	2032	98.9	ML2304
387	119	14.55	35.377	26.391	2085	91.2	ML2303
388	193	13.70	35.282	26.507	2097	91.6	ML2302
390	254	13.54	35.318	26.563	2085	88.3	ML2301
391	498	11.59	35.012	26.714	2119	44.2	ML2300
392	797	7.97	34.607	27.012	2163	-39.9	ML2299
393	1096	4.62	34.374	27.263	2202	-83.5	ML2298
394	1418	3.14	34.463	27.478	2247	-130.6	ML2297
395	1739	2.58	34.605	27.643	2269	-151.5	ML2296
586	2042	2.35	34.702	27.738	2272	-153.0	ML2313
587	2490	2.02	34.754	27.807	2268	-160.9	ML2312
588	2939	1.63	34.749	27.832	2271	-156.4	ML2311
590	3387	1.20	34.740	27.855	2285	-150.0	ML2310
591	3834	0.61	34.710	27.867	2281	-156.0	ML2309
592	4282	0.22	34.691	27.873	2281	-158.1	ML2308
593	4730	0.09	34.687	27.878	2283	-154.3	ML2307
594	5175	0.04	34.682	27.876	2278	-162.9	ML2306
595	5325	0.03	34.688	27.881		-159.8	ML2305*

STATION 429

POSITION 47 40 S 57 51 E DATE 780206 BOTTOM 4563 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	4	6.49	33.726	26.525	2108	28.0	ML2331
487	74	6.21	33.760	26.588	2101	29.4	ML2330
488	149	4.12	33.813	26.868	2137	14.3	ML2329
490	248	3.08	34.045	27.152	2165	-16.5	ML2328
491	452	2.59	34.247	27.355	2217	-81.3	ML2327
492	684	2.42	34.436	27.520	2247	-124.8	ML2326
493	995	2.38	34.595	27.652	2264	-149.8	ML2325
494	1382	2.23	34.722	27.765	2257	-147.0	ML2324
495	1765	2.01	34.764	27.815	2255	-143.7	ML2323
286	2065	1.76	34.770	27.839	2252	-143.6	ML2322
287	2406	1.44	34.757	27.852	2257	-149.6	ML2321
288	2745	1.11	34.739	27.860	2274	-151.3	ML2320
290	3085	0.75	34.719	27.866	2270	-159.6	ML2319
291	3424	0.42	34.701	27.871	2276	-161.5	ML2318
292	3762	0.18	34.688	27.874	2269	-160.0	ML2317
293	4098	0.00	34.681	27.878	2277	-169.3	ML2316
294	4433	-0.18	34.708	27.923	2268	-164.9	ML2315
295	4562	-0.28	34.671	27.883		-158.2	ML2314*

STATION 430

POSITION 59 59 S 60 59 E DATE 780210 BOTTOM 4738 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	4	1.80	33.842	27.093		-19.9	ML2349*
487	99	-0.85	34.023	27.383	2193	-41.9	ML2348
488	309	1.91	34.583	27.678	2270	-143.0	ML2347
490	498	1.89	34.666	27.746	2276	-149.4	ML2346
491	747	1.82	34.723	27.797	2270	-153.6	ML2345
492	997	1.67	34.746	27.827	2265	-149.3	ML2344
493	1296	1.38	34.745	27.846	2264	-154.0	ML2343
494	1593	1.08	34.735	27.857	2265	-155.1	ML2342
495	1814	0.89	34.721	27.859	2273	-161.5	ML2341
286	2135	0.62	34.708	27.865	2276	-163.3	ML2340
287	2486	0.39	34.698	27.870	2276	-163.3	ML2339
288	2835	0.19	34.686	27.872	2277	-158.1	ML2338
290	3186	-0.01	34.679	27.876	2278	-160.8	ML2337
291	3536	-0.17	34.674	27.880	2272	-159.1	ML2336
292	3874	-0.31	34.667	27.881	2276	-162.8	ML2335
293	4213	-0.44	34.663	27.884	2274	-159.5	ML2334
294	4561	-0.55	34.661	27.883	2264	-159.1	ML2333
295	4695	-0.64	34.658	27.888		-145.8	ML2332*

STATION 431

POSITION 64 11 S 83 59 E DATE 780213 BOTTOM 3624 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
286	9	2.36	33.789	27.009	2167	-66.9	ML2375
287	29	0.69	33.961	27.248	2182	-67.9	ML2374
288	46	-0.86	34.186	27.516	2204	-92.9	ML2373
290	210	1.60	34.655	27.758	2277	-147.8	ML2372
292	674	1.32	34.721	27.830	2270	-155.1	ML2370
293	905	1.09	34.721	27.846	2278	-159.1	ML2369
294	1119	0.93	34.718	27.855	2281	-164.0	ML2368
295	1392	0.73	34.712	27.862	2281	-159.5	ML2367
395	1665	0.50	34.701	27.866	2284	-161.4	ML2366
394	1939	0.32	34.692	27.869	2281	-161.2	ML2365
393	2214	0.14	34.682	27.871	2283	-161.6	ML2364
392	2490	-0.01	34.676	27.874	2289	-163.1	ML2363
391	2763	-0.14	34.674	27.879	2281	-161.7	ML2362
390	2975	-0.23	34.674	27.883	2278	-155.5	ML2361
388	3186	-0.29	34.674	27.886	2276	-151.9	ML2360
387	3396	-0.35	34.677	27.892	2273	-148.8	ML2359
386	3580	-0.43	34.680	27.897	2276	-151.4	ML2358

STATION 432

POSITION 59 20 S 92 38 E DATE 780216 BOTTOM 4490 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	9	1.82	33.864	27.110		-54.0	ML2401*
487	91	-0.84	34.170	27.502	2232	-93.8	ML2400
488	252	1.32	34.589	27.725	2277	-135.9	ML2399
490	413	1.51	34.674	27.781	2281	-142.7	ML2397
491	588	1.54	34.715	27.811	2276	-149.5	ML2396
492	797	1.51	34.740	27.833	2284	-152.8	ML2395
493	1096	1.20	34.731	27.848	2280	-151.5	ML2394
494	1395	0.91	34.721	27.858	2283	-155.6	ML2393
495	1693	0.69	34.711	27.863	2289	-163.1	ML2392
286	1986	0.46	34.700	27.868	2283	-159.7	ML2391
287	2292	0.26	34.690	27.871	2295	-164.2	ML2390
288	2597	0.09	34.684	27.875	2295	-168.2	ML2389
595	2612	0.08	34.684	27.875	2294	-160.4	ML2402
290	2903	-0.06	34.680	27.880	2279	-159.9	ML2388
291	3209	-0.18	34.680	27.885	2282	-156.1	ML2387
292	3514	-0.27	34.679	27.889	2280	-154.8	ML2385
293	3818	-0.34	34.678	27.891	2288	-152.5	ML2378
294	4122	-0.40	34.678	27.894	2274	-151.9	ML2377
295	4427	-0.48	33.276	28.939	2110	-141.7	ML2376

STATION 433

POSITION 53 00 S 103 02 E DATE 780218 BOTTOM 3942 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
286	10	3.33	33.905	27.018	2156	-14.4	ML2404
586	59	3.22	33.909	27.031	2154	-19.4	ML2422
590	139	0.90	34.038	27.310	2198	-49.6	ML2421
587	350	1.98	34.473	27.585	2268	-120.8	ML2420
591	639	2.16	34.677	27.733	2270	-145.8	ML2419
592	860	1.98	34.717	27.780	2279	-149.1	ML2418
593	1079	1.84	34.740	27.809	2275	-144.7	ML2417
594	1298	1.67	34.750	27.831	2276	-154.5	ML2416
595	1583	1.37	34.743	27.845	2281	-148.6	ML2415
588	1867	1.15	34.736	27.854	2284	-153.7	ML2414
287	2182	0.83	34.719	27.861	2287	-159.0	ML2403
387	2381	0.68	34.712	27.865	2283	-171.4	ML2413
391	2612	0.42	34.700	27.870	2291	-154.3	ML2411
392	2843	0.26	34.693	27.873	2285	-158.2	ML2410
393	3073	0.07	34.687	27.878	2284	-156.0	ML2409
394	3300	-0.05	34.684	27.882	2289	-156.8	ML2408
395	3527	-0.14	34.682	27.885	2297	-153.2	ML2407
388	3749	-0.16	34.682	27.886	2293	-157.5	ML2406

STATION 435

POSITION 39 57 S 109 58 E DATE 780222 BOTTOM 4621 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	4	15.49	34.842	25.771		98.1	QL 789*
490	53	13.72	34.747	26.084	2085	87.8	QL 792
487	208	10.38	34.775	26.750	2102	89.4	QL 790
491	432	9.94	34.790	26.838	2114	68.4	QL 793
492	644	8.86	34.655	26.913	2134	26.0	QL 794
493	858	6.97	34.486	27.059	2168	-56.1	QL 795
494	1071	4.41	34.356	27.269	2208	-97.8	QL 796
495	1369	3.01	34.442	27.475	2250	-144.0	QL 797
488	1672	2.58	34.576	27.619	2272	-150.7	QL 791
291	2975	1.38	34.744	27.845	2278	-159.5	QL 784
292	3305	1.06	34.730	27.856	2285	-162.8	QL 785
293	3632	0.75	34.717	27.865	2282	-166.3	QL 786
294	3959	0.59	34.710	27.868	2284	-161.2	QL 787
295	4286	0.51	34.706	27.870	2292	-165.3	QL 788
288	4611	0.47	34.705	27.871	2288	-210.3	QL 783

STATION 436

POSITION 29 15 S 109 58 E DATE 780308 BOTTOM 5556 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	10	24.51	35.734	24.070	2007	140.4	QL 761
487	74	19.44	35.866	25.588	2048	147.3	QL 806
488	134	16.20	35.678	26.251	2075	146.0	QL 807
490	223	13.63	35.336	26.559	2088	138.6	QL 808
491	312	11.35	35.013	26.759	2107	106.8	QL 809
492	437	9.50	34.749	26.880	2124	50.9	QL 810
493	797	5.00	34.404	27.243	2214	−106.3	QL 811
494	1146	3.49	34.546	27.513	2281	−167.6	QL 812
495	1492	2.72	34.651	27.666	2300	−169.9	QL 813
286	1896	2.22	34.714	27.760	2313	−185.0	QL 798
287	2295	1.87	34.726	27.796	2315	−190.8	QL 799
288	2694	1.59	34.729	27.818	2311	−187.6	QL 800
290	3093	1.35	34.728	27.834	2310	−190.0	QL 801
291	3491	1.15	34.726	27.847	2313	−184.4	QL 762
292	3990	0.93	34.719	27.855	2305	−178.0	QL 802
293	4488	0.78	34.718	27.863	2301	−172.9	QL 803
294	4986	0.67	34.714	27.867	2294	−160.3	QL 804
295	5485	0.61	34.711	27.868	2293	−167.8	QL 805

STATION 437

POSITION 24 28 S 104 55 E DATE 780311 BOTTOM 1587 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
286	10	24.29	35.739	24.139	2009	149.5	QL 814
287	39	23.25	35.699	24.415	2012	142.7	QL 815
288	70	21.18	35.638	24.951	2026	151.6	QL 816
290	158	17.96	35.742	25.877	2089	142.4	QL 817
291	228	15.78	35.598	26.287	2087	146.1	QL 818
292	298	13.22	35.300	26.616	2097	86.7	QL 819
293	377	11.17	34.996	26.780	2108	116.8	QL 820
294	457	9.65	34.774	26.876	2118	46.8	QL 821
295	719	5.36	34.455	27.235	2219	−88.5	QL 822

STATION 438

POSITION 19 29 S 101 17 E DATE 780312 BOTTOM 5825 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	15	26.25	35.279	23.194	1973	137.5	QL 763
487	69	23.46	35.312	24.062	1986	138.6	QL 850
488	198	18.34	35.658	25.717	2075	125.8	QL 851
490	348	12.12	35.156	26.724	2108	76.2	QL 852
491	498	9.13	34.730	26.927	2128	6.5	QL 853
492	646	6.91	34.567	27.132	2214	-107.1	QL 854
493	946	5.32	34.646	27.397	2302	-167.5	QL 855
494	1196	4.40	34.648	27.502	2319	-169.3	QL 856
495	1494	3.45	34.672	27.615	2309	-181.6	QL 857
286	1888	2.52	34.714	27.735	2312	-191.1	QL 841
287	2238	2.00	34.726	27.786	2314	-189.7	QL 842
288	2737	1.55	34.728	27.820	2309	-188.5	QL 843
290	3236	1.23	34.723	27.839	2310	-191.0	QL 844
291	3734	1.00	34.718	27.850	2305	-182.4	QL 845
292	4232	0.86	34.716	27.857	2305	-179.6	QL 846
293	4729	0.76	34.714	27.862	2298	-176.0	QL 847
294	5223	0.71	34.713	27.864	2293	-165.4	QL 848
295	5717	0.70	34.713	27.864	2289	-169.4	QL 849

STATION 439

POSITION 13 02 S 97 08 E DATE 780315 BOTTOM 1487 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
286	15	28.74	34.393	21.754		130.0	QL 858*
287	149	18.59	34.950	25.109	2090	63.8	QL 859
288	268	13.21	35.185	26.530	2126	47.0	QL 860
290	348	10.47	34.944	26.864	2127	35.2	QL 861
291	447	8.41	34.681	26.997	2185	-72.9	QL 862
292	597	7.03	34.659	27.186	2271	-143.5	QL 863
293	895	5.09	34.631	27.410	2308	-171.9	QL 864
294	1196	4.11	34.661	27.543	2319	-179.7	QL 865
295	1495	3.31	34.713	27.663		-186.3	QL 866*

STATION 440

POSITION 09 21 S 95 01 E DATE 780317 BOTTOM 5238 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
1035	0					123.3	QL 867
486	60	24.06	34.541	23.302	1985	104.2	QL 868
487	103	18.55	34.652	24.892	2119	24.9	QL 869
488	146	14.55	34.703	25.878	2178	-21.6	QL 870
490	264	11.29	34.884	26.674	2222	-75.5	QL 871
491	539	8.34	34.769	27.082	2255	-110.4	QL 872
492	786	6.56	34.738	27.314	2302	-153.8	QL 873
493	1132	4.76	34.698	27.502	2327	-172.7	QL 874
494	1478	3.75	34.741	27.643	2330	-187.9	QL 875
495	1822	2.76	34.746	27.739	2333	-189.9	QL 876
286	2201	2.09	34.739	27.786	2329	-191.0	QL 877
287	2497	1.81	34.736	27.807	2330	-190.1	QL 878
288	2793	1.58	34.734	27.823	2328	-187.2	QL 879
290	3089	1.39	34.726	27.830	2325	-193.1	QL 880
291	3484	1.11	34.720	27.844	2324	-189.8	QL 881
292	3878	0.91	34.716	27.854	2309	-185.9	QL 882
293	4273	0.81	34.714	27.859	2307	-179.9	QL 883
294	4669	0.77	34.714	27.861	2299	-179.9	QL 884
295	5063	0.76	34.714	27.862	2303	-178.9	QL 885

STATION 441

POSITION 05 01 S 91 46 E DATE 780320 BOTTOM 4927 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	20	28.94	34.481	21.757	1926	122.6	QL 886
487	75	24.38	35.319	23.817	2062	67.1	QL 887
488	159	14.76	34.830	25.911	2186	-33.1	QL 888
490	249	11.64	34.987	26.686	2210	-68.9	QL 889
491	379	10.15	34.923	26.907	2239	-83.9	QL 890
492	499	9.08	34.873	27.046	2262	-106.6	QL 891
493	798	7.08	34.855	27.334	2309	-150.5	QL 892
494	1198	5.14	34.805	27.543	2330	-170.7	QL 893
495	1594	3.60	34.785	27.692	2337	-168.9	QL 894
286	1993	2.55	34.758	27.767	2332	-186.5	QL 895
287	2295	2.07	34.746	27.796	2329	-192.4	QL 896
288	2597	1.76	34.739	27.814	2333	-187.2	QL 897
290	2899	1.54	34.733	27.825	2325	-191.5	QL 898
291	3301	1.25	34.724	27.838	2326	-191.0	QL 899
292	3700	0.97	34.717	27.851	2316	-182.5	QL 900
293	4097	0.82	34.713	27.857	2311	-173.9	QL2001
294	4492	0.79	34.715	27.861	2298	-179.4	QL2002
295	4881	0.77	34.714	27.861	2308	-181.3	QL2003

STATION 442

POSITION 01 12 S 90 45 E DATE 780322 BOTTOM 4606 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
394	20	29.67	33.731	20.955	1872	119.4	QL2005
586	89	23.12	35.183	24.061	2081	50.1	QL 769
587	149	15.45	35.126	25.999	2195	-27.6	QL2006
588	247	12.97	35.114	26.522	2208	-59.2	QL2007
590	396	10.80	35.029	26.873	2239	-87.8	QL2008
591	595	9.25	34.955	27.083	2256	-105.1	QL2009
592	796	8.07	34.989	27.297	2301	-77.3	QL 770
593	1096	6.24	34.919	27.498	2323	-152.3	QL2010
594	1495	4.00	34.829	27.688	2333	-180.9	QL2011
595	1790	3.10	34.797	27.750	2336	-188.3	QL2012
287	2138	2.27	34.765	27.796	2334	-188.4	QL2013
288	2489	1.84	34.749	27.816	2334	-189.7	QL2014
290	2840	1.57	34.739	27.828	2335	-185.3	QL2015
291	3190	1.38	34.731	27.835	2332	-193.3	QL2016
292	3539	1.07	34.724	27.849	2323	-188.7	QL2017
293	3888	0.84	34.719	27.860	2307	-176.6	QL2018
294	4236	0.81	34.718	27.862	2300	-179.7	QL2019
295	4582	0.79	34.717	27.862	2305	-176.2	QL2020

STATION 444

POSITION 0 36 N 88 36 E DATE 780324 BOTTOM 4464 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
186	2054	2.35	34.766	27.788		-181.8	QL2021
187	2352	1.99	34.750	27.807	2333	-190.5	QL2022
188	2651	1.69	34.741	27.821	2334	-203.5	QL2023
190	2951	1.48	34.733	27.830	2330	-190.1	QL2024
191	3250	1.29	34.728	27.839	2334	-192.7	QL2025
192	3549	1.11	34.724	27.847	2324	-190.7	QL2026
193	3849	1.05	34.720	27.848	2324	-193.6	QL2027
194	4149	1.05	34.719	27.848	2333	-189.2	QL2028
195	4448	1.04	34.718	27.847	2319	-188.1	QL2029

STATION 445

POSITION 08 31 N 86 02 E DATE 780326 BOTTOM 3642 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	20	29.03	34.227	21.531	1910	102.3	QL2030
487	59	25.71	34.285	22.618	1999	83.6	QL2031
488	129	17.35	34.869	25.358	2200	-39.0	QL2032
490	238	12.22	35.015	26.595	2265	-85.3	QL2033
491	348	10.74	35.035	26.888	2278	-99.7	QL2034
492	497	9.63	35.017	27.068	2293	-111.6	QL2035
493	747	7.89	34.978	27.314	2317	-143.1	QL2036
494	996	6.52	34.933	27.472	2332	-155.9	QL2037
495	1245	5.30	34.887	27.591	2341	-167.5	QL2038
286	1484	4.28	34.848	27.671	2345	-187.0	QL2039
287	1733	3.24	34.808	27.745	2345	-188.3	QL2040
288	1982	2.57	34.779	27.782	2348	-195.7	QL2041
290	2230	2.16	34.760	27.800	2353	-203.9	QL2042
291	2479	1.86	34.748	27.813	2354	-197.7	QL2043
292	2727	1.64	34.740	27.823	2344	-198.3	QL2044
293	3024	1.44	34.731	27.831	2347	-202.0	QL2045
294	3322	1.26	34.728	27.841	2346	-196.5	QL2046
295	3617	1.14	34.722	27.844	2362	-195.4	QL2047

STATION 446 BAY OF BENGAL

POSITION 12 29 N 84 29 E DATE 780328 BOTTOM 3286 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
386	20	28.32	33.688	21.359	1891	116.6	QL2048
387	44	27.98	33.701	21.476	1902	97.7	QL2049
388	99	27.44	35.057	22.658	1987	91.5	QL2050
390	162	18.26	34.848	25.120	2195	-27.1	QL2051
391	247	12.64	34.995	26.497	2264	-81.9	QL2052
392	396	10.42	35.029	26.941	2296	-103.5	QL2053
393	597	8.96	35.003	27.167	2320	-129.8	QL2054
394	796	7.64	34.969	27.344	2323	-149.9	QL2055
395	995	6.49	34.929	27.473	2330	-157.4	QL2056
186	1190	5.53	34.898	27.570	2340	-164.6	QL2057
187	1441	4.48	34.856	27.658	2347	-177.5	QL2058
188	1692	3.32	34.810	27.739	2352	-187.5	QL2059
190	1943	2.59	34.779	27.780	2353	-198.1	QL2060
192	2443	1.88	34.749	27.813	2364	-199.0	QL2061
193	2692	1.66	34.740	27.822	2363	-202.2	QL2062
194	2991	1.44	34.732	27.832	2354	-194.3	QL2063
195	3286	1.22	34.725	27.841	2362	-197.8	QL2064

STATION 447

POSITION 04 59 N 79 57 E DATE 780405 BOTTOM 4187 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	2	29.99	33.917	20.990	1903	105.0	QL2065
487	30	28.86	34.848	22.055	1955	102.8	QL2066
488	94	20.53	34.827	24.492	2140	17.7	QL2067
490	188	12.89	35.072	26.511	2249	-72.3	QL2068
491	288	11.61	35.099	26.779	2246	-68.9	QL2069
492	388	10.68	35.064	26.921	2245	-89.3	QL2070
493	499	10.06	35.059	27.027	2262	-100.2	QL2071
494	801	7.95	34.982	27.309	2312	-137.0	QL2072
495	1196	5.72	34.912	27.558	2338	-123.8	QL2073
286	1463	4.53	34.859	27.657	2334	-177.1	QL2074
287	1662	3.84	34.835	27.708	2349	-185.3	QL2075
288	1961	2.64	34.783	27.780	2344	-194.9	QL2076
290	2361	1.99	34.757	27.811	2336	-193.5	QL2077
291	2760	1.61	34.739	27.825	2343	-197.9	QL2078
292	3159	1.37	34.730	27.835	2349	-185.0	QL2079
293	3559	1.19	34.726	27.843	2344	-195.1	QL2080
294	3859	1.10	34.720	27.845	2339	-191.5	QL2081
295	4158	1.05	34.720	27.848	2334	-187.7	QL2082

STATION 448

POSITION 00 01 N 80 03 E DATE 780406 BOTTOM 4640 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
595	1	29.84	34.328	21.349	1904	112.7	QL2083
486	49	25.01	34.544	23.023	1978	95.1	QL2084
487	177	15.10	35.165	26.026	2189	-19.2	QL2085
488	295	11.76	35.069	26.723	2213	-63.8	QL2086
490	494	9.71	34.969	27.017	2238	-93.1	QL2087
491	693	8.37	35.000	27.258	2296	-126.7	QL2088
492	893	7.56	34.985	27.368	2308	-143.1	QL2089
493	1093	5.92	34.916	27.536	2326	-158.8	QL2090
494	1292	5.28	34.882	27.588	2329	-163.3	QL2091
495	1590	3.85	34.829	27.704	2333	-183.7	QL2092
286	1755	3.24	34.804	27.742	2338	-181.1	QL2093
287	2154	2.30	34.766	27.793	2341	-186.3	QL2094
288	2554	1.77	34.741	27.814	2338	-185.7	QL2095
290	2952	1.46	34.733	27.831	2334	-192.9	QL2096
291	3352	1.27	34.724	27.837	2348	-191.7	QL2097
292	3650	1.17	34.722	27.842	2334	-184.8	QL2098
293	3949	1.10	34.720	27.845	2343	-196.2	QL2099
294	4248	1.05	34.720	27.848	2328	-187.1	QL2100
295	4597	1.02	34.718	27.849	2328	-191.1	QL2101

STATION 449

POSITION 05 00 S 79 59 E DATE 780408 BOTTOM 5107 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	10	29.30	34.433	21.602	1917	114.5	QL2102
487	129	16.66	35.068	25.680	2176	-2.2	QL2103
488	297	10.69	34.930	26.816	2220	-73.7	QL2104
490	496	9.04	34.859	27.040	2244	-99.8	QL2105
491	696	7.81	34.849	27.225	2285	-131.1	QL2106
492	906	6.53	34.815	27.378	2313	-145.3	QL2107
493	1196	4.99	34.786	27.546	2324	-174.0	QL2108
494	1470	4.03	34.790	27.653	2336	-187.2	QL2109
495	1741	3.08	34.774	27.733	2330	-184.6	QL2110
286	2043	2.34	34.760	27.786	2332	-190.5	QL2111
287	2394	1.88	34.747	27.811	2329	-187.4	QL2112
288	2745	1.60	34.737	27.824	2326	-192.0	QL2113
291	3496	1.18	34.726	27.844	2331	-191.1	QL2115
292	3895	1.08	34.723	27.848	2336	-196.8	QL2116
293	4295	1.04	34.723	27.851	2326	-188.1	QL2117
294	4692	0.99	34.720	27.852	2320	-189.9	QL2118
295	5089	0.95	34.720	27.854	2318	-188.5	QL2119

STATION 450

POSITION 10 00 S 79 59 E DATE 780410 BOTTOM 5334 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	9	28.21	34.408	21.932	1918	128.9	QL2120
487	118	18.41	34.854	25.089	2129	33.8	QL2121
488	376	9.43	34.757	26.899	2216	-85.3	QL2122
490	595	7.33	34.707	27.183	2276	-138.3	QL2123
491	745	6.50	34.735	27.321	2306	-154.5	QL2124
492	894	5.44	34.692	27.416	2314	-163.8	QL2125
493	1165	4.57	34.743	27.559	2327	-175.8	QL2126
494	1446	3.65	34.756	27.665	2327	-186.0	QL2127
595	1746	2.81	34.750	27.738	2325	-186.3	QL2128
286	1973	2.41	34.747	27.769	2324	-183.1	QL2129
287	2372	1.91	34.738	27.802	2315	-186.2	QL2130
288	2772	1.58	34.730	27.820	2316	-189.9	QL2131
290	3173	1.33	34.723	27.832	2321	-190.4	QL2132
291	3574	1.13	34.718	27.841	2326	-188.0	QL2133
292	3974	1.04	34.716	27.846	2318	-184.1	QL2134
293	4374	0.99	34.717	27.849	2322	-186.5	QL2135
294	4922	0.97	34.716	27.850	2317	-186.3	QL2136
295	5325	0.97	34.715	27.850	2317	-185.4	QL2137

STATION 451

POSITION 14 59 S 79 57 E DATE 780413 BOTTOM 5001 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	10	27.82	34.547	22.161	1923	126.6	QL2138
487	132	21.58	35.058	24.400	2034	107.3	QL2139
488	266	14.97	35.175	26.143	2128	50.5	QL2140
490	316	13.99	35.394	26.539	2103	94.1	QL2141
491	465	9.85	34.828	26.883	2168	-5.0	QL2142
492	646	7.19	34.602	27.119	2209	-101.9	QL2143
493	941	5.41	34.698	27.427	2299	-155.0	QL2144
494	1199	4.45	34.703	27.540	2311	-175.0	QL2145
495	1595	3.14	34.716	27.682	2314	-189.7	QL2146
286	1884	2.52	34.730	27.748	2318	-183.9	QL2147
287	2185	2.06	34.734	27.788	2317	-193.4	QL2148
288	2485	1.76	34.733	27.809	2308	-191.3	QL2149
290	2884	1.48	34.730	27.827	2313	-186.7	QL2150
291	3284	1.26	34.726	27.839	2317	-189.9	QL2151
292	3683	1.10	34.723	27.847	2310	-187.2	QL2152
293	4080	1.03	34.720	27.850	2312	-194.5	QL2153
294	4477	1.01	34.719	27.850	2319	-191.8	QL2154
295	4874	1.00	34.720	27.851	2313	-191.2	QL2155

STATION 452

POSITION 20 05 S 79 59 E DATE 780415 BOTTOM 4791 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	10	26.80	34.753	22.636		124.7	QL2156*
487	118	21.09	35.284	24.708	2038	115.1	QL2157
488	246	17.10	35.505	25.904	2090	132.5	QL2158
490	346	13.66	35.341	26.555	2108	108.3	QL2159
491	445	11.54	35.063	26.764	2111	64.3	QL2160
492	596	9.52	34.765	26.890	2128	13.2	QL2161
493	847	5.85	34.496	27.213	2225	-106.0	QL2162
494	1197	4.20	34.647	27.522	2304	-166.6	QL2163
495	1492	3.33	34.696	27.648	2313	-173.2	QL2164
286	1786	2.69	34.724	27.729	2310	-187.8	QL2165
287	2086	2.20	34.728	27.771	2317	-181.3	QL2166
288	2386	1.85	34.728	27.798	2303	-173.5	QL2167
290	2687	1.62	34.728	27.815	2305	-179.4	QL2168
291	3087	1.36	34.729	27.835	2307	-186.1	QL2169
292	3486	1.16	34.725	27.845	2310	-183.9	QL2170
293	3885	1.06	34.720	27.847	2316	-184.5	QL2171
294	4284	1.01	34.719	27.849	2320	-189.6	QL2172
295	4681	1.00	34.718	27.850	2323	-189.4	QL2173

STATION 453

POSITION 23 00 S 74 01 E DATE 780418 BOTTOM 4153 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	14	24.74	35.415	23.762	1988	142.9	ML2452
487	98	20.40	35.691	25.192	2034	135.5	ML2451
488	198	15.82	35.558	26.245	2084	122.4	ML2450
490	347	12.47	35.152	26.652	2102	74.3	ML2449
491	546	10.62	34.923	26.824	2121	27.8	ML2448
492	746	8.41	34.646	26.974	2148	-36.2	ML2447
493	926	5.49	34.439	27.212	2198	-107.1	ML2446
494	1228	3.73	34.571	27.510	2285	-158.9	ML2445
686	1515	3.09	34.671	27.651	2303	-173.9	ML2453
286	1597	3.00	34.696	27.678	2305	-177.3	ML2437
287	1794	2.64	34.716	27.725	2307	-177.9	ML2444
288	2023	2.24	34.721	27.762	2302	-181.4	ML2493
290	2373	1.77	34.728	27.804	2290	-173.4	ML2442
291	2724	1.49	34.733	27.829	2285	-174.2	ML2441
292	3075	1.26	34.731	27.843	2291	-178.4	ML2440
293	3426	1.17	34.726	27.845	2297	-183.1	ML2439
294	3772	1.12	34.724	27.847	2303	-190.0	ML2438

STATION 454

POSITION 26 59 S 67 05 E DATE 780421 BOTTOM 4834 M

CST BOT	DEPTH M	POT-T C	SALIN o/oo	SIGMA THETA	TCO2 uM	DC14 o/oo	LAB/ PREP#
486	9	24.48	35.521	23.920	1990	134.8	ML2471
487	88	22.13	35.587	24.631	2014	135.7	ML2470
488	198	16.48	35.557	26.093	2080	117.8	ML2469
490	298	13.99	35.364	26.504	2106	100.7	ML2468
491	447	12.20	35.126	26.686	2116	67.3	ML2467
492	598	10.88	34.958	26.803	2128	18.9	ML2466
493	847	8.45	34.653	26.975	2148	-48.9	ML2465
494	1131	4.46	34.430	27.323	2225	-123.0	ML2464
495	1415	3.31	34.568	27.548	2280	-148.5	ML2463
286	1697	2.65	34.653	27.674	2288	-164.7	ML2462
287	1897	2.41	34.685	27.717	2287	-167.6	ML2461
288	2197	1.90	34.717	27.787	2296	-173.7	ML2460
290	2598	1.65	34.724	27.810	2301	-173.0	ML2459
291	2998	1.50	34.725	27.821	2300	-179.0	ML2458
292	3396	1.39	34.724	27.828	2300	-174.6	ML2457
293	3795	1.27	34.722	27.835	2309	-174.0	ML2456
294	4193	1.22	34.720	27.837	2310	-169.0	ML2455
295	4688	1.21	34.721	27.839	2304	-170.6	ML2454

[RADIOCARBON, VOL 25, No. 1, 1983, P 30-38]

ANU RADIOCARBON DATE LIST X

HENRY POLACH and CHARLES BARTON*

Compiled by Stella Wilkie

Radiocarbon Dating Research Laboratory

The Australian National University, PO Box 4, Canberra, ACT, Australia

^{14}C DATES FOR SIX AUSTRALIAN FRESHWATER LAKES

^{14}C ages were obtained for the Australian lakes recorded below in order to complement research into their magnetic stratigraphy and sedimentology. It has been possible to establish precise ^{14}C chronologies in six separate lakes, and also to compare ages obtained from stratigraphically equivalent horizons in different parts of the same lake so as to determine the reproducibility of these ages.

Sets of 54mm diam cores were collected by Charles Barton, Research School of Earth Sciences, ANU, from each of the maars using a 6m Mackereth corer (Mackereth, 1958), fitted with an orienting device (Barton and Burden, 1979) and a short 1.5m Mackereth corer (Mackereth, 1969) to recover undisturbed samples of the upper sediments. In Lakes Keilambete and Gnotuk coring terminated in a dense gray clay at 4m which plugged the ends of the core tubes. Ages are reported as ^{14}C yr BP, *ie,* corrected for isotopic fractionation and based on the Libby half-life of 5568 yr. The modern reference standard was ANU sucrose, secondary international calibration standard, correlated with 95% of ^{14}C activity of NBS oxalic acid, normalized to $\delta^{13}C = -19‰$ wrt PDB (Polach, 1979; Currie and Polach, 1980). All samples were washed in dilute HCl prior to combustion of the total organic fraction, with the exception of ANU-2051A which was a carbonate. Except where noted, the value for $\delta^{13}C$ is estimated as $-24.0 \pm 2.0‰$.

SAMPLE DESCRIPTIONS

Lake Bullenmerri series

Lake Bullenmerri lies in clover-leaf shaped volcanic basin in SW Victoria (38° 15′ S, 143° 07′ E), intersecting that of Lake Gnotuk at col on NW side. Upper 8m sediments are black to brown organic muds (typically 20 to 40% organic, 5% carbonate), more uniform in appearance and having fewer thin aragonite layers than Lakes Keilambete and Gnotuk. A comprehensive set of samples was obtained to determine reliability of ^{14}C ages in this fairly typical, mildly saline lacustrine environment.

ANU-1657. **$D^{14}C = -648.8 \pm 4.9‰$** **8410 ± 110**

Dark grayish lake sediment from weakly saline lake. Sample from bottom of Core B (580 to 593cm depth), and one of the furthest from lake center.

ANU-1659. **$D^{14}C = -607.2 \pm 23.4‰$** **7510 ± 490**

Piece of wood and lake sediment. Core B, 541 ± 0.5cm depth. Dilution, 15% sample.

* Graduate School of Oceanography, University of Rhode Island, Kingston, USA

ANU-1660. **$D^{14}C = -169.9 \pm 8.5‰$** **1500 ± 80**

Dark gray lake sediment. Core B, 115 to 125cm.

ANU-1909. **$D^{14}C = -191.7 \pm 9.4‰$** **1710 ± 90**

Grayish-colored lake mud with probably some carbonate present. Core C, 23.5 to 28.5cm. Dilution, 31% sample.

ANU-1911. **$D^{14}C = -93.0 \pm 9.5‰$** **780 ± 80**

Grayish-colored lake mud with probably some carbonate present. Core C, 72.5 to 78.5cm. Dilution, 36% sample.

ANU-1793. **$D^{14}C = -223.7 \pm 7.9‰$** **2030 ± 80**

Dark gray to black lake mud. Core C, 150 to 159cm. Dilution, 49% sample.

ANU-1798. **$D^{14}C = -242.2 \pm 5.5‰$** **2230 ± 60**

Dark gray to black lake mud. Core C, 159 to 166cm.

ANU-1802. **$D^{14}C = -299.0 \pm 6.8‰$** **2850 ± 80**

Grayish-colored, fine-grained lake mud with substantial amount of carbon present. Core C, 166 to 173.5cm.

ANU-1805. **$D^{14}C = -360.1 \pm 8.3‰$** **3590 ± 100**

Dark grayish lake mud with carbonate present. Core C, 272 to 277cm. Dilution, 33% sample.

ANU-1790. **$D^{14}C = -450.5 \pm 6.9‰$** **4810 ± 100**

Dark gray to black lake mud. Core C, 377 to 382cm. Dilution, 49% sample.

ANU-1753. **$D^{14}C = -461.6 \pm 9.6‰$** **4970 ± 140**

Black, highly organic lake mud. Core C, 382 to 387cm. Dilution, 35% sample.

ANU-1905. **$D^{14}C = -555.4 \pm 11.6‰$** **6510 ± 210**

Grayish-colored lake mud with probably some carbonate present. Core C, 479 to 485cm. Dilution, 19% sample.

ANU-1901. **$D^{14}C = -521.6 \pm 10.4‰$** **5920 ± 180**

Grayish-colored lake mud with probably some carbonate present. Core C, 515 to 520cm. Dilution, 23% sample.

ANU-1788. **$D^{14}C = -612.9 \pm 8.2‰$** **7630 ± 170**

Dark gray to black lake mud. Core C, 583 to 593cm. Dilution, 36% sample.

ANU-1904. **$D^{14}C = -543.6 \pm 6.8‰$** **6300 ± 120**

Grayish-colored lake mud with probably some carbonate present. Core C, 472 to 479cm. Dilution, 42% sample.

ANU-1912. **$D^{14}C = -157.6 \pm 8.5‰$** **1380 ± 80**

Grayish-colored lake mud with probably some carbonate present. Core D, 127.5 to 132.5cm. Dilution, 42% sample.

ANU-1792. **$D^{14}C = -104.4 \pm 8.2‰$** **890 ± 70**

Dark gray to black lake mud. Core D, 192 to 201.5cm.

ANU-1799. **$D^{14}C = -264.2 \pm 6.7‰$** **2460 ± 70**

Dark gray to black lake mud. Core D, 201.5 to 209cm.

ANU-1803. **$D^{14}C = -240.4 \pm 6.6‰$** **2210 ± 70**

Dark grayish lake mud with some carbonate. Core D, 211.5 to 216.5cm.

ANU-1806. **$D^{14}C = -352.2 \pm 7.6‰$** **3490 ± 90**

Dark grayish lake mud with some carbonate. Core D, 315.5 to 320cm. Dilution, 37% sample.

ANU-1789. **$D^{14}C = -449.6 \pm 6.3‰$** **4800 ± 90**

Dark gray to black lake mud. Core D, 404.5 to 409.5cm.

ANU-1754. **$D^{14}C = -453.6 \pm 8.2‰$** **4860 ± 120**

Black, highly organic lake mud. Core D, 409.5 to 414.5cm. Dilution, 44% sample.

ANU-1906. **$D^{14}C = -535.1 \pm 8.4‰$** **6150 ± 150**

Grayish-colored lake mud, with probably some carbonate present. Core D, 495.5 to 502.5cm. Dilution, 32% sample.

ANU-1907. **$D^{14}C = -633.7 \pm 21.3‰$** **8070 ± 480**

Grayish-colored lake mud with probably some carbonate present. Core D, 502.5 to 507.5cm. Dilution, 10% sample.

ANU-1902. **$D^{14}C = -537.7 \pm 8.8‰$** **6200 ± 150**

Grayish-colored lake mud with probably some carbonate present. Core D, 542.5 to 547.5cm. Dilution, 28% sample.

ANU-1908. **$D^{14}C = -131.0 \pm 9.9‰$** **1130 ± 90**

Grayish-colored lake mud with probably some carbonate present. Core E, 26 to 31cm. Dilution, 30% sample.

ANU-1910. **$D^{14}C = -170.2 \pm 9.3‰$** **1500 ± 90**

Grayish-colored lake mud with probably some carbonate present. Core E, 80 to 84cm. Dilution, 36% sample.

ANU-1794. **$D^{14}C = -222.2 \pm 10.3‰$** **2020 ± 110**

Dark gray to black lake mud. Core E, 141 to 148cm. Dilution, 33% sample.

ANU-1795. **$D^{14}C = -259.6 \pm 6.6‰$** **2420 ± 70**

Dark gray to black lake mud. Core E, 150 to 155cm.

ANU-1801. **$D^{14}C = -252.0 \pm 7.1‰$** **2330 ± 80**

Grayish-colored, fine-grained lake mud with substantial amount of carbonate present. Core E, 155 to 161.5cm.

ANU-1804. **$D^{14}C = -357.2 \pm 6.5‰$** **3550 ± 80**

Dark grayish lake mud with carbonate present. Core E, 244 to 249cm. Dilution, 48% sample.

ANU-1791. **$D^{14}C = -454.2 \pm 8.6‰$** **4860 ± 130**

Dark gray to black lake mud. Core E, 343 to 348cm. Dilution, 36% sample.

ANU-1752. **$D^{14}C = -542.2 \pm 8.7‰$** **5970 ± 150**

Black, highly organic lake mud. Core E, 348 to 353cm. Dilution, 25% sample.

ANU-1903. **$D^{14}C = -563.3 \pm 8.6‰$** **6650 ± 160**

Grayish-colored lake mud with probably some carbonate present. Core E, 459 to 464cm. Dilution, 29% sample.

ANU-1800. **$D^{14}C = -619.0 \pm 4.1‰$** **7750 ± 90**

Dark gray to black lake mud. Core E, 580 to 590cm.

ANU-1943. **$D^{14}C = -591.0 \pm 6.0‰$** **7180 ± 120**

Organic lake mud. Core H, 490 to 510cm.

ANU-1944. **$D^{14}C = -635.6 \pm 5.8‰$** **8110 ± 130**

Organic lake mud. Core H, 580 to 600cm.

ANU-1945. **$D^{14}C = -643.9 \pm 4.5‰$** **8290 ± 100**

Organic lake mud. Core H, 660 to 675cm.

ANU-1946. **$D^{14}C = -711.7 \pm 3.5‰$** **9990 ± 100**

Black organic mud. Core H, 790 to 805cm.

ANU-1947. **$D^{14}C = -750.6 \pm 3.3‰$** **11,150 ± 110**

Pale brown organic mud. Core H, 820 to 835cm.

ANU-1948. **$D^{14}C = -779.8 \pm 3.7‰$** **12,150 ± 140**

Pale brown organic lake mud. Core H, 930 to 950cm.

ANU-1949. **$D^{14}C = -820.0 \pm 3.5‰$** **13,770 ± 160**

Pale brown organic lake mud. Core H, 990cm to end of core.

ANU-1951. **$D^{14}C = -755.5 \pm 4.2‰$** **11,320 ± 140**

Orange organic lake mud. Core I, 933 to 947cm.

ANU-1952. **$D^{14}C = -797.2 \pm 3.0‰$** **12,820 ± 120**

Orange organic lake mud. Core I, 1045 to 1060cm.

ANU-1953. **$D^{14}C = -822.9 \pm 3.0‰$** **13,900 ± 140**

Orange-gray calcareous mud. Core I, 1075 to 1090cm.

ANU-2032. **$D^{14}C = -843.2 \pm 4.8‰$** **14,890 ± 250**

Grayish organic mud. Core I, 1120 to 1130cm.

ANU-1954. **$D^{14}C = -865.2 \pm 2.5‰$** **16,100 ± 150**

Black organic mud. Core I, 1160 to 1173cm. Sample reaches lowest point of any core in Lake Bullenmerri.

ANU-1955. **$D^{14}C = -709.2 \pm 3.8‰$** **9920 ± 110**

Carbonate-rich organic mud. Core J, 715 to 730cm.

General Comment: this 16,000-year sequence of dates indicates continuous sedimentation in Lake Bullenmerri throughout interval, including period ca 15,000 to 10,000 yr BP when Lakes Gnotuk and Keilambete were dry. Many of dated samples (20 pairs) were from magnetically equivalent horizons in four different cores. In three cores, 11 pairs of samples were from vertically adjacent stratigraphic levels. Age differences for these paired results were more than 20% for 5 of magnetically correlated pairs and for 4 of stratigraphically adjacent pairs. This demonstrates that standard counting uncertainties (typically < 5%) are a poor indication of true errors in ^{14}C ages of these sediments (Barton and Polach, 1980). ANU-1951 to -1954 also used to support analyses carried out by J R Dodson (1979).

Lake Gnotuk series

Recent bathymetric profiles (Curry, 1970; Timms, 1976) show Lake Gnotuk in SW Victoria (38° 16′ S, 143° 07′ E) is uniform, flat-bottomed and steep-sided volcanic lake, similar to Lake Keilambete. Dense gray clay and ash (Yezdani, ms) were found at depths ca 3.5m, plugging bottom of most cores, underlying banded gray muds, which in turn are overlain by fine-grained organic muds (10 to 20% organic carbon) with much white aragonite laminae (12% carbonate) which provide precise stratigraphy. *Ostracod* shells are common, increasing in density at ca 3m. *Coxiella striata* shells are scattered through homogeneous black muds between 135cm and 190cm, in core GC, the master core.

ANU-1987. **$D^{14}C = -402.7 \pm 5.1‰$** **4140 ± 70**

Black organic mud. Core B, 130 to 140cm.

ANU-1988. **$D^{14}C = -511.5 \pm 4.3‰$** **5750 ± 70**

Black organic mud. Core B, 190 to 200cm.

ANU-1989. **$D^{14}C = -596.6 \pm 4.6‰$** **7290 ± 100**

Black organic mud. Core B, 250 to 260cm.

ANU-1990. **$D^{14}C = -683.5 \pm 4.7‰$** **9240 ± 120**

Black-gray organic mud. Core B, 310 to 320cm.

ANU-1936. **$D^{14}C = -96.2 \pm 8.5‰$** **810 ± 80**

Organic lake mud. Core G1C, 5 to 10 and 10 to 15cm.

ANU-1935. $D^{14}C = -152.2 \pm 7.6‰$ **1330 ± 70**

Lake mud with carbonate laminae. Core G1C, 50 to 56, 56 to 61, and 61 to 66cm.

ANU-2031. $D^{14}C = -307.1 \pm 7.8‰$ **2950 ± 100**

Dark grayish lake mud. Core G, 40 to 54cm.

General Comment: above dates compare favorably with those obtained by Yezdani (ms; Barton, Bowler, and Polach, ms in preparation). Regression line extrapolates to age of 295 ^{14}C yr at water-sediment interface, which is estimated from adjacent short cores to be 27cm above top of core GC. This does not necessarily imply any systematic contamination from ancient carbon within lake. In view of high internal consistency of ^{14}C ages, it is probable that step at 2000-3000 yr BP in Keilambete ages would also appear in more comprehensive set of Gnotuk ages.

Lake Keilambete series

Lake Keilambete floor is uniformly flat to ca 200m offshore (38° 13′ S, 142° 52′ E) in SW Victoria. Within this region aragonite laminae < 1mm thick can be traced in each core, such stratigraphic markers indicating very undisturbed sediments.

ANU-1807. $D^{14}C = -659.0 \pm 3.5‰$ **8640 ± 80**

Grayish, fine-grained lake mud with some carbonate present. Core F, 390 to 405cm.

ANU-1808. $D^{14}C = -718.9 \pm 3.2‰$ **10,190 ± 90**

Dark grayish lake mud with carbonate present. Core F, 420 to 440cm.

ANU-2053. $D^{14}C = -277.5 \pm 7.5‰$ **2610 ± 90**

Dark grayish lake mud. Core J, 50 to 70cm.

ANU-2054. $D^{14}C = -353.0 \pm 7.6‰$ **3500 ± 100**

Dark grayish lake mud. Core J, 100 to 120cm.

ANU-2055. $D^{14}C = -438.2 \pm 5.0‰$ **4630 ± 80**

Dark grayish lake mud. Core J, 160 to 180cm.

ANU-2056. $D^{14}C = -525.0 \pm 6.4‰$ **5980 ± 110**

Dark grayish lake mud. Core J, 225 to 245cm.

General Comment: after calibration and correction for water content and salinity, all dates give highly consistent sequence including comparison with previous dates on same area — "K4" (Bowler and Hamada, 1971), dated and reported as recommended by Stuiver and Polach (1977).

Valley Lake series

Valley Lake is 2nd largest of 4 lakes in recent volcanic craters at Mt Gambier, in SE corner of S Australia (37° 51′ S, 140° 46′ E). All 4 cores have clearly defined 8 to 10cm band of extremely fine-grained creamy white aragonite above graded column of calcareous tuff. These are overlain by ca 1m black freshwater organic mud, rich in shells (id by B J Smith, Nat Mus Victoria, as "assemblage of ostracod and freshwater bivalve *Pisidium* sp. These are found in freshwaters low in dissolved salts and usually permanent").

ANU-2051A. **$D^{14}C = -854.1 \pm 2.9‰$** **15,450 ± 160**
Est $\delta^{13}C = -5.0 \pm 2.0‰$

Carbonate mud, containing some organic material. Carbonate fraction. Core A, 117 to 124cm.

ANU-2051B. **$D^{14}C = -822.3 \pm 7.9‰$** **13,900 ± 370**

Carbonate mud containing some organic material. Organic fraction. Core as for ANU-2051A. *Comment*: carbonate fraction (ANU-2051A) is significantly different from organic fraction, which must be considered as having most reliable age. Dilution, 31% sample.

ANU-2125. **$D^{14}C = -308.0 \pm 7.1‰$** **2960 ± 90**

Lake mud. Core B, 40 to 50cm.

ANU-2126. **$D^{14}C = -390.0 \pm 5.7‰$** **3960 ± 80**

Lake mud. Core B, 80 to 90cm.

ANU-2052. **$D^{14}C = -536.6 \pm 4.2‰$** **6180 ± 80**

Grayish lake mud. Core B, 110 to 120cm.

ANU-1809. **$D^{14}C = -991.6 \pm 1.9‰$** **$38{,}400 \begin{matrix} +2070 \\ -1640 \end{matrix}$**

Dark grayish lake mud with carbonate present. Core D, 107 to 117cm.

General Comment: date obtained for ANU-1809 prompted more detailed research into cores chronology. Correlation between cores VD and VB for ANU-1809 is based on equal sedimentation rates between tuffs and may be in error by ca ± 5cm. It was unusual to find sufficient organic material in aragonite sample for result. Within organic muds monotonic age sequence is consistent with uniform deposition since ca 6000 yr BP.

Lake Purrumbete

Lake Purrumbete is freshwater lake in circular crater 8km SE of Camperdown, Victoria (38° 17′ S, 143° 14′ E). Floor is flat and sides unusually steep. Four cores recovered but only one ^{14}C date obtained.

ANU-1658. **$D^{14}C = -534.1 \pm 6.5‰$** **6140 ± 110**

Dark gray lake sediment. Bottom of core D, 580 to 590cm, from center of lake.

Lake Muir series

Organic-rich deposits were sampled from 3 sites in SW West Australia of which only Cowerup Swamp, peat bog at N end of Lake Muir was sampled for ^{14}C dates (34° 30′ S, 116° 39.5′ E).

ANU-1918. **$D^{14}C = -220.4 \pm 7.1‰$** **2000 ± 70**

Grayish-colored lake mud with probably some carbonate present. Core A, 8 to 11cm. Dilution, 45% sample.

ANU-1919. **$D^{14}C = -385.7 \pm 6.1‰$** **3910 ± 80**

Grayish-colored lake mud with probably some carbonate present. Core B, 8 to 13cm.

ANU-1917. **$D^{14}C = -796.2 \pm 10.8‰$** **12,800 ± 480**

Grayish-colored lake mud with probably some carbonate present. Core B, 79 to 102cm. Dilution, 19% sample. Sample contained max amount of dark material found in clay and approx defines base of lake excavation.

ANU-1916. **$D^{14}C = -195.8 \pm 7.1‰$** **1750 ± 70**

Grayish-colored organic lake mud with probably some carbonate present. Core C, 10 to 15cm.

ANU-1915. **$D^{14}C = -270.3 \pm 6.6‰$** **2530 ± 70**

Grayish-colored organic lake mud with probably some carbonate present. Core D, 5 to 117cm.

General Comment: results suggest that organic-rich freshwater lake sediments contain insufficient magnetic material and have water contents which are too high for useful paleomagnetic research.

SUMMARY

Recently, comparison was made between historic and observed magnetic data, archaeomagnetic data from aboriginal fireplaces, and paleomagnetic data from Lakes Keilambete, Bullenmerri, and Gnotuk (Barton and Barbetti, 1982). The study indicated that, although ^{14}C chronologies from these lakes are internally consistent, ^{14}C ages for upper sediments, and probably entire sequences, are systematically too old by ca 450 ^{14}C years (350 calendar years). The effect is not readily apparent from wet sedimentation rate curves due to greatly increased sedimentation in modern times.

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[RADIOCARBON, VOL 25, No. 1, 1983, P 39-58]

BRITISH MUSEUM NATURAL RADIOCARBON MEASUREMENTS XVI

RICHARD BURLEIGH, JANET AMBERS, and KEITH MATTHEWS

Research Laboratory, The British Museum, London WC1B 3DG, England

The following list consists of dates for archaeologic and geologic samples mostly measured from June 1981 to June 1982. The dates were obtained by liquid scintillation counting of benzene using the laboratory procedures outlined in previous lists (see, eg, BM-VIII, R, 1976, v 18, p 16). Dates are expressed in radiocarbon years relative to AD 1950 based on the Libby half-life for ^{14}C of 5570 yr, and are corrected for isotopic fractionation ($\delta^{13}C$ values are relative to PDB). No corrections have been made for natural ^{14}C variations (although in some instances approximate calibrated dates taken from the tables of R M Clark (1975) have been given in the comments where this aids interpretation of results). The modern reference standard is NBS oxalic acid (SRM 4990). Errors quoted with dates are based on counting statistics alone and are equivalent to $\pm$ 1 standard deviation ($\pm 1\sigma$). Descriptions, comments, and references to publications are based on information supplied by submitters.

ARCHAEOLOGIC SAMPLES

Algeria

Cherchel series

Samples from pit containing successive kilns in Roman Forum at Cherchel (36° 40′ N, 1° 40′ W). Coll 1979 and subm by T Potter, Dept Prehist and Romano-British Antiquities, British Mus.

1760 ± 130
$\delta^{13}C = -25.4‰$

BM-1909. Cherchel

Charcoal.

1620 ± 70
$\delta^{13}C = -23.0‰$

BM-1910. Cherchel

Charcoal, ref C79, 159.

General Comment (TP): on archaeol grounds kilns have *terminus post quem* of ca AD 450, but lie in deep pit within ruins of church, built ca AD 420, with substantial timber elements. Wood burned in kilns may have been seasoned timber from structure of church. Full pub will be in Benseddik, N and Potter, T W, Excavations at the Forum site at Cherchel: Archéol Algér Bull (supp vol), ms in preparation.

British Isles

Late Pleistocene/early Holocene mammalian extinctions and related samples

Bone samples (collagen fractions) from larger terrestrial mammals now extinct in Britain, dated as part of study of latest dates of survival of these sp in British Isles (R, 1976, v 18, p 30-31; R, 1982, v 24, p 262-269; Clutton-Brock and Burleigh, in press and in preparation).

8270 ± 80

BM-1725. Kildale $\delta^{13}C = -19.3‰$

11th dorsal vertebra of bull (*Bos primigenius*) from skeleton found in peaty marl deposit between Kildale Hall and R Leven, Kildale Park, N E Yorkshire, England (54° 25′ N, 1° 5′ W, Natl Grid Ref NZ 609097). Coll 1968 by R Close and R H Hayes and subm 1980 by Caroline Grigson, Odontol Mus, Royal Coll Surgeons, London. Dated for comparison with age of peaty marl (Zone IV/V interface by pollen analysis) and date for peat directly surrounding part of skeleton, 10,350 ± 200: GaK-2707, unpub (Jones, 1971, p 84-86, 90; Simmons, 1975, p 57). *Comment* (CG): result shows skeleton dates to Pollen Zone VI (late Boreal/Mesolithic period) and is thus among earlier group of dates for remains of *Bos primigenius* in Britain (*cf* BM-1841: 8620 ± 80, R, 1982, v 24, p 264), but does not agree with dating based on pollen evidence and GaK-2707 implying earliest *Bos primigenius* known from Britain (Grigson, 1978, p 50-53).

20,100 ± 1900

BM-1807. Thor's Fissure $\delta^{13}C = -19.3‰$

Calcaneum of reindeer (*Rangifer tarandus*) from Buxton Mus colln, labeled as from Thor's Fissure, Manifold Valley, Staffordshire, England (53° 5′ N, 1° 55′ W, Natl Grid Ref SK 090540). Coll 1950 and subm 1980 by D Bramwell, Peakland Archaeol Soc and R Jacobi, Dept Classics and Archaeol, Univ Lancaster. *Comment* (RJ): result suggests presence of reindeer in S Peak Dist at time of max spread of Devensian ice-sheet.

4790 ± 70

BM-1889. Corhampton $\delta^{13}C = -21.8‰$

Cranial (occipital) bone of *Bos primigenius* found in assoc with Windmill Hill style pottery during drainage excavation at Corhampton, Hampshire, England (51° 0′ N, 1° 10′ W, Natl Grid Ref SU 609202). Coll 1951 by F Cottrill and subm 1981 by C Grigson to provide date for *Bos* remains and assoc pottery. *Comment* (CG): result agrees with archaeol evidence and pattern of dates for other remains of *Bos primigenius* in S Britain (Grigson, in press).

Modern

BM-1980. Gugh $\delta^{13}C = -21.2‰$

Thoracic vertebra of juvenile *Bos* from articulated partial skeleton found at 2m depth below estimated original surface in later infilling in Pleistocene periglacial slope deposit ("Ram" or "Head") just above rocky shore, midway between Cow and Calf Rock and Kittern Rock, N end of Gugh I, Is of Scilly, Cornwall, England (49° 55′ N, 6° 20′ W, Natl Grid Ref SV 890080). Coll 1981 by B Tucker and subm by A J Sutcliffe, Dept Palaeontol, British Mus (Nat Hist). *Comment* (RB): large size of bones (juvenile with unfused epiphyses; growth incomplete) suggested remains of *Bos primigenius* and hence possible transport (as live animal or meat) to Is of Scilly by prehistoric man in Neolithic or Bronze age period, but date shows remains are those of recent large ox, possibly derived from shipwreck.

Netherton series

Samples from deserted late Saxon and Medieval manor site at Netherton, Faccombe, Hampshire, England (51° 20′ N, 1° 25′ W, Natl Grid Ref SU 374575). Coll 1977 to 1979 and subm by J Fairbrother, Dept Archaeol, Univ Southampton (Webster, 1978; 1979; 1980).

920 ± 35

BM-1899. Netherton $\delta^{13}C = -26.0‰$

Charcoal, ref NE/77 N10 2189 B1, from industrial area.

1000 ± 100

BM-1900. Netherton $\delta^{13}C = -25.5‰$

Charcoal, ref NE/78 P9 2643B, from primary fill of late Saxon industrial Pit 2643.

1000 ± 80

BM-1901. Netherton $\delta^{13}C = -23.9‰$

Charcoal, ref NE/78 P9 2648B, from late Saxon industrial Pit 2648.

720 ± 50

BM-1902. Netherton $\delta^{13}C = -25.9‰$

Combined charcoal samples, ref 9 Q4 3358 and NE/79 P5 3331A, from post holes of late Saxon aisled hall, Bldg 2.

710 ± 80

BM-2006. Netherton $\delta^{13}C = -22.3‰$

Charcoal, ref NE/79 Q4 3354, from late Saxon aisled hall, Bldg 2. Measured as check on BM-1902, above.

150 ± 50

BM-1905. Maldon $\delta^{13}C = -19.6‰$

Collagen from limb bones (radius, femur, and tibia) of domestic pig from complete skeleton found at ca 1m depth during excavation of late Iron age and early Roman salt-works at Osea Road Red Hill, Maldon, Essex, England (51° 45′ N, 0° 45′ E, Natl Grid Ref TL 887075). Coll 1972 by Kay de Brisay, Colchester Archaeol Group and subm 1981 by S Payne, Cambridge (de Brisay, 1972; 1973). Skeleton could not be dated from stratigraphic evidence (date for charcoal from site, Q-1173: 2130 ± 40, R, 1975, v 17, p 48). *Comment* (SP): skeleton (Payne, 1981) is evidently relatively recent and not contemporary with Iron age salt extraction workings.

South Lodge Camp series

Samples from Deverel-Rimbury enclosed settlement site at South Lodge Camp, Berwick St John, Cranborne Chase, Wiltshire, England (50° 50′ N, 2° 0′ W, Natl Grid Ref ST 954174), assoc with characteristic pottery and metalwork and close to Deverel-Rimbury barrow cemetery.

Coll 1980 during re-excavation of site by J Barrett and R Bradley (Barrett *et al*, in press) and subm by R Bradley, Univ Reading. Comment by R Bradley.

2790 ± 70
BM-1917 South Lodge Camp $\delta^{13}C = -24.7‰$

Charcoal, ref BPA 005, assoc with cremated bone in fill of Bucket Urn, buried in deposit of flint nodules in top of ditch fill of Barrow 3.

2680 ± 110
BM-1918. South Lodge Camp $\delta^{13}C = -25.0‰$

Charcoal, ref BPA 010, from fill of ?Bucket Urn containing cremation within group of burials outside Barrow 3.

2910 ± 60
BM-1919. South Lodge Camp $\delta^{13}C = -25.0‰$

Charcoal, ref BPA 011, from unurned cremation assoc with burned flint outside Barrow 3.

2660 ± 60
BM-1920. South Lodge Camp $\delta^{13}C = -26.4‰$

Charcoal, ref BPA 023/01, assoc with cremation and fragmented bronze spearhead (Taunton industrial phase) cut into top of ditch fill of Barrow 2.

3020 ± 60
BM-1921. South Lodge Camp $\delta^{13}C = -24.9‰$

Charcoal, ref SL80 F529a, from fill of post hole of principal roundhouse within enclosed settlement. Enclosure is aligned on bldg and sample should therefore date use of enclosure.

2890 ± 50
BM-1922. South Lodge Camp $\delta^{13}C = -25.6‰$

Charcoal, ref SL80 F529b, from same context as BM-1921, above.

2680 ± 50
BM-2023. South Lodge Camp $\delta^{13}C = -26.1‰$

Charcoal, ref BPA 80 023/01, from same context as BM-1920, above.

2730 ± 70
BM-2024. South Lodge Camp $\delta^{13}C = -26.1‰$

Charcoal, ref BPA 80 014 B, assoc with cremation outside Barrow 3 and overlain by base of globular urn.

General Comment (RB): BM-1921, -1922 are consistent with traditional date for site, suggested by metalwork and Taunton industrial phase, but enclosure is secondary to earlier field system that respects several nearby barrows. Remaining dates are for secondary burials in Barrows 2 and 3 of this group, the primary burials having been excavated by General Pitt Rivers in late 19th century. BM-1920, -1921 suggest Barrow 2 may be of later date than Barrow 3. Overall dates are entirely consistent with those from Handley Barrow 24 (BM-1644 to -1649, R, 1981, v 23, p 20-21), and similar enclosure at Down Farm (BM-1850 to -1854, R, 1982, v 24, p 271) and show continued use of Deverel-Rimbury pottery during late Bronze age in this area. Dates also suggest longer currency for Taunton metalwork than previously supposed.

1500 ± 40

BM-1923. Poundbury $\delta^{13}C = -20.8‰$

Collagen from human femur and tibia from inhumation ref PC80/1425, decapitation burial in Iron age ditch on edge of late 5th century AD Romano-British cemetery at Poundbury Camp, Dorchester, Dorset, England (50° 40′ N, 2° 25′ W, Natl Grid Ref SY 685912). Coll 1980 by C Green and A Graham and subm by Theya Molleson, British Mus (Nat Hist), to provide date for possible survival of pagan practice (Green, 1974; Harman, Molleson and Price, 1981). *Comment* (RB): result provides late date for decapitation burial in Britain within Christian era.

Street House Farm series

Samples from barrow site at Street House Farm, Loftus, Cleveland, England (54° 30′ N, 0° 50′ W, Natl Grid Ref NZ 736196). Coll 1980 and subm by B E Vyner, Cleveland Co Council, Archaeol Sec.

4720 ± 60

BM-1966. Street House Farm $\delta^{13}C = -26.3‰$

Charcoal, ref 30, from Plank 3, Quad 26.

4620 ± 60

BM-1967. Street House Farm $\delta^{13}C = -25.1‰$

Charcoal, ref 56, from vertical post 9, id as *Quercus* sp by Rowena Gale, Royal Botanic Gardens, Kew.

4690 ± 60

BM-1968. Street House Farm $\delta^{13}C = -25.9‰$

Charcoal, ref 33, from Plank 3, Quad 22.

4720 ± 50

BM-1969. Street House Farm $\delta^{13}C = -26.1‰$

Charcoal, ref 57, from vertical post 10, id as *Quercus* sp by R Gale.

3220 ± 45

BM-2007. Street House Farm $\delta^{13}C = -24.9‰$

Charcoal, ref 85, id as *Quercus* sp by R Gale, from interface between Bronze age cairn and Neolithic mound.

2485 ± 45

BM-2008. Street House Farm $\delta^{13}C = -24.4‰$

Charcoal, from Feature 46; interface between Bronze age cairn and Neolithic mound.

3360 ± 50

BM-2009. Street House Farm $\delta^{13}C = -25.0‰$

Charcoal, from base 31/interface 46; interface between Bronze age cairn and Neolithic mound.

3170 ± 45

BM-2010. Street House Farm $\delta^{13}C = -24.0‰$

Charcoal, from Feature 116, pit in center of mortuary enclosure.

4630 ± 80

BM-2011. Street House Farm $\delta^{13}C = -24.2‰$

Charcoal, ref 144, from Feature 105, old ground surface beneath clay mound.

4610 ± 80

BM-2012. Street House Farm $\delta^{13}C = -25.5‰$

Charcoal, ref 150, from Feature 105, old ground surface beneath clay mound.

4510 ± 90

BM-2013. Street House Farm $\delta^{13}C = -26.2‰$

Charcoal, from Feature 111, S sec of facade trench.

4630 ± 70

BM-2014. Street House Farm $\delta^{13}C = -25.5‰$

Charcoal, from Feature 110, S sec of facade trench.

4500 ± 130

BM-2060. Street House Farm $\delta^{13}C = -25.6‰$

Charcoal, ref 111, from Feature 92, underlying kerb of mortuary enclosure.

5070 ± 50

BM-2061. Street House Farm $\delta^{13}C = -25.3‰$

Charcoal, from Feature 99, proximal pit. Only timber found *in situ* in facade trench.

General Comment (BEV): BM-1966 to -1969 are from timbers of mortuary structure and form very consistent group within expected age range. BM-2013, -2014 are also consistent and confirm suggestion that facade timbers are roughly contemporary with those of mortuary structure. BM-2061, also from facade trench, was from largest timber on site (ca 1m diam) and date may reflect initial age of wood. BM-2011, -2012 probably represent clearance or ritual activity prior to construction of mortuary structure. BM-2007 to -2009 represent interface between Neolithic structure and overlying Bronze age mound, although BM-2008 seems anomalous in this context. BM-2010 is from apparently sealed pit and does not accord with expectations. BM-2060 confirms charcoal underlying cairn represents activity on site ca time of construction of mortuary structure. Generally, results are extremely consistent and agree with present interpretation of site.

Ascott-under-Wychwood series

Collagen from bone samples from burials in separate stone cists in Neolithic long barrow at Ascott-under-Wychwood, Oxfordshire, England (51° 50′ N, 1° 35′ W, Natl Grid Ref SP 299176). Coll 1968 and subm by D Benson, Oxford City and Co Mus (now Dyfed Archaeol Trust Ltd).

4430 ± 130

BM-1974. Ascott-under-Wychwood $\delta^{13}C = -21.4‰$

Collagen from adult humerus, ref 534/37, from Deposit E, Chamber 7.

3480 ± 50

BM-1975. Ascott-under-Wychwood $\delta^{13}C = -21.8‰$

Collagen from adult femur, ref 330/5, from thick deposit of bones piled outside and against outer stone of outer cist, sealing Abingdon bowl.

4535 ± 40

BM-1976. Ascott-under-Wychwood $\delta^{13}C = -19.7‰$

Collagen from adult femur, ref 891/55, from Deposit A, Chamber 3.

General Comment (RB): *cf* BM-491b, -492, -832, -833, -835 to -837 and *General Comment*: R, 1976, v 18, p 19-20.

845 ± 40

BM-2018. Vale Castle $\delta^{13}C = -24.5‰$

Charcoal, ref D2B 7, from base of prehistoric rampart at Vale Castle, Guernsey, Channel Is (49° 35′ N, 2° 35′ W, Natl Grid Ref WV 357817). Coll 1980 by K J Barton, Hampshire Mus and subm by I A Kinnes, Dept Prehist and Romano-British Antiquities, British Mus. *Comment* (RB): invalidated by misassoc.

1300 ± 500

BM-2019. Jerbourg $\delta^{13}C = -25.0‰$

Charcoal, ref RIA(WIA), from 1st rampart of defended site at Jerbourg, Guernsey, Channel Is (49° 30′ N, 2° 45′ W, Natl Grid Ref WV 338751). Coll 1980 by R B Burns, Guernsey Mus, and subm by I A Kinnes. Fractionation correction estimated. *Comment* (RBB): sample, although small, was apparently stratigraphically secure in Early Bronze age context. No evidence of activity appropriate to this 1st millennium AD date was recovered, but result is clearly invalidated by misassoc.

820 ± 150

BM-2044. Canterbury $\delta^{13}C = -20.0‰$

Collagen from right femur of large domestic dog, id by Juliet Clutton-Brock, Dept Zool, British Mus (Nat Hist), from articulated skeleton lying on thin layer of silt overlying tessellated floor of 2nd century AD Roman bldg and constituting primary fill of 7th century Saxon hut, at Canterbury, Kent, England (51° 15′ N, 1° 5′ E, Natl Grid Ref TR 150570). Coll 1978 by Marion Day and subm by T Tatton-Brown, Dir Canterbury Archaeol Trust. *Comment* (RB): *cf* BM-1523: 1850 ± 70, R, 1982, v 24, p 231-232. Disparity may be due to contamination of bone used for BM-1523, with ancient carbon during casting before destruction for dating. On basis of new result, BM-2044 (bone not cast), skeleton may represent interment of remains of large Medieval hunting dog into Saxon levels during 12th century, and not redeposited Romano-British skeleton (see BM-1523, *Comment*, R, 1982, v 24, p 232); 12th century robber ditches on site (Tatton-Brown, pers commun).

Cyprus

Ayios Epiktitos Vrysi series

Samples from ultimate and penultimate stages of late phase of Neolithic settlement (Peltenburg, 1975) at Ayios Epiktitos Vrysi, E of Kyrenia (32° 20′ N, 33° 25′ E). Coll 1972 to 1973 and subm by E J Peltenburg, Univ Edinburgh.

5030 ± 80
BM-1906. Ayios Epiktitos Vrysi $\delta^{13}C = -25.4‰$

Charcoal, ref VD 1, from pit and wall tumble.

5120 ± 45
BM-1907. Ayios Epiktitos Vrysi $\delta^{13}C = -26.0‰$

Charcoal, ref VE 8.

5180 ± 60
BM-1908. Ayios Epiktitos Vrysi $\delta^{13}C = -26.1‰$

Charcoal, ref VD 10.

General Comment (EJP): BM-1906, -1907 provide dates for accumulation of debris forming late phase at Vrysi; BM-1908 dates immediately preceding levels. BM-1906 is particularly important in determining pace of developments during transition from Neolithic to Chalcolithic Cyprus. For other dates from site, *cf* Birm-182: 3875 ± 145, R, 1971, v 13, p 155; Birm-337: 3790 ± 140, R, 1973, v 15, p 468; GU-453: 3468 ± 79, -454: 3401 ± 94, -455: 3303 ± 150, R, 1973, v 15, p 489; BM-843: 3405 ± 67, -844: 3325 ± 47, -845: 3410 ± 57, R, 1977, v 19, p 146.

Ecuador

Hacienda Guarumel series

Samples from layers corresponding to occupation horizons, in shell midden of Jambeli culture, at coastal site Hacienda Guarumel, Canal de Jambeli, near Machala, Azuay (3° 20′ S, 80° 0′ W). No ^{14}C dates available for culture, which represents small-scale exploitation of coastal resources; culture is provisionally dated to 500 BC to AD 500. Coll 1976 and subm by Elizabeth J Carter, Inst Archaeol, Univ London.

1475 ± 35
BM-1688. Hacienda Guarumel $\delta^{13}C = -24.1‰$

Charcoal, ref HG 76 A4 S22.

1960 ± 40
BM-1689. Hacienda Guarumel $\delta^{13}C = -23.3‰$

Charcoal, ref HG 76 B27 S52.

Egypt

3180 ± 140
BM-1846. Gawāsīs $\delta^{13}C = -10.1‰$

Knot of grass rope (*Desmostachya* sp id by D Cutler, Royal Botanic Gardens, Kew), from shrine of Ankhow at mouth of Wādī Gawāsīs, N of Quseir, on Red Sea coast (26° 40′ N, 34° 10′ E) assoc with Pharaonic port and texts of Sesostris I (Sayed, 1977; 1978; 1980). Coll 1976 and subm by A Sayed, King Abdulaziz Univ, Jeddah. *Comment* (RB): measured as check on BM-1844: 3230 ± 45, R, 1982, v 24, p 276.

France

Montgaudier series

Samples from Magdalenian levels in different sites within or adjacent to very large multi-chambered caves (Duport, 1976) at Montgaudier Cave, near Montbron, Charente (45° 40′ N, 0° 30′ E). Coll 1975 to 1980 by L Duport, Angoulême and subm by G de G Sieveking, Dept Prehist and Romano-British Antiquities, British Mus.

11,450 ± 70
BM-1911. Montgaudier $\delta^{13}C = -19.7‰$

Collagen from bone fragments, from Abri Gaudry, Sq A′44, Layer 2.

12,180 ± 130
BM-1912. Montgaudier $\delta^{13}C = -19.9‰$

Collagen from bone fragments, from Abri Gaudry, Sq D′43, Layer 1.

18,050 ± 230
BM-1913. Montgaudier $\delta^{13}C = -20.4‰$

Collagen from bone fragments, from exterior platform.

18,180 ± 1070
BM-1914. Montgaudier $\delta^{13}C = -21.0‰$

Collagen from bone fragments, from opposite hearth, Sq J 20.

13,320 ± 360
BM-1916. Montgaudier $\delta^{13}C = -19.6‰$

Collagen from bone fragments, from Abri Paignon.

General Comment (GdeGS): BM-1911, -1912 are from superimposed final Magdalenian occupation deposits in Abri Gaudry. Results are in stratigraphic order and are closely similar to other determinations for final Magdalenian in France. BM-1913 dates bone fragments assoc with Magdalenian artifacts, on platform in front of main entrance to cave, where 19th century excavations uncovered decorated baton and other Magdalenian IV material. This result is much earlier than any other Magdalenian IV date and seems to suggest that early Magdalenian deposits underlie those of Magdalenian IV here. BM-1914, from bone assoc with Magdalenian deposits from 1st floor level in cave, suggests that deposits are also of early Magdalenian date.

Figure of Christ series

Wood samples (*Juglans* sp, id by Rowena Gale, Royal Botanic Gardens, Kew) drilled from detachable arms and body of near life-size carved wooden figure of Christ, of French origin and claimed to date to 12th century AD. Subm 1981 by N M Stratford, Dept Medieval and Later Antiquities, British Mus.

BM-1977. Figure of Christ **440 ± 60** $\delta^{13}C = -24.6‰$

Wood drilled from center of body at back of figure.

BM-1978. Figure of Christ **830 ± 100** $\delta^{13}C = -24.0‰$

Wood drilled from left arm.

BM-1979. Figure of Christ **830 ± 120** $\delta^{13}C = -23.2‰$

Wood drilled from right arm.

Greece

Agios Petros series

Samples from Level 7 in Neolithic settlement site at Agios Petros, Kyra Panagia, N Sporades (39° 20′ N, 24° 0′ E). Coll 1981 and subm by N Efstratiou, Inst Archaeol, Univ London. Site is earliest settlement found in Aegean region (Evans and Renfrew, 1968).

BM-2020. Agios Petros **6400 ± 80** $\delta^{13}C = -24.8‰$

Charcoal from W of Wall K.

BM-2021. Agios Petros **5510 ± 390** $\delta^{13}C = -25.0‰$

Charcoal from topsoil level. Fractionation correction estimated.

General Comment (NE): dates are as expected; BM-2020 is well within Middle Neolithic period of Greek sequence while BM-2021 comes from disturbed deposit and is understandly quite late.

Hungary

E Hungarian Neolithic series

Samples dated to establish Neolithic sequence as part of Hungarian Acad Sci Topographic Program in Ko Békés II, E Hungary. Coll by Dr J Makkay, Hungarian Acad Sci and subm by Dr J Chapman, Univ Newcastle upon Tyne.

BM-1860. Békésszentandrás no. 28 **6080 ± 60** $\delta^{13}C = -22.6‰$

Charcoal from 80 to 160cm level of late Alföld Bandkeramik refuse pit at Békésszentandrás no. 28, 5km SSE of Békésszentandrás, Ko Békés (46° 50′ N, 20° 30′ E). Coll 1978.

BM-1861. Szarvas no. 1 **5630 ± 140** $\delta^{13}C = -23.7‰$

Charcoal from depth 160 to 190cm in Szakalhát period level at Szarvas no. 1, 1km NW of Szarvas, Ko Békés (46° 55′ N, 20° 30′ E). Coll 1975.

BM-1862. Battonya-Basarága **6580 ± 60** $\delta^{13}C = -24.3‰$

Charcoal from fill of Körös culture refuse Pit no. III at Battonya-Basarága, near Battonya, Ko Békés (46° 15′ N, 21° 0′ E). Coll 1977.

Endröd no. 39 series

Samples from fill of Körös culture refuse pits at Endröd no. 39, 1 of largest early Neolithic sites in Békés II area, 4.5km SSW of Ko Békés (46° 55′ N, 20° 45′ E). Coll 1975 to 1976.

6840 ± 110
BM-1863. Endröd no. 39 $\delta^{13}C = -26.3‰$

Charcoal from Pit no. IV/I.

6830 ± 60
BM-1868. Endröd no. 39 $\delta^{13}C = -24.9‰$

Charcoal from Pit no. I, Tr XVIII, at depth 60 to 90cm.

6600 ± 80
BM-1870. Endröd no. 39 $\delta^{13}C = -25.1‰$

Charcoal from Pit no. I, Tr XVIII, at depth 90 to 120cm.

6470 ± 70
BM-1871. Endröd no. 39 $\delta^{13}C = -25.0‰$

Charcoal from Pit no. I, Tr XIX.

6090 ± 60
BM-1864. Endröd no. 35 $\delta^{13}C = -28.7‰$

Charcoal from fill of Körös refuse Pit no. III, at Endröd no. 35, 3km S of Endröd, Ko Békés (46° 55′ N, 20° 50′ E). Coll 1976.

Szarvas no. 23 series

Samples from Körös culture refuse pits at Szarvas no. 23, 1.5km E of Szarvas, Ko Békés (46° 50′ N, 20° 35′ E), assoc with pottery possibly dating to earliest Neolithic occupation of Hungary. Coll 1976.

6190 ± 140
BM-1865. Szarvas no. 23 $\delta^{13}C = -27.7‰$

Charcoal from fill of Pit no. VII/I.

6620 ± 60
BM-1866. Szarvas no. 23 $\delta^{13}C = -25.1‰$

Charcoal from fill of Pit no. IX/I.

5730 ± 90
BM-1867. Szarvas no. 102 $\delta^{13}C = -25.3‰$

Charcoal from inside House 1 of classic Alföld Bandkeramik period at Szarvas no. 102, 2km NNE of Szarvas, Ko Békés (46° 55′ N, 20° 30′ E). Coll 1977.

General Comment (JC): BM-1863, -1868, -1870, -1871 agree well with middle to late Körös stylistic dating. BM-1863 and -1868 provide 1st dates for middle Körös phase, whilst BM-1870 and -1871 agree well with late Körös dates from Deszk, Hódmezővásárhely-Kotacpart (Bln-75: 7090 ± 100 bp, R, 1964, v 6, p 315), Devavanya-Atyaszeg (6190 bp; Kalicz and Makkay, 1977, p 110) and BM-1862 from Battonya. BM-1865 and -1866 agree with late-latest Körös dates from Deszk (Bln-581 to -584: 6605-6260 bp, R, 1970, v 12, p 408); Szarvas-23 Pits VIII and IX contain late Körös material in assoc with early AVK pottery. BM-1864 is 300 to 400 yr too young. BM-1867 seems 300 to 400 yr too young for a classic Alföld Bandkeramik phase (*cf* date for Tarnabod, Bln-123: 6280 ± 100 bp, R, 1964, v 6, p 316). BM-1860 fits well with late Alföld Bandkeramik dates of 6136 ± 100 bp from Szamossályi (Bln-404, R, 1966, v 8, p 39), 6180 ± 100 bp from Ostoros (Bln-549, R, 1970, v 12, p 410) less well with Bln-505 from Tiszavasvari-Keresztfal (6305 ± 100 bp, R, 1970, v 12, p 413). BM-1861 appears to be 400 to 500 yr too young and may date 4th millennium Tisza occupation on site.

Pakistan

Pakistan series

Charcoal samples measured to provide information on previously undated periods in Pakistan (Durrani, 1981; 1982; Khan, 1981; Allchin, 1982). All samples coll 1980 to 1981 and subm by K D Thomas, British Archaeol Mission to Pakistan, and Inst Archaeol, Univ London.

Sarai Khola series

Samples from site at Sarai Khola, Taxila Valley, Taxila, Punjab Prov (33° 30′ N, 72° 30′ E). BM-1934, -1935, -1937, -1939, -1940 all from Neolithic contexts from floors assoc with degraded mud-brick and ash pits. These levels are only manifestations of this culture in the Punjab. No previous dates for Neolithic in Pakistan E of R Indus. BM-1936, -1938, -1942 to -1946 from Kot Dijian levels. BM-1947 from Medieval level.

4250 ± 110
BM-1934. Sarai Khola $\delta^{13}C = -23.7‰$
Charcoal, ref SK 81/4.

4140 ± 230
BM-1935. Sarai Khola $\delta^{13}C = -23.5‰$
Charcoal, ref SK 81/3.

3890 ± 230
BM-1936. Sarai Khola $\delta^{13}C = -24.6‰$
Charcoal, ref SK C8.

3810 ± 60
BM-1938. Sarai Khola $\delta^{13}C = -24.6‰$
Charcoal, ref SK C6.

4310 ± 120
BM-1939. Sarai Khola $\delta^{13}C = -25.2‰$
Charcoal, ref SK 81/6.

4380 ± 170
BM-1940. Sarai Khola $\delta^{13}C = -24.2‰$
Charcoal, ref SK 81/5.

3910 ± 70
BM-1942. Sarai Khola $\delta^{13}C = -24.5‰$
Charcoal, ref C4.

3700 ± 60
$\delta^{13}C = -24.9‰$

BM-1943. Sarai Khola
Charcoal, ref SK81/2.

4040 ± 200
$\delta^{13}C = -26.1‰$

BM-1944. Sarai Khola
Charcoal, ref C5.

3790 ± 60
$\delta^{13}C = -24.7‰$

BM-1945. Sarai Khola
Charcoal, ref SK81/1.

3700 ± 80
$\delta^{13}C = -23.1‰$

BM-1946. Sarai Khola
Charcoal, ref C1.

870 ± 50
$\delta^{13}C = -24.5‰$

BM-1947. Sarai Khola
Charcoal, ref C7.

3690 ± 450
$\delta^{13}C = -24.7‰$

BM-1941. Islam Chauki
Charcoal from ash pit in Kot Dijian level sealed by floors and degraded mud-brick at Islam Chauki, W of Bannu City, North West Frontier Prov (33° 0′ N, 70° 30′ E).

Hathial West series

Samples from well-sealed floor levels of Kot Dijian period at Hathial West, near Taxila Mus, Punjab Prov (33° 30′ N, 72° 30′ E).

3600 ± 60
$\delta^{13}C = -25.4‰$

BM-1948. Hathial West
Charcoal, ref 1.

3750 ± 100
$\delta^{13}C = -25.2‰$

BM-1949. Hathial West
Charcoal, ref 2.

1740 ± 40
$\delta^{13}C = -24.4‰$

BM-1950. Hathial North
Charcoal from under structural materials assoc with fortification of early Historic period at Hathial North, near Taxila Mus, Punjab Prov (33° 30′ N, 72° 30′ E), assoc with early Historic period and unique gray-ware pottery.

Bhir Mound series

Samples from major occupation levels from one of Historic period cities of Taxila Valley at Bhir mound, Taxila, Punjab Prov (33° 30′ N, 72° 30′ E).

1990 ± 60
$\delta^{13}C = -26.5‰$

BM-1951. Bhir Mound
Charcoal, ref 1.

BM-1952. Bhir Mound **1920 ± 170**
$\delta^{13}C = -24.7‰$
Charcoal, ref 2.

BM-1953. Bhir Mound **1930 ± 50**
$\delta^{13}C = -25.2‰$
Combined charcoal samples, refs 3 and 4.

BM-1954. Bhir Mound **1830 ± 40**
$\delta^{13}C = -23.5‰$
Charcoal, ref 5.

BM-1955. Bhir Mound **2050 ± 60**
$\delta^{13}C = -25.2‰$
Charcoal, ref 6.

BM-1956. Bhir Mound **1795 ± 35**
$\delta^{13}C = -24.8‰$
Charcoal, ref 7.

BM-1957. Bhir Mound **2000 ± 45**
$\delta^{13}C = -24.1‰$
Charcoal, ref 8.

BM-1958. Bhir Mound **2010 ± 40**
$\delta^{13}C = -24.4‰$
Charcoal, ref 9.

BM-1959. Bhir Mound **1950 ± 50**
$\delta^{13}C = -24.7‰$
Charcoal, ref 10.

BM-1960. Bhir Mound **1805 ± 35**
$\delta^{13}C = -24.7‰$
Charcoal, ref 11.

BM-1961. Bhir Mound **2050 ± 80**
$\delta^{13}C = -25.2‰$
Charcoal, ref 12.

BM-1963. Bhir Mound **2120 ± 200**
$\delta^{13}C = -25.4‰$
Charcoal, ref 14.

BM-1964. Bhir Mound **2080 ± 80**
$\delta^{13}C = -24.2‰$
Charcoal, ref 15.

BM-1965. Bhir Mound **2090 ± 90**
$\delta^{13}C = -25.1‰$
Charcoal, ref 16.

Rehman Dheri series

Samples from Kot Dijian III layers at Rehman Dheri, 23km N of Dera Ismail Khan City, North West Frontier Prov (31° 50′ N, 70° 55′ E).

BM-2062. Rehman Dheri **3730 ± 50**
$\delta^{13}C = -24.7‰$

Charcoal, ref RHD1, from depth 170cm.

BM-2063. Rehman Dheri **3580 ± 110**
$\delta^{13}C = -22.8‰$

Charcoal, ref RDH2, from depth 50cm.

General Comment (KDT): BM-1934, -1935, -1937, -1940, all from Neolithic contexts, are comparable with dates from sites W of R Indus, Ghaligai, Swat and Burzahom, Kashmir (Agrawal, 1982, p 270-271), but are later than those from Kili Ghul Mohammad (Agrawal, 1982, p 270) and Mehrgarh (Lechevallier and Quivron, 1981, p 91) both in Baluchistan. Results are close to dates from early Kot Dijian levels (see below) and suggest that Sarai Khola was not abandoned for long period between Neolithic and Kot Dijian occupations. BM-1936, -1942, -1944, relating to early Kot Dijian pits at Sarai Khola, and BM-1938, -1945, from upper fills of these pits, are rather later than expected, clustering in late Kot Dijian when compared with dates from Kot Diji (Khan, 1981), Gumla (Dani, 1971), Amri (Casal, 1964) and Rehman Dheri III (Durrani, 1981; 1982, but see BM-2062, -2063, below). Other dates from Kot Dijian contexts, BM-1943, -1946 from later floors at Sarai Khola, BM-1941 from Islam Chauki, BM-1948, -1949 from Hathial West and BM-2062, -2063 from Rehman Dheri III form remarkably consistent homogeneous group that compares well with dates from Tarakai Kala Dheri (BM-1690 to -1695, R, 1982, v 24, p 281). All these dates indicate survival of Kot Dijian elements into latter part of 3rd millennium BC and are much later than other Kot Dijian sites in Pakistan, falling into period of mature Harappan. A reappraisal of chronol, cultural, and geographic relationship of Kot Dijian and Harappan "cultures" is indicated; it may be significant that, with the exception of small mound of Hisam Dheri near Rehman Dheri (Dani, 1971), no Harappan sites are known in vicinity of Kot Dijian sites discussed here. Dates for Hathial North (BM-1950) and Bhir Mound (BM-1951 to -1965) all relate to Historic period. BM-1950 appears considerably later than date suggested by assoc pottery (Allchin, 1982, p 13). Bhir Mound, till recently believed to be 1st city in Taxila but now replaced by Hathial (Allchin, 1982), remains one of most important archaeol sites in Pakistan. Samples were coll from small excavation adjacent to extensive excavations of Sharif in 1969. BM-1961 to -1965, from series of clearly stratified floors of earliest occupation, have produced samples much later than expected and may indicate that this part of city was built quite late and persisted during occupation at Sirkap, previously held to succeed Bhir Mound (Marshall, 1951). BM-1951 to -1960 are apparently assoc with industrial activity, indicated by large amounts of charcoal and iron slag. Range of dates may reflect age of wood exploited but most dates are late, clustering in 1st century AD after calibration. Date as late as 1740 ± 40 (BM-1950) is quite unexpected and it seems clear that chronol of site and others in Taxila will have to be reconsidered. BM-1947, from rubbish pit in Phase IV at Sarai Khola is acceptable for late Hindu Shahi site E of R Indus (Halim, 1972a,b, p 112).

Peru

2380 ± 70

BM-1633. Cusichaca project $\delta^{13}C = -23.0‰$

Charcoal, ref Q211-75-Level 12, from Bldg 17, Group 3 of promontory site overlooking R Cusichaca, near confluence with R Urubamba, Chuncuchua, Huillca Raccay, Dept Cuzco, Peru (13° 10′ S, 72° 25′ W). Coll 1975 and subm by Ann Kendall, Dir Cusichaca Archaeol Proj. Sample from 1m depth in test pit, occupation level assoc with Chanapata pottery (Kendall, 1976). *Comment* (AK): result fits well within broad age range of 1000 to 300 BC expected.

Spain

Moncín series

Samples from clearly stratified Bronze-age midden 2.2m deep, overlying stone wall, at multi-period settlement site at Moncín (Moreno-Lopez, Legge, and Harrison, in press) Borja, Zaragoza (41° 50′ N, 1° 30′ W). Houses on stone terraces and Bell Beaker and Early Bronze-age cultural material present on site. Coll 1980 by R J Harrison, Dept Classics and Archaeol, Univ Bristol and subm by R J Harrison and A J Legge, Extra Mural Dept, Univ London.

2960 ± 40

BM-1924. Moncín $\delta^{13}C = -23.2‰$

Charcoal, ref 1, (Period III), from fill of large pit, F2, cutting into earlier midden deposit. Assoc with animal bone and pottery.

3020 ± 45

BM-1925. Moncín $\delta^{13}C = -25.0‰$

Charcoal, ref 2, (Period III), from fill of large pit, F3, similar to F2.

2880 ± 35

BM-1926. Moncín $\delta^{13}C = -25.1‰$

Charcoal, ref 3, (Period II), from Layer 3.

3040 ± 45

BM-1927. Moncín $\delta^{13}C = -28.7‰$

Charcoal, ref 5, (Period I), from Layer 6.

2915 ± 45

BM-1928. Moncín $\delta^{13}C = -23.8‰$

Charcoal, ref 4, (Period II), from Level 7.

General Comment (RJH): examination of archaeol material from midden shows it to be important and homogeneous deposit of beginning of Spanish Late Bronze age, and characteristic Boquique decorated sherds agree exactly with ^{14}C dates. Midden is last phase of 1200-yr occupation of site, which stretches from 2200 to 1000 BC. Culturally, material is analogous to Valencian Bronze age of Spanish Levant.

Ferrandell-Oleza series

Samples from Beaker settlement site at Ferrandell-Oleza, Old Settlement, Valldemosa, Mallorca, Baleares (39° 40′ N, 2° 30′ E), assoc with Beaker pottery, worked flints and domestic animal remains. Coll 1981 and subm by W H Waldren, Donald Baden-Powell Quaternary Res Centre, Pitt Rivers Mus, Univ Oxford and Dir, Deya Archaeol Mus and Research Centre, Deya de Mallorca.

3720 ± 35
BM-1981. Ferrandell-Oleza $\delta^{13}C = -23.0‰$

Charcoal, from Exploratory Tr S, Sec Q-J3, assoc with flint blades and Beaker sherds.

1710 ± 60
BM-1982. Ferrandell-Oleza $\delta^{13}C = -24.5‰$

Charcoal, from Structure C2, from under renovated pebble floor. *General Comment* (RB): *cf* BM-1843: 3950 ± 60, R, 1982, v 24, p 282, (see also Waldren, 1981a; b). BM-1982 is ca 2000 yr later than expected and appears to be invalidated by misassoc.

Muertos Gallard series

Samples from Beaker occupation of rock shelter at Muertos Gallard, Deya, Mallorca, Baleares (39° 40′ N, 2° 35′ E). Coll 1967 and subm by W H Waldren.

855 ± 35
BM-1993. Muertos Gallard $\delta^{13}C = -25.3‰$

Charcoal, ref 2 and 3, from under 'F' rock, 90cm level.

4760 ± 50
BM-1994. Muertos Gallard $\delta^{13}C = -24.2‰$

Charcoal, ref 19, from Sec J6, 160cm level.

General Comment (RB): *cf* Y-1789: 3790 ± 80 (Waldren, 1981a); BM-1994 is much earlier than expected, BM-1993 is invalidated by misassoc.

3380 ± 50
BM-1995. Son Matge $\delta^{13}C = -24.0‰$

Charcoal from Tr 3C, 240cm level, at rock shelter at Son Matge, Estret, Valldemosa, Mallorca, Baleares (39° 35′ N, 2° 25′ E). Coll 1975 and subm by W H Waldren. *Comment* (RB): date is late Pretalayotic/early Talayotic (for other dates for Son Matge, see Waldren, 1981a).

2645 ± 40
BM-1998. Son Puig-Servera $\delta^{13}C = -24.2‰$

Charcoal from habitation level at Son Puig-Servera, Palma, Mallorca, Baleares (39° 35′ N, 2° 30′ E). Coll 1967 by G Rossello-Bordoy, Dir Mus Mallorca, Palma and subm by W H Waldren. *Comment* (RB): *cf* Y-2673: 2180 ± 100 (Waldren, 1981a).

Taula de Torralba d'en Salord series

Samples from 3 distinct levels in interior (E part of bldg) of Taula de Torralba d'en Salord, 2.5km SE of Alayor, Menorca, Baleares (39° 55′ N, 4° 10′ E). Coll 1981 and subm by E A C Sanders, Deya Archaeol Mus and Research Centre. Samples measured to verify dating based on ceramics and coins (BM-2003), to establish time of abandonment of Taula (BM-2004; also provides min date for introduction to Menorca of shrew, *Crocidura* sp, not previously found in archaeol context there), and to help resolve disputed question of whether Taula was roofed (BM-2005).

2090 ± 50

BM-2003. Taula de Torralba d'en Salord $\delta^{13}C = -23.2‰$

Charcoal from Sec Entrada A, Level Lower IV (125cm), representing period of continual (probably ritual) use of Taula. Ceramics and 3 of 4 coins from this level indicate date of 230 to 150 BC; 4th coin was minted in Roman colony of Nîmes ca 0 BC and may be intrusive.

1890 ± 35

BM-2004. Taula de Torralba d'en Salord $\delta^{13}C = -24.4‰$

Charcoal from Sec M, Level Upper IV (90 to 95cm). End of period of (ritual) use of Taula (abandonment of bldg); 1st level containing remains of shrew, *Crocidura* sp.

1560 ± 80

BM-2005. Taula de Torralba d'en Salord $\delta^{13}C = -24.5‰$

Combined charcoal samples from Sec M, Level III (80cm) and Sec K, Level III (85cm). Level III covers lower levels preserving many whole artifacts, indicating rapid sedimentation following abandonment of Taula (possibly following collapse of roof). If bldg was roofed as has been suggested and sample represents collapsed and burned roof timbers, date should be earlier than underlying level Upper IV (BM-2004).

General Comment (RB): BM-2003 tends to support earlier dating for period of use of Taula of 230 to 150 BC based on ceramics and coins, but at $+ 1\sigma$ does not prove later Roman coin is intrusive (*cf* also, BM-2004). BM-2004 provides date for abandonment of Taula and this appears later than dates of 2 major hist events suggested as possible causes of abandonment (last Punic war, 146 BC and Roman occupation of Balearic Is, 123 BC). Result also dates 1st recorded occurrence in archaeol levels on Menorca of remains of shrew *Crocidura* sp, now numerous on I. BM-2005 does not support suggestion that Taula was roofed (while leaving open possibility that bldg was roofed and remains of roof are not represented by this sample).

Syria

Tell Brak series

Samples from occupation site at Tell Brak (Mallowan, 1947; Oates, 1977; 1982), near El Haseke, NE Syria (36° 40′ N, 41° 0′ E). Coll 1981 and subm by Joan Oates, Girton Coll, Univ Cambridge. All samples except BM-1970 from destruction level preceding construction of Agade "palace" by Naram-Sin ca 2400 to 2225 BC.

3440 ± 50

BM-1970. Tell Brak $\delta^{13}C = -24.2‰$

Wood charcoal from Tr F5, Loc 29 (late Agade/early Ur III).

3590 ± 50

BM-1971. Tell Brak $\delta^{13}C = -22.7‰$

Burned grain sample scraped from jar in room in Tr CH, Loc 450.

3620 ± 50

BM-1972. Tell Brak $\delta^{13}C = -24.2‰$

Burned grain sample scraped from different jar in same room as BM-1971 above.

3590 ± 45

BM-1973. Tell Brak $\delta^{13}C = -24.1‰$

Wood charcoal from Tr CH, Loc 445.

General Comment (RB): dates when calibrated are ca 250 yr later than expected for Agade destruction (ca 2300 BC) and late Agade/early Ur III (ca 2100 BC), but agree with previous measurements (R, 1982, v 24, p 285).

Thailand

1810 ± 210

BM-2016. Ban Don Ta Phet $\delta^{13}C = -25.0‰$

Sample of carbon extracted by acid treatment from pottery sherds 413 55 5 and 1578 65 7, from Ban Don Ta Phet, Phanom Thuan dist, Kanchanaburi prov, SW Thailand (14° 15′ S, 99° 45′ E). Coll 1981 by I Glover, Inst Archaeol, Univ London and subm by M Cowell, Research Lab, British Mus following failure of thermoluminescence dating due to radon loss. *Comment* (RB): result agrees broadly with archaeol date expected (Rajpitak and Seeley, 1979), but possible sources of error are contamination by ancient organic carbon from clay body of sherd (probably less than 10%) and fractionation ($\delta^{13}C$ estimated).

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LYON NATURAL RADIOCARBON MEASUREMENTS IX

JACQUES EVIN, JOELLE MARECHAL, and GERARD MARIEN

Laboratoire de radiocarbone, Centre de Datation et d'Analyses isotopiques, Université Claude-Bernard de Lyon
43 boulevard du 11 Novembre 1918, 69621 Villeurbanne, France

INTRODUCTION

This list includes most of the measurements made in 1979 through 1981 and some values obtained during preceding years. The reporting of results, their calculation (half-life: 5570 ± 0, standard ^{13}C correction only for bones), and the dilution ratios are as previously described in Lyon VIII (R, 1979, v 21, p 402-452).

The counting technique using proportional detectors has now been completely abandoned; only a few measurements on water samples and the Chassey series were measured in this way. Almost all analyses were made using the three Packard liquid scintillation spectrometers which were specially shielded with 5cm of lead and placed in an underground room beneath 3 to 4m of earth. Ca 30 glass counting vessels were selected. The differences in their backgrounds did not exceed 0.2cpm. The backgrounds of the 3 routine counters were, respectively: 1.9 ± 0.1, 2.2 ± 0.1, and 3.2 ± 0.2cpm. Adjustments to yields of ca 55% were made by the quenching correction of simultaneous counting on two channels corresponding to different window opening. For these conditions, 3ml of benzene from the oxalic acid standard gave an uncorrected counting rate of ca 17cpm.

Pretreatment of samples was according to the type of dating material, conforming to generally applied methods and particular archaeologic or geologic problems. We took into account some experiments made on specific dating materials (paleosoil, terrestial shells) (R, 1980, v 22, p 545-555, 919-929) which confirm previous studies made by other laboratories, the synthesis of which will soon be published (Evin, 1983). These studies demonstrated the often inadequate elimination of contamination by basic treatment or hydrolysis on organic material or by superficially acid washing of carbonaceous material. Pretreatment of bones, which seems satisfactory, remains the same and is uniformly applied, always following the procedure of Longin (1971).

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SAMPLE DESCRIPTIONS

I. EXPERIMENTAL SAMPLES

The following samples were measured often on laboratory request 1) to check laboratory adjustment with other laboratories (Ly-2224 and Chêne de Stolford series, 2) to verify reliability of some dating materials (Paléosol de Beylongue series, Ly-1884 and -2500), 3) to demonstrate utility and accuracy of ^{14}C measurements for commercial (Ly-2223 and aromatic components series) or artistic (Ly-1854 and -1907) purposes.

Ly-2224. Bois de Berne **2330 ± 90**

Wood from unknown origin subm 1980 by T Riesen, Radiocarbon Lab, Bern, Switzerland (5427 min count). *Comment*: agrees perfectly with Bern measurement: B-3499, 2220 ± 100.

Chêne de Stolford series, Wales

Wood from submerged forest coll 1979 by A Heyworth, Univ Aberystwyth and subm 1980 by M S Baxter, Univ Glasgow in participation with Lyon lab Internatl Tree-Ring Replicate Study. Results appear in table 1. Sampling of wood, selection of proposed material, and preparation procedures were previously pub with synthesis of results (Baxter, 1983).

TABLE 1
Chêne de Stolford

Sample no.	Wood ref	Counting time	Dilution ratio	Conventional age
Ly-2157	Stolford 147-156	6872 min	2/5	5070 ± 90
-2225	Stolford 118-127	3339 min	1	5120 ± 130
-2156	Stolford 88-89	10,161 min	1	5175 ± 60
-2226	Stolford 60-69	3878 min	14/15	5200 ± 160
-2155	Stolford 31-40	6503 min	2/5	5330 ± 100

General Comment: results agree in general with those obtained by 20 other labs. Comparison of counting times between different statistical margins shows that errors necessarily made during successive phases of preparation and counting of each sample (eg, errors in weighing sample, counting standard, background stability of purity corrections, etc) become preponderant with respect to statistics for counting times longer than 5000 minutes. Taking into account only counting statistics would lead to underestimate of error.

Paléosol de Beylongue series, Morcenx, Landes

Peaty sediments from Layer 5 in Beylongue geol sec (44° 00′ N, 0° 55′ W). Coll and subm 1971 by C Thibault and P Legigan, Univ Bordeaux. Layer is interstadial or interglacial paleosoil attributed to Würmian period. Measurement was made to strengthen conclusions of study on evolution of organic matter in soil and sample treatment methods of paleosoil datings (Gilet-Blain, Marien, and Evin, 1980).

Ly-1537. Hydrolysat **13,960 ± 360**

Soluble fraction of acid hydrolyse. (2/3 diluted sample)

Ly-1538. Reliquat **16,760 ± 440**

Insoluble fraction after several acid hydrolyse. (9/10 diluted sample)

General Comment: as suggested by general study, age is probably too young since last interstadial (long enough to form a paleosoil) occurred 17,000 yr ago. Both results indicate increasing age according to chemical evolution conditions of soil organic matter and only give min age for sediments (Evin *et al*, 1979).

Ly-1884. Trébous II D I, Deyme, Haute Garonne **29,200 +2800 −2000**

Shells and opercula of gastropods from silt (43° 29′ N, 1° 31′ E). Coll 1979 by J C Revel, Lab Pédol, Univ Toulouse. Sample from bottom of geol series of sediments, organic matter of which were dated by Monaco Lab (unpub) of ca 23,000 ± 1000 BP. *Comment* (JCR): date agrees with expected range of dates and indicates Late Würmian age but disagrees with results from organic matter. However, both values may be considered min ages. True age may be older and observed ^{14}C activities may come from contamination which can never be eliminated from such dating materials (Evin *et al*, 1980; Gilet-Blain, Marien, and Evin, 1980).

Ly-2500. Tombe 142, Casabianda, Aléria, Haute-Corse **2890 ± 120**

Hélix shells from inner wall of Grave 142 of Casabianda necropolis (42° 05′ N, 9° 30′ E). Coll 1971 by J and L Jehasse, preserved in Jérôme Carcopino Mus Aléria, and subm 1981 by J Evin. Graves were dug in sandy clays and precisely dated by assoc archaeol material from Greece at beginning of 5th century BC; snails are from this last period or a little younger. *Comment*: date is ca 500 yr too old and confirms previous findings (Evin *et al*, 1980) on impossibility of using shells of terrestrial gastropods for dating archaeol sites.

Ly-2223. Gypsum mine, Carcès, Var **2570 ± 130**

Wood found in gypsum mine (43° 29′ N, 6° 11′ E). Coll and subm 1980 by G Truc, Dept Geol, Univ Lyon. *Comment* (GT): recent age of wood indicates it came from ancient timbers and embedding sediments are collapse of ancient gallery.

Aromatic components series

Aromatic organic components are present in such products as perfume, aperitifs, alimentary adjuvants, etc, from various origins (synthetic or natural, homogeneous or mixed). Subm from 1978 to 1980 by industrial firms or fraud-control labs. All samples were very slowly burned in pure oxygen after placement on quartz wool (table 2).

TABLE 2
Aromatic components

Sample no.	Sample origin	Dilution ratio	$\delta^{13}C$/PDB	Activities dpmg	% modern
Ly-1629	Natural citral (*Cybopogon citratum*)	1	−11.6‰	20.1 ± 0.4	148.5% ± 2.1
-1630	Natural citral (*Litsea bubeba*)	1	−26.7‰	17.6 ± 0.4	123.9% ± 1.9
-1631	Natural citral (?)	1		19.3 ± 0.5	142.5% ± 2.3
-1632	Synthetic citral	1	−27.4‰	inf/=0.3	inf/=1.8%
-1800	Synthetic fennel	1	−33.4‰	inf/=0.2	inf/=1.5%
-1815	Synthetic fennel PM 1	1		14.3 ± 0.4	105.4% ± 1.5
-1816	Synthetic fennel RM 2	1		12.7 ± 0.4	93.4% ± 1.7
-1953	Anethol 1	1	−27.3‰	18.1 ± 0.4	133.4% ± 0.4
-1954	Anethol 2	1	−30.0‰	18.9 ± 0.4	139.6% ± 2.4
-1955	Anethol 3	1	−31.1‰	15.4 ± 0.3	113.9% ± 1.9
-1956	Anethol 4	1	−28.9‰	17.5 ± 0.3	129.1% ± 1.8
-1957	Anethol 5	1	−29.1‰	19.6 ± 0.5	144.8% ± 2.5
-2011	Oil of Badiane	7/10	−27.9‰	20.7 ± 0.5	152.9% ± 3.6
-2012	Synthetic estragol	1	−29.7‰	0.4 ± 0.1	2.6% ± 0.6
-2013	Vanilla extract from gaiacol	1/3	−29.3‰	inf/=0.3	inf/=2.0%
-2014	Synthetic vanilla	1	−28.5‰	inf/=0.3	inf/=2.0%
-2015	Vanilla from oil of resin	9/10	−20.8‰	18.6 ± 0.3	137.4% ± 2.4
-2016	Vanilla from estragol	1	−31.8‰	19.1 ± 0.3	141.1% ± 2.0
-2017	Anise seeds	1	−27.5‰	17.9 ± 0.3	131.7% ± 2.1
-2018	Badiane seeds	1	−26.9‰	19.5 ± 0.3	144.1% ± 2.3
-2019	Fennel seeds	1		19.0 ± 0.3	140.4% ± 2.0
-2020	Anethol from badiane 1st pt of preparation	21/30	−24.3‰	18.7 ± 0.4	138.1% ± 2.9
-2021	2nd pt of preparation	1	−25.5‰	18.4 ± 0.3	135.9% ± 1.9
-2022	3rd pt of preparation	5/6	−30.3‰	18.2 ± 0.3	133.9% ± 2.7
-2064	American anethol	2/3		19.7 ± 0.4	145.6% ± 2.8
-2065	Estragol from wood	1	−30.1‰	19.6 ± 0.3	144.7% ± 1.9
-2066	Anethol from badiane	9/10	−32.3‰	20.0 ± 0.4	147.2% ± 2.8
-2092	Vanilin from lignine	1/3	−26.4‰	18.2 ± 0.4	134.0% ± 3.1
-2093	Natural menthol	1/3		19.3 ± 0.5	142.0% ± 3.6
-2094	Synthetic menthol	1		inf/=0.2	inf/=1.2%

General Comment: differences among results indicate need for determining sample origins. Some samples have activities lower than 16dpmg which must represent mixing of natural components with synthetic chemical products. Some amounts may be measured but extracts are not distinguishable from seeds and woods. Three values for Ly-2020, -2021, and -2023 from several phases of same preparation indicate slight isotopic fractionation during operation of an industrial lab. Such differences are small but may be consistent enough to explain differences among products extracted from natural components grown in same year (Bricout & Koziet, 1978).

Ly-1854. Statuette de Crémieu **260 ± 150**

Wood from pedestal of statuette attributed by style to 11th or 12th century. Coll 1979 in Antiquities Market at Crémieu, Isère (45° 53′ N, 5° 15′ E), from unknown origin and subm 1979 by G Villedieu, Villeurbanne. Measurement made to authenticate artifact. *Comment* (GV): date much younger than expected and suggests statuette was sculpted in Middle-Age style from old wood.

Ly-1907. Statuette chinoise de Tch'ang-cha, Hou-Nan, China **2370 ± 140**

Wood from Chinese statuette attributed to Han epoch (206-220 BC). Coll at Tch'ang-cha (28° 05′ N, 113° 01′ E). Subm 1979 by C T Loo, Paris. As such statuettes often were imitated, measurement was made to authenticate artifact. *Comment* (CTL): date agrees with expected old age and indicates beginning of Han period, but only gives age of wood on which statuette was sculpted.

II. GEOLOGIC SAMPLES

A. Samples from peat bogs

Ly-1940. Marais de Chautagne, Serrière-en-Chautagne, Savoie **1170 ± 140**

Peat from top of peaty layer several m thick in Chautagne peat bog (45° 53′ N, 5° 50′ E). Coll 1978 by Co Natle Rhône and subm 1979 by M Bornand, Inst Recherche Agronom, Montpellier. Layer overlies thick fluvio-glacial gravels. Dated to determine min age of gravels which blocked Le Bourget Lake outlet. *Comment* (MB): dates end of peat accumulation, and not formation of lake dam (Bornand & Guyon, 1979).

Ly-2298. Le Lit-au-Roi, Cressin, Ain **1900 ± 120**

Peat from base of peaty layer 1.5m thick in peat bog (45° 35′ N, 5° 43′ E). Coll and subm 1980 by R Vilain, Dept Geol, Univ Lyon. Peat bog formed at final stage of filling of glacial lake. *Comment* (RV): date, much younger than expected, indicates rapidity of peat formation and recent filling of lake.

Ly-2349. Saint-Paul-les-Durance, Bouches du Rhône **6870 ± 160**

Peaty slime from 10.6 to 10.9m depth in boring at point PK 4800 near bank of Durance Canal (49° 29′ N, 5° 42′ E). Coll 1967 and subm 1980 by J L de Beaulieu, Lab Bot Hist Palynol, Univ Marseille. Level was attributed to Riss-Würm interglacial period elsewhere called "Eemian" (Beaulieu, 1972; Bonifay, 1962). *Comment* (JL de B): date is much younger than expected, dating peaty formation to Holocene; *cf* another measurement on calcareous tufa lying close to peaty level, MC-2171: 7000 ± 100 (Farizier, 1980). Discrepancy between results and previous geol or palynol "Eemian" attribution is now under study.

Lago Zapano series, Lagonegro, Campania, Italy

Organic clay from three levels in basal sediments of Zapano Lake (40° 09′ N, 15° 50′ E). Coll and subm 1978 by M Reille, Lab Palynol, Univ Marseille. Pollen diagram indicates very recent age (end of Sub-Atlantic period) while clay facies suggest interglacial origin.

Ly-2253. II, 119-121cm **390 ± 150**

From bottom of a peaty layer in clays; presence of *Fagus* and cereal pollen. (11/30 diluted sample)

Ly-2254. II, 124-126cm **700 ± 170**

From top layer of clay; large amounts of *Fagus* and *Ablies.* (1/2 diluted sample)

Ly-2255. III, 143-147cm **1290 ± 170**

From mid-layer of clay; presence of leaf remains. (1/2 diluted sample)

General Comment (MR): as expected, peaty layer (Ly-2253) is very recent. Both other dates confirm absence of lacuna between organic clay and peaty layer and that, despite interglacial facies, clay is also recent.

Ly-1774. Lago Laceno, Bagnoli d'Irpino, Campania, Italy **2120 ± 230**

Organic clay from 380 to 387cm depth in lake sediments (40° 45′ N, 15° 7′ E). Coll 1977 and subm 1977 by M Reille. (5/6 diluted sample). *Comment* (MR): presence of *Fagus* and depth suggest either interglacial level (> 30,000 BP) or rapid sedimentation rate. Date confirms latter.

Ly-2319. Bourricos, Pontenx les Forges, Landes **2070 ± 130**

Peat from 30cm depth in compact peaty layer 80cm thick, outcropping in quarry (44° 09′ N, 0° 65′ W). Coll 1980 and subm 1981 by P Legigan, Univ Bordeaux. *Comment* (PL): palynol confirms entire layer formed between Sub-boreal and present.

Pré Maudit series, Gathemo, Manche

Peat or clay with organic matter from three levels of core (48° 45′ N, 0° 97′ W). Coll and subm 1981 by L Barthélemy, Centre Géog Phys, Univ Paris-X, Nanterre.

Ly-2407. 308 **6870 ± 170**

Peat from 331 to 334cm depth. Pollen indicates humidification phase with *Betula, Alnus,* and *Quercetum mixtum,* attributed to Atlantic period. (5/6 diluted sample)

Ly-2405. 307 **7450 ± 180**

Peat from ca 340cm depth. Decrease in pollen of *Corylus,* increase of *Betula, Quercetum mixtum, Alnus, Myrica* gale, *Salix,* attributed to beginning of Atlantic. (1/2 diluted sample)

Ly-2406. 305 **9250 ± 180**

Clay with organic matter from 353 to 357cm depth. Dominance of *Corylus,* assoc with *Alnus, Betula,* and increase of total arboreal pollen attributable to beginning of Atlantic period. (3/5 diluted sample)

General Comment (LB): Ly-2407 and -2405 confirm geomorphol and palynol conclusions. Ly-2406 corresponds to Pre-boreal period and suggests peat bog settled during Alleröd with sedimentation hiatus occurring during Boreal.

Seillons-Source d'Argens series, Var

Peat from three levels of peat bog 2.5km E of Seillons (43° 30′ N, 5° 52′ E). Coll 1979 and subm 1980 by H Triat-Laval, Lab Palynol, Univ Marseille (Triat-Laval, 1981).

Ly-2218. 110-120cm **2200 ± 100**

Pollen diagram indicates increase in deforestation which had begun previously; Sub-atlantic age expected.

Ly-2119. 190-200cm **4080 ± 130**

Pollen diagram indicates small clearing of wood at this level; Sub-boreal age expected.

Ly-2220. 330-340cm **4650 ± 110**

From base of peat bog at level where pollen diagram indicates forest of deciduous trees existed before start of deforestation: Atlantic age expected.

General Comment: three dates agree perfectly with expected range of dates. Only 600 yr and 1.3m sediment between Ly-2220 and -2219 indicates rapid sedimentation for beginning of filling.

Ly-1583. Praveille, La Versanne, Loire **7410 ± 190**

Peat from 1.2 to 1.3m depth at bottom of acid, raised peat bog on side of Pilat massif, near Le Grand-Bois pass (45° 19′ N, 4° 30′ E). Coll and subm 1977 by N Gilet and A M Domenach, Lab Ecol Végétale, Univ Lyon. Pollen diagram by H Méon shows extension of *Tilia* and presence of *Quercus* and *Alnus, ie,* beginning of relatively warm climate. *Comment* (AMD): date agrees with palynol as it shows beginning of Atlantic period when slight increase of temperature occurred.

Casabianda series, Aléria, Haute Corse

Peat from top and basal layers of a peaty horizon embedded in slimy basal sediments of pond (42° 15′ N, 7° 10′ E). Coll and subm 1980 by M Reille.

Ly-2257. Top **5650 ± 190**

From top of peaty layer just underlying layer in which *Quercus ilex, Olea* sp, and cereal pollen indicate Sub-atlantic period. (1/2 diluted sample)

Ly-2256. Base **5920 ± 190**

From base of peaty layer just overlying layer in which pollen clearly indicates Atlantic period. (3/5 diluted sample)

General Comment (MR): both dates confirm that peaty layer belongs to Atlantic period and sedimentation hiatus occurred on top of peat.

Bordure Nord du Massif du Cantal series, Cantal

Seven borings were made in four peat bogs (table 3) at ca 1200m alt in Cantal massif, and table 4 lists results of samples of peat and organic clay coll and subm by M Reille and J L de Beaulieu, Lab Palynol, Univ Marseille.

TABLE 3
Bordure Nord du Massif Cantal—sampling sites

Boring	Village	Loc	Colln yr	Subm yr
Le Joland I	Ségur les Villas	(45°12′N, 2°50′E)	1979	1980
Le Joland II	Ségur les Villas	(45°12′N, 2°50′E)	1981	1981
Brugeroux	Chastel sur Murat	(45°09′N, 2°50′E)	1978	1978
La Taphanel III	Riom es Montagne	(45°16′N, 2°41′E)	1978	1980
La Taphanel IV	Riom es Montagne	(45°16′N, 2°41′E)	1978	1981
La Taphanel II	Riom es Montagne	(45°16′N, 2°41′E)	1978	1982
Lastioules	Champs sur Tarentaise	(45°29′N, 2°39′E)	1979	1980

TABLE 4
Bordure Nord du Massif Cantal—samples

Sample no.	Boring	Depth	Expected climatic phase	Dilution ratio	Age BP
Ly-2494	Le Joland II	50-60cm	Post-Middle age	1/15	1280 ± 360
-2495	Le Joland II	90-100cm	Middle age	3/10	1030 ± 160
-2132	Le Joland I	230-240cm	Sub-atlantic	1/4	2850 ± 260
-2496	Le Joland II	150-160cm	End of Sub-boreal	1/2	2610 ± 150
-2133	Le Joland I	300-310cm	Sub-boreal	1/6	2670 ± 320
-2497	Le Joland II	250-260cm	Sub-boreal	11/30	4410 ± 210
-2498	Le Joland II	290-297cm	End of Atlantic	1/3	5880 ± 200
-2134	Le Joland I	440-450cm	End of Atlantic	2/3	5350 ± 210
-2447	Lastioules	40-45cm	End of Sub-boreal	1/6	2460 ± 210
-2448	Lastioules	128-135cm	Beginning of Sub-boreal	1/5	5060 ± 250
-2555	La Taphanel II	355-370cm	Sub-boreal	3/10	2800 ± 160
-2135	La Taphanel III	45-55cm	Sub-atlantic	3/5	2890 ± 180
-2136	La Taphanel III	105-110cm	Sub-boreal	1/2	4130 ± 190
-2137	La Taphanel III	135-140cm	Beginning of Sub-boreal	1	4860 ± 140
-2138	La Taphanel III	200-205cm	Middle Boreal	1	5850 ± 150
-2139	La Taphanel III	255-260cm	Beginning of Atlantic	1	7520 ± 150
-2140	La Taphanel III	335-340cm	Middle Atlantic	1	8440 ± 160
-2141	La Taphanel III	405-410cm	Beginning of Boreal	1/2	9700 ± 230
-2142	La Taphanel III	415-420cm	End of Pre-boreal	9/30	9530 ± 200
-2143	La Taphanel III	435-440cm	Beginning of Pre-boreal	2/5	10,040 ± 200
-2144	La Taphanel III	445-455cm	End of Late Dryas	7/15	10,390 ± 230
-2145	La Taphanel III	460-470cm	Late Dryas	1/3	10,450 ± 250
-2212	La Taphanel IV	565-576cm	Early Dryas	3/5	12,380 ± 210
-2361	La Taphanel IV	610-630cm	Early Dryas	7/30	10,780 ± 410
-2119	Brugeroux	350-360cm	Boreal	1/4	8310 ± 300
-2120	Brugeroux	450-500cm	Pre-boreal	3/8	9860 ± 280
-1855	Brugeroux	556-564cm	Beginning of Pre-boreal	7/15	10,310 ± 420
-1856	Brugeroux	575-585cm	Late Dryas	7/15	10,270 ± 430
-2121	Brugeroux	588-600cm	Alleröd	7/15	10,790 ± 240
-2122	Brugeroux	630-640cm	Beginning of Alleröd	1/2	11,450 ± 240
-2123	Brugeroux	645-655cm	Bölling	4/15	12,350 ± 360
-2124	Brugeroux	660-670cm	Early Dryas	1/20	11,610 ± 850

General Comment (MR & JL de B): Holocene results agree with values expected from pollen study. Late-glacial results are less accurate because of low carbon content of samples; these seem consistent, especially La Taphanel series from 435 to 470cm where they well define Late Dryas period. Ly-2122 and -2361 are too young for unknown reasons.

Le Cézalier Massif series, Puy de Dôme

Table 5 lists results obtained from clay with little organic content from several levels in cores from three neighboring sites at 1300m alt: Les Chastelets and Le Lac d'En Bas boring near La Godivelle (45° 23′ N, 2° 55′ E), and Jassy boring near Saint-Alyre-es-Montagne, (45° 23′ N, 2° 58′ E). Coll and subm 1979 by M Reille.

TABLE 5
Massif du Cézalier

Sample no.	Boring	Depth	Expected climatic phase	Dilution ratio	Age BP
Ly-2260	Les Chastelets	120-130cm	Sub-atlantic	2/15	2940 ± 210
-2261	Les Chastelets	190-200cm	Sub-atlantic	4/15	2600 ± 230
-2262	Les Chastelets	240-250cm	Sub-atlantic	7/30	3020 ± 240
-2263	Les Chastelets	850-860cm	Atlantic	1/15	19,400 ± 1560
-2117	Le Lac d'En Bas	680-690cm	Atlantic	1/9	5590 ± 410
-2118	Le Lac d'En Bas	800-810cm	Atlantic	2/13	6070 ± 320
-2446	Jassy	240-245cm	Atlantic	1/6	5040 ± 330

General Comment (MR): 1st 3 results of Les Chastelets series fit in expected range of dates despite large uncertainty and stratigraphic inversion. Ly-2261 is too young. Ly-2263 is aberrant and remains unexplained. Both results from Le Lac d'En Bas seem too old by ca 1000 yr compared with palynol data in region and Ly-2446 which seems to be most reliable of series. Small amounts of available carbon may cause discrepancies between results and expected values despite lengthening of counting times.

Massif de la Margeride series, Lozère et Haute-Loire

Peat from several borings at ca 1300m alt. Coll and subm 1980 by A Pons and M Reille.

Ly-2360. Mont-Chauvet I, Malzieu-Forain, Lozère **Modern** **$\Delta^{14}C = -1.6 \pm 1.2\%$**

From 130 to 140cm depth (44° 55′ N, 1° 15′ E) (3/10 diluted sample). Pollen diagram indicates beginning of last extension of *Pinus* and cereals, *ie* very recent (ca 200 to 300 BP).

Ly-2356. Sainte-Eulalie, Lozère **2120 ± 170**

From 90 to 95cm depth (44° 47′ N, 1° 17′ E) (11/30 diluted sample). Pollen indicates last extension of *Fagus,* before beginning of extension of cultivation, expected during Sub-atlantic period.

Ly-2359. Chanaleilles, Haute-Loire **2660 ± 180**

From 65 to 70cm depth (44° 51′ N, 1° 17′ E) (7/15 diluted sample). Pollen indicates, as for Ly-2359, beginning of last regression of *Fagus.*

Ly-2357. Lestivalet I, 65 to 70, Malzieu-Forain, Lozère **1360 ± 160**

From 60 to 70cm depth (44° 51′ N, 1° 13′ E) (3/5 diluted sample). Pollen indicates, as for Ly-2360, extension of *Pinus* and cereals.

Ly-2358. Lestivalet I, 125 to 130, Malzieu-Forain, Lozère 8790 ± 220

From 125 to 130cm depth (1/2 diluted sample). Layer does not contain pollen, only charcoal. There seems to be sedimentation hiatus at overlying level.

Ly-2444. Lestivalet II, 146.5 to 154.5, Malzieu-Forain, Lozère 11,330 ± 280

From 146.5 to 154.5cm depth (11/30 diluted sample). Pollen indicates cold period with only 8% arboreal pollen.

Ly-2445. Lestivalet II, 156.5 to 159.5, Malzieu-Forain, Lozère 7300 ± 150

From 156.5 to 159.5cm depth (13/15 diluted sample). Pollen indicates temperate period with 15% arboreal pollen, mainly *Betula* and *Salix*.

General Comment (MR & AP): 4 more recent dates agree with expected values (Sub-atlantic) (Reille & Pons, 1982). Ly-2358 proves sedimentation hiatus occurred before Boreal. Ly-2444 is either too young or too old as it corresponds to generally accepted Alleröd age contrary to cold period indications by pollen; Ly-2445 is much too young for unknown reason.

Massif de l'Aubrac series, Lozère

Table 6 lists results from 2 borings in peat bogs at ca 1050m alt at Brameloup near Recoules d'Aubrac (44° 43′ N, 3° 04′ E) and at La Chaumette near Brion (44° 43′ N, 3° 05′ E). Coll 1979 and subm 1980 (Ly-2604 and -2605) by M Reille.

TABLE 6
Massif de l'Aubrac

Sample no.	Boring	Depth	Expected climatic phase	Dilution ratio	Age BP
Ly-2440	Brameloup	80-95cm	Sub-atlantic	3/10	820 ± 180
-2441	Brameloup	135-170cm	Sub-boreal	1/2	2660 ± 190
-2442	Brameloup	180-195cm	Sub-boreal	23/30	4010 ± 170
-2443	Brameloup	230-245cm	End of Atlantic	1/10	5770 ± 480
-2604	Brameloup	300-320cm	Atlantic	1/3	6110 ± 210
-2605	Brameloup	410-435cm	Beginning of Atlantic	2/3	6990 ± 160
-2110	La Chaumette	20-27cm	Sub-atlantic	1/2	4300 ± 180
-2111	La Chaumette	55-62cm	Sub-boreal	2/5	4670 ± 190
-2112	La Chaumette	142-150cm	Beginning Atlantic	3/5	6880 ± 200
-2113	La Chaumette	177-185cm	Boreal	1/3	7980 ± 260
-2114	La Chaumette	292-300cm	Pre-boreal	1/8	10,430 ± 570
-1857	La Chaumette	339-347cm	Alleröd	5/6	10,910 ± 360
-1858	La Chaumette	403-413cm	Bölling	1	12,370 ± 340
-2115	La Chaumette	413-423cm	Bölling	1	11,490 ± 170
-2116	La Chaumette	423-433cm	Bölling	4/5	12,810 ± 250

General Comment (MR): Brameloup series agrees with palynol. Ly-2441 seems a little too young but may indicate sedimentation hiatus. Chaumette series is also consistent except Ly-2115 which looks ca 1000 yr too young. Ly-1858 and -2116 are 1st 2 dates of Bölling period in Central Massif and correspond with beginning of *Juniperus* phase.

Peyrebeille series, La Villate, Ardèche

Table 7 lists results obtained from peat from several levels in peat bog at 1265m alt (44° 35′ N, 3° 58′ E). Coll and subm 1979 by M Couteaux, Lab Palynol, Univ Marseille.

TABLE 7
Peyrebeille

Sample no.	Boring	Depth	Pollen event	Expected climatic phase	Dilution ratio	Age BP
Ly-2203	Peyrebeille I	45-49cm	Beginning of *Abies* extent	Sub-atlantic	1	3310 ± 120
-2201	Peyrebeille II	52-58cm	Beginning of *Abies* extent	Sub-atlantic	1	3200 ± 120
-2204	Peyrebeille I	50-58cm	2nd extent of *Fagus*	Sub-boreal	2/11	4160 ± 310
-2202	Peyrebeille II	59-64cm	1st extent of *Fagus*	Sub-boreal	1	4360 ± 130
-2205	Peyrebeille I	58-66cm	1st extent of *Fagus*	Sub-boreal	1	3800 ± 110
-2206	Peyrebeille I	79-85cm	Before 1st increase of *Fagus*	End of Atlantic	7/10	4740 ± 170
-2207	Peyrebeille I	87-94cm		End of Atlantic	1/2	5340 ± 190
-2208	Peyrebeille I	105-118cm		Beginning of Atlantic	1	5810 ± 140
-2209	Peyrebeille I	119-134cm		Beginning of Atlantic	1	6910 ± 140
-2210	Peyrebeille I	139-143cm	1st max of *Quercus*	Late Boreal	3/5	7240 ± 170
-2211	Peyrebeille I	143-146cm	1st max of *Corylus*	Early Boreal	1/2	8550 ± 240

General Comment (MC): dates agree well with expected range of values of palynol zones. Agreement between Ly-2203 and -2201 proves that *Abies* developed as early as end of Sub-boreal and not only during Sub-atlantic (Couteaux, 1978). Comparison of Ly-2202 and -2204 vs Ly-2205 shows that last result is ca 550 yr too young.

Lac de Siguret series, Saint-André d'Embrun, Hautes Alpes

Table 8 lists results obtained from clay with organic matter from boring 78 SM at ca 1000m alt in lake sediments (44° 37′ N, 6° 33′ E). Coll 1979 and subm 1981 by J L de Beaulieu.

TABLE 8
Lac de Siguret

Sample no.	Depth	Expected climatic phase	Dilution ratio	Age BP
Ly-2125	335-345cm	Atlantic	1/10	7110 ± 420
-2126	355-360cm	Late Dryas	1/15	10,820 ± 810
-2127	390-400cm	Late Dryas	2/5	12,930 ± 380
-2128	437-442cm	Middle Dryas	2/5	13,540 ± 350
-2129	460-468cm	Middle Dryas	1/2	17,800 ± 450
-2130	480-490cm	Early Dryas	1	17,410 ± 220
-2131	504-520cm	Würmian III	1	20,770 ± 620

General Comment (JL de B): previous results obtained by Louvain lab on same site was pub (de Beaulieu, 1977): upper levels attributed to the Subatlantic, from 215 to 220cm, Lv-709: 2920 ± 70 and to Sub-boreal, from 275 to 290cm, Lv-710: 3660 ± 75. Another result from deeper level, 430 to 440cm, Lv-712: 13,190 ± 260 fits well with Ly-2128 from same depth. However, all values except Ly-2125 and -2128 which are in expected date range because of large statistical margins, are too old for palynol data: Ly-2127 seems ca 2000 yr too old, Ly-2128 (Lv-712) ca 1000 yr, and Ly-2129, at least 4000 yr. In comparison with Pelléautier profile (below; R, 1979, v 21, p 414-416) Ly-2130 should also be ca 3000 yr too old while rather old date of Ly-2131 remains questionable.

Pelléautier series, Hautes Alpes

Gray clay from two deep layers in "La Motte-qui-Tremble" peat bog (44° 31′ N, 6° 11′ E). Coll 1976 and subm 1979 by J L de Beaulieu, Univ Marseille. Samples subm to check relatively old age obtained from lowest level of 18 results of previously pub series (R, 1979, v 21, p 414-416).

Ly-1942. VI, 670-678cm **$19,700^{+4100}_{-2700}$**

Clay with very little organic matter. (7/60 diluted sample)

Ly-1943. VI, 678-690cm **15,920 ± 700**

Brown clay. (3/7 diluted sample)

General Comment (JL de B): three dates of previous series dated 600 to 635cm level between 14,500 and 15,500 BP, close to Ly-1943; but Ly-1796: $23,700^{+1900}_{-1500}$ previously obtained for 700cm level also fits with Ly-1942. Thus, because of lack of more data, discrepancy between Ly-1942 and -1943 remains unexplained and fairly old age of Ly-1796 is still questionable.

Haut Dauphiné series, Isère

Tables 9 and 9A list results of measurements of peat and clay from several levels of borings in high alt peat bog ponds. Coll by M Couteaux.

TABLE 9
Haut Dauphiné

Sites	Village	Alt	Loc	Colln yr
Vallon de Lavey	La Muande, St-Christophe en Oisan	2050m	(44°58′N, 6°13′E)	1980
La Tourbière	Muzelle, Vénosc	2140m	(44°57′N, 6°06′E)	1978
Draye de Pertu	Les Etages, St-Christophe en Oisan	1590m	(45°53′N, 6°15′E)	1980
Côte Brune	Les Deux Alpes, Mont de Lans	1646m	(45°00′N, 6°07′E)	1980

TABLE 9A

Sample no.	Boring	Depth	Expected climatic phase	Dilution ratio	Age BP
Ly-2374	Muande I-B	35-39cm	End of Sub-boreal	2/5	2320 ± 190
-2375	Muande I-A	51-56cm	End of Sub-boreal	8/15	2570 ± 170
-2376	Muande I-A	71-75cm	End of Sub-boreal	13/30	5150 ± 200
-2394	Muzelle I-808	280-290cm	Sub-atlantic	4/5	2060 ± 130
-2395	Muzelle I-809	305-315cm	Sub-boreal	1	3040 ± 120
-2396	Muzelle I-8010	345-355cm	Sub-boreal	11/15	4440 ± 180
-2397	Muzelle I-8011	370-380cm	Atlantic	1	5320 ± 140
-2402	Muzelle I-8012	665-670cm	Beginning of Atlantic	1	8430 ± 150
-2403	Muzelle I-8013	680-684cm	Boreal	3/5	10,540 ± 190
-2404	Muzelle I-8014	684-690cm	Beginning of Boreal	4/5	10,410 ± 200
-2398	Muzelle II-804	490-500cm	Boreal	14/15	8420 ± 160
-2399	Muzelle II-805	505-511cm	Boreal	1	9480 ± 180
-2400	Muzelle II-806	519-527cm	Beginning of Boreal	14/15	10,920 ± 200
-2401	Muzelle II-807	536-542cm	Late Dryas	3/10	13,460 ± 390
-2148	Draye de Pertu I	6m	Late Dryas	1/3	7130 ± 240
-2146	Côte Brune	Top		1	12,310 ± 150
-2147	Côte Brune	Base		1	12,890 ± 180

General Comment (MC): comparison between results from La Muande neighboring borings for same pollen event establishes boundary between Sub-boreal and Sub-atlantic periods when *Pinus mugo* Torr gave way to *Pinus cembra* L. This boundary is rarely seen in pollen diagrams from high alt sites (Couteaux, 1981). At La Muzelle, dates are older than expected for pollen phases, which may be explained by presence of carbonaceous secondary carboniferous sediments in samples. La Draye de Pertu date differs from expected one. Dated level actually was Atlantic fire level, sparse remaining pollen of which wrongly suggested cold climate vegetation. Both La Côte Brune dates are, as expected, before Alleröd but are too young because of introduction of roots (Couteaux and Evin, 1981).

B. Bone samples from grottoes

Ly-2171. Ours de Forsyth-Major, Monte Estremo, Corsica **200 ± 90**

Bone fragments from ribs of bear skeleton, coll 1906 by C Forsyth Major in Inferno grotto (42° 22′ N, 8° 49′ E). Preserved since colln in Paleontol Lab, Mus Hist Nat Paris and subm 1979 by F Poplin, Paris. *Comment* (FP): despite apparently young aspect of bones (Forsyth-Major, 1930) skeleton was believed to represent presence of bears in Corsica early in Pleistocene times. Date disproved this and demonstrated that animal was brought onto island by man.

Ly-2311. Le Mont Terret, Vallée du Perthuis, Thorens-Glières, Haute Savoie **1280 ± 150**

Ursus arctos bones from small grotto that opens onto slope of mt (45° 57′ N, 6° 15′ E). Coll 1979 by G Fontana, Belley; studied and subm 1980 by R Ballesio, Geol Dept, Univ Lyon (29/30 diluted sample). *Comment* (RB): date suggests relatively recent age for brown bears in Préalps mts, while they only disappear from high part of W Alps at beginning of 20th century.

Ly-1805. Grottes Glacée, Bechloul, Bouira, Algeria 9620 ± 200

Bear bones from clayey fill of "Grotte Glacée" (36° 30′ N, 4° 00′ E). Coll 1977 by P Gillon and P E Coiffait, Univ Constantine, and subm 1978 by G Auboire, Joinville, France. *Comment* (GA): paleontol study still in process will probably confirm bear is *Ursus spelaeus,* who presumably disappeared from Algeria during Neolithic. Date is compatible with this hypothesis and attributes Holocene age to grotto filling.

Grotte Zawalona series, Mnikow, Krakow Province, Poland

Bone of large mammifera from last loess layer mixed with cryoclastic rock rubble of Zawalona grotto (51° 52′ N, 19° 40′ E). Coll and subm 1978 by J L Kozlowski, Inst Archaeol, Univ Jagellon, Krakow.

Ly-2270. Top 14,060 ± 340

From top of layer, just underlying uncharacteristic industry (probably Magdalenian); result is average of two measurements on 2/3 and 14/15, respectively, diluted samples.

Ly-2271. Base 15,380 ± 340

From base of layer, assoc with uncharacteristic Gravettian industry.

General Comment (JKK): both dates offer precise chronology to series of loess and cryoclastic sediments very often found in fill of Polish grottoes; period following main phase of loess sedimentation may be dated to 16,000 or 15,000 BP. This questions hypothesis of contemporaneity between late upper loess and loessic and cryoclastic upper sediments of Polish grottoes.

Ly-2277. Aven Bouët, Les Matelles, Hérault 15,460 ± 380

Bones from fill of karstic fossil system (43° 44′ N, 3° 49′ E). Coll 1979 by J P Brigal and subm 1980 by J L Vernet, Univ Montpellier. Assoc with expected Late Pleistocene fauna containing small feline resembling present-day lion. *Comment* (JLV): date confirms faunal attribution to Late Würmian period.

Ly-2416. Aven des Cervidés, Cournonterral, Hérault 15,700 ± 430

Bones (*Cervus elephas*) from surface of clayey filling in bottom of Les Cervidés aven (43° 41′ N, 3° 41′ E). Coll 1978 by X Gutherz and subm 1980 by A Bonnet, Nîmes. Assoc with fauna of great red deer, horse, bovine, and small capridae, probably from Würmian interstadial or postglacial period. (1/3 diluted sample). *Comment* (AB): dates fauna to Würmian IV when climate fitted well with such fauna.

Ly-2452. Grotte des Bisons, Lurbe-Saint-Christau, Pyrénées Atlantiques 20,830 ± 710

Bones from upper level of fill of grotto, small cavity in karstic system (43° 07′ N, 0° 35′ W). Coll 1977 and subm 1981 by G Marsan, Inst

Quaternaire, Univ Bordeaux. (3/10 diluted sample). *Comment* (GM): dates fauna to Late Würmian with dominance of *Bison priscus, Equus caballus,* and presence of *Ursus spelaeus, Rangifer tarandus,* and *Rupicapra rupicapra,* which also fits paleontol data.

Ly-2102. Grotte de Bos, Caniac du Causse, Lot 21,460 ± 480

Bones from 15 upper cm of gallery fill in small grotto (44° 38′ N, 1° 40′ E). Coll 1978 and subm 1980 by R Séronie-Vivien, Le Bouscat, Gironde. No assoc industry. *Comment* (RS-V): no definite age was expected, but date agrees with value obtained for base of Layer 9b in Pégourié site, Ly-1835: 24,200 ± 1100 (below) and with relatively recent ages previously found in numerous karstic fills of Causse de Gramat region (Philippe, Mourer, & Evin, 1981).

Ly-2415. La Baume Longue, Dions, Gard 26,500 ± 1000

Bones (*Ursus spelaeus*) from base of fill in bottom of "Grand Puits" pit (43° 56′ N, 4° 18′ E). Coll 1970 and subm 1980 by A Bonnet. Assoc with *Ursus spelaeus* and *Crocuta spelaea* probably from Early Würmian. Dates confirm previous measurements from La Sartanette site (Ly-1591: 22,700 ± 1700 and Ly-1590: 21,900 ± 1500, R, 1979, v 21, p 418-419) and from Grotte Latrone (Ly-1966, below) and suggest that cavern bear only disappeared during last part of Würmian in Europe.

Ly-2251. Grotte du Castellas, Dourgne, Tarn 26,400 ± 700

Bones from one of filled levels (43° 29′ N, 2° 09′ E). Coll 1979 by P M de la Morsanglière and subm 1980 by F Prat, Univ Bordeaux. Assoc with tall mammals and Upper Paleolithic industry. (13/15 diluted sample). *Comment* (PMdelaM): dates sediments to Würmian III age in agreement with fauna and archaeol.

Grotte de Bourdette series, Sainte-Colombe en Bruilhois, Lot et Garonne

Bones from several levels (44° 12′ N, 0° 24′ W). Coll 1979 by J Chagneau and subm 1980 by F Prat.

Ly-2345. Couche 1a 32,000 ± 1400

From Layer 1a under 1 to 2.5cm of clay, presumably from Middle or Late Würmian. (13/15 diluted sample)

Ly-2346. Couche 3 inf 30,300 ± 1200

From base of Layer 3, presumably Middle Würmian. (17/30 diluted sample)

Ly-2347. Couche 8 30,400 ± 1000

From Layer 8 at ca 2m deeper than Layer 1a, presumably from Early Würmian. (23/30 diluted sample)

General Comment (JC): three dates attribute fill to same age. Some detected activity suggests contamination, origin of which remains unknown because of overlying clayey sediment. Series could be considered min age of ≥ 29,000 BP; the only certain conclusion should be that grotto fill was deposited before Würmian III period.

Ly-1966. Grotte de Latrone, Sainte Anastasie, Gard 29,600 ± 1100

Bone (*Ursus spelaeus*) from soil of gallery at bottom of pit at Russan, (43° 56′ N, 4° 20′ E). Coll 1948 by R Jeantet, preserved in mus and subm 1978 by A Bonnet. Expected date: Early Würm. *Comment* (AB): dates sample to beginning of Würm III and agrees with previous measurement from neighboring site, La Sartanette, Ly-1591: 22,700 BP ± 1700, (R, 1979, v 21, p 48) and from Baume Longue at Dions, Ly-2415 (above). Results confirm *Ursus spelaeus* is present at least up to late Würmian.

Ly-2309. Grotte du Coustal, Noailles, Corrèze ≥30,000

Bones from fill of Coustal grotto karstic system (45° 05′ N, 1° 20′ E). Coll 1980 by J P Raynal and subm 1981 by M Philippe, Mus Hist Nat Lyon. Assoc with presumed Rissian fauna which may also be Würmian. (1/3 diluted sample). *Comment* (MP): date confirms 1st attribution; it is not Late Würmian and agrees with many other results in Causse de Martel calcareous region (Philippe, Mourer, & Evin, 1981).

Ly-2278. Gouffre de Moustayous, Saint-Pé de Bigorre, Hautes Pyrénées ≥36,000

Bones (*Lynx lynx*) from surface of gallery fill in karstic system (43° 01′ N, 0° 10′ W). Coll and subm 1980 by A Clot, Bordères sur Echez, Hautes Pyrénées. (1/6 diluted sample). *Comment* (AC): bone does not belong to Late Würmian (Clot, 1982).

C. Samples from fluviatile sediments

Ly-2190. Berge du File, Milly-Lamartine, Saône et Loire Modern $\Delta^{14}C = -2.2 \pm 1.6\%$

Wood from lowest level of sediment series from side of Le File Stream (46° 21′ N, 4° 43′ E). Coll 1979 and subm 1980 by A J Argant, Bron. *Comment* (AJA): date confirms sediment series probably is fill of mill reservoir. Deposit consists of alternating pebbly and clayey sediments overlying rubble; series suggests postglacial deposit overlying Late glacial sediment. ^{14}C date negates need for pollen analyses.

Ly-2299. Larche, Corrèze Modern $\Delta^{14}C = 1.6 \pm 1.4\%$

Bones from low terrace of La Vézère R (45° 8′ N, 1° 26′ E). Coll 1979 by P Y Demars and subm 1980 by J P Raynal, Inst Quaternaire, Univ Bordeaux. Measured to date formation of upper part of terrace. *Comment* (JPR): younger than expected: date only indicates redeposition of sediments and does not give max age to 1st deposition of alluvia on top of terrace.

Bernalda and Pomarico series, Basilicates, Italy

Charcoal from paleosoils in sands of alluvia of coastal rivers between Bernalda and Pomarico near Matera (40° 26′ N, 16° 39′ E). Coll and subm 1978 by S Tazioli, Univ Bari, Italy.

Ly-1852. Paléosol supérieur **840 ± 190**

From 4m depth.

Ly-1851. Paléosol inférieur **1550 ± 350**

From 9m depth. (11/20 diluted sample)

General Comment (ST): both dates agree with expected age of assoc potsherds (Nébois, 1974) and indicate sedimentation rate of alluvia.

Villers-le-Lac series, Doubs

Vegetal remains coll by borings from four levels in deep alluvia lying in local deepening in Le Doubs R valley, upstream from Chaillexon Lake (47° 04′ N, 6° 40′ E). Coll and subm 1977 by M Campy, Dept Géol, Univ Besançon. (9/10 diluted sample for Ly-2027 and -2028).

Ly-2025. 13.75m **2970 ± 130**

Ly-2026. 15.5m **3130 ± 120**

Ly-2027. 18.5m **3220 ± 170**

Ly-2028. 23.5m **4000 ± 160**

General Comment (MC): ages in larger time range were expected. Closer and relatively recent ages obtained prove large Holocene filling, due to rapid lacustrine sedimentation after slide of cliffs into valley (Campy, 1980).

Anglefort series, Ain

Wood from ca 14m depth in Rhône R alluvia, found during laying of foundation of generating sta (45° 55′ N, 5° 50′ E). Coll 1978 by Co Natle Rhône (CNR) and subm 1978 by R Vilain (Ly-1976 and -1977), Dept Géol, Univ Lyon, and 1980 by CNR (Ly-2187).

Ly-1976. No. 1 **2890 ± 150**

Ly-2187. CNR **3550 ± 120**

Ly-1977. No. 6 **6090 ± 160**

General Comment (RV): Ly-1976 is very close to Ly-135: 2880 ± 220 (R, 1971, v 13, p 55), from "Chêne de la Balme" wood found 20km downstream in same alluvia. Expected range of dates was older because of depth. Differences among three samples prove that several deposits of flattened wood occurred at same loc because of meandering main channel in alluvial plain.

Ly-1961. Sion, Valais, Switzerland **3650 ± 140**

Wood from 16m depth in alluvia of Rhône R valley at alt 480m (46° 14′ N, 7° 20′ E). Coll by M Eschbach and subm 1979 by A Bezinge, Sté Grande Dixence, Sion. *Comment* (AB): dates rapid filling of alluvial valley; many assoc artifacts from Roman times.

Blanchon series, Saint-Jean-le-Vieux, Ain

Wood from sandy layer embedded in alluvia of Ain R valley (46° 03′ N, 6° 21′ E). Coll and subm 1978 by A Billard, Inst Geog, Univ Paris.

Ly-2085. No. 1 **7010 ± 130**

Ly-2086. No. 2 **6790 ± 130**

Ly-2087. No. 3 **7060 ± 140**

Ly-2088. No. 4 **7440 ± 130**

General Comment (AB): similar ages of four samples indicate homogeneous deposit. They agree with expected Holocene age of embedding alluvia and show that lowest terrace of river cannot be older than Atlantic period.

Ly-2001. Le Fontanil, Isère **9900 ± 250**

Charcoal from single layer of vegetal material in alluvia of dejection cone underlying alluvia with frost-cracked stones (45° 15′ N, 5° 20′ E). Coll 1969 by M Colardelle and subm 1969 by A Bosquet, Centre Documentation Préhist Alpine, Grenoble. *Comment* (AB): at sampling, embedding sediment was thought to be from interstadial and expected deduced age > 30,000 yr. Date is much younger but still possible if overlying sediment was deposited during very cold phase of Late Dryas period.

Les Torrents du Bochaine series, Hautes-Alpes

Wood from tree trunks rooted in silt and gravel of sloping banks of Bochaine region, Le Buëch R basin, near Aspres-sur-Buëch. Coll 1977 and subm 1978 by M Archambault, Geog Dept, Univ Orléans. Samples listed in table 10.

TABLE 10
Les Torrents du Bochaine

Sample no.	Valley	Village	Loc	Depth	Age BP
Ly-1900	Torrent des Richardets	St Auban d'Oze	(44°30′N, 5°51′E)	−7m	3790 ± 140
-1901	Torrent de Bourdoutane	St Pierre d'Argençon	(44°31′N, 5°43′E)	−2.5m	7150 ± 260
-1899	Torrent Bachassette	Oze	(44°31′N, 5°48′E)	−8m	8820 ± 240
-1902	Torrent Barnèche	Le Saix	(44°29′N, 5°48′E)	−5m	10,040 ± 260

General Comment (MA): last three results agree well with many other tree trunks in region (Archambault, 1967). They all confirm Holocene age of youngest sloping banks. Ly-1900 (R, 1973, v 15, p 516) is younger than expected and may correspond with phase of detrital accumulation after sloping banks' edification period.

Muret series, Haute-Garonne

Wood from 4m depth in alluvia of lowest terrace of La Garonne R 3km SW of Muret (43° 27′ N, 1° 18′ E). Coll and subm 1979 by J C Revel, Lab Pédol, Univ Toulouse.

Ly-2172. No. 1, gravels **9790 ± 170**

Ly-2173. No. 82, sands **9320 ± 200**

General Comment (JCR): both dates confirm chronol homogeneity of sediments and rapid sedimentation rate in valley as samples come from distance of 1.5km of actual river bed. They also confirm Holocene age attributed to terrace and are close to other results from sample found in same alluvia ca 150km downstream at Golfech near Valence d'Agen, Gif-2338: 8900 ± 160 (R, 1974, v 16, p 62).

Pugère du Rocher series, Sénas, Bouches du Rhône

Samples from several levels in alluvial cone lying on one of terraces of La Durance R (43° 45′ N, 5° 13′ E). Coll 1976 by G Clauzon, Inst Geog, Univ Aix-en Provence.

Ly-1917. A-142 **10,440 ± 460**

Bones from upper level of cone, assoc with Epipaleolithic industry (Escalon de Fonton, 1976). (1/3 diluted sample)

Ly-1972. A-142 bis **34,800** $^{+3300}_{-2300}$

Small bits of charcoal scattered in same levels as Ly-1917.

Ly-2320. A-231 **≥28,200**

Terrestrial gastropod shells from lower level of cone. (1/10 diluted sample)

General Comment (GC): Ly-1917 agrees with age of Montadian (Epipaleolithic) assoc industry attributed by previous measurement on sample from Layer 3 of neighboring La Montagne site (Escalon de Fonton, 1976), MC-1159: 9000 ± 100. This value also dates end of cone formation while Ly-1972 proves redeposit of ancient materials previously dated at Vautubières to ca 31,000 BP, Ly-769 (R, 1975, v 17, p 9) and Ly-1002 (R, 1976, v 18, p 65). Ly-2320 gives min age for bottom of alluvial cone and therefore to River terrace, as terrace was deposited after La Durance capture by Le Rhône R; Ly-2320 also proves that capture occurred before Late Würmian.

Ly-2103. Polignac, Haute-Loire **33,000 ± 1000**

Horse bones (45° 4′ N, 3° 52′ E). Coll 1979 by R Séguy, Le Puy, and subm 1979 by J P Raynal, Inst Géol Quaternaire, Univ Bordeaux. No assoc industry. (2/3 diluted sample). *Comment* (JPR): comparable with Ly-1988 (below) from lowest levels of Les Riveaux site in which same horse was discovered. Both dates agree well with expected Würmian III.

Ly-1988. Les Rivaux Loc 1 base, Espaly-Saint-Marcel, Haute-Loire **30,600** $^{+1600}_{-1300}$

Horse bones from base of B unit, Levels 312 and 316, Loc 1, (45° 3′ N, 3° 51′ E). Coll 1977 by J P Raynal and subm 1978. *Comment* (JPR):

date agrees with sedimentol, paleontol, and archeol data which attribute Würmian III age to base of Unit B (Raynal *et al*, 1980).

Erquighem-sur-la-Lys series, Nord

Silt with vegetal debris from several levels of boring in deep alluvia of La Lys R (50° 40′ N, 2° 50′ E). Coll 1977 by Bur Recherches Géol Min and subm 1979 by J Sommé, Univ Lille.

Ly-2029. 46 **20,640 ± 750**

From 7.5 to 7.75m depth. Pollen diagram indicates 40% of arboreal pollen with dominance of *Pinus* and presence of *Corylus, Alnus,* and *Picea.* Attributed to Weichselian interstadial. (1/3 diluted sample)

Ly-2030. 45 **24,000 ± 600**

From 7.8 to 7.95m depth. Pollen diagram indicates 20% arboreal pollen with dominance of *Pinus* and *Corylus* and presence of *Alnus.* Attributed to Weichselian interstadial. (2/3 diluted sample)

Ly-2031. 28 **35,000 +1700 −1500**

From 13.5 to 13.75m depth. Pollen diagram indicates 90% arboreal pollen with dominance of *Corylus* and presence of *Alnus, Quercus, Ulmus,* and *Fraxinus.* Attributed to 2nd part of Middle Eemian interglacial. (9/10 diluted sample)

Ly-2032. 26 **29,000 ± 700**

From 14 to 14.25m depth. Pollen diagram indicates same data as Ly-2031.

General Comment (JS): Ly-2031 and -2032 must be considered min ages, detected low activity from contamination not eliminated by chemical pretreatment. Ly-2029 and -2030 agree with Weichselian attribution, but slightly older dates corresponding to interstadials generally dated from 40,000 to 30,000 BP were expected. Some contamination may be present.

D. Samples from various continental sediments

Massif forestier d'Osseja series, Pyrénées Orientales

Charcoal from sub-surface sediments in SE Osseja (42° 22′ N, 2° 07′ E). Coll by J N Puig and subm 1980 by J L Vernet, Univ Montpellier, to date min age of underlying soil, to evaluate age of colluvia contemporaneous with charcoal, and to establish evolution of vegetation. Table 11 lists results.

TABLE 11
Massif forestier d'Osseja

Sample no.	Sample ref	Colln date	Dilution ratio	Age BP
Ly-2412	80026 Le Puig	1980	1/3	280 ± 190
-2413	80022 Couronnes	1980	1/6	1380 ± 240
-2414	8195 Rhodoraie	1978	2/5	1410 ± 180

General Comment (JLV): dates prove that different periods of clearing of sub-alpine and mountainous forests occurred from 4th to 8th centuries and from 15th and 19th centuries.

Forêt domaniale de Bédoin series, Vaucluse

Very small amount of charcoal from several levels of pedologic profile at 820m alt in Bédoin forest (44° 09′ N, 5° 13′ E). Coll and subm 1978 by M Thinon, Lab Bot, Marseille. Table 12 lists results.

TABLE 12
Forêt domaniale de Bédoin

Sample no.	Sample ref	Depth	Dilution ratio	Age BP
Ly-1693	Bédoin 3	30cm	1/10	710 ± 500
-1692	Bédoin 2	50cm	1/10	1540 ± 470
-1691	Bédoin 1	1m	1/6	1830 ± 440

General Comment (MY): despite large uncertainty margins due to small amounts of available material, three results confirm botanic study of charcoal which suggests recent anthropogenic deforestation and substitution of *Quercus* sp and *Taxus baccata* by *Quercus ilex* (Thinon, 1978).

Ly-2000. Bois du Spitzberg **2200 ± 130**

Fragment of black tree trunk from Spitzberg (78° 00′ N, 17° 00′ E). Coll 1965 by J Corbel, Caluire, preserved in ^{14}C lab and measured 1978. *Comment*: date is comparable with values often found on such ice-floating wood which probably come far from S continent, see eg, Lu-241: 2650 ± 55 BP from Adventdalen, Spitzberg (R, 1970, v 12, p 546).

Ly-1960. Glacier de Tzeudet, Valais, Switzerland **8110 ± 180**

Fragment of tree trunk found at 2460m alt on moraine surface of Tzeudet glacier, on slope of Vélan Mt near Bourg-Saint-Pierre (45° 53′ N, 7° 11′ E). Coll by M May and subm 1979 by A Bezinge, Sté Grande Dixence, Sion. *Comment* (AB): date corresponds well with many other measurements on moraine wood from region, eg, from Arolla glacier, Ly-749: 8400 ± 200; Z'Mutt glacier, Ly-681: 7590 ± 180 (both in R, 1975, v 17, p 7, 8); Gorner glacier, Ly-298: 8160 ± 220 (R, 1972, v 15, p 135). These dates indicate very high uplift of timber line at end of Boreal period (Vivian, 1975; Bezinge & Vivian, 1976).

Ly-2294. Glacier de Thorens, Saint-Martin-de-Belleville, Savoie **3920 ± 100**

Fragment of tree trunk from 2200m alt in Thorens glacial moraine (45° 22′ N, 6° 30′ E). Coll and subm 1980 by R Vivian, Inst Geog Alpine, Univ Grenoble. *Comment* (RV): date agrees with those of similar trees of Belleville region at alt > 2000m, which is presently above timber line. Dates indicate that forest grew at this alt during end of Atlantic period and probably disappeared at beginning of Sub-boreal.

Creissels series, Aveyron

Calcareous tufa from two tufa cliffs rising above Tarn R valley (44° 05′ N, 1° 35′ E). Coll and subm 1978 by A Tavoso, Univ Marseille.

Ly-2316. Tuf des cascades **24,000 ± 500**

Ly-2315. Tuf des Roches du Château **32,500 ± 1000**

General Comment: despite uncertainty of this material, both dates agree with geol interpretations of age formation of both tufas: one is attributed to Late Würmian, other to Würmian interstadial. Ly-2315 should be considered min age (Ambert & Tavoso, 1981).

E. Samples from marine and lagoonal sediments

Lac Tanma series, Cayar region, Sénégal

Table 13 lists samples of gray or black clay with vegetal remains from several levels in borings from sediments of Tanma coastal lake (14° 54′ N, 17° 05′ W). Coll and subm 1979 by J Médus, Lab Bot Hist, Univ Marseille.

TABLE 13
Lac Tanma

Sample no.	Boring	Depth	Dilution ratio	Age BP
Ly-2264	S 4	7m	1/3	7610 ± 260
-1911	S 4	8m	3/20	5990 ± 530
-2265	S 4	12m	11/15	7790 ± 190
-2057	S 4	15m	1	7790 ± 150
-2058	S 4	17m	1/7	9550 ± 480
-1893	S 4	20m	1/5	10,640 ± 600
-1973	S 4 ?	45m	5/6	4070 ± 250
-2023	S 4 ?	48m	1/10	6080 ± 450
-2024	S 4 ?	49m	3/20	7170 ± 400
-2266	S 2	12m	13/30	7760 ± 240
-2267	S 2	19m	7/30	7830 ± 260
-2268	F 5	2m	1/6	1560 ± 240
-2269	F 5	12m	14/15	7510 ± 150

General Comment (JM): Ly-1893, -1973, and -2029 remain unexplained. For all other samples, dates fit well with depths and sea-level fluctuation curve drawn from other data (Faure & Elouard, 1967), mainly from Mauritania coast (Einsele *et al*, 1977). Ly-2058 and -1893 correspond with short transgression which rose again ca 8000 BP (6 results) and reached max with Ly-1911. Ly-2268 indicates that Tanma Lake was lagoon up to recent period, like previously dated Retba Lake (R, 1976, v 18, p 68).

Delta du Sénégal series, Sénégal

Table 14 lists samples of marine shells from several geol secs of sediments of Sénégal R delta near Saint-Louis. Coll and subm 1978 to 1980 by J Monteillet, Dept Geol, Inst Fondamental Afrique Noire, Dakar.

TABLE 14
Delta du Sénégal

Sample no.	Site ref	Loc	Sample	Dilution ratio	Age BP
Ly-2158	Gandon (I-A bis)	(16°56′N, 16°26′W)	*Anadara senilis*	1	5200 ± 120
-2039	Piste Dahra-Linguère (8021)	(15°27′N, 15°15′W)	*Limnicolaria chudeanei*	1/2	660 ± 150
-1931	Ndig (2a)	(16°17′N, 16°19′W)	*Pachymelania aurita*	1/2	1080 ± 210
-2045	Mbodiène (8027)	(16°12′N, 16°15′W)	*Pachymalania aurita*	1	1440 ± 120
-2042	Boubene I (8024)	(16°07′N, 16°23′W)	*Pachymelania aurita*	3/5	1490 ± 180
-2043	Djeus Boubene (8025)	(16°08′N, 16°23′W)	*Pachymelania aurita*	1/2	1580 ± 160
-1928	Guembeul (K G 2)	(15°55′N, 16°28′W)	*Anadara senilis*	1	1290 ± 130
-1927	Guembeul (K G 1)	(15°55′N, 16°28′W)	*Anadara senilis*	1	1530 ± 130
-1926	Khant (KTM 2a)	(16°02′N, 16°22′W)	*Pachymelania aurita*	4/15	1650 ± 280
-1925	Khant (KTM 1b)	(16°03′N, 16°21′W)	*Anadara senilis*	1	2760 ± 120
-2041	Dialame (8023)	(16°08′N, 16°20′W)	*Pachymelania aurita*	2/3	3280 ± 150
-2044	Savoigne 3 (8026)	(16°12′N, 16°17′W)	*Pachymelania aurita*	4/5	3230 ± 170
-1932	Savoigne (SV-Ic)	(16°12′N, 16°18′W)	*Anadara senilis*	14/15	5310 ± 240
-1933	Savoigne (SV-4b)	(16°13′N, 16°17′W)	*Anadara senilis*	1	5640 ± 190
-2040	Makhana puits DD2 (8022)	(16°05′N, 16°23′W)	*Anadara senilis*	1	5770 ± 130
-1930	Dialam Dia	(16°08′N, 16°20′W)	*Tourbe*	1	6060 ± 150
-1929	Djeus boubene (Dj. B C)	(16°08′N, 16°23′W)	*Anadara senilis*	1	6080 ± 190
-1918	Niaodoum (S)	(16°03′N, 16°24′W)	*Pachymelania aurita*	1	2150 ± 130
-1919	Ndiael (1)	(16°17′N, 16°01′W)	*Typanotonus fuscatus*	1	4450 ± 140
-1923	Tieng-To (10-11m)	(16°18′N, 16°21′W)	*Anadara senilis*	1	6980 ± 190
-1920	Diama Do (2-3m)		*Pachymelania sp*	3/10	1690 ± 220
-1924	Tieng T 5 (21-22m)	(16°18′N, 16°21′W)	*Pachymelania tympanotonus*	1/10	7320 ± 600
-1922	Diama Do (10m)	(16°11′N, 16°25′W)	*Anadara senilis*	1	6990 ± 180
-1921	Diama Do (11.5 à 12m)	(16°11′N, 16°25′W)	*Anadara senilis*	1	⩾33,700

General Comment (JM): Ly-2158 confirms previously pub result, Ly-1346: 5200 ± 210 (R, 1979, v 21, p 426). These two series establish local variation curve of sea level from 8000 BP to present and amount of continental flexure during last transgression (Faure *et al*, 1980). They also indicate wet climatic phase between 2000 and 3000 BP.

Salinas series, Alicante prov, Spain

Clay with very low organic content from two depths in upper sediments of shallow pond at Salinas near Elda (38° 27′ N, 0° 57′ W). Coll and subm 1978 by G Truc, Dept Geol, Univ Lyon. (4/15 diluted samples)

Ly-1654. 25cm **1850 ± 400**

Ly-1653. 45cm **1510 ± 390**

General Comment (GT): small amount of organic matter prevents distinction of two layers only separated by 20cm depth. Average value suggests relatively high sedimentation rate of ca 20cm millennium for bottom sediments of basin which was formed by Triassic diapir and is still salt marsh.

Mas de Listel series, Le Grau du Roi, Gard

Marine shells from present surface of Listel-Ventadis, ancient offshore bar in SW part of Rhône R delta (43° 45′ N, 4° 10′ E). Coll and subm 1978 by J Archambault, Univ Orsay and A L'Homer, Bur Recherche Geol Min, Orléans, during study of offshore bar formations of Rhône delta.

Ly-1764. Coupe de Mondragon, J9 1090 ± 200

Tests of *Cerastoderma glaucum*, shells.

Ly-1765. Cordon de Listel-Ventadis, no. 21 1880 ± 230

Several spp of *Cardiaces* shells. (9/10 diluted sample)

General Comment (JA): both dates give Holocene age to Listel-Ventadis offshore bar, in agreement with general trend of coastal evolution deduced from other data (see, eg, Le Grau du Roi series, R, 1979, v 21, p 426; Bazile *et al,* 1981); this may be due to different chemical evolution of shells (Archambault-Guézou, in press).

Ly-2035. L'Aubette, Berre l'étang, Bouches du Rhône 1740 ± 430

Shells (*Chlamys glabra*) from remains of quarry (43° 27′ N, 5° 10′ E). Coll 1980 by E Colomb, Univ Marseille, and subm 1980 by A Prieur, Dept Geol, Univ Lyon. (1/5 diluted sample). *Comment* (AP): paleontol expected age, end of Quaternary. Recent age of shells suggest they did not come from geol terrace but were brought in by man.

Ly-2105. Corail de Uré, Ile des Pins, New Caledonia 19,490 ± 330

Calcium carbonate from cement of coral breccia found during digging of well at Uré in Kanuméra Bay (22° 40′ S, 167° 25′ E). Coll 1977 by D Frimigacci and subm 1980 by F Poplin, Mus Natl Hist Nat, Paris. Coral breccia contains *Sylviornis neocaledoniae* fauna. *Comment* (FP): main coral level in which Uré well was dated to > 100,000 yr by UTh dating method. ^{14}C date suggests coral breccia may assoc old coral and much younger material and cement but does not attribute age to fauna, as very low collagen content of bones prevents direct measurement of bones (Poplin, 1980).

La Mer Pélagienne series, Tunisia

Table 15 lists samples from borings, dredgings, and collns made 1976 and 1977 in deep sea, on continental plateau, and on continent in Pelagian Sea region (Gabès Gulf) during sedimentol study of continental platform of region by Co fr Pétroles and Soc Natle Elf-Aquitaine. 10% of 760 samples were dated by Lyon, Gif-sur-Yvette, and Monaco ^{14}C labs. Details of environment, sample descriptions, interpretations of results were pub (Burollet, Clairefond, & Winnock, 1979). Most measurements were made on total carbonate fraction of samples (except Ly-1753 and -1679) because some preliminary assays showed that results obtained on organic fraction and those on carbonate fraction (eg, Ly-1753/1752, Ly-1679/1680) are close enough for purposes of study (Delibrias & Evin, 1979). As there was very little organic matter and almost no detrital carbonates, dates on total carbonate fraction was assumed sufficient.

TABLE 15
La Mer Pélagienne

Lab no.	Sample no.	Depth	Colln yr	Loc	Dilution ratio	$\delta^{13}C$ ‰	Age BP
				Gulf borings			
Ly-1717	KST-10	20-30cm	1976	(33°52′N, 10°26′E)	1	+2.29	21,250 ± 550
-1726	KST-19	150-162cm	1976	(31°14′N, 10°50′E)	4/5	+2.29	8580 ± 330
-1727	KST-19	325-327cm	1976	(31°14′N, 10°50′E)	1	+2.29	18,350 ± 440
-1728	KST-19	445-455cm	1976	(31°14′N, 10°50′E)	1	+2.29	27,200 ± 1000
-1718	KST-21	Surface	1976	(31°17′N, 11°05′E)	1	+2.29	4630 ± 160
-1711	KST-21	220-230cm	1976	(31°17′N, 11°05′E)	1	+2.29	9930 ± 210
-1677	KST-21	225-230cm	1976	(31°17′N, 11°05′E)	1	+2.29	9830 ± 230
-1678	KST-21	435-440cm	1976	(31°17′N, 11°05′E)	1	+2.0	27,100 ± 1000
-1712	KST-21	440-447cm	1976	(31°17′N, 11°05′E)	1	+1.5	31,200 ± 2000
-1713	KST-102	221-238cm	1976	(34°19′N, 11°52′E)	1/2	+3.6	12,600 ± 500
-1714	KST-102	458-479cm	1976	(34°19′N, 11°52′E)	1	+2.1	20,740 ± 550
-1725	KST-103	190-200cm	1976	(34°21′N, 12°07′E)	1		21,300 ± 500
-1679	KST-104	58-63cm	1976	(34°20′N, 12°22′E)	1/10	+9.90	11,200 ± 860
-1680	KST-104	58-63cm	1976	(34°20′N, 12°22′E)	1	+2.90	12,960 ± 260
-1681	KST-104	117-120cm	1976	(34°20′N, 12°22′E)	1/2	+2.90	18,300 ± 800
-1719	KST-106	10-20cm	1976	(34°20′N, 12°51′E)	5/6	+1.6	13,300 ± 350
-1682	KST-106	168-170cm	1976	(34°20′N, 12°51′E)	9/10	−1.6	12,850 ± 400
-1683	KST-106	170-172cm	1976	(34°20′N, 12°51′E)	2/3	−1.6	13,490 ± 550
-1684	KST-106	325-335cm	1976	(34°20′N, 12°51′E)	1	+1.3	13,650 ± 320
-1685	KST-107	32-36cm	1976	(34°27′N, 12°12′E)	1	+1.7	13,050 ± 260
-1686	KST-107	60-65cm	1976	(34°27′N, 12°12′E)	1	+1.7	17,200 ± 450
-1721	KST-110	225-240cm	1976	(34°40′N, 13°15′E)	2/3	+0.3	22,400 ± 800
-1720	KST-110	350-365cm	1976	(34°40′N, 13°15′E)	1	+0.1	23,300 ± 750
-1722	KST-118	445-458cm	1976	(34°46′N, 13°04′E)	1	+1.6	27,600 ± 1000
-1723	C-27	170-185cm	1977	(36°38′N, 12°18′E)	5/6	−0.1	18,020 ± 520
-1724	C-27	560-575cm	1977	(36°38′N, 12°18′E)	2/3	+0.4	20,100 ± 800
				Dredging and "Doris" boring in Gulf			
Ly-1687	DRT-16	0cm	1976	(31°10′N, 10°33′E)	1		1500 ± 140
-1715	DW-2	3245cm	1976	(34°26′N, 11°18′E)	1		30,500 ± 1700
-1716	DW-2	4296cm	1976	(34°26′N, 11°18′E)	1	+1.4	⩾35,000
				Sampling on continent and in Sebkhra region			
Ly-1757	HA-1	45-50cm	1977	(34°21′N, 10°19′E)	2/5	+2.4	5930 ± 340
-1707	HA-40	0cm	1977	(34°21′N, 10°13′E)	1/2	−1.5	8580 ± 360
-1708	KN-41	0cm	1977	(34°40′N, 11°08′E)	1	−4	34,500 ± 2000
-1705	KN-54	0cm	1977	(34°37′N, 11°03′E)	1		9730 ± 190
-1706	KN-60	0cm	1977	(34°47′N, 11°16′E)	1		17,760 ± 480
-2006	KSS		1977	(34°19′N, 10°18′E)	1		5140 ± 180
				Dredging in herbariums region			
Ly-1709	KK-7	20cm	1977	(34°42′N, 11°19′E)	1/2	+2.6	4420 ± 300
-1751	KK-24	120-130cm	1977	(34°40′N, 11°10′E)	1	+3.1	1830 ± 140
-1752	KK-29	90-100cm	1977	(34°44′N, 11°19′E)	1	+2.3	2430 ± 160
-1753	KK-29	90-100cm	1977	(34°44′N, 11°19′E)	9/10		1040 ± 250
-1754	KK-29	100-110cm	1977	(34°45′N, 11°19′E)	1	+4.1	1860 ± 150
-1710	KK-44	38cm	1977	(34°48′N, 11°20′E)	5/6	+2.2	5920 ± 260
-1755	KK-45	130-140cm	1977	(34°49′N, 11°18′E)	1		3450 ± 150
-1756	KK-46	125-135cm	1977	(34°49′N, 11°17′E)	1	+4.7	1150 ± 130

General Comment: 24 and 9 other results, respectively, were obtained by Gif and Monaco labs from same zone or same cores. All results agree perfectly with each other and all values were pub by CFP Soc and T Lajmi, Geol Survey Tunisia (Burollet, Clairefond, & Winnock, 1979). Conclusions drawn from ^{14}C analyses are described in Delibrias & Evin (1979). All results agree with data from other facets of study (palynol, sedimentol, and paleontol), demonstrating that carbonate sediments of Pelagian Sea were recently deposited either during Neotyrrhenian (Late Würmian) period or Versillian (Holocene) period.

Ly-2420. Oued Akarit, Tunisia **8240 ± 170**

Cardium shells from +10m alt in lagoonal layer embedded in Würmian terrace of Oued Akarit R, SE of Gabès (34° 07′ N, 7° 40′ E). Coll and subm 1981 by P Sanlaville, Univ Lyon. *Comment* (PS): date confirms other unpub measurements and suggests rise of shore of ca 20m in eight millennia.

Oued Karrouba series, Tunisia

Marine shells from offshore bars between mouths of Oued Ferd and Oued Saquiet el Karrouba R, SE of Gabès (33° 47′ N, 7° 54′ E). Coll 1981 by R Paskoff and P Sanlaville and subm 1981 by P Sanlaville, Univ Lyon.

Ly-2418. +3m **5530 ± 160**

Ly-2419. +4m **5490 ± 130**

General Comment (PS): both values confirm assumed Holocene age of offshore bars which redeposit materials from ancient Thyrennian offshore bars. They also confirm two unpub results from neighboring Oued Melah R site, MC-2155: 6420 ± 100; MC-2154: 6200 ± 100. These four dates indicate Holocene shore was higher than present sea levels in S Tunisia.

Tin Oueich series, Mauritania

Marine shells from two calcareous beds outcropping at Tin Oueich, 25km SE of Nouackchott (18° 4′ N, 15° 49′ W). Coll 1980 by J Evin et D Carité, Fr Tech assistance at Nouackchott (Carité, 1977).

Ly-2160. Plateau **$35,800 \begin{smallmatrix} +1900 \\ -1600 \end{smallmatrix}$**

Shells (*Anadar senilis*) from lumachelle layer at +4m.

Ly-2189. Zone base **29,900 ± 600**

Shells (*Crassostrea gasar*) from falun layer at +2m.

General Comment (DC): both layers are made of sediments deposited during transgressive phases. According to sediment facies, layer of lowest region of site was presumed to be deposited during Nouackchottian transgression which was dated many times (see, eg, Nouackchott series with Ly-350: 5510 ± 120, R, 1975, v 17, p 15). However, both results indicate two phases of single transgression in site; Inchirian transgression which was also dated many times in region, eg, at Tafarit Cap, Ly-443: 31,400 $^{+2300}_{-1800}$ (R, 1975, v 17, p 16).

III. ARCHAEOLOGIC SAMPLES

A. Historic period

Ly-2274. Pirogue du Lac de Paladru, Lepin, Isère 580 ± 230

Wood from monoxyl barge found in mud of Paladru Lake (45° 27′ N, 5° 33′ E). Coll 1979 and subm 1980 by M Colardelle, Centre Archéol Hist, Grenoble. (2/5 diluted sample). *Comment* (MC): despite large uncertainty due to small sample size, date confirms historic period expected from iron nails fixed in wood (Laurent, 1968).

Ly-2252. Garnat sur Engièvre, Allier 900 ± 110

Wood from monoxyl barge from 2.5m depth in alluvium of channel of Loire R (46° 38′ N, 3° 42′ E). Coll and subm 1980 by M Sauget, Dir Antiquités Hist, Clermont-Ferrand. No assoc industry (Vertet, 1981). (9/10 diluted sample). *Comment* (JMS): date assigns medieval age to boat.

Ly-2199. Epervans, Saône 1 1260 ± 140

Fragments of monoxyl barge found at Epervans, Saône et Loire (46° 45′ N, 4° 55′ E). Coll and subm 1979 by L Bonnamour, Mus Denon, Châlon. Assoc mainly with Gallo-Roman ceramics but also with some Merovingian vases. *Comment* (LB): younger than expected, but date is not surprising for such a boat, shape of which remains fairly unchanged from Early Neolithic up to 19th century AD.

Ly-1845. La Tour des Chiens, Corenc, Isère 490 ± 160

Bark (*Picea* sp) found in mortar of stone wall (45° 14′ N, 5° 47′ E). Coll and subm 1978 by M Lafont, Corenc. *Comment* (ML): text certifies that "La Tour des Chiens" was already built in AD 1241; date indicates either wall was built after main bldg or was later repaired.

Bois de l'Abbaye de St Victor series, Marseille, Bouches du Rhône

Fragments of two pieces of wood from treasure of Saint Victor abbey (48° 18′ N, 5° 23′ E). Coll and subm Dec 1979 by A Pons, Lab Palynol, Marseille and measured in March 1980. According to old tradition, wood was considered relics from 1st century AD; they were brought to Marseille in 13th century, but disappeared for short time during French Revolution and beginning of 19th century. Three dates are possible: beginning of Christian era, Middle ages, or 19th century.

Ly-1990. Bois long 710 ± 150

Ly-1991. Bois court 750 ± 150

General Comment (AP): closeness of dates of both wood fragments which also belong to same sp (*Salix alba* L) confirms they are of same origin if not same tree. Dates are of Middle ages probably corresponding to Crusades. They also indicate that temporary disappearance of wood did not affect their relative authenticity.

Eglise de Viuz series, Faverges, Haute Savoie

Human bones and charcoal (Ly-1879) from grave in Saint-Jean-Baptiste Church (45° 45′ N, 6° 17′ E). Coll 1978 and subm 1979 by M Colardelle.

Ly-1877. 150 **490 ± 120**

Ly-1878. 71 **1010 ± 130**

Ly-1879. 61 **2210 ± 130**

Ly-1880. 29 **880 ± 140**

General Comment (MC): Ly-1879 may be too old because of vicinity of older archaeol layers. Three other values seem to confirm archaeol data that nobody was buried in church after 15th or 16th century (Colardelle, 1980).

Nécropole Saint-Girard series, Sainte-Croix, Drôme

Bones and charcoal (Ly-1874) from several graves in Saint-Girard necropolis (44° 46′ N, 5° 16′ E). Coll 1978 and subm 1979 by M Colardelle.

Ly-1871. Sépulture 29 **870 ± 150**

Ly-1872. Sépulture 55 **1010 ± 140**

Ly-1873. Sépulture à chambre **730 ± 130**

General Comment (MC): three dates establish chronology of 1st occupation period of necropolis.

Ly-2293. Les Bellets, Saint-Pancrasse, Isère **1610 ± 130**

Charcoal from presumed lime-kiln excavation on Les Petites-Roches Plateau (45° 16′ N, 5° 53′ E). Coll 1978 by C Jail and subm 1979 by M Colardelle, Centre archéol Hist, Grenoble. Plateau was occupied since High Middle age. (5/6 diluted sample). *Comment* (MC): date is a little older than expected and suggests that lime kilns were occupied as soon as end of Roman times.

Ly-2306. Le Pusmin de Saint Armel, Sarzeau, Morbihan **380 ± 120**

Wood fragment from lintel of door of house (47° 31′ N, 2° 48′ W). Coll and subm 1980 by P Gevin, Geol Dept, Univ Lyon. *Comment* (PG): previous date on timber of basement of house was much older: Ly-1626: 1250 ± 150 (R, 1979, v 21, p 428). Present date, ca AD 1570, exactly fits with inscription on another lintel of house.

Ly-2179. Sépulture 2, CD 258, Saint-Germain-des Fossés, Allier **1130 ± 120**

Human bones from Sépulture 2 from graves at side of CD 258 rd (46° 12′ N, 3° 26′ E). Coll 1979 and subm 1980 by J P Daugas and L Magoga, Dir Antiquités Préhist Auvergne, Clermont-Ferrand, and J P Raynal, Inst Quaternaire Bordeaux, Talence. (2/5 diluted sample). *Comment*

(JPD & JPR): date confirms High Middle age sepulture close to Gallo-Roman archaeol site overlapping child's grave probably from Neolithic period.

Ly-1777. Mérignac, Gironde **1180 ± 190**

Bones from grave lying at level −1.6m in SE apse of old church of Saint-Vincent (44° 51′ N, 0° 39′ W). Coll and subm 1977 by J Sautreau, Léognan. This 1st Christian church at Mérignac was built on ruins of Roman bldg and became necropolis at beginning of Middle ages. *Comment* (JS): date confirms archaeol hypothesis that grave cannot belong to end of Roman times.

Brandes series, l'Alpes d'Huez, Isère

Bones from cemetery of ancient village of Brandes (45° 05′ N, 6° 05′ E). Coll 1978 by J Bruno and M C Bailly-Maître and subm 1979 by M Colardelle. Village was settled during 11th century near silver-lead mine and deserted during 15th century.

Ly-2272. Tombe NE **600 ± 120**

From NE grave, at 2.5m depth. (4/5 diluted sample)

Ly-2273. Tombe NC **610 ± 150**

From NC grave at 2.5m depth. (7/30 diluted sample)

General Comment (MC): both dates are mid-14th century and in expected range, confirming contemporaneity of graves.

Ly-1874. Eglise Saint-Martin, Saint-Julien-en-Genèvois, Haute Savoie **1080 ± 140**

Charcoal from grave in Saint-Martin Funerary basilica (46° 08′ N, 6° 05′ E). Coll 1978 and subm 1980 by M Colardelle. *Comment* (MC): date confirms fairly late use of basilica (Colardelle, 1980).

Roissard series, Isère

Charcoal from dwelling (Ly-1875) and necropolis (44° 53′ N, 5° 38′ E). Coll 1978 and subm 1979 by M Colardelle.

Ly-1875. Fond de cabane **1180 ± 130**

From hearth in cabin of presumed Merovingian dwelling.

Ly-1876. Sépulture 9 **1640 ± 140**

From Sépulture 9 of necropolis containing artifacts of High Middle ages. (1/2 diluted sample)

General Comment (MC): both dates agree with expected ages; Ly-1875 dates ca AD 770, very end of Merovingian times, and Ly-1876, ca AD 310, beginning of High Middle ages, considering uncertainty margin; necropolis must have been in use early.

Ly-1801. Le Champ des Pics, Saint-Yvoine, Puy de Dôme **1420 ± 200**

Human bones from Le Champ des Pics Cemetery (45° 35′ N, 3° 13′ E). Coll 1880 by M Millon and subm by A Cogoluehnes, Dept Geol, Univ

Lyon. *Comment* (AC): date indicates Middle age for tombs without assoc industry.

Les Valleyres series, Cussac-sur-Loire, Haute Loire

Samples from foot-hill sediments underlying rocks (44° 58′ N, 3° 55′ E). Coll 1979 and subm 1981 by A Crémillieux, Le Monastier-sur-Gazeille, Haute-Loire. Assoc with less characteristic industry and rich fauna (Crémillieux, 1979).

Ly-2437. 1 **1750 ± 160**

Charcoal. (23/30 diluted sample)

Ly-2439. 2 **1880 ± 220**

Bones. (4/15 diluted sample)

General Comment (AC): both dates are much younger than expected. Age of ca 30,000 yr was expected from regular stratification of sediment and presence of cut flints. Modern value cannot be explained without complete study of site.

Ly-2344. Font Carluze, Perols/Vézère, Corrèze **2020 ± 110**

Wood fragment from Gallo-Roman oak pipe from peat bog (45° 35′ N, 2° 02′ W). Coll 1969 and subm 1980 by G Lintz, Dir Antiquités Hist, Limoges. *Comment* (GL): dated to calibrate 1st dendrochronol curve in Limousin region. Date confirms expected Gallo-Roman period.

B. Protohistoric period

Kandiama series, Velingara, Haute Casamance, Sénégal

Table 16 lists samples of charcoal from fill of three galleries at a few m depth in soil (13° 10′ N, 13° 51′ W). Coll and subm 1979 by J Girard, Lab Ethnol, Univ Lyon II. Galleries are assumed troglodyte habitats or underground hiding places of ancient kingdom of Tekrour, destroyed ca AD 1350; they also might be drifts of ancient laterite mine.

TABLE 16
Kandiama

Sample no.	Gallery	Dilution ratio	$\delta^{13}C$ ‰	Conventional age
Ly-1993	Kandamia C'h	1	−0.1 ± 1.7	Modern
-1992	Kandamia C'm	1	+0.7 ± 1.8	Modern
-1994	Kandamia C'b	1	−0.2 ± 1.6	Modern
-1995	Kandamia C'b	2/3	+0.9 ± 2.2	Modern
-1996	Kandamia C'b	1	0.00 ± 1.8	Modern
-1997	Kandamia C'b	1	+2.4 ± 1.9	Modern

General Comment: if charcoal was actually embedded in sediments, fill of galleries is modern. Dates do not confirm expected age (6th-7th century) attributed to all galleries. Modern values suggest that previous pub results (Kandiama series, R, 1979, v 21, p 431) are either too old or are apparent age of burned wood. Thus, both series cannot be used to confirm ethnol hypothesis on origin of galleries (Girard, 1980).

Ly-2188. Mbaouane, Cayar, Sénégal **1410 ± 140**

Charcoal scattered in lowest levels of sandy dune (14° 44′ N, 17° 07′ W) containing potsherds and overlying Neolithic site. Coll and subm 1980 by J Evin and A Ravisé, IFAN, Dakar. *Comment* (AR): date is much younger than expected and proves recent change in loc of dune with transport of relatively heavy material. Charcoal cannot be considered contemporaneous with site.

Sintiou Bara series, Matam Dept, Sénégal

Table 17 lists samples of charcoal from several levels in three archaeol excavations in ancient village Sintiou Bara, near Ourossogui, le Fleuve region (15° 42′ N, 13° 24′ W). Coll 1977 and subm 1977 by G Thilmans, IFAN.

TABLE 17
Sintiou Bara

Lab no.	Sample ref	Excavation sq	Depth	Dilution ratio	Age BP
Ly-1741	IFAN 124	M 16	205cm	2/5	1470 ± 210
-1742	IFAN 126	O 16	160cm	4/7	970 ± 150
-1743	IFAN 127	K 16	96cm	3/5	1460 ± 220
-1744	IFAN 128	K 17	134cm	1	1090 ± 160
-1745	IFAN 129	K 16-17	165cm	1	1550 ± 140

General Comment (GT): results agree with archaeol data and other series from same type of site in region (Ogo, Saré Tioffi, and Tioubalel series, below). With three unpub results: Dak-192: 900 ± 110 (sq L 14, 225cm), Dak-155: 1363 ± 120 (sq M 18, 270cm), and Gif-4522: 920 ± 80 (sq X 16, 255cm), series suggests site occupation for at least 600 yr during 2nd half of 1st millennium AD and negates any relationship between depths and ages of layers.

Saré Tioffi series, Podor Dept, Sénégal

Samples from cut-off burial hillock in ancient village Saré Tioffi, le Fleuve region (16° 40′ N, 14° 58′ W). Coll 1976 and subm by B Chavane, Dakar.

Ly-2033. S-III 40cm **920 ± 100**

Charcoal from geol level with grave; subm 1979.

Ly-1937. S-III 95cm **1580 ± 130**

Charcoal from layer overlying grave; subm 1978.

Ly-1603. S-III 80cm **4830 ± 770**

Bones of intact skeleton found in grave; subm 1976. (1/4 diluted sample)

General Comment (BC): 1st two measurements date site occupation and agree well with expected value and Ogo and Sintiou Bara series from same Iron age culture of ancient Tekrour Kingdom (Chavane, 1980). Ly-1603 is obviously too old for unknown reason even with widest statistical margin.

Ogo series, Matam Dept, Sénégal

Samples from proto-historic Ogo village, Le Fleuve region (15° 34′ N, 13° 17′ W). Site is small hill with accumulation of cultural remains.

Ly-2034. Charbons de bois **790 ± 100**

Charcoal from 60 to 70cm depth in excavation sq S_2. Coll and subm 1979 by B Chavane. Assoc with iron metallurgy artifacts.

Ly-2159. Torchis **1910 ± 210**

Dried mud with much charred vegetal remains from wall of burned house at 50 to 70cm depth in sq S_2. Coll 1980 by J Evin to test use of sampling material (1/3 diluted sample) despite burning of 600g of dried black mud.

General Comment (BC): Ly-2034 agrees with expected date corresponding with end of village occupation and ancient kingdom of Tekrour (Chavane, 1980). Two unpub dates were obtained for deeper layers in site: Gif-4529: 910 ± 90 (55cm depth) and Gif-4530: 1020 ± 90 (2.55m depth). Thus, three charcoal dates suggest at least 200-yr range of site. Ly-2159 is obviously too old, establishing that elements of mud wall cannot be used as sample. In fact, it seems that measured carbon partly comes from remaining organic matter in clay used for wall, not only from vegetal remains added to clay as temper.

Tioubalel series, Matam Dept, Sénégal

Charcoal from two depths in excavation at site of ancient village lying along Senegal R (16° 16′ N, 13° 59′ W). Coll 1977 by G Thilmans and subm 1980 by IFAN. Assoc with potsherds and copper and iron artifacts (Thilmans & Ravisé, in press).

Ly-2049. IFAN 148 **1170 ± 90**

From 53cm depth; expected age: 600 BP.

Ly-2048. IFAN 147 **1960 ± 400**

From 117cm depth; expected age: 800 BP. (1/2 diluted sample)

General Comment (GT): both dates are older than expected but agree with those from other villages of same culture in Le Fleuve region (Saré-Tioffi, Sintiou-Bara, and Ogo series, above).

Fond-Brûlé series, Le Lorrain, Martinique

Charcoal from level of 1st Arawak period of Fond-Brûlé site (10° 30′ N, 61° 00′ W). Coll 1978 by M Mattioni and M Schvoerer and subm 1978 by M Schvoerer, Lab Physique Appl Archeol, Univ Bordeaux. Dated to cross-check dates by TL method. (1/6 diluted samples)

Ly-2196. BDX-177, Carré K3 **1630 ± 220**

Ly-2197. BDX-175, Carré 04-P2 **2200 ± 210**

General Comment (MS): TL dates from same level are BDX-156: 2010 ± 350 BP and BDX-161: 1840 ± 220 BP. Previous ^{14}C date for volcanic eruption which ended 1st occupation period of site ca 1655 BP. These five dates agree very well and disagree with two unpub dates from Nancy, ca 2360 and 2660 BP for same level. Another TL date was obtained for 2nd Arawak occupation period (assoc with Carribean industries): BDX-154: 1110 ± 170 BP.

Sou and Sou Blama Radjil series, Logone et Cahri, Cameroun

Table 18 lists samples of charcoal from two open-air sites at Sou (12° 12′ N, 14° 42′ E) and Sou Blama Radjil (12° 13′ N, 14° 42′ E) near Afadé. Coll by J Rapp, Strasbourg and by J P Lebeuf, Paris. Assoc with industries of decorated ceramics and in some levels with metal, stone, or bone.

TABLE 18
Sou and Sou Blama Radjil

Lab no.	Site	Sample no.	Yr coll and subm	Layer	Depth	Dilution ratio	Age BP
Ly-2002	Sou (Pt XIX)	41.1407	1979	3	100-110cm	1	500 ± 130
-2003	Sou Blama R	168-277	1979	3	240-247cm	1	2310 ± 150
-2004	Sou Blama R	168-281	1979	3	260-267cm	1	2280 ± 170
-2005	Sou Blama R	168-296	1979	3	300-307cm	1	2530 ± 130
-2280	Sou Blama R	168-429	1980	2b	148cm	2/15	2570 ± 240
-2281	Sou Blama R	168-519	1980	4	304cm	1/5	2740 ± 210
-2282	Sou Blama R	168-539	1980	5	340cm	1/5	3200 ± 250
-2283	Sou Blama R	168-561	1980	7	405-407cm	7/30	2430 ± 250
-2284	Sou Blama R	168-563	1980	7	430-440cm	1/6	3280 ± 360

General Comment (JR): only date from Sou site, Ly-2002, agrees with expected age corresponding to youngest Sao cultural phase, later than 10th century AD. Except Ly-2283, which is obviously too young, all dates of Sou Blama site are consistent with stratigraphy despite large statistical margins of samples coll in 1980. Dates also agree with unpub result, Gif-4821: 2340 ± 100 for Layer 3 but agree with another unpub result: 2800 ± 110 for Layer 7. Dates indicate relatively long duration of earliest phase of Sao culture assoc with fine ceramics.

Ly-2104. Sanctuary Cybèle, Fourvière, Lyon, France 2100 ± 140

Charcoal from level rich in organic matter lying under SW angle of Cybèle sanctuary in Roman site (44° 46′ N, 4° 50′ E). Coll 1978 and subm 1979 by A Audin, Gallo-Roman Mus Fourvière, Lyon. (3/5 diluted sample). *Comment* (AA): date agrees with expected age, *ie,* just before Roman epoch as dated layer underlies 1st level of Roman bldg.

Tureng-Tepe series, Gorgan, Iran

Table 19 lists samples of charred wood from several fire levels indicating end of several occupation periods of Tureng Tepe tell (36° 55′ N, 54° 35′ E). Coll from 1969 to 1977 by J Deshayes and subm 1974 to 1978 by J Deshayes and S Cleuziou, Centre Recherche Archeol, Paris.

TABLE 19

Tureng-Tepe

Lab no.	Sample no.	Colln yr	Level and culture	Calibrated expected age	Dilution ratio	Age BP
Ly-1149	TT C-71-10	1971	VII	AD 700	1	1410 ± 140
-2248	TT 77-4	1977	Soil of Sassanide fortress	AD 500	1	1650 ± 100
-1065	TT C-71-9	1971	Soil of fortress	AD 500	1	1940 ± 80
-2249	TT 71-5	1977	VI	AD 500	1/5	3440 ± 220
-1147	TT C-69-1	1969	III C2 Bronze age	2000 BC*	1	3580 ± 130
-1148	TT C-71-2	1971	III C1 Bronze age	2300 BC*	2/3	3920 ± 250
-2302	TT 77-2	1977	III C High terrace	2200 BC*	1	3690 ± 130
-2301	TT 77-1	1977	III C Hissar	2200 BC*	1	3620 ± 130

* MASCA calibration curve

General Comment (SC): 1st three results of hist period are a little older than expected but may give apparent ages of wooden timbers. Ly-2249 is very different from expected date and may be explained either by re-use of old timber or by sampling problem. As dendrochronol correction of conventional ^{14}C dates was used for determining expected ages, Ly-1147 and -1148 agree with expected range of dates and with pub result, TUNC-42: 3625 ± 71 BP (R, 1973, v 15, p 596). These three results from level of low ancient town while Ly-2302 and -2301 deal with destruction of high terrace, also assumed from III C1/III C2 transition period. Results agree with expected ages and previous results (Deshayes, 1976). Another big timber, charred in same fire dated by Ly-2301 and -2302 gave Gif-3339: 4000 ± 110, which also fits if apparent age of biggest timber is considered older.

C. *Iron age*

Ly-1808. En Magne, Chavéria, Jura **1130 ± 430**

Human bone from sepulture under Tumulus XIV (46° 31′ N, 5° 33′ E). Coll 1969 and subm 1978 by D Vuaillat, Dir Antiquités Préhist, Besançon. Assoc with Bronze sword from Hallstatt period. (1/5 diluted sample). *Comment* (DV): for unknown reasons date is completely different from expected age. Stratigraphic data indicates no re-use or rehandling of sepulture occurred, and no contamination of sample may have modified result since it was obtained from only one bone.

Collondon series, Doucier, Jura

Samples from two places in Les Crevasses site (46° 38′ N, 5° 64′ E). Coll and subm by D Vuailliat.

Modern

Ly-2010. Tumulus 1 **$\Delta^{14}C = +1.3\% \pm 2.3$**

Charcoal from lateral hearth, coll and subm 1979. Assoc with poor industry of Iron age. (1/2 diluted sample)

Ly-2009. Enclos carré **1640 ± 300**

Burned bones and charcoal from cremation area in middle of enclosure. Assoc with Iron age fibulae. (2/5 diluted sample)

General Comment (DV): both dates do not confirm age expected by assoc industries. Ly-2010 rather shows occupation of hearth just before excavation, embedded under colluvia. Ly-2009 indicates carbonaceous remains in enclosure are contaminated by rootlets.

Ly-2300. La Tourette, Pont-du-Château, Puy de Dôme **2060 ± 120**

Charcoal from dwelling level of Early or beginning of Middle La Tène period (45° 37′ N, 3° 12′ E). Assoc with ceramics and metal artifacts such as Dux fibula, from ca 280 to 250 BC. Coll 1976 by F Malacher and subm 1980 by J P Daugas and F Malacher, Dir Antiquités Préhist Auvergne, Clermont-Ferrand. *Comment* (JPD): date is a little younger than expected suggesting that charcoal was introduced by colluvia.

Ly-2082. Baccarat, Les Laumes **2240 ± 160**

Charcoal from 1.4 to 1.7m depth in alluvia of Oze R, Côte d'Or (47° 32′ N, 4° 27′ E). Coll 1978 by M Ariente and subm 1978 by J J Puisségur, Inst Geol, Univ Dijon. Assoc with coarse potsherd attributed to Iron age. *Comment* (JJP): agrees with archaeol attribution.

Ly-1807. Lit de la Saône, Seurres, Côte d'Or **2510 ± 130**

Wood from leg of statuette of naked man found by dredging in channel of La Saône R (47° 00′ N, 5° 31′ E). Coll and subm 1977 by L Bonnamour, Mus Denon Châlon-sur-Saône. *Comment* (LM): conforms with expected age since such votive statues used to be thrown in fountains or rivers from Early Bronze age to end of Roman times, mainly at end of Hallstatt and during La Tène period, when person was represented naked. Late Hallstatt ceramics agrees perfectly with date.

Les Jiraudonnes series, Augères, Creuse

Charcoal from two tumuli (46° 05′ N, 1° 42′ E). Coll 1975 by P Léger and subm 1980 by G Mazière, Dir Antiquités Préhist, Limoges.

Ly-2353. Tumulus 1 **2150 ± 120**

From cremation tumulus containing Late Hallstatt industry.

Ly-2354. Tumulus 2 **2190 ± 250**

From tumulus with collective burial containing Late Hallstatt and Early La Tène industries. (11/30 diluted sample)

General Comment (GM): both dates agree with each other but ca 200 yr too young. They do not distinguish between two Iron age periods.

Ly-1862. Tumulus Tugayé I, Ger, Pyrénées Atlantiques **2470 ± 300**

Burned bones and charcoal from funerary urn in Tugayé I (43° 15′ N, 0° 05′ W). Subm 1978 by Coquerel, Tarbes. *Comment* (RC): despite large dilution of sample (1/5) and large statistical margin, date confirms expected age around transition between First and Second Iron ages, which seems to have been delayed in Central Pyrénées massif.

Ly-1971. La Forêt Basse, Saint-Pierre-de-Fursac, Creuse **2390 ± 120**

Charcoal and burned bones from central sepulture "cairn", 2m deep, of tumulus (46° 09′ N, 1° 28′ E). Coll and subm 1979 by G Mazière, Dir Antiquités Préhist d'Auvergne, Limousin. Assoc hillock contains potsherds, flints, and Early Iron age sepulture with Iron belt ring. *Comment* (GM): date indicates re-use of earth sepulture which also contains Neolithic and Bronze age remains.

Ly-2222. Camp de Larina, Annoisin et Chatelans, Isère **2420 ± 110**

Charcoal from hearth in Loc 3 of Camp de Larina site (45° 47′ N, 5° 18′ E). Coll and subm 1979 by H Chatain, Villefontaine, Isère. *Comment* (HC): date indicates end of Hallstatt period. Hearth, without typical archaeol material must be assoc with several artifacts of Hallstatt period from other areas of site. Ly-2222 is 1st and only date for settlement, which remained occupied from Neolithic to Merovingian times. It may be compared with Ly-880: 2450 ± 110 (R, 1976, v 18, p 72), from La Balme site at Sollières-Sardière, Savoie.

Ly-1912. Roja, Castifao, Haute-Corse **2420 ± 180**

Bones from 20cm depth in Roja rock shelter (42° 30′ N, 9° 07′ E). Coll 1976 by L Acquaviva, Nice, and subm 1979 by J Jehasse, Dir Antiquités, Corsica. Site is collective sepulture with fairly poor industry probably of First Iron age. *Comment* (JJ): dates sample at 1000 to 500 BC, and seems satisfactory.

Ly-2242. Cami Salié, Pau, Pyrénées Atlantiques **2650 ± 140**

Charcoal under funerary urn in Tumulus 1 (43° 19′ N, 0° 25′ W). Coll 1977 and subm 1978 by G Marsan, Lab Geol Quaternaire, Univ Bordeaux. Assoc with First or Second Iron age industry. *Comment* (GM): date agrees with possible range of dates for First Iron age (Hallstatt), but precise limit of Second Iron age (La Tène) is not well-defined in region.

Ly-2191. Beauverger, Villeneuve-les-Cerfs, Puy de Dôme **2370 ± 100**

Charcoal from 1m depth in clayey and sandy Tumulus 6 of Beauverger site (46° 02′ N, 3° 20′ E). Coll 1979 and subm 1980 by D Miallier, Centre Recherches Interdisciplinaires Archéol Anal, Univ Bordeaux. *Comment* (DM): according to regional context and some assoc potsherds, tumulus may belong to 1st Iron age in agreement with result. TL measurements on assoc potsherd are in process; provisional result, calibrated with well-dated samples, is BDX-328: 2384 ± 180 BP. Agreement between both dating methods seems perfect.

Fosse de Caramontron de Sinzelles series, Polignac, Haute Loire

Charcoal from fill of pit outcropping in rd bank (45° 04′ N, 3° 52′ E). Assoc with industry with mixed characteristics of Late Bronze III age and beginning of Iron age, similar to alpine coastal stas. Coll and subm 1978 by J J Houdré and J Vidal, Le Puy.

Ly-2036. 6th and 8th cleaning **2410 ± 130**

From 20 to 30cm depth in middle of pit.

Ly-2037. 10th cleaning **2520 ± 120**

From 50 to 55cm depth at base of pit.

General Comment (JJH&JV): both dates attribute Iron age to fill of pit and confirm lasting Late Bronze influences in region. They are much more recent than Late Bronze culture in alpine lakes: see, eg, Ly-17: 2700 ± 100 BP (R, 1969, v 11, p 115) from Châtillon coastal sta in Le Bourget lake.

D. Bronze age

Ly-2056. Sandgrube, Sierentz, Haut-Rhin **2550 ± 100**

Charcoal from 0.8 to 1.1m depth in cremation Sepulture 10 of open-air site Sandgrube (47° 40′ N, 7° 26′ E). Coll 1978 by J J Wolf and subm 1979 by A Thevenin, Dir Antiquités Préhist, Strasbourg (Wolf, 1978). *Comment* (AT): date only agrees with expected age of assoc Late Bronze III industry, ca 3000 to 2700 BP, if double standard deviation is used.

Ly-2053. Tumulus 22, Kirchlach, Schirrhein, Bas-Rhin **1490 ± 120**

Charcoal from 60cm depth in hearth (48° 48′ N, 7° 54′ E) assoc with poor ceramic industry attributed to Middle Bronze age. Coll and subm 1978 by A Thevenin. *Comment* (AT): date is obviously too young; it may indicate reuse of site for Middle age hearth or disturbance of layers by roots.

Kastenwald series, Appenwhir, Bas-Rhin

Charcoal from cremation sepultures underlying two neighboring hillocks in Kastenwald forest (48° 02′ N, 7° 27′ E). Coll by C Bonnet, S Pouin, and F Lambach and subm 1978 by A Thévenin (Bonnet & Plouin, 1979).

Ly-2055. Tombe 1 **2770 ± 130**

Coll 1975, from Sepulture 1 at 0.1m depth, assoc with Middle Bronze age III industry.

Ly-2054. Tombe 5 **2900 ± 130**

Coll 1974 from Sepulture 5 at 1m depth, assoc with Middle Bronze age III, a little more recent than Ly-2055.

General Comment (AT): dates confirm both hillocks are contemporaneous but were built during Late Bronze age contrary to archaeol attribution of assoc industry.

Ly-2325. Chemin de la Pêcherie BCP-55, Berry-au-Bac, Aisne **2770 ± 160**

Bones from refuse pit of house of Late Bronze age village in Aisne R valley (see Neolithic series from same valley, below) (49° 24′ N, 3° 53′ E). Coll 1978 and subm 1979 by Unité Recherche Archéol no. 12, Inst Art Archéol, Paris. (11/15 diluted sample). *Comment* (URA 12): date seems a little too young because of attribution of site to Late Bronze IIb (Hallstatt A2 in German chronology), presumably 3000 to 2100 BP.

Ly-1951. Pirogue du Crèt de Chatillon, Sévrier, Haute-Savoie **2700 ± 140**

Wood from monoxyl barge in oak found at 4m depth in Annecy Lake on coastal sta Le Crèt de Chatillon (45° 52′ N, 6° 08′ E). Coll 1979 by P Persond and subm 1979 by A Bocquet, Centre Préhist Documentation Alpine, Grenoble. *Comment* (AB): date indicates end of Bronze age in perfect agreement with archaeol material of coastal sta and previous dates from site, *ie*, Ly-17: 2700 ± 100 (R, 1969, v 11, p 115) and Ly-274: 2670 ± 110 (R, 1971, v 13, p 57).

Ly-1986. Salle des Gardes, Caen, Calvados **3030 ± 450**

Human bones from excavation under so-called Salle des Gardes bldg in medieval castle (49° 10′ N, 0° 22′ W). Coll 1976 by C Pilet, Dir Antiquités Hist Caen, and subm 1979 by G Verron, Dir Antiquités Préhist, Caen. (1/2 diluted sample). *Comment* (GV): dates to Bronze age skeleton which was lying without assoc industry under level from beginning of Roman period (1st century BC).

Ly-1866. Grotto Linars, Rocamadour, Lot **3080 ± 240**

Human bones from Linars sepulchral grotto (44° 48′ N, 1° 37′ E). Coll by L Genot, Leyme, Lot, and subm by A Cogoluenhes, Dept Geol, Univ Lyon. Assoc with ceramic industry of Les Champs d'Urnes culture of Late Bronze age. *Comment* (AC): date agrees with archaeol estimate and confirms that site was not disturbed as was previously thought.

Ly-2244. Le Verger, Saint-Romain, Côte d'Or **3540 ± 230**

Charcoal from base of Early Bronze age layer (46° 59′ N, 4° 43′ E) (see also Neolithic layers of same site, below). Coll and subm 1979 by S Grappin, Dir Antiquités, Dijon. (2/5 diluted sample). *Comment* (SG): confirms archaeol attribution to Early Bronze age.

Ly-1773. Camp de Chassey, IL 56 TP, Chassey, Saône et Loire **3480 ± 140**

Charcoal from piling hole of rampart of fortified plateau (45° 53′ N, 4° 46′ E). Rampart is not assoc with industry but is assumed to be from protohistoric period (Bronze or Hallstatt). Coll 1972 and subm 1978 by J P Thévenot, Dir Antiquités Préhist, Dijon. *Comment* (JPT): in expected range, dates rampart most probably to Middle Bronze age as confirmed by stratigraphy.

Ly-1831. La grotte de Pégourié 1725, Caniac du Causse, Lot **3650 ± 250**

Charcoal from hearth found in one of upper layers of grotto fill (44° 37′ N, 1° 39′ E). Coll 1977 and subm 1978 by R Séronie-Vivien, Le Bouscat, Gironde. Presumably Chassean potsherds were found close to hearth, but site may have also been used during Middle or Early Bronze ages. (2/5 diluted sample). Many other dates were obtained from lowest layers of site (below). *Comment* (RS-V): as expected, dates boundary between Early and Middle Bronze ages. *Cf* unpub results from Les Claups grotto, Gif-3568: 3210 ± 110 and pub results from Layers 2 and 3 of Le Noyer grotto, Gif-1631: 3150 ± 110, and Gif-1159: 3250 ± 110 (R, 1972, v 14, p 288).

Stathmos Aggistas series, Serres, E Macedonia, Greece

Charcoal from two locs in N excavation of Stathmos Aggistas site (41° 00′ N, 23° 57′ E). Coll 1977 by Ch Koukouli-Chrysanthaki, Kavala Archaeol Mus, and subm 1978 by J Deshayes, Paris. Site is tell underlying tumulus of Macedonian grave. Tell presumably belongs to Macedonian culture of final Late Bronze age, 1400-1100 BC (Koukouli-Chrysanthaki, 1980). (1/2 and 3/5, respectively diluted samples)

Ly-1778. 2.8m, N sec **3700 ± 270**

Ly-1779. Pit 3, N sec **4300 ± 230**

General Comment (CKC): since MASCA calibration of both dates set them at end of 3rd millennium BC*, they are much older than expected. Oldest layer of site, that of Ly-1748, is archaeol dated by Mycenean vases to 14th century BC. Ly-1748 comes from more recent layer. Organic material found in Pit 3 (Ly-1749) was previously dated by Zentral Inst Berlin to 940 ± 65 BC (uncalibrated and unpub).

Ly-1806. Tumulus F 16, Lamarque-Pontacq, Hautes-Pyrénées **3730 ± 190**

Charcoal from cremation area of F 16 tumulus (43° 12′ N, 0° 07′ W). Coll 1966 and subm 1977 by R Coquerel, Tarbes. Although without assoc industry site may be compared with La Gourgue d'Asque site, Hautes-Pyrénées (Clot, Coquerel, & Omnès, 1978) previously dated by Ly-1053: 3800 ± 40 (R, 1978, v 20, p 40). *Comment* (RC): date confirms contemporaneity with Ly-1053; both dates indicate relatively old age of cremations in Central Pyrénées (Coquerel, 1966).

Ly-2180. Berges de l'Artière, Les Martres d'Artière, Puy de Dôme **4200 ± 160**

Animal bones from left bank of Artière R (45° 50′ N, 3° 04′ E). Coll 1978 and subm 1980 by J P Daugas, Dir Antiquités Préhist d'Auvergne, Clermont-Ferrand, and J P Raynal, Inst Quaternaire Bordeaux, Talence. (4/5 diluted sample). Outcropping sediments were formed by filling of ancient river channel. Level also contains "en barbelé" decorated ceramic, well-known in S France and attributed to beginning of Early Bronze age.

Comment (JPD&JPR): date is a little older than expected by assoc industry and shows ancient river channel was filled from Late Neolithic to Early Bronze ages.

Ly-1868. Grotte de l'Homme-Mort, Lomné, Hautes-Pyrénées **3760 ± 150**

Human bones from debris of ancient excavation in sepulchral gallery of Lomné grotto near Lannemezan (43° 0′ N, 0° 17′ E). Coll and subm 1979 by J Omnès, Lourdes. *Comment* (JO): date agrees with presumed Bronze age and assoc industry, stabber and nail-decorated ceramics (Omnès, 1981). *Cf* Ly-1904 from Artigaou grotto (below).

E. Chalcolithic/Neolithic

Dolmen de Mourioux series, Mourioux, Creuse

Charcoal from soil of dolmen in Bois de Mourioux (46° 04′ N, 1° 39′ E). Coll by R Credot and M Dominique and subm 1978 by G Mazière, Dir Prehist, Limoges. Assoc with Neolithic industry.

Ly-1968. No. 1 **240 ± 160**

Coll 1976. (9/10 diluted sample)

Ly-1969. No. 2 **2010 ± 130**

Coll 1977.

General Comment (GM): dates indicate re-use of sample as frequently happens in megalithic monuments, which therefore cannot be dated in this manner.

Santourin series, Billième, Savoie

Charcoal from two levels (45° 49′ N, 5° 23′ E) coll 1978 and subm 1979 by L Lagier-Bruno, Yenne, Savoie. Site is mainly stone circles which may have been sheepfolds or Neolithic dwellings (Lagier-Bruno, 1981). (Ca 1/5 diluted sample)

Ly-2287. Level II **3550 ± 220**

Ly-2288. Level III **4340 ± 290**

General Comment (LLB): previous date on Level I, Ly-1604: 2240 ± 260 (R, 1979, v 22, p 432) indicates dates are in stratigraphic order; also indicates Late-Neolithic/Early-Bronze transition in agreement with presumed ages of other megalithic monuments.

La Touvière series, Thoyes, Arbignieu, Ain

Samples from so-called La Couche Brune level at two locs in rock shelter (45° 45′ N, 5° 39′ E). Coll and subm 1978 and 1979 (Ly-2259) by R Vilain, Dept Geol, Univ Lyon. Assoc with uncharacteristic industry which may be Chalcolithic.

Ly-1974. F-4 **1010 ± 130**

Charcoal from Sq F-4 in front part of rock shelter.

Ly-1975. C-4-5 **2520 ± 200**

Charcoal from Sqs C-4 and C-5 in front part of rock shelter. (2/3 diluted sample)

Ly-2259. Sepulture **3210 ± 160**

Human bones from multiple sepulture in bottom of rock shelter. (7/10 diluted sample)

General Comment (RV): dates from charcoal are too young for assoc industry in level. They indicate extensive influence of modern hearth found near excavated sqs. Date on bones is plausible for assoc industry, which may either belong to Bronze age or, more probably, is older but redeposited by burials (Morelon, 1974).

Ly-2214. Frépestel, Meyrueis, Lozère **1660 ± 160**

Human bones from under flagstone-covered sepulture (44° 12′ N, 3° 27′ E), assoc with industry most probably from Chalcolithic. Coll 1979 by G Fagès and subm 1980 by A Cogoluènhes. (11/15 diluted sample). *Comment* (GF): much younger than expected; dates show disturbance in sepulture suspected from bone distribution.

Ly-2245. Hermanky, Ceska Lipa, Bohemia, Czechoslovakia **3820 ± 210**

Charcoal from Hermanky rock shelter (50° 43′ N, 14° 35′ E). Coll and subm 1979 by J Svoboda, Univ Brno. Samples were found in Neolithic living areas in rock shelter (Svoboda, 1979). (7/30 diluted sample). *Comment* (JS): date is much too young; may be contaminated by recent roots.

Ly-2295. Aven de Jacques, Lussac, Ardèche **3660 ± 130**

Human bones from Jacques sepulchral grotto-aven (44° 37′ N, 4° 29′ E). Coll 1979 and subm by A Cogoluènhes, Dept Geol, Univ Lyon. Assoc with Fontbouïse Chalcolithic industry. *Comment* (AC): date is younger than generally thought for Fontbouïse culture, but it may fit in usual range with double statistical margin.

Ly-1904. Grotte de Las Crouts d'Artigaou, Esparros, Hautes Pyrénées **3720 ± 140**

Human bones from sepulchral recess near Lannemezan (43° 02′ N, 0° 05′ E). Coll and subm 1978 by J Omnès, Lourdes. *Comment* (JO): date agrees with Chalcolithic age presumed by poor assoc ceramic industry. *Cf* Ly-1868 (above) from Lomné sepulchral grotto (Omnès, 1981).

Ly-1750. Bré-Sourbette, Veyreau, Aveyron **3800 ± 130**

Bones from sepulchral grotto (44° 06′ N, 3° 02′ E) assoc with Late Rodezian Chalcolithic or Chalcolithic with "Céramiques à triangles hachurés" industry and with fluted point lodged in bone (Fagès & Mourer-Chauviré, in press). Coll 1978 by G Fagès, Florac, and subm 1978 by C Mourer-Chauviré, Dept Geol, Univ Lyon I. *Comment* (GF&CMC): date is younger than expected from Late Neolithic assoc industry previously dated in La Treuille grotto: 3 Gif dates ca 4600 BP (R, 1974, v 16, p 25), but agrees with dates of other sites of same industry: Sargel grotto, Gif-328: 3710 ± 180 (R, 1970, v 12, p 423), Les Côtes of Roquefort, Gif-37: 3930 ± 150 (R, 1966, v 8, p 130), and La Fajole, Ly-2213 (below).

Ly-2213. La Fajole, Vebron, Lozère 3990 ± 110

Human bone from megalithic sepulture Galdri (44° 17′ N, 3° 32′ E) assoc with so-called Rodezian Chalcolithic/Early Bronze industry. Coll and subm by G Fagès and subm 1980 by A Cogoluènhes. *Comment* (GF): agrees with expected age and another date from same culture in region, Ly-1750 from Bré Sourbette site (above).

Ly-2305. Pirogue de Meimart, Brisson-Saint-Innocent, Savoie 3740 ± 130

Wood from monoxyl barge in oak found 2m deep on bottom of Le Bourget Lake (45° 44′ N, 5° 52′ E). Coll 1980 by R Castel and subm 1980 by A Bocquet, Centre Préhist Documentation alpine, Grenoble. *Comment* (AB): dates barge to Late Neolithic and three centuries later than fragment of wooden cup of Saône et Rhône culture from same site, Ly-190: 4060 ± 120 (R, 1971, v 13, p 57).

Ly-1989. Chapeau-Rouge, Menetrol, Puy-de-Dôme 3750 ± 240

Human bones from probable Neolithic sepulture (45° 52′ N, 3° 18′ E). Coll and subm 1979 by J P Daugas and J P Raynal. (2/3 diluted sample). *Comment* (JPD&JPR): date may be younger than expected because of chemical composition of embedding sediment, Terre Noire de Limagne, which is black earth rich in organic matter (Daniel *et al*, 1979).

Chalain lake series, Doucier, Jura

Wood from two foundation pilings of two eroded coastal stas of W side of Chalain Lake (46° 40′ N, 5° 48′ E). Coll and subm 1978 by D Vuaillat, Dir Antiquités, Préhist Centre, Besançon.

Ly-2007. Sta 5 4250 ± 130

Ly-2008. Sta 6 4170 ± 140

General Comment (DV): no artifacts remained in sta although three other sites were discovered and dated in E part of lake; 1st one from Middle Neolithic culture near Les Roseaux inlet, at Fontenu, Ny-143: 5790 ± 220 and Ny-144: 5850 ± 180 (R, 1974, v 16, p 120); others, stas 1 and 2 from Late Neolithic Saône et Loire culture, Gif-2637: 4220 ± 140 and Gif-2638: 4280 ± 180 (unpub). Dates confirm contemporaneity of stas 5 and 6 with stas 1 and 2 and exclude their attribution to Bronze age.

Ly-2078. Croix-Tombée cemetery, Pérouges, Ain 4060 ± 100

Human bones from grave of Gallo-Roman cemetery (45° 53′ N, 5° 11′ E). Coll 1979 by J L Challard and subm 1979 by A Cogoluenhes, Dept Geol, Univ Lyon. This grave was laid at lower level than other graves with different orientation. *Comment* (AC): date confirms expected old age of this isolated grave which may belong to Neolithic or Chalcolithic periods because of assoc flints.

Ly-2417. La Vallée, Girolles, Loiret **4010 ± 140**

Charcoal from fill of small calcareous cavity on hill (48° 04′ N, 2° 53′ E). Coll 1977 and subm 1980 by A Aubourg, Amilly, Loiret. Assoc with uncharacteristic industry, maybe from Neolithic. (4/5 diluted sample). *Comment* (AA): dates cavity fill to Late Neolithic.

Ly-1903. Grotte du Castillet, Lourdes, Hautes-Pyrénées **4380 ± 140**

Human bone from sepulchral gallery (43° 06′ N, 0° 07′ E). Coll and subm 1978 by J Omnès. *Comment* (JO): date agrees with Late Neolithic attribution with poor industry mainly of bone arrows and fingers or nail-decorated ceramics.

Ly-1962. Grotte de la Gardette, Labastide de Virac, Gard **4310 ± 130**

Human bones from Late Neolithic or Chalcolithic sepulchral grotto, Ardèche (44° 21′ N, 4° 24′ E). Coll 1977 by P Perreve and subm 1978 by A Cogoluènhes. *Comment* (AC): agrees with expected age and comparable to other dates of Late Neolithic Ferrières in region, eg, in Traves grotto at Montclus, Gard, Gif-1909: 4260 ± 140 (R, 1974, v 16, p 31).

Ly-1963. Abauntz, Level b, Arraiz, Navarra, Spain **4240 ± 140**

Charcoal from Level b in Abauntz grotto (43° 01′ N, 1° 42′ W). Coll 1976 and subm 1978 by P Utrilla-Miranda, Univ Zaragoza. Assoc with burned human bones and with Late Neolithic or Chalcolithic industry. *Comment* (PUM): date agrees with expected value; *cf* date from Level IIIB in Los Husos grotto at Elvillar, Alava, Spain, I-3985: 3920 ± 100 (unpub). Two other dates by Teledyne Isotope lab are from Neolithic Level b4, I-11,309: 5390 ± 120 and Level c, I-11,537: 6910 ± 450 (Utrilla-Miranda, 1980).

Ly-1941. Le Jas des Chèvres, Allan, Drôme **4390 ± 160**

Charcoal from 40cm depth from open-air site (44° 28′ N, 4° 48′ E). Coll 1978 and subm 1979 by A Beeching, Dir Antiquités Préhist, Lyon. Assoc with a Pre-Campaniforme Chalcolithic industry (Beeching, 1980). (9/10 diluted sample). *Comment* (AB): agrees with expected age, indicating relatively old age for Chalcolithic industry, but compared with unpub result on charcoal from Bruyères site at Saint Julien de Peyroles, Gard, MC-976: 4225 ± 80 (Gilles, 1975).

Ly-2348. Beaulieu, Bardouville, Seine Maritime **4550 ± 130**

Human bones from collective sepulture of Beaulieu quarry (49° 26′ N, 0° 51′ E). Coll 1966 by R Caillaud and E Lagnel and subm 1980 by G Verron and J Dastugue, Caen. Assoc with Late Neolithic industry, Seine-Oise-Marne (SOM) (Caillaud and Lagnel, 1967). *Comment* (GV): dates generally obtained for SOM culture are younger but those from Videlles site, GrN-4676: 4500 ± 50 and GrN-4675: 4500 ± 60 (R, 1967, v 9, p 133) are close to present one.

Ly-1738. La Pierre Godon, Tillay le Peneux, Eure et Loir **4550 ± 150**

Bones from 90cm depth under pavement of access passage of dolmen under tumulus at Soignolles (48° 10′ N, 1° 47′ E). Coll and subm 1978 by G Richard, Orléans. *Comment* (GR): date indicates 1st occupation of tumulus occurred during Late/Middle (Chassean) Neolithic period. *Cf* date from Fort Harrouard, nearby, Gsy-97: 4400 ± 135 (R, 1966, v 8, p 131); 2nd occupation of site occurred at end of Neolithic, from ca 4300 to 3800 BP, SOM culture with Campaniforme influences (Richard, 1980).

Le Fournet series, Montmaur, Drôme

Table 20 lists samples of human bones from several locs in sepulchral grotto (44° 41′ N, 5° 20′ E). Coll 1966 by A Heritier and subm by A Cogoluènhes.

TABLE 20
Le Fournet

Sample no.	Bone ref	Dilution ratio	Age BP
Ly-2433	11/1	1/2	3590 ± 180
-2431	10/17	1/3	3840 ± 190
-2432	6/1	9/10	4240 ± 160
-2434	10/1	1	5440 ± 130

General Comment (AC): from previous series of 4 dates from same site (R, 1979, v 21, p 436) ages at end of Neolithic were expected. These 4 new results show grotto was used from Middle Neolithic (Ly-2434) to Bronze age (Ly-2433). Assoc industry for whole bones is Chassean (agreeing, eg, with Ly-2434) or Chalcolithic (Ly-2431, -1178, -1733). Both series indicate need for many results to determine total duration of occupation (Cogoluènhes, 1977).

Ly-1688. Le Brudoux, Plan de Baix, Drôme **4710 ± 150**

Human bones from sepulchral grotto (44° 49′ N, 5° 10′ E). Coll by M C Haze and subm 1978 by A Cogoluènhes. Assoc with heterogeneous, poor industry of Chalcolithic. *Comment* (AC): date is too old for Chalcolithic but site was disturbed.

Ly-2518. La Montagne de Comin, Bourg-et-Comin, Aisne **4880 ± 120**

Charcoal from fire layer underlying Middle Neolithic (Chassean or Michelsberg) occupation level on spur at top of plateau (49° 25′ N, 3° 40′ E). Coll and subm 1981 by CNRS Unit 12. *Comment* (URA 12): dated to solve complex stratigraphic problem of clayey levels; date confirms fire layer is contemporaneous with Neolithic occupation since result is close to other results for Michelsberg industries in Aisne R Valley (Ly-2328 and -2334, below).

La Roberte series, Chateauneuf du Rhône, Drôme

Bones from two trenches of Chassean site (44° 32′ N, 4° 43′ E). Subm 1979 by A Beeching. This was open-air site presently covered by 10m of earth (Beeching & Thomas-Beeching, 1975).

Ly-2076. St 4, 72P **4830 ± 150**

From 60 to 65cm depth in Pit 4. Coll 1977 by J Thomas-Beeching, Lyon. (4/5 diluted sample)

Ly-2075. St 2, 1P **4970 ± 200**

From fill of Pit 2. Coll 1976 by M Lambert, Montélimar. (3/5 diluted sample)

General Comment (AB): both dates are in mutual statistical margins but some differences in Chassean typology suggest that Pit 2 (Ly-2075) should be a little older than Pit 4 (Ly-2076). Both dates are closer to generally obtained value for Middle Neolithic in region than those obtained in neighboring Chassean site, Francin, Savoie, Lv-389: 3870 ± 170 and Lv-390: 4300 ± 75 (R, 1970, v 12, p 554).

Chassey camp series, Chassey, Saône et Loire

Table 21 lists samples of charcoal from Neolithic Chassean layers (46° 53′ N, 4° 46′ E). Coll 1977 and subm 1978 by J P Thévenot.

TABLE 21
Chassey Camp

Sample no.	Sample	Sq and level	Age BP
Ly-1767	Chassey 1 XLII-56	F 8	5220 ± 140
-1771	Chassey 2 XLIII-54	F 8	5380 ± 160
-1768	Chassey 3 XLII-56	TC 9	5660 ± 150
-1769	Chassey 4 XLIII-56-57	A 9	5540 ± 120
-1770	Chassey 5 XLII-55	484 9	5380 ± 140
-1772	Chassey 6 L-56	Diaclase	5700 ± 150

General Comment (JPT): dates agree with stratigraphy and date Level 8 at ca 5300 BP and Level 9 at ca 5600 BP. Ly-1770 is ca 300 yr too young but sample contained large amount of roots. Ly-1772 comes from small zone containing intrusive sediments between two diaclases and industry may be either from Level 8 or 9 and re-used (Thévenot, 1978). Ly-1772 shows date of zone close to Level 9 and does not confirm re-use.

Ly-1791. Collective sepulture, Abri Moula, Soyons, Ardèche **5660 ± 140**

Human bones from remains of multiple sepulture embedded in sediments deposited on upper part of fill of Moula shelter (44° 53′ N, 4° 50′ E). Coll 1972 by Crouzet Archaeol Club and subm 1978 by P Payen, Valence, and A Cogoluènhes. Assoc with poor industry of ceramics and flint of Middle Neolithic. *Comment* (PP): Chassean date agrees with assoc industry.

Les Rivaux Loc 1 sommet, Espaly-Saint-Marcel, Haute-Loire

Table 22 lists samples of charcoal (all but Ly-2194, which is animal bones) from several stratigraphic units (hearths or dwelling levels) of Neolithic-Chassean open-air site (45° 03′ N, 3° 51′ E). Coll and subm by J P Daugas, Dir Antiquités Préhist Auvergne, Clermont-Ferrand.

TABLE 22
Les Rivaux

Sample no.	Strat unit	Colln date	Dilution ratio	Assoc industry	Age BP
Ly-2303	2e/2a	1971	2/5	Late Chassean	4240 ± 200
-1349	CCP 2	1974	1/3	Late Chassean	4540 ± 210
-2083	3	1970	1/2	Chassean	4670 ± 190
-2304	4b	1973	5/6	Chassean	4530 ± 140
-2289	4a	1973	1/6	Chassean	4790 ± 260
-2246	5	1973	2/3	Chassean	4740 ± 140
-2247	CAC	1973	7/30	Chassean	5020 ± 200
-2084	6	1973	2/5	Chassean	5340 ± 190
-1348	6.4/6.5/F.7	1974	1/3	Chassean	5600 ± 210
-2194	CM4	1973	1 (bone)	Chassean	5030 ± 100
-1596	BdF 1a	1974	1/2	Early Chassean	5200 ± 250
-1987	BdF 2	1974	3/20	Early Chassean	5310 ± 470

General Comment (JPD): despite small amount of material, series agrees with expected values. Deepest samples, Ly-1596 and -1987, assoc with Early Chassean were expected to be older but contamination by recent roots developed at this level, BdF, and Ly-1987 is possible, ca 6000 BP, taking into account 2σ statistical margin. Ly-2194 is also too young but it comes from pit which may have been mixed with heterogeneous material. All dates confirm long duration of site occupation (ca 1000 yr) and contemporaneity with eponymic Chassey site (above) (Daugas *et al*, 1980).

La Baume series, Arlempdes, Haute Loire

Charcoal from 1.5 to 1.8m depth in layers with Mesolithic industry at Fraycenet d'Arlempdes (44° 52′ N, 3° 54′ E). Coll and subm 1977 by A Cremillieux (1980).

Ly-1864. 11 **5290 ± 300**

Sample from topmost level. (2/5 diluted sample)

Ly-1865. 13 **4560 ± 930**

Sample from deepest level. (1/15 very diluted sample)

General Comment (AC): dates do not fit assoc industry and show that charcoal came from upper level with Neolithic industry. Average date, Ly-1864/1865: 5180 ± 280 agrees with two dates in same region, La Roche Dumas, Arsac en Velay, Ly-1588: 5120 ± 320 and Le Chambon, Goudet, Ly-1549: 5160 ± 250 (R, 1979, v 21, p 437) of Chassean industry. *Cf* also Les Riveaux series (above).

La Vergentière series, Cohons, Haute-Marne

Samples from excavation pit S1 in fortified promontory of La Vergentière (47° 46′ N, 5° 20′ E). Assoc with Bourguignon Middle Neolithic industry with Cortaillod and Michelsberg characteristics. Coll 1977 and subm 1978 by L Lepage, Saint-Dizier.

Ly-1859. S1-A8 **5230 ± 300**

Bones from level underlying archaeol layer. (1/3 diluted sample)

Ly-1860. S1-A17 **5350 ± 270**

Charcoal from level underlying limed central part of rampart of buttress. (1/2 diluted sample)

General Comment (LL): both dates are in statistical range of each other, weighted average, Ly-1859/1860: 5300 ± 210. Building of rampart was contemporaneous with Middle Neolithic occupation (Lepage, 1980).

Grotte de la Pyramide series, Penne, Tarn

Charcoal from two levels in Loc 3, which opens into archaeol fill of grotto at Le Travers de Janoye (44° 05′ N, 1° 43′ E). Coll and subm by J Lautier, Albi. Both levels contain Chassean industry (Lautier, 1982).

Ly-1867. Layer 6E **5490 ± 310**

From Layer 6E, Sq K8. Coll 1973, subm 1977. (3/10 diluted sample)

Ly-1408. Layer 6A **4750 ± 270**

From Layer 6A, Sq J11. Coll 1976, subm 1977. (1/3 diluted sample)

General Comment (JL): dates fit Chassean industry which lasted for at least 800 yr, but for unknown reason, sample from lowest layer gives younger result. *Cf* dates from two sites with same Chassean industry, Le Noyer grotto at Esclauzels, Lot, Gif-1633: 500 ± 130 (R, 1972, v 14, p 289) and Sargel grotto at Saint-Rome-de-Cernon, Aveyron, Gif-445: 4570 ± 150 (R, 1966, v 8, p 130).

Le Verger series, Saint-Romain, Côte d'Or

Charcoal from two neighboring sites in hearth area in Neolithic part of Le Verger site (46° 59′ N, 4° 43′ E), (see Ly-2244, above, from Bronze age layer of site). Coll and subm 1978 (Ly-1985) and 1979 (Ly-2243) by S Grappin, Dijon. Assoc with not well-defined Middle Neolithic industry.

Ly-1985. 1-2 **5590 ± 130**

Ly-2243. 3 **5860 ± 170**

General Comment (SG): Ly-1985 is contemporaneous with Middle Neolithic Chassey camp (above). Ly-2243 seems too old for Middle Neolithic industry in region.

Ly-2195. Grotte La Balme d'Epy, Jura **5640 ± 200**

Human bones from upper part of fill of grotto (46° 23′ N, 5° 25′ E). Coll 1975 and subm 1979 by A Cogoluènhes. Assoc with Chalcolithic industry. (1/5 diluted sample). *Comment* (AC): date is a little older than expected, but compatible with less characteristic industry. Previous date from same grotto dated to end of Würmian, Ly-362: $20{,}300 \begin{smallmatrix} +1900 \\ -1600 \end{smallmatrix}$ (R, 1973, v 15, p 516).

Ly-2077. Grande Barme de Savigny, La Biolle, Savoie 5010 ± 140

Bones from Level IIb, 70cm deep in grotto (45° 44′ N, 5° 55′ E). Coll 1977 by J Thomas-Beeching and subm 1979 by A Beeching. Assoc with atypical industry of Early Neolithic/Middle Neolithic transition, presumed age of which is uncertain but may be same as Cortaillod culture (Beeching, 1979). *Comment* (AB): date is a little younger than expected but indicates range generally given for Middle Neolithic period in region.

Ly-1766. Port Renard, Vinneuf, Yonne 3130 ± 150

Charcoal from Hearth 29, Loc XIII (48° 31′ N, 3° 28′ E). Coll 1976 by A Carré and subm by J P Thévenot. Sample is from entrance of hearth in hut of Cerny culture (Middle Neolithic). *Comment* (JPT): date is much too young and may be explained by roots that penetrated archaeol level as it was close to surface.

Vallée de l'Aisne series, Aisne

Table 23 lists samples of bones from refuse pits of Early and Middle Neolithic villages in Aisne R valley. Coll from 1975 to 1981 and subm by Unité Recherche Archéol no. 12, Paris, at following sites: la Croix-Maigret (BCM) near Berry-au-Bac (49° 24′ N, 3° 53′ E), Les Jombras (CLJ) near Concevreux (49° 23′ N, 3° 48′ E), Les Fontenettes (CCF), near Cuiry-les-Chaudardes (49° 23′ N, 3° 45′ E), Derrière le Village (MDV) near Menneville (49° 25′ N, 4° 01′ E), les Grandes Grèves (VSG), near Villeneuve-St-Germain (49° 24′ N, 3° 22′ E).

TABLE 23
Aisne River Valley

Sample no.	Ref	Colln date	Dilution ratio	Assoc industry	Age BP
Ly-2370	BCM-206	1979	1	Late Roessen	5330 ± 130
-2326	BCM-100	1978	4/15	Menneville group	5530 ± 320
-2329	BCM-100	1979	11/15	Menneville group	5100 ± 160
-2371	BCM-202	1979	1	Late Roessen	5340 ± 130
-2327	BCM-124	1978	1	Recent Rubané	6030 ± 130
-2328	CLJ-6-15	1977	14/15	Michelsberg	4810 ± 120
-2334	CCF-359	1979	11/15	Michelsberg	5020 ± 150
-1826	CCF-25	1974	1/4	Recent Rubané	5360 ± 510
-1827	CCF-27	1974	2/5	Recent Rubané	5860 ± 300
-1828	CCF-52	1974	2/5	Recent Rubané	6580 ± 400
-1829	CCF-175	1975	4/5	Recent Rubané	5930 ± 190
-1737	CCF-246	1976	1	Recent Rubané	6220 ± 230
-1736	CCF-230	1976	1	Recent Rubané	6450 ± 160
-2321	CCF-295	1978	13/15	Recent Rubané	5960 ± 170
-2330	CCF-324-325	1978	1	Recent Rubané	5910 ± 130
-2331	CCF-311	1979	1	Recent Rubané	6000 ± 120
-2332	CCF-321	1979	29/30	Recent Rubané	5800 ± 170
-2333	CCF-357	1979	1	Recent Rubané	5980 ± 110
-2335	CCF-378-1	1980	1	Recent Rubané	5840 ± 140
-2336	CCF-375	1980	7/10	Recent Rubané	5960 ± 150
-1735	MDV-13	1976	1	Recent Rubané	6200 ± 190
-2324	MDV-13	1976	1	Recent Rubané	6110 ± 140
-2322	MDV-19	1977	1	Recent Rubané	6030 ± 130
-2323	MDV-39	1977	7/30	Recent Rubané	5860 ± 190
-1734	MDV-1	1976	4/5	Recent Rubané	6140 ± 210
-1824	VSG-70	1975	5/6	Neolithic post-Rubané	6130 ± 200
-1825	VSG-114	1976	4/5	Neolithic post-Rubané	6010 ± 220

General Comment (URA 12): disregarding Ly-1826 (much too young) and Ly-1828 and -1736 (too old), this important series of Recent Rubané of Paris Basin sites in Aisne R valley indicates that culture occupied region for ca 300 yr from 6100 to 5800 BP. Dates are contemporary with end Linear pottery culture of Rhine and Netherland regions and may be a little later. Dates of Villeneuve-Saint-Germain Neolithic, Ly-1824 and -1825 are contemporary with Recent Rubané, which is surprising because typologic evidence suggests younger age. Both Michelsberg dates agree with expected range. Late Röessen and Menneville group dates are 1st for these cultures in Paris Basin.

Ly-2463. Bois de Refuge, Misy sur Yonne, Seine et Marne **6050 ± 160**

Bones from Pit C (48° 21′ N, 3° 04′ E). Coll 1971 by C Mordant and J Bontillot; subm 1981 by C Mordant and D Mordant. Assoc with Late Recent Rubané industry (Mordant & Mordant, 1977). *Comment* (CM& DM): expected date agrees with many others from Aisne R valley, where same Recent Rubané industry was found (above).

Vallée de la Seine series, Seine et Marne

Bones from pits and trenches in Middle or Late Neolithic villages in La Seine R valley. Coll 1973 to 1980 by C Mordant and D Mordant; subm by D Mordant. Table 24A lists sites; Table 24B lists samples.

TABLE 24A
Seine Valley sites, Seine et Marne district

Site	Village	Loc	Ref
Le Gros Bois	Balloy	(48°24′N, 3°09′E)	Mordant (1967)
Maram	Catenay sur Seine	(48°25′N, 3°06′E)	
Chemin de la Tombe	Gravon	(48°24′N, 3°07′E)	
Les Roqueux	Grisy sur Seine	(48°26′N, 3°19′E)	
Le Haut des Nachères	Noyen sur Seine	(48°26′N, 3°21′E)	Mordant & Mordant (1977)

TABLE 24B
Seine Valley samples

Lab no.	Site	Loc	Colln date	Dilution ratio	Industry	Age BP
Ly-2460	Balloy	Pit 4	1965	1	Neolithic (middle-late)	4770 ± 160
-2459	Gravon	Pit FA 1	1979	1/5	Neolithic (middle-late)	4900 ± 210
-2457	Noyen/Seine I	Pit FD 3	1973	1	Neolithic (middle-late)	4870 ± 160
-2458	Noyen/Seine I	Pit FB	1973	1/4	Neolithic (middle-late)	5260 ± 200
-2461	Noyen/Seine I	Enclosure II	1979	4/5	Neolithic (middle-late)	4970 ± 140
-2462	Noyen/Seine I	ABC I	1979	1/3	Neolithic (middle-late)	5140 ± 170
-2456	Grisy sur Seine	Enclosure F 3	1980	3/10	Neolithic (middle-late)	5100 ± 180

General Comment (CM&DM): oldest dates are contemporaneous with unpub result for Chassean industry at Joncquières site, Oise, Gif-2919: 5120 ± 130. However, all these industries mainly come from N origin (Michelsberg) and ceramics of some sites are similar to Early Michelsberg style (MK I/II) in most of sites in Rhône Valley from 5500 to 5300 BP. Youngest dates indicate length of human occupation at Noyen site and *in situ* evolution of ceramic styles which remain contemporary with more recent ceramics of German MK (Mordant & Poitout, in press).

Ly-2464. Les Chappes, Molay, Yonne — 4460 ± 110

Bones from silo pit in Late Neolithic site (47° 44′ N, 4° 56′ E). Coll 1980 and subm 1981 by C Mordant. *Comment* (CM): date seems a little too young because of similarity of assoc industry with Noyen industry, Ly-4810: 5260 ± 200 (above).

Ly-2455. Les Grèves de Frécul, Barbuise-Courtavant, Aube — 5530 ± 150

Bones from Pit 23 of Cerny culture (Middle Neolithic) (48° 39′ N, 3° 32′ E). Coll 1970 by J Piette and subm 1970 by D Mordant and J Piette. (2/3 diluted sample). *Comment* (DM): date confirms site is contemporary with two sites with same Cerny industry previously dated by Gif-5002: 5510 ± 140 BP (unpub) at Jablines (Seine et Marne) and Gif-5005: 5630 ± 120 at Pincevent (Seine et Marne). Cerny culture seems to be homogeneous in E Ile de France region.

Ly-1944. Le Creux-Rouge, Clermont-Ferrand, Puy de Dôme — 6070 ± 140

Human bones from grave in volcanic ash (45° 47′ N, 3° 5′ E). Coll 1973 and subm 1979 by J P Daugas and J P Raynal. *Comment* (JPD& JPR): date agrees with archaeol estimate of grave at Early Middle Neolithic of Auvergne region, *ie,* at limit between Pre-Chassean and Chassean cultures (Daugas & Malacher, 1978; Raynal & Daugas, 1979).

Ly-1797. La Chaise, Malesherbes, Loiret — 6190 ± 210

Human bones from under flagstone-covered sepulture (48° 17′ N, 2° 23′ E). (3/5 diluted sample). Coll 1978 by J Vintrou and subm 1979 by G Richard, Orléans. *Comment* (GR): this type of sepulture which surely occurred before dolmens was never dated by industries. Date, oldest for all W central France, makes this monument oldest megalithic monument in France, which is contemporaneous with Recent Rubané culture in Aisne R Valley (above) (Richard & Vintrou, 1979).

Vieille Eglise series, La Balme de Thuy, Haute-Savoie

Bones of deer and boar from two levels of La Vieille Eglise rock shelter (45° 55′ N, 6° 17′ E). Coll 1977 and subm 1978 by J P Ginestet, Thones.

Ly-1934. Level 5A **5940 ± 210**

From Layer 5A, assoc with Chassean and Cortaillod ceramics and uncharacteristic flints. (7/9 diluted sample)

Ly-1935. Level 5B **6500 ± 230**

From Layer 5B, assoc with same ceramics as Ly-1934 but lithic industry shows Tardenoisian (Mesolithic) influence. (2/3 diluted sample)

General Comment (JPG): both dates agree with each other and confirm expected ages and fairly old age of Layer 5B with Mesolithic influences.

Ly-2198. Hassi Mouillah, Ouargla, Algeria **5660 ± 210**

Charcoal from level assoc with Neolithic of Capsian tradition in Hassi Mouillah site on side of Mellala Sebkha (31° 58′ N, 5° 22′ E). Coll 1977 by G Trécolle and subm 1978 by M Schvoerer, Lab Physique Appl Archaeol, Univ Bordeaux. Dated to cross-check dates by TL method. *Comment* (MS): date agrees fairly well with previous unpub result, Gif-438: ca 5280 BP, obtained from same level. Three TL dates from upper part of site gave following values: BDX-110: 7890 ± 680 BP, BDX-112: 6570 ± 560 BP, and BDX-114: 6270 ± 540 BP. Considering statistical margins of both methods and MASCA calibration of ^{14}C dates (which established true ages of ca 4400 BC*), agreement between both methods seems satisfactory.

Mehrgarh series, Baluchistan, Pakistan

Table 25 lists samples of charcoal from tell near Kachi (29° 20′ N, 66° 12′ E). Coll by French Archeol Mission Indus and subm by J F Jarrige, Mus Guimet, Paris.

TABLE 25
Mehrgarh

Lab no.	Sample no.	Loc and layer	Assoc industry	Colln yr	Dilution ratio	Age BP
Ly-1527	MRI-MRK 2B	Loc 93,—1m	Bronze age	1976	1	3570 ± 130
-1529	MR2-MRK 9H	Loc 204,—1.1m	Bronze age	1976	1	3960 ± 140
-1528	MR3-MRC 8I	Loc ? ,—3.5m	Bronze age	1976	1	4190 ± 140
-1945	MR4-F5F	Layer 4,—2.2m	Chalcolithic	1978	7/10	5360 ± 310
-1947	MR-3T 536	Layer 4,—3.5m	Neolithic	1979	1	5830 ± 190
-1946	MR3 AIA 433	Layer 3,—1.9m without humus	Neolithic	1979	1	33,000 ± 3000
-1950	MR3 AIA	Layer 3,—1.9 with humic fraction	Neolithic	1979	1	8440 ± 250
-1949	MR37 537	Layer X —3.7m only humic fraction	Neolithic	1979	1	5530 ± 180
-1948	MR37 537	Layer X —3.7m without humic fraction	Neolithic	1979	1/6	5720 ± 730

General Comment: as site was probably occupied from 5500 to 3500 BP for Chalcolithic upper layers and ca 7500 BP for Neolithic lower layers, dates do not agree with expected ages and are either too young by at least 2000 yr, or obviously too old. For last two, Ly-1946 and -1950, old ages can be explained. Charcoal came from hearths where burned wicker baskets were treated with bitumen, which is found near site, at time of manufacture. Thus, dead carbon was introduced to sample and measured later with it. All other dates seem too young but sample cannot have been contaminated by modern organic soluble components as humic fraction, Ly-1949, and no humic fraction, Ly-1948, have same apparent age. Discrepancy with expected ages may be explained either by very large amount of ancient roots in layers, eg, because of deep cultivation at ca 5500 BP during temporary abandonment of site, or by fact that site is much younger than expected (Jarrige & Lechevalier, 1980). Many other dates from other ^{14}C labs from same site show same range of dates and suggest that revision of archaeol stratigraphic interpretation is necessary.

Ly-2483. Erg-Tihodaīn, Sahara occidental, Algeria 6010 ± 160

Ostrich egg fragments from black soil at Neolithic site of Capsian tradition, assoc with flint and human skeletons, on W border of Erg Tihodaïn, between Tassali and Hoggar in central Sahara desert (25° 19′ N, 6° 50′ E). Coll and subm 1980 by A Bonnet, Nîmes. *Comment* (AB): date agrees with expected value and others of Neolithic Capsian sites (Camps, Delibrias, & Thommeret, 1968). Result indicates suitability of this dating material. Another date, from 6km N of site, in black soil with ceramics, was previously pub, Ly-407: 6870 ± 150 (R, 1973, v 15, p 146).

Ly-2149. El Haroua II, Témara, Morocco 5900 ± 210

Bones from double Neolithic sepulture, Rabat region (33° 57′ N, 6° 56′ W). Coll 1978 by A Debénath, Prehist Paleontol Mission Morocco, and subm 1979 by A Debénath. Assoc with Neolithic industry. *Comment* (AD): date agrees with expected archaeol range; no other absolute dates from seashore of N Morocco (Debénath & Sbihi-Alaoui, 1979).

F. Mesolithic

Murchison R series, Australia

Table 26 lists samples from open-air sites or rock shelters in Murchison R Basin, near Mullewa (27° 30′ S, 115° 00′ E) at Billibilong Spring, Billily Claypan, Inguelba Shelter, Wail Outcamp, and Yallalong Sta, and in Sandford R Valley, near Cue (27° 20′ S, 117° 55′ E) at Walga Rock. Coll by C Dortch, W Australia Mus and F Bordes, J P Raynal, and C Thibault, Inst Quaternaire, Bordeaux, for Fr Archaeol Mission Australia; subm by F Bordes and J P Raynal.

TABLE 26
Murchison River Basin

Sample no.	Site & ref	Level depth	Sample	Colln yr	Dilution ratio	Age BP
Ly-1810	Billibilong 3	Unit 2 base	Charcoal	1978/1978	1/4	2030 ± 330
-1809	Billibilong 2	Unit 3 base	Charcoal	1978/1978	1	3590 ± 130
-2169	Billibilong 8	Unit 3 base	Charcoal	1979/1980	1/4	3810 ± 130
-2170	Billibilong 6	Unit 4 base	Charcoal	1979/1980	1/4	4000 ± 220
-2079	Billily 1	Unit 2 base	Charcoal	1979/1980	1	650 ± 110
-2366	Inguelba 1	10-15cm	Charcoal	1980/1980	19/30	270 ± 160
-2367	Inguelba 2	25-30cm	Charcoal	1980/1980	1/2	560 ± 160
-2168	Wail Outcamp 3	Unit 4 top	Charcoal	1979/1980	1	2420 ± 120
-2080	Wail Outcamp 4	Unit 4 top	Calcareous algae	1979/1980	1	4310 ± 110
-2081	Wail Outcamp 7	Unit 4 top	Shells	1979/1980	1/5	4650 ± 290
-2167	Yallalong 5	Unit 4 base	Shells	1979/1980	1	4210 ± 130
-2097	Walga Rock 3	70-75cm	Charcoal	1978/1979	2/3	790 ± 160
-2098	Walga Rock 4	57-80cm	Charcoal	1978/1979	1/3	1040 ± 180
-2099	Walga Rock 6	110-115cm	Charcoal	1978/1979	2/3	3820 ± 200
-1846	Walga Rock 1	110-115cm	Charcoal	1978/1978	2/5	7010 ± 350
-1847	Walga Rock 2	115-125cm	Charcoal	1978/1978	1/10	9950 ± 750

General Comment (JPR): dates establish chronology of recent lithic industries of Murchison R Basin. Period of occupations with non-microlithic industries is seen in Layer 11 of Walga Rock site. This layer is deeply channelled by subsequent humid period. Microlithic industries appear in Units 4 and 2 at Walga Rock, Billibilong, and Billily during semi-arid period with wind deposits, sedimentation, and colluvia. These microlithic industries last up to very recent period at Walga Rock and Ingulba Shelter.

Ly-2365. La Source, Cosnac, Corrèze **7270 ± 240**

Charcoal from sandstone fill of rock shelter at Roche-Longue (45° 08′ N, 1° 35′ E). Coll 1980 by P Andrieu and P Chennebault, and subm 1980 by G Mazière, Dir Antiquités Préhist, Limoges. (11/30 diluted sample). *Comment* (GM): date is a little too young for Early or Middle Sauveterrian assoc industry; this may be due to downward infiltration of recent charcoal or rootlets.

Ly-2297. Abri des Cabônes, Ranchot, Jura **8730 ± 170**

Bones from upper layer in Les Cabônes shelter. Coll 1980 by M Campy and S David, and subm 1980 by M Campy, Hist Geol Paleontol Lab, Besançon. Assoc with triangle Mesolithic industry. (3/5 diluted sample). *Comment* (MC): date agrees with typologic and palynologic attribution to Boreal period. *Cf* unpub Louvain date from Gigot shelter at Bretonvillers, Doubs, Lv-1112: 8500 ± 95 BP.

Ly-2200. Les Mians, Gordes, Vaucluse **8620 ± 380**

Charcoal from Les Luquets rock shelter (43° 55′ N, 5° 11′ E). Coll and subm 1979 by M Livache. (1/5 diluted sample); assoc with Sauveterrian industry (Livache, 1976). *Comment* (ML): date is comparable to results from neighboring site Gramari, *ie,* with Levels 3B and 4C, respectively, Gif-753: 8000 ± 190 and Gif-754: 9340 ± 220 (R, 1971, v 13, p 219). It also fits with other dates for this Sauveterrian industry in other regions in France.

La Pécoulette series, Lagorce, Ardèche

Table 27 lists samples from site lying at entrance to La Pécoulette grotto (44° 24′ N, 4° 19′ E). Coll 1977 and subm 1978 by D Philibert, Univ Lyon. Assoc with Sauveterrian (Epipaleolithic) industry (Philibert & Debard, 1977-78).

TABLE 27
La Pécoulette

Sample no.	Square	Depth	Sample	Dilution ratio	Age BP
Ly-2364	La Pécoulette A2	60-70cm	Bones	7/30	8450 ± 350
-2410	La Pécoulette A2	70-75cm	Charcoal	1/6	6280 ± 320
-1978	La Pécoulette ad	75-100cm	Bones	7/10	8570 ± 320
-2411	La Pécoulette A2	100-110cm	Bones	3/10	8740 ± 230
-1979	La Pécoulette A2	110-120cm	Bones	1/5	9060 ± 800
-1980	La Pécoulette A2	125-135cm	Bones	2/9	8200 ± 750

General Comment (DP): single charcoal date is too young probably because of roots and shallow level. Bone dates are in expected range for Epipaleolithic industry. Low collagen content and small sample size made statistical margins too large to check ages stratigraphically.

Ly-2107. La Madeleine des Albis, Penne, Tarn 8850 ± 190

Bones from 2.5m depth in small fissure filled with geol and archaeol sediments close to Magdalenian site (44° 05′ N, 1° 43′ E). Coll 1977 by H Bessac and subm 1978 by J Lautier, Albi. No assoc industry but upper part of fissure deposit contains potsherds from Middle ages. *Comment* (JL): date shows that bones are either Mesolithic or mixing of recent and other bones from neighboring Magdalenian sites previously dated at Ly-1109: 11,180 ± 300 and -1175: 10,110 ± 440 (R, 1978, v 20, p 46-47).

G. Paleolithic

Ly-1970. Pierre Magnat, Fromental, Haute-Vienne Modern $\Delta^{14}C = 1.1 \pm 2.3\%$

Charcoal from 60cm depth in foot-hill site (46° 09′ N, 1° 27′ E). Coll 1978 by R Crédot and M Dominique, and subm 1979 by G Mazière. Assoc with presumably Late Magdalenian industry. (3/5 diluted sample). *Comment* (GM): date indicates upper layers of site were re-used or disturbed by recent roots.

Ly-1605. Martinet, Sauveterre-La-Lemance, Lot et Garonne 12,600 ± 1100

Bones from Layer IV in Le Martinet site (44° 36′ N, 1° 01′ E). Coll during ancient excavation by L Coulonges and subm 1977 by J M Le Tensorer, Univ Bordeaux. *Comment* (JML): uncertainty margin of date is very large, because of small amount of collagen. Date may only be considered compatible with archaeol attribution to Magdalenian (Le Tensorer, 1980; 1981).

Abauntz series, Arrais, Navarre, Spain

Sample from Abauntz grotto (43° 01′ N, 1° 42′ W). Coll from 1976 to 1978 and subm 1979 by P Utrilla-Miranda, Univ Zaragoza.

Ly-1964. 19/20 **9530 ± 300**

Burned bones from Level "d" assoc with Azilian (Epipaleolithic) culture without geometrics. (2/5 diluted sample)

Ly-1965. 19/20 **15,800 ± 350**

Bones from Level "e" assoc with Early Magdalenian industry without harpoon.

General Comment (PU-M): dates agree with expected ages. Ly-1964 is comparable to dates from Zatoya site at Abaurrea Alta, Navarre, Levels I and II, Ly-1457: 8260 ± 550 and Ly-1398: 8150 ± 170 (R, 1979, v 21, p 442). Ly-1965 is contemporaneous with Altamira site at Santillana del Mar, Santander, M-829: 15,500 ± 700 (R, 1969, v 11, p 109), with Juyo at Igollo, Santander, M-830: 15,300 ± 700 (R, 1968, v 10, p 46) or with Pascano series, BM-1455: 16,560 ± 131, BM-1453: 15,988 ± 193, and BM-1452: 15,173 ± 160 (R, 1982, v 24, p 249-250) (Utrilla-Miranda, in press).

Le Calvaire series, Lourdes, Hautes-Pyrénées

Bone fragments from two geol secs (43° 06′ N, 0° 07′ E). Coll 1977 and subm 1978 by J Omnès.

Ly-1905. Left sec, level 0/0.30m **11,750 ± 430**

Ly-1906. Front sec, level 1.70/2.50m **12,450 ± 330**

General Comment (JO): Ly-1905 corresponds with little known microlithic industry which should be Epipaleolithic. As this is 1st find of its kind in region, date cannot be compared. Ly-1906 corresponds with Late Magdalenian industry and with other dates of region (Clot & Omnès, 1980) eg, at Espelugues, Ly-1406: 13,170 ± 260 (R, 1979, v 21, p 444).

Ly-2184. Fontanet Foyer, Ornalac-Ussat-Les- Bains, Ariège **12,770 ± 420**

Charcoal from hearth in Fontanet grotto (42° 49′ N, 1° 38′ E). Coll and subm 1979 by J Clottes, Dir Antiquités préhist, Foix. (2/11 diluted sample). *Comment* (JC): archaeol evidence suggests that grotto was occupied for only short periods of time. Date seems to confirm previous measurement, Ly-846: 13,810 ± 740 (R, 1975, v 17, p 23) considering statistical margins of both dates, average of which is Ly-846.2184: 13,020 ± 370.

Ly-2296. Abri des Cabônes, Ranchot, Jura **12,620 ± 250**

Bones from lower layer of les Cabônes shelter (47° 09′ N, 5° 44′ E). Coll 1980 by M Campy and S David, subm 1980 by M Campy. (13/15 diluted sample). Assoc with Late Magdalenian industry. *Comment* (MC): correspondence of date with generally accepted range of dates of Bölling period is surprising for assoc Late Magdalenian industry in region but agrees with other dates from distant French sites such as Le Chamois-Boivin grotto at Blois/Seille, Ly-440: 12,040 ± 270 (R, 1973, v 15, p 168).

Enval series, Vic-le-Comte, Puy de Dôme

Charcoal from Durif shelter (45° 29′ N, 3° 14′ E), from so-called Sol de la Grange part of site. Sample corresponds to Magdalenian industry a little older than that of Fond de l'Abri part of site previously dated, Ly-425: 13,000 ± 300 (R, 1973, v 15, p 149) and Ly-727: 13,700 ± 380 (R, 1975, v 17, p 27). Coll 1973 and subm 1978 by Y Bourdelle, Clermont-Ferrand (Bourdelle, 1979).

Ly-2046. No. 304 **13,090 ± 270**

From Level D1. (2/3 diluted sample)

Ly-2047. No. 35 **6440 ± 350**

From Level B. (1/5 diluted sample)

General Comment (YB): despite expected older age, Ly-2046 indicates same range of date as previous results. Ly-2047 is aberrant and proves local contamination at site.

Comarque series, Sireuil, Dordogne

Bones from right part of small grotto (44° 57′ N, 1° 06′ E). Coll and subm 1979 by B Delluc and G Delluc, Périgueux. Assoc lithic industry may be defined as Magdalenian but without characteristic elements, and wall of grotto has engravings (Delluc & Delluc, 1981).

Ly-2154. 1 **13,370 ± 340**

Bones of miscellaneous animal spp. (2/3 diluted sample)

Ly-2355. 2 **12,710 ± 200**

Bones of reindeer.

General Comment (BD&GD): Ly-2355 confirms -2154 and homogeneity of bone material of grotto deposits. Average of both dates is Ly-2154/2355: 12,880 ± 170, agreeing with expected age according to style of engravings (Early Style IV, according to Leroi-Gourhan), assoc industry (Magdalenian III or IV), and vegetation (cold climatic phase indicated by pollen analysis). Occupation time of grotto may have occurred during last part of Early Dryas period.

Moulin Neuf, Saint Quentin de Baron, Gironde

Bone fragments from rock shelter (44° 38′ N, 0° 16′ W). Coll 1977 and subm 1979 by M Lenoir, Univ Bordeaux. Assoc with Late or Middle Magdalenian industry without harpoons (Lenoir, 1977).

Ly-2352. Cz a **13,570 ± 260**

From top of Layer 2. (2/3 diluted sample)

Ly-2275. Cz b **14,280 ± 440**

From base of Layer 2. (3/5 diluted sample)

General Comment (ML): both dates suggest that assoc industry belongs to Middle Magdalenian.

Ly-2100. La Marche, Lussac-les-Chateaux, Vienne 14,280 ± 160

Bones from only layer of La Marche grotto (46° 24′ N, 0° 43′ E). Coll 1957 and subm 1979 by L Pradel, Chatellerault. Assoc with Magdalenian III industry (Pradel, 1958, p 170-191). *Comment* (LP): date agrees with attribution to Pre-Bölling interstadial deduced from pollen analysis (Leroi-Gourhan, 1973). It is also similar to unpub date from Le Roc au Sorcier shelter, Grn-1913: 14,160 ± 100 (R, 1963, v 5, p 169) and Grn-1903: 13,920 ± 80.

Ly-1830. Grotte de la Bergerie, Caniac du Causse, Lot 15,830 ± 400

Bones from Layer 7 of Paleolithic site at base of grotto, at La Bergerie des Quatre chemins (44° 38′ N, 1° 40′ E). Assoc with atypical poor industry containing *pointe à cran* flint of Hamburgian type and bone tools (Seronie-Vivien, 1972). *Comment* (RS-V): date helps classify this poor industry into group of microlithic industries, with or without *scalène* triangles, of Middle Magdalenian. Such industries came before eponymic Magdalenian (Séronie-Vivien *et al*, 1979). Date comparable to similar levels at Fongaban, Ly-977: 14,300 ± 680, Le Flageolet II, Layer IX, Ly-918: 15,250 ± 320, Combe Cullier, Layer IX, Ly-978: 15,030 ± 330 (R, 1976, v 18, p 80), Ste-Eulalie, Gif-1745: 15,100 ± 270 and Gif-2194: 15,200 ± 300 (R, 1974, v 16, p 26).

La Grotte Maszycka series, Poland

Bones from Maszycka grotto near Maszyce, Krakow dist (50° 20′ N, 19° 40′ E). Coll 1883 by G Ossowski and subm 1981 by J K Kozłowski, Inst Archaeol, Univ Jagiellonski, Krakow. Assoc with Magdalenian with Navette industry similar to Fr Magdalenien à Navette industry (Kozłowski, 1962).

Ly-2453. Nos. 1 and 2 (incised) 14,600 ± 240

Ly-2454. No. 3, bones 15,490 ± 310

General Comment (JKK): although only incised bones are assoc with Magdalenian culture, both dates close to dates for same industry at Arlay, Jura, Ly-497: 15,320 ± 370, Ly-559: 15,770 ± 390 (R, 1973, v 15, p 520), and Le Grand Abri site, La Garenne, Saint Marcel, Indre, C-578: 15,847 ± 1220 (Libby, 1952).

Ly-1998. Abri de la Chaire à Calvin, Mouthiers, Charente 15,440 ± 440

Bone fragments from older Magdalenian Layer (54° 33′ N, 0° 07′ E). Coll 1969 and subm 1979 by J M Bouvier. Inst Quaternaire, Univ Bordeaux I. (5/6 diluted sample). *Comment* (JMB): date is older than expected and does not agree with Magdalenian facies without harpoons (Bouvier, 1969). It agrees with two unpub dates from Saint-Germain-La-

Rivière site, Gironde, with similar industries, Gif-5478: 15,300 ± 410 from Layer C2, and Gif-5479: 16,200 ± 600 from Layer C4.

Ly-2228. La Tannerie, Lussac-les-Chateaux, Vienne 18,020 ± 270

Bones from terrace in front of La Tannerie Grotto (46° 24′ N, 0° 43′ E). Coll 1950 and subm 1980 by L Pradel, Chatellerault. Assoc with Late Solutrean industry (Pradel, 1950). *Comment* (LP): dates agree with those of Zero Magdalenian industry from Layer 6, Abri Fritch site in same region, Ly-1124: 1124 ± 350 BP (R, 1978, v 20, p 50).

Grotte Pégourié series, Caniac du Causse, Lot

Table 28 lists samples of bones from Pégourié grotto (43° 37′ N, 1° 39′ E). Coll and subm by R Séronie-Vivien, Le Bouscat, Gironde.

TABLE 28
Grotte Pégourié

Lab no.	Layer	Sample no.	Assoc industry	Colln date	Dilution ratio	Age BP
Ly-1390	4	1209	Azilian	1976	2/3	11,290 ± 320
-1598	5 top	1210	Azilian	1976	4/5	13,980 ± 510
-1832	5	646	Azilian	1977	1	11,870 ± 290
-1391	5 middle	1211	Azilian	1976	2/3	11,680 ± 330
-1833	5	645	Azilian	1977	1	11,850 ± 280
-1392	5 base	1212	Azilian	1976	1/3	12,690 ± 530
-1393	6 top	1213	Azilian	1976	1/6	8730 ± 890
-1834	8 a	644	Early Magdalenian *à raclettes*	1977	1	17,400 ± 460
-1394	8 b	1220	Early Magdalenian *à raclettes*	1976	1/2	17,490 ± 520
-1836	9 a	642	Early Magdalenian *à raclettes*	1977	9/10	17,420 ± 390
-1835	9 b	643	Early Magdalenian *à raclettes*	1977	11/20	24,200 ± 1100

General Comment (RS-V): dates agree with expected ranges of both industries (Séronie-Vivien *et al*, 1979). As expected, Azilian industry occurred ca 11,500 BP, as in other regions, eg, Alsace at Rochedane, Ly-1192: 11,090 ± 200 (R, 1978, v 20, p 46) and Languedoc at Saint Remèze, Ly-320: 11,500 ± 380 (R, 1971, v 13, p 62). Early Magdalenian dates are also homogeneous ca 17,400, in agreement with those from Abri Pataud, 4 dates from 16,500 to 1800 BP (R, 1978, v 20, p 50) and at Laugerie Haute, Ly-972: 18,260 ± 360 (R, 1976, v 18, p 80). Ly-1835 was obtained from bones at base of grotto deposit that may belong to another depositional cycle (see Bos grotto, above). Ly-1393 may be compared with Ly-1837 and -1838 (R, 1980, v 22, p 547) and Gif-2568: 8450 ± 250 (unpub). These four dates, ca 8500 BP, are younger than expected and may indicate re-use assoc with climatic phenomena.

Las Caldas series, San-Juan-de-Prioro, Spain

Table 29 lists samples of bones from three loci in Las Caldos grotto Prov Oviedo (43° 20′ N, 5° 59′ W). Coll 1980 by M S Corchon and subm 1980 by F J Cerda, Prehist Dept, Univ Salamanca.

TABLE 29
Las Caldas

Sample no.	Ref	Area	Level	Industry	Age
Ly-2427	C II	Sala II	III-IV	Middle Magdalenian	13,400 ± 150
-2421	CI 1	El Pasillo	3	Upper Solutrean	18,250 ± 300
-2422	CI 2	El Pasillo	4	Upper Solutrean	17,050 ± 290
-2423	CI 5	El Pasillo	7	Typical Upper Solutrean	18,310 ± 260
-2424	CI 6	El Pasillo	9	Typical Upper Solutrean	19,390 ± 260
-2425	CI 12	El Pasillo	12 top	Middle Solutrean	19,030 ± 320
-2426	CI 9	El Pasillo	12 base	Middle Solutrean	19,480 ± 260
-2428	CE 15	Sala I	16	Middle Solutrean	19,510 ± 330
-2429	CE 16	Sala I	18	Middle Solutrean	19,000 ± 280

General Comment (FJC): dates agree with each other and with expected ages. They confirm correlations among three excavated secs are comparable to other dates from Spain or SW France. Ly-2428 corresponds to wet and cold climatic phase, attributed to Early Dryas, and agrees with other dates of Middle Magdalenian in France. Two dates of Late Solutrean agree with others of same industry from Chufin site, obtained but unpub by Madrid lab, CSIC-258: 17,420 ± 200. Their apparent inversion may be due to post-sedimentary inversion. All other results are consistent with two series from Oullins and Solutré sites, France. They confirm archaeol hypothesis of *in situ* evolution of Middle Solutrean industry in Layer 12 corresponding to Würmian III-IV interstadial phase, into typical Solutrean in Layers 9 and 7, corresponding to beginning of Early Dryas phase.

Ly-2279. Puy-Jarrige II, Brive-La-Gaillarde, Corrèze 19,310 ± 790

Bones from Sq LVI of Rockshelter II (45° 17′ N, 1° 28′ E). Coll and subm by G Mazière, Dir Antiquités Préhist, Limoges. (1/6 diluted sample). *Comment* (GM): date is too young for assoc industry (Perigordian IV with *Pointes de Bayac* generally dated ca 24,000 BP. Contamination may be due to Middle-age occupation of rockshelter.

Oullins series, La Bastide de Virac, Ardèche

Bones from La Baume d'Oullins site (44° 20′ N, 4° 32′ E). Coll and subm 1978 by F Bazile, Vauvert. Assoc with *à pointes à crans* Solutrean industry (Bazile & Bazile-Robert, 1981). (4/5 diluted sample)

Ly-1984. Level D 20,100 ± 500

Ly-1983. Level 9 20,060 ± 450

General Comment (FB): dates agree with expected ages of assoc industry in W Languedoc region. They disagree with two dates previously pub (R, 1975, v 17, p 22) and obviously too young, from two Early Solutrean layers in same site, Ly-779: 19,710 ± 400 for Layer 7 and Ly-798: 19,360 ± 420 for Layer 6. They agree with 5 dates ca 19,000 BP for Early *Salpétrian* (Early Magdalenian) industries and unpub Monaco Lab result from Early or Middle Solutrean industry, la Salpêtrière site at Remoulins

Gard, MC-2449: 21,600 ± 70. They also agree with Groningen series for same industry from Laugeric Haute site, Dordogne (R, 1967, v 9, p 116).

Ly-2101. Laraux, Lussac-les-Châteaux, Vienne 21,950 ± 350

Bones from Layer 3 in Laraux shelter (46° 24′ N, 0° 43′ E) (Pradel, 1979). Coll 1949 and subm 1981 by L Pradel. (29/30 diluted sample). *Comment* (LP): previous date from same layer, Ly-1739: 21,530 ± 910 (R, 1979, v 21, p 447). New measurement was made on larger sample which reduces uncertainty margin; average value of both measurements, Ly-1739/2101: 21,890 ± 330.

Ly-1863. La Mère Clochette, Rochefort-sur-Nenon, Jura 25,800 ± 700

Fragments of mammoth tusk from La Mère Clochette grotto (47° 9′ N, 5° 55′ E). Coll 1906 by J Feuvrier and subm 1979 by R Desbrosse, Blanzy. *Comment* (RD): collections of artifacts confirm existence of Mousterian, Aurignacian (points with split base) and Early Perigordian (Châtelperron and Les Cottés points) (Desbrosse, 1981). Ly-1863 indicates much younger age.

Ly-1861. Pech Merle, Cabrerets, Lot 11,200 ± 800

Charcoal from Excavation VII under so-called *La Frise noire* painting in Pech Merle grotto (44° 31′ N, 1° 38′ E). Coll and subm 1978 by M Lorblanchet, Centre Natl Recherche Sci, Gramat. (1/15 diluted sample). Parietal painting of grotto belongs to Magdalenian style (ca 15,000 BP). *Comment* (ML): even considering very large statistical margin, due to small sample size, date is much younger than expected and seems too recent to mark last occupation time of grotto which is surely contemporaneous with painting. Slight contamination by recent carbon may be responsible for this discrepancy.

Abri Moula series, Ardèche

Table 31 lists samples of bones from shelter deposit near Soyons (44° 52′ N, 4° 50′ E). Coll by Crouzet Archaeol Club and subm by P Payen, Valence. Assoc with scattered, presumed Late Mousterian industry.

TABLE 31
Abri Moula

Sample no.	Square	Depth	Colln date	Dilution ratio	Age BP
Ly-1595	F2,F3	0.7-2m	1976	1	$24,400 \, {}^{+2000}_{-1600}$
-2217	F3,F4,G3,G4	3.2-3.9m	1980	1	20,100 ± 310
-2488	F4,F5,G4,G5	4.1m	1980	1	33,200 ± 1500

General Comment (PP): only Ly-2488 agrees with expected age, relatively recent for end of Mousterian industries, which are, thus, contemporaneous with 1st early Late Paleolithic industries, as previously found in other sites; see, eg, Level VIII, Gigny/Suran, Ly-566: 29,500 ± 1400 (R, 1973, v 15, p 521) and Ly-789: 28,500 ± 1400 (R, 1975, v 17, p 83). Two other dates are too young and suggest re-use in upper levels where Mousterian flints may have mixed with younger bones as stratigraphy and geol hist of sediments seem to be fairly complex.

Saint-Cesaire series, Charente-Maritime

Bones from La Roche à Pierrot site (45° 45′ N, 0° 31′ W). Coll and subm 1979 by F Lévêque, Dir Antiquités Préhist Poitiers (Lévêque & Vandermeersch, 1980).

Ly-2192. Ejo sup **21,100 ± 540**

From so-called *ensemble jaune-orange* upper layer, assoc with Proto-Aurignacian industry. (13/30 diluted sample)

Ly-2193. Ejop sup **22,960 ± 840**

From so-called *ensemble jaune-orange-pâle* upper layer, assoc with Castelperronian (Early Late Paleolithic) industry. (7/30 diluted sample) *General Comment* (FL): both dates are much too young despite good sample. Large amount of recent organic matter deposited for short time on site before excavation may have contaminated small amount of collagen remaining on bones.

Ly-1793. Esquicho-Grapaou Sainte-Anastasie, Gard **27,700 ± 1100**

Bone from Layer CC2, Rassan (43° 56′ N, 4° 19′ E). Coll and subm 1978 by F Bazile, Vauvert. Assoc with Mousterian industry which is last such level in site and may be attributed to Würm-II/III interstadial. (5/6 diluted sample). *Comment* (FB): age is younger than expected and conflicts with unpub date from Late Paleolithic level overlying SLC1b: MC-2161: 34,540 ± 2000 BP.

Grotte Tournal series, Bize-Minervois, Aude

Table 30 lists samples from several loci in Tournal grotto (43° 20′ N, 2° 31′ E). Coll and subm by A Tavoso, Univ Marseille. Site is grotto deposition on stalagmitic floors, constituted by very concreted sediments containing Mousterian, Late Aurignacian, and Magdalenian industries. Sediments have been disturbed by suction action of karstic system sometimes open under stalagmitic floors.

TABLE 30
Tournal Grotto

Lab no.	Sample no.	Layer and sq	Sample	Assoc industry	Subm date	Dilution ratio	Age BP
Ly-1231	Bize 2	K31 C	Charcoal	Magdalenian IV	1975	1	12,550 ± 210
-1894	Bize 6	K31 C	Bone	Magdalenian IV	1978	1	12,860 ± 320
-1897	Bize 8	030 I	Bone	Magdalenian	1979	1	13,790 ± 420
-1232	Bize 3	M34 ALM	Bone	Magdalenian	1975	1/2	14,530 ± 510
-1675	Bize 4	M34 AF	Charcoal	Magdalenian	1975	2/5	14,770 ± 970
-1896	Bize 7	N32 PC	Bone	Late Paleolithic	1978	1	25,870 ± 830
-1895	Bize 5	LM32 F	Charcoal	Early Aurignacian	1978	1/6	≥29,000
-1031	Bize 1	L31 C	Carbonaceous earth	Early Aurignacian	1974	1/3	≥34,200
-1676	Bize 5	K29 C	Charcoal	Mousterian	1978	1	33,600 ± 1300
-1898	Bize 9	P31 G	Charcoal	Mousterian	1978	1/4	≥35,800

General Comment (AT): because of fractioning of deposits in isolated units, most measurements were made to control correlation assumed from one unit to another. Most dates were expected. Magdalenian occupation of site took place during Middle Magdalenian and beginning of Late Magdalenian epochs although assoc industry is not characteristic. Because of small amount of available Early Aurignacian material, this industry could not be dated (Ly-1895). Ly-1031 seems too old and -1676 too young, with regard to stratigraphy. U/Th measurements were made on teeth and bones but dates are different for both samples.

Brugas series, Layer 4, Vallabrix, Gard

Charcoal from base of rock shelter (44° 03′ N, 4° 29′ E). Coll and subm 1978 by L Meignen, Centre Recherches Archéol, Valbonne. (17/30 diluted sample)

Ly-2038. 1 **≥32,000**

Ly-2351. 2 **29,000 ± 860**

General Comment (LM): Ly-2351 is too young for unknown reason. Ly-2038 confirms industry does not belong to very Late Mousterian.

IV. HYDROGEOLOGIC SAMPLES

Wassia series, Saudi Arabia

Table 32 lists samples of water from five superimposed aquifers of several underground areas of Arabia. Coll from 1974 to 1977 by Bur Recherches Geol Min (BRGM) for Water and Agric Agency Arabian Kingdom. Subm from 1975 to 1977. Aquifers lie in sedimentary basin mainly deposited from Cretaceous to Neogene eras. They are, from lowermost to uppermost: Behiad (from ante-Cenomanian strata), Wassia (from Cenomanian), Um er Radhuma (Paleocene), Alat Kobar, and Neogene. Study was pub in BRGM rept (1980).

TABLE 32
Wassia

Sample no.	Sample	Date	Dilution ratio	Activity (% of modern)
Torrent in Djedah region (21°29′N, 39°16′E)				
Ly-1066	Oued	1/3/77	1	78.8 ± 2.0
Springs around Hofuf palm-tree grove (25°25′N, 49°45′E)				
Ly-1087	Aīn Najim 44	6/5/75	1	3.5 ± 0.4
-1088	Aīn Khudud 1	7/5/75	1	16.6 ± 0.6
-1089	Aīn Buhairiyah 9	8/5/75	1	24.2 ± 0.7
-1090	Aīn Jauhariyah 5	9/5/75	2/3	3.9 ± 0.4
-1091	Aīn Sabaa 3	10/5/75	2/3	≤1.5
-1092	Aīn Manah 12	11/5/75	1	5.5 ± 0.4
-1432	Aīn Um Sabba	2/75	1	3.8 ± 1.8
-1433	Aīn Khalif	2/77	1	13.7 ± 2.2
-1434	Aīn Al Marah 112	2/77	1	15.2 ± 2.1
-1435	Aīn Jauhariyah	2/77	1	≤4.8
-1436	Aīn Najim	2/77	5/6	5.2 ± 2.7
-1437	Aīn Harrah	2/77	1/8	≤4.0
-1473	Aīn Khilud	30/4/77	2/3	21.2 ± 1.3
-1474	Aīn Barabir	1/5/77	1	8.5 ± 0.6
-1475	Aīn Huweirrah	2/5/77	2/3	4.7 ± 0.6
-1476	Aīn Buhairiyah	10/5/77	2/3	7.8 ± 1.0

TABLE 32 (continued)

Sample no.	Sample		Date	Dilution ratio	Activity (% of modern)
Borings in Al Hassa and Hofuf region (25°25'N, 49°45'E)					
Ly-1045	WM 541	Neogene	15/3/75	1	9.6 ± 1.5
-1048	WM 194	Neogene	18/3/75	1	1.9 ± 0.3
-1049	D 1072	Neogene	19/3/75	1	1.5 ± 0.3
-1356	A 1681	Neogene	76	2/3	⩽2.5
-1360	G 241	Neogene	76	2/3	⩽2.5
-1364	G 001	Neogene	76	1/2	⩽3.0
-1429	A 1699	Neogene	2/77	1	16.9 ± 0.6
-1445	A 609	Neogene	3/77	2/3	9.7 ± 1.0
-1446	A 818	Neogene	3/77	5/6	⩽1.8
-1449	HD 4N	Neogene	3/77	1	⩽1.9
-1450	HH 1 N	Neogene	3/77	1	2.1 ± 0.7
-1453	HH 2 N	Neogene	3/77	5/6	⩽2.8
-1455	HH 2 N	Neogene	3/77	1	⩽4.3
-1456	HC 6 N	Neogene	3/77	5/6	2.0 ± 0.6
-1479	HC 4 N	Neogene	25/4/77	2/3	6.7 ± 0.8
-1481	HE 2 N	Neogene	20/4/77	1	2.7 ± 0.5
-1483	HD 2 N	Neogene	8/4/77	2/3	⩽1.5
-1485	HC 3 N	Neogene	4/4/77	2/3	3.8 ± 0.7
-1486	HC 2 N	Neogene	1/5/77	2/3	6.1 ± 0.8
-1487	HD 1 N	Neogene	3/5/77	2/3	2.3 ± 0.6
-1492	HD 5 N	Neogene	20/5/77	2/3	3.3 ± 0.8
-1500	HE 1 N	Neogene	18/6/77	2/3	⩽2.1
-1068	UW 810	Alat Kobar	26/3/75	1	3.0 ± 0.5
-1047	WW 810	Alat Kobar	16/3/75	1	⩽1.0
-1352	B 84	Alat Kobar	76	1/2	⩽2.5
-1355	A 613	Alat Kobar	76	1/2	3.6 ± 1.6
-1358	B 85	Alat Kobar	76	2/3	⩽2.5
-1359	A 576	Alat Kobar	76	1	⩽2.0
-1362	A 612	Alat Kobar	76	1/2	3.7 ± 1.2
-1363	A 560	Alat Kobar	76	1	⩽3.5
-1365	G 240	Alat Kobar	76	2/3	⩽3.0
-1428	DH/WW 2	Alat Kobar	2/77	2/3	2.8 ± 0.7
-1439	A 570	Alat Kobar	3/77	2/3	⩽2.0
-1440	G 013	Alat Kobar	3/77	2/3	⩽2.5
-1441	A 604	Alat Kobar	3/77	2/3	4.1 ± 0.8
-1442	A 1679	Alat Kobar	3/77	1	⩽2.2
-1444	U 897	Alat Kobar	3/77	2/3	⩽1.9
-1452	HH 2 K	Alat Kobar	3/77	1/2	⩽4.0
-1454	HC 6 K	Alat Kobar	3/77	1	⩽2.1
-1478	HE 2 K	Alat Kobar	17/4/77	1	2.7 ± 0.4
-1480	HC 4 K	Alat Kobar	23/4/77	1	6.4 ± 0.9
-1490	HD 3 K	Alat Kobar	5/5/77	2/3	2.2 ± 0.3
-1498	HU 5 K	Alat Kobar	9/6/77	2/3	4.5 ± 0.7
-1503	HE 1 K	Alat Kobar	4/7/77	1	⩽1.6
-1046	UW 909	Um er Radhuma	16/3/75	1	10.0 ± 1.5
-1067	UW 819	Um er Radhuma	25/3/75	1/2	⩽2.0
-1069	UW 816	Um er Radhuma	27/3/75	1	1.4 ± 0.3
-1071	UW 999	Um er Radhuma	29/3/75	1/3	7.2 ± 1.4
-1118	WA 1597b	Um er Radhuma	4/6/75	5/6	60.7 ± 1.7
-1353	A 596	Um er Radhuma	76	1/3	⩽2.5
-1354	S 57	Um er Radhuma	76	1	3.1 ± 0.7
-1357	SH 808	Um er Radhuma	76	1	⩽2.5
-1366	A 828	Um er Radhuma	76	1	2.2 ± 0.7
-1423	U 817	Um er Radhuma	2/77	1	⩽2.5
-1424	U 818	Um er Radhuma	2/77	1	4.3 ± 1.8
-1425	AD 812	Um er Radhuma	2/77	1	2.4 ± 1.6
-1426	AD 809	Um er Radhuma	2/77	1	4.5 ± 2.1
-1427	SH 812	Um er Radhuma	2/77	1	⩽2.5
-1430	SH 805	Um er Radhuma	2/77	5/6	⩽2.4
-1431	HA 814	Um er Radhuma	2/77	1	6.0 ± 1.8
-1438	A 579	Um er Radhuma	3/77	3/5	65.0 ± 3.5
-1443	A 608	Um er Radhuma	3/77	2/3	⩽2.2

Table 32 (continued)

Sample no.	Sample		Date	Dilution ratio	Activity (% of modern)
Ly-1447	A 562b	Um er Radhuma	3/77	1	2.8 ± 0.5
-1448	HD 4 U	Um er Radhuma	25/3/77	1	2.3 ± 0.5
-1451	HH 1 U	Um er Radhuma	3/77	2/3	2.5 ± 0.7
-1482	HH 5 U	Um er Radhuma	27/4/77	2/3	⩽2.9
-1484	HD 2 U	Um er Radhuma	7/4/77	2/3	⩽2.1
-1488	HD 1 U	Um er Radhuma	2/5/77	1	2.0 ± 0.5
-1489	U 904	Um er Radhuma	4/5/77	1/3	⩽2.6
-1491	HD 5 U	Um er Radhuma	20/5/77	1	2.9 ± 0.5
-1499	HC 5 U	Um er Radhuma	30/5/77	1	3.2 ± 0.5
-1501	HH 3 U	Um er Radhuma	4/7/77	2/3	⩽2.4
-1502	HE 1 U	Um er Radhuma	4/7/77	1	2.1 ± 0.6
-1070	UW 887	Wassia or Behjar	28/3/75	1/6	⩽2.0
-1077	HA 1 W	Wassia or Behjar	20/4/75	1/3	⩽2.0
-1086	HA 2 W	Wassia or Behjar	3/5/75	2/3	⩽1.6
-1477	HD 4 TW	Wassia or Behjar	7/4/77	1	3.5 ± 0.5
Borings in Wadi Myah region (19°N, 48°E)					
Ly-1081	WA 251	Neogene	27/4/75	2/3	53.2 ± 1.7
-1079	MI 3 A	Alat Kobar	25/4/75	2/3	⩽2.8
-1078	MI 1 U	Alat Kobar	25/4/75	1	⩽1.5
-1080	MI 2 K	Alat Kobar	26/4/75	2/3	⩽1.7
-1113	MI 2 WP	Wassia	25/5/75	1/3	⩽2.7
Borings in Al Quatif (26°35′N, 50°00′E)					
Ly-1094	WA 1682	Neogene	14/5/75	1/6	91.6 ± 4.0
-1095	WM 1238	?	15/5/75	2/3	3.7 ± 0.4
-1050	WA 793	Alat Kobar	22/4/75	2/3	⩽1.0
-1082	Q 3 A	Alat Kobar	28/4/75	2/3	⩽2.8
-1083	Q 2 K	Alat Kobar	29/4/75	2/3	⩽1.5
-1093	WA 1678	Alat Kobar	13/5/75	1/3	⩽3.2
-1074	S 394	Alat Kobar Um er Radhuma	11/4/75	1/2	⩽2.0
-1084	Q 1 U	Um er Radhuma	29/4/75	1	⩽1.8
-1072	Abqaiq 835	Wassia	2/4/75	1/6	⩽2.0
-1085	BU' AYJ 802	Wassia	2/5/75	1	1.6 ± 0.4
-1073	Berri 809	Wassia	9/4/75	1/2	⩽1.5
Borings in Harad (14°15′N, 49°00′E) and Khurais (24°55′N, 48°05′E) regions					
Ly-1075	Khurais	805	14/4/75	1/2	⩽1.5
-1096	HAP 5	Um er Radhuma	18/5/75	1/4	⩽1.5
-1097	HAP 43	Um er Radhuma	18/5/75	2/3	4.7 ± 1.1
-1160	HD 1 W	Wassia	5/12/75	1/2	2.8 ± 0.7
-1199	KH 1 W	Wassia	25/1/76	1/2	3.3 ± 0.8
Borings in Aīn Dar region (25°55′N, 45°10′E)					
Ly-1119	WA 603	Um er Radhuma	6/6/75	1/2	2.0 ± 0.3
-1361	AD 804	Um er Radhuma	76	1/2	⩽2.0
Borings in W Riyad region (24°N, 46°30′E)					
Ly-1076	WB 6	Wassia	15/4/75	1	⩽1.1
-1120	N 5	Wadi Nisah Wassia	9/6/75	2/3	33.9 ± 1.3
Borings in NW Riyad region (27°N, 45°30′E)					
Ly-1115	WA 1632	Um er Radhuma	31/5/75	2/3	110.0 ± 2.1
-1117	S 734	Um er Radhuma	3/6/75	1/6	⩽4.0
-1114	WA 1613	Wassia	30/5/75	1/2	50.7 ± 1.7
-1116	WA 1601	Wassia	1/6/75	2/3	84.7 ± 2.3

General Comment (BRGM): results prove that five superimposed aquifers are independent from isotopic point of view although there are local phenomena of drainage.

La Grotte de la Cocalière series, Courry, Gard

Table 33 lists samples of water from three loci in karstic system of La Cocalière grotto (44° 19′ N, 3° 10′ E). 501 samples coll and quickly prepared by strong acidification in lab by G Marien, C Pachiaudi, and P Renault, Geol Dept, Univ Lyon. Measurements were made as part of study of origin and turnover of calcium bicarbonates in karstic systems and on hydrogeol of fissured limestones (Burger, 1980). Samples were taken either from bottom of two underground rivers right tributary (AD) or left tributary (AG) or outflow of system (R). Only undiluted samples were measured in proportional counters; others in liquid scintillation devices.

TABLE 33

La Cocalière Grotto

Sample no.	Loc	Date	Dilution ratio	$\delta^{13}C$ (‰ PDB ± 0.1)	Activity (% of modern)
Ly-1110	AD	7/5/75	1/3	−14.5	97.1 ± 3.2
-1111	R	27/6/75	1/4	−12.6	106.6 ± 2.6
-1112	AD	27/6/75	1/6	−15.3	96.5 ± 4.6
-1129	R	2/6/75	1/4	−11.5	110.3 ± 5.8
-1130	AD	2/10/75	1/3	—	123.2 ± 4.5
-1131	R	27/11/75	4/15	− 7.3	124.7 ± 4.4
-1132	R	2/12/75	1/3	− 7.4	119.8 ± 3.8
-1174	AD	28/1/76	1/5	−13.2	120.2 ± 4.9
-1277	AG	11/3/76	1	−17.1	113.7 ± 2.5
-1278	R	11/3/76	1	−15	117.1 ± 2.5
-1227	AG	26/5/76	4/15	−11.0	121.4 ± 4.4
-1228	AD	27/5/76	1/6		119.9 ± 6.8
-1336	AD	22/7/76	1/6	−14.2	102.3 ± 5.0
-1337	AD	21/9/76	4/15		116.4 ± 4.3
-1338	R	21/9/76	1/5	−18.3	91.1 ± 4.3
-1339	AG	2/12/76	1/5	−14.5	112.2 ± 4.6
-1340	AD	2/12/76	1/6	−13.2	112.3 ± 5.3
-1539	AG	10/12/77	1/4		123.7 ± 4.2
-1540	R	10/12/77	2/3	−15.3	116.2 ± 3.1
-1541	AD	22/4/77	1	−13.8	107.9 ± 1.6
-1542	AG	22/4/77	2/3	−14.3	96.3 ± 3.2
-1543	AG	30/5/77	1	−13.0	121.5 ± 1.9
-1544	R	30/5/77	1	−11.6	120.7 ± 2.0
-1545	AG	9/6/77	1/3	− 9.0	122.0 ± 5.2
-1546	R	9/6/77	1		119.5 ± 3.1
-1547	R	17/6/77	1	−13.1	122.5 ± 3.1
-1548	AG	17/6/77	1/3	−15.1	118.8 ± 4.6

General Comment: results are very homogeneous and confirm reliability of sampling, transport, and preparation procedures. Compared to other climatologic data (mainly precipitation and evapotranspiration), highest activities (ca 120% modern) correspond to periods with normal precipitation when karstic system mainly let flow 1-yr-old waters. During low-water periods lowest activities (up to 91% modern) indicate temporarily larger contribution of waters > 1 yr old, probably stocked in fissures of limestone. On larger scale, same phenomena was previously studied by numerous ^{14}C measurements in Fontaine de Vaucluse system (see Le Chene series, R, 1971, v 13, p 65).

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[RADIOCARBON, VOL 25, No. 1, 1983, P 129-136]

UCLA RADIOCARBON DATES X

RAINER BERGER

Institute of Geophysics, Departments of Anthropology and Geography
University of California, Los Angeles, California 90024

and

JONATHON ERICSON

Department of Anthropology and Peabody Museum
Harvard University, Cambridge, Massachusetts 02138

The measurements reported in this date list form the chronometric framework for obsidian hydration and trade studies in California (Ericson, 1975; 1977; 1978; 1981; Ericson *et al*, 1975; Singer and Ericson, 1977). All samples were analyzed as CO_2 gas at close to 1 atm in a 7.5L proportional counter with three energy channels. Radiocarbon ages are based by convention on the 5568 ± 30 yr half-life. The biospheric standard is 95% the count rate of NBS oxalic acid for radiocarbon laboratories. Background is based on CO_2 obtained from marble. Counter operation is checked against a historically dated wood sample from the funerary boat of Sesostris III, 1872 $^{+4}_{-8}$ BC (Hayes, 1962). All samples were subjected to accepted NaOH, HCl or other special chemical treatments to exclude contamination. No tree-ring calibration was applied to any of the samples listed.

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SAMPLE DESCRIPTIONS

California

Mammoth Junction series

Samples coll 1963-64 during excavation of Mammoth Junction site, 4-Mno-382, Mono Co (37° 39′ N, 118° 50′ W) by J W Michels and G L Sterud, Dept Anthropol, Univ California, Los Angeles and subm by J E Ericson.

Mammoth Junction site was large (8.5 ha) obsidian quarry workshop and occupation site, adjacent to Casa Diablo obsidian source (Ericson, Hagan, and Chesterman, 1976). This series of dates, assoc with many obsidian hydration measurements, was selected in order to substantiate diachronic production of obsidian for trade.

UCLA-1724A. Mammoth Junction **660 ± 60**

Charcoal, Pit 26, 15 to 30cm depth.

UCLA-1724B. Mammoth Junction **430 ± 80**

Charcoal, Pit 29, 15 to 30cm depth.

UCLA-1724C. Mammoth Junction **1000 ± 50**

Charcoal, Pit 14, 45 to 60cm depth.

UCLA-1724D. Mammoth Junction **170 ± 60**

Charcoal, Pit 17, 15 to 30cm depth.

UCLA-1724E. Mammoth Junction **450 ± 100**

Charcoal, Pit 16, 15 to 30cm depth.

UCLA-1724F. Mammoth Junction **600 ± 60**

Charcoal, Pit 14, 15 to 30cm depth.

Elderberry Canyon series

Samples coll 1970 during salvage excavations of Elderberry Canyon site, 4-LAn-324, Los Angeles Co (34° 34′ N, 118° 38′ W) by Clay A Singer and personnel of Archaeol Survey, UCLA, and Northridge Archaeol Research Center, California State Univ, Northridge, supported by California Dept Parks and Recreation prior to inundation of site by waters of Castaic Dam. Subm by J E Ericson.

UCLA-1771A. Elderberry Canyon **1720 ± 50**

Marine shell (*Haliotis*) from W sidewall of Knoll (55/EO), 45 to 60cm depth. This sample (W66-1088) dates cairn and "central" cemetery area.

UCLA-1771B. Elderberry Canyon **2040 ± 350**

Bone collagen from very thick occipital region of human skull of unique, uncremated cairn burial, Unit H4, 135cm below surface. Sample dates burial and "early or middle" period of site occupation.

Ridge site series

Samples coll summer of 1973 during salvage excavations of Ridge site, SBCM-128, San Bernardino Co (34° 20′ N, 117° 26′ W) conducted by C White, Dept Anthropol, Univ California, Los Angeles, in conjunction with San Bernardino Co Mus; subm by J E Ericson. *Comment* (CW): for both samples, expected date was AD 500, based on bead chronology.

UCLA-1789A. Ridge site **1440 ± 50**

Charcoal from probable cooking area, N4/E4, subquad D, 30 to 40cm.

UCLA-1789B. Ridge site **1960 ± 50**

Charcoal from probable cooking area, N6/W8, 30 to 40cm.

UCLA-1794C. 4-Son-518 **120 ± 45**

Charcoal from circular house pit of 4-Son-518 (38° 20′ N, 122° 44′ W). This sample dates appearance of cultural traits characteristic of Southern Pomo just prior to (or just after) arrival of Caucasian settlers. Sample coll 1973 by Ward Upson, Santa Rosa, California, under contract with Sonoma Co Water Agency; subm by J E Ericson.

Mostin site series

Series of human burials recovered in 1973 from test excavations of cemetery assoc with Paleo-Indian village of Mostin site, 4-Lak-380, formerly SDA-66 (39° N, 122° 50′ W) at depth 6m below present surface in lacustrine deposits, deposited during later high-level stage of Clear Lake, Lake Co (McNitt, 1968). Close proximity of site to Mt Konocti and Borax Lake obsidian sources (Meighan and Haynes, 1970) dates one of oldest examples of obsidian use known in America (Ericson and Berger, 1974). Subm by D Fredrickson, Sonoma.

1795A. Mostin **10,260 ± 340**

Bone collagen from left fibula, 6m from left tibia, and diaphysis of right femur of human skeleton, Burial 4, below surface, assoc with seven analyzed obsidian artifacts (Ericson and Berger, 1974).

9040 ± 210

1795B. Mostin $\delta^{13}C = -19.2‰$

Bone collagen from left and right femur of late adolescent human skeleton, Burial 1, tightly flexed, 6m below surface, assoc with seven analyzed obsidian artifacts (Ericson and Berger, 1974). Aspartic acid date for this skeletal sample was 8100 yr BP (Jeffrey Bada, pers commun). $^{13}C/^{12}C$ ratio indicates largely terrestrial diet of individual.

1795C. Mostin **7750 ± 400**

Bone collagen from right radius, right femur, left humerus of young adult (21 to 22 yr old) human skeleton, Burial 9, semi-flexed, to 6m below surface, assoc with seven analyzed obsidian artifacts. Aspartic acid date for this skeletal material was 10,500 yr BP (Jeffrey Bada, pers commun).

Stone Valley series

Samples coll 1962 during excavations of Stone Valley site, 4-CCo-308, Contra Costa Co (37° 51′ N, 122° 1′ W) by David Fredrickson, California State Coll, Sonoma, and subm by J E Ericson. This important series dates change in obsidian utilization (Fredrickson, 1969), derived almost in total from St Helena obsidian source in Napa Co (Jackson, 1975). Also dates Central California Horizon sequence in area.

UCLA-1786A. Stone Valley **470 ± 120**

Charcoal (Sample 1B) from human burial matrix, Burial 4 (matrix), 1.30m depth, assoc with Type 2a1 and 1a Olivella beads. *Comment* (DF): sample believed to date early Phase 1 of Central California's Late Horizon (ca < AD 300).

UCLA-1786B. Stone Valley **2860 ± 120**

Charcoal (Sample 2B) from human burial matrix, Burial 32 (matrix), 3.65m depth, assoc with quartz crystal, bone awl fragment, and chipped-stone fragments. *Comment* (DF): sample believed to date middle of Central California's Middle Horizon (ca 2500 BP).

UCLA-1786C. Stone Valley **2870 ± 240**

Charcoal from deepest part of site, derived from human burial, Burial 3 (matrix), 6.20m depth, assoc with bone tool fragments and two projectile points. *Comment* (DF): sample believed to date early Middle Horizon of Central California, contemporaneous with late Early Horizon (ca > 3000 BP), date younger than expected when compared with UCLA-1786B.

UCLA-1792A. Stone Valley **870 ± 50**

Charcoal from site midden, M-1, 75 to 90cm depth. *Comment* (DF): sample believed to date early Phase 1 of Central California's Late Horizon (ca < AD 300).

UCLA-1792B. Stone Valley **940 ± 50**

Charcoal from site midden, M-1, 105 to 120cm depth. *Comment* (DF): sample believed to date early Phase 1 or Middle Horizon/Late Horizon Transitional Phase of Central California (ca AD 300).

UCLA-1792C. Stone Valley **950 ± 50**

Charcoal from site midden, M-1, 120 to 140cm depth. *Comment* (DF): sample believed to date beginning of early Phase 1 of Middle Horizon/Late Horizon Transitional Phase of Central California (ca AD 300).

UCLA-1792D. Stone Valley **1190 ± 130**

Charcoal from site midden, M-1, 165 to 180cm depth. *Comment* (DF): sample believed to date Middle Horizon/Late Horizon Transitional Phase of Central California (ca > AD 300).

UCLA-1792E. Stone Valley **1250 ± 230**

Charcoal from site midden, M-2, 3.6 to 3.8m depth. *Comment* (DF): sample should date middle of Central California's Middle Horizon (ca 2500 BP). Date is much too young; not consistent with remainder of dates from site.

UCLA-1792F. Stone Valley **3130 ± 230**

Charcoal from site midden, M-3, 4.1 to 4.3cm depth. *Comment* (DF): sample believed to date early portion of Central California's Middle Horizon; may be contemporaneous with late Early Horizon.

La Serena series

Samples coll 1962 during excavations of La Serena site, 4-CCo-30, Contra Costa Co (37° 50′ N, 122° 1′ W) by David Fredrickson, and subm by J E Ericson. This series dates change in obsidian utilization (Fredrickson, 1969), derived almost totally from St Helena obsidian source in Napa Co (Jackson, 1975). Also dates Central California Horizon sequence in area. *Comment* (DF): major occupation of site was middle Phase 1, although some Phase 2, post AD 1500 occupation.

UCLA-1793A. La Serena **440 ± 50**

Charcoal from site midden, I-28, 45 to 60cm depth. *Comment* (DF): sample believed to date Phase 1 of Central California's Late Horizon (ca > AD 1500).

UCLA-1793B. La Serena **590 ± 50**

Charcoal from site midden, I-28, 90 to 105cm depth. *Comment* (DF): sample believed to date Phase 1 of Central California's Late Horizon (ca > AD 1500).

UCLA-1793C. La Serena **370 ± 50**

Charcoal from site midden, Q-40, 45 to 60cm depth. *Comment* (DF): sample should date Phase 1 of Central California's Late Horizon (ca > AD 1500), but may be from Phase 2 occupation.

UCLA-1793D. La Serena **470 ± 50**

Charcoal from site midden, Q-40, 90 to 105cm depth. *Comment* (DF): sample should date Phase 1 (ca > AD 1500), but may be from Phase 2 occupation.

UCLA-1853B. Houx **680 ± 40**

Charcoal from site midden, 4-Lak-261, SM-24, 45 to 60cm depth (38° 52′ N, 122° 36′ W). Sample coll during excavations in 1961 by D Fredrickson; subm by S DeAtley and F J Findlow. *Comment* (DF): sample believed to date North Coast Range equivalent to Central California's Middle Horizon (ca > AD 300). Some post-AD 1500 occupation of site on basis of clam-shell disk bead cross-dating.

Pocheco site series

Samples coll Spring 1973 during excavation of Pocheco site, 4-Mrn-152, Marin Co (37° 42′ N, 123° 32′ W) by C W Clewlow, Archaeol Survey, Inst Archaeol, Univ California, Los Angeles, and subm by J E Ericson. *Comment* (CWC): although dates were unexpectedly early, subsequent analysis of assoc materials confirmed Central California Early Horizon date. Samples probably represent burials, earliest known in Marin Co, California.

UCLA-1891A. Pocheco **3270 ± 70**

Bone collagen, derived from human bone, Burial 4, 3N/5W and 2N/5W, 85 to 90cm depth.

UCLA-1891B. Pocheco **3050 ± 130**

Bone collagen derived from human bones. Burial 5, 90cm depth.

"Tlotlic"-Cold Creek Canyon site series

Samples coll April 1973 during excavation of Cold Creek Canyon site, "Tlotlic" village, 4-Lak-153, Lake Co (39° 5′ N, 122° 32′ W) by R L Orlins, Univ California, Davis; subm by J E Ericson.

UCLA-1913A. Cold Creek Canyon **<300**

Charcoal from site midden, Unit S12/E16, 20 to 30cm depth. *Comment* (RLO): expected date, 1000 BC; Houx Pattern of North Coast Range cultural sequence after Fredrickson (1973).

UCLA-1913B. Cold Creek Canyon **620 ± 60**

Charcoal from base of site midden, Unit S12/E16, 60 to 70cm depth. *Comment* (RLO): expected date, 3000-5000 BC; Borax Lake Pattern of North Coast Range cultural sequence after Fredrickson (1973).

4-Mad-179 series

Samples coll 1971 during excavations of Late Horizon/Protohistoric site, 4-Mad-179, Madera Co (37° 8′ N, 119° 52′ W) by E Gary Stickel, and members of Dept Anthropol, California State Univ, Long Beach, and subm by J E Ericson. Samples should date very late occupation of site.

UCLA-1920A. 4-Mad-179 **430 ± 110**

Charcoal, House pit No. 15, 120 to 140cm depth.

UCLA-1920B. 4-Mad-179 **1000 ± 300**

Charcoal, House pit No. 15, 140 to 160cm depth.

UCLA-1950. Peterson 2 **390 ± 90**

Charcoal (Lowie Mus 1-80528) from Tr 1, Unit 3, 76cm depth. Coll 1948 during excavations of Peterson 2 site, 4-Sol-2, Solano Co (38° 15′ N, 121° 47′ W), by the late R F Heizer and members of Archaeol Field Method Class 195, Univ California, Berkeley; subm by J E Ericson.

North San Juan series

Samples coll Summer 1954 during excavations of North San Juan site, 4-Nev-15, Nevada Co (39° 22′ N, 121° 06′ W) by members of Anthropol Class S197, Univ California, Berkeley; subm by J E Ericson.

UCLA-1951A. North San Juan **1950 ± 60**

Charcoal (Lowie Mus 1-173143) from 16-SW-23, 30 to 60cm depth.

UCLA-1951B. North San Juan **280 ± 40**

Charcoal (Lowie Mus 1-172975) from 21-SE-27, 30 to 60cm depth.

Winslow Cave series

Samples coll April 1952 during excavations of Winslow Cave, 4-Cal-99, Calaveras Co (38° 09′ N, 120° 29′ W), by C W Meighan and M A Baumhoff, then students of Dept Anthropol, Univ California, Berkeley; subm by J E Ericson.

UCLA-1952A. Winslow Cave **1620 ± 400**

Bone collagen, extracted from faunal bones (Lowie Mus 1-139073), from Pit 3, surface to 15cm depth.

UCLA-1952B. Winslow Cave **1200 ± 100**

Bone collagen, extracted from faunal bones (Lowie Mus 1-139082), from Pit 3, 60 to 75cm depth.

UCLA-1953. Hotchkiss site **350 ± 50**

Charcoal (Lowie Mus 1-226900) from 1G-S5, 110 to 125cm depth, coll 1968-70 during excavations of Hotchkiss site, 4-CCo-138, Contra Costa Co (37° 57′ N, 121° 35′ W) by J A Bennyhoff and members of Anthropol Class 195, Univ California, Berkeley.

UCLA-1954. Snow Creek No. 5 site **280 ± 60**

Charcoal sample Pit 4, Feature 2, 20 to 40cm depth, assoc with hearth and milling slab, dating recent aboriginal occupation of site; coll during Sept 1974 excavation of Snow Creek No. 5 site, Mono Co (37° 38′ N, 188° 59′ W) by N Leonard, Univ California, Riverside. *Comment* (NL): expected Late Horizon date, after AD 1200.

UCLA-1955. Colville Rockshelter **1910 ± 60**

Charcoal (Lowie Mus 1-130644) from Unit C-8, 15 to 30cm depth, coll July 1951 during excavations of Colville Rockshelter, 4-Iny-222, Inyo Co (36° 45′ N, 177° 30′ W) by C W Meighan and M A Baumhoff.

UCLA-1957. Cottonwood **<300**

Bone collagen, 15cm depth, extracted from faunal bones (Lowie Mus 1-202690), from Unit 5-LI; coll 1950-51 during excavations of Cottonwood site, 4-Iny-2, Inyo Co by Mr and Mrs H Riddell, Jr.

UCLA-1958. 4-Eld-44 **2150 ± 190**

Bone collagen, extracted from faunal bones (Lowie Mus 1-197574) from Tr A, Sq 2, 30 to 60cm depth; coll March 1956 during excavations of 4-Eld-44, El Dorado Co (38° 42′ N, 120° 58′ W) by F A Riddell, Archaeol Survey, Univ California, Berkeley.

UCLA-1959. 4-Alp-7 **1090 ± 100**

Charcoal (Lowie Mus 1-145132) from B-6, 0 to 30cm depth; coll Aug 1953 during excavations of 4-Alp-7, Alpine Co (38° 41′ N, 119° 46′ W) by A B Elsasser and staff of Archaeol Survey, Univ California, Berkeley. Subm by J E Ericson.

UCLA-1960. Bamert Cave **440 ± 80**

Charcoal (Lowie Mus 1-121013) from test pit, coll April 1950 during test excavation of Bamert Cave, 4-Ama-3, Amador Co (38° 15′ N, 120° 58′ W) by the late R F Heizer and A E Treganza, Archaeol Survey, Univ California, Berkeley. Subm by J E Ericson.

El Sobrante series

Samples coll 1951-52 during excavations of El Sobrante site, 4-CCo-151, Contra Costa Co (37° 58′ N, 122° 18′ W) by the late R F Heizer, C W Meighan, and members of Anthropol Class 195, Univ California, Berkeley. Subm by J E Ericson.

UCLA-1961A. El Sobrante **1010 ± 130**

Charcoal (Lowie Mus 1-210507) from B-4, 150cm depth, coll Spring 1951.

UCLA-1961B. El Sobrante **1260 ± 110**

Charcoal (Lowie Mus 1-211162) from J-7, 190cm depth, coll Spring 1952.

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[RADIOCARBON, VOL 25, No. 1, 1983, P 137-142]

UNIVERSITY OF MIAMI RADIOCARBON DATES XXII

R A JOHNSON, G E TREADGOLD, and J J STIPP

Department of Geology, University of Miami
Coral Gables, Florida 33124

The following radiocarbon dates are a partial list of samples measured for a variety of projects and materials since August 1980. Chemical and counting procedures remain the same as indicated in R, v 20, p 274-282.

Calculations are based on the 5568-year Libby ^{14}C half-life. Precision is reported as one standard deviation based only on statistical counting uncertainties in the measurement of the background, NBS modern standard, and sample activities. ^{13}C values are measured relative to PDB and reported ages are corrected for isotopic fractionation by normalizing to $-25‰$.

I. GEOLOGIC SAMPLES

United States

Florida

Florida Everglades series

Marl and peat samples from three cores in the Everglades (25° 48′ 55″ N, 80° 31′ 1″ W). Coll 1980, subm 1981 by P Stone and G Treadgold, Univ of Miami. Core CT3 was 7.2km, CT2 was 6.4km, and CA3-8 was 90m W of water sta S334. Marl dates represent environmental change possibly attributable to sea-level fluctuations.

UM-2341. Core CT2, 25.4-28cm **2710 ± 90**

Basal marl sample.

UM-2342. Core CT2, 22-24cm **2400 ± 70**

Middle marl sample.

UM-2343. Core CT2, 18-20cm **2910 ± 100**

Top marl sample.

UM-2344. Core CT3, 27-28cm **3730 ± 620**

Basal marl.

UM-2345. Core CT3, 9-16cm **2090 ± 90**

Top marl.

UM-2363. Core CT2, 18-28cm **2550 ± 180**

Peat intermixed with marl layers.

UM-2365. Core CA3-8, 14-18cm **1880 ± 90**

Lower marl.

UM-2370. Core CA3-8, 25-30cm **1860 ± 90**

Upper marl layer.

Lacosta Island series

Beach ridge rock and shell samples from Lacosta I. (26° 42′ N, 82° 20′ W), SW coast of Florida. Dated to establish time of deposition for sea-level study. Coll 1981 and subm by T M Missimer and J R Ackley, Univ Miami.

UM-2327. LBR-1-2 **640 ± 70**

Shallow excavation in beach ridge ca 1m below surface. Possible replacement of carbonate.

UM-2327B. LBR-1-2B **1040 ± 90**

Same source as UM-2327 but material non-recrystallized.

UM-2328. ULBR-1-3 **4110 ± 90**

Shallow excavation on beach ridge ca 800cm below surface, directly above UM-2327.

UM-2329. USH-1-4 **2290 ± 70**

Shallow excavation on beach ridge ca 1.1m deep.

UM-2331. USH-2-5-6-D **2530 ± 90**

Sample from ca 1.1m deep.

UM-2368. ULBR-1-3 **4110 ± 80**

Shallow excavation on beach ridge ca 800cm below surface, directly above UM-2327.

Key Largo Depression series

Marine shell samples coll from Pleistocene depression "The Elbow" and Tavernier Key. Samples taken to determine effect of physical forces on sedimentation of mudstone layer. Samples were from thin wackestone and packstone over, and underlying, thick, relatively shell-free mudstone unit. Coll 1980 and subm 1981 by J Craig and S Ross, Univ Miami.

3620 ± 100
UM-2353. CORE 8001-31, 222-228cm $\delta^{13}C = +2.1‰$

Shelly wackestone overlying mudstone, SE of Rodriguez Key.

3360 ± 100
UM-2354. CORE 7-19-7, 205-212cm $\delta^{13}C = +2.0‰$

Wackestone overlying mudstone (25° 0.5′ N, 80° 22.4′ W).

3930 ± 100
UM-2355. CORE 7-19-13, 205-215cm $\delta^{13}C = +1.9‰$

Wackestone overlying mudstone (25° 3.5′ N, 80° 23.5′ W).

4620 ± 90
UM-2356. CORE 7-19-13, 395-400cm $\delta^{13}C = +0.6‰$

Shelly packstone underlying mudstone (25° 3.5′ N, 80° 23.5′ W).

8190 ± 420

UM-2357. CORE 7-19-7, 324-334cm $\delta^{13}C = +0.6‰$

Wackestone underlying mudstone (25° 0.5′ N, 80° 22.4′ W).

Georgia

Chesser Prairie series

Samples coll from piston cores from Chesser Prairie in Okefenokee Swamp (30° 54′ N, 82° 20′ W). Samples dated to test proposed method of prairie formation by series of peat burns. Samples coll 1978 by P Stone and subm 1981 by P Stone, Univ South Carolina, Columbia and R A Johnson.

600 ± 60

UM-2266. CP4, 67-72cm $\delta^{13}C = -26.3‰$

Water-lily peat deposited immediately above burn layer. Dates first returning, peat-forming vegetation to area.

1520 ± 60

UM-2267. CP4, 76-81cm $\delta^{13}C = -27.7‰$

Cypress peat directly below burn event.

3250 ± 60

UM-2268. CP4, 159-165cm $\delta^{13}C = -27.4‰$

Basal cypress peat overlying sandy layer.

1880 ± 70

UM-2301. CP3, 90-94cm $\delta^{13}C = -26.3‰$

Water-lily peat coll directly above bottom burn layer in core CP3.

2350 ± 60

UM-2302. CP3, 90-102cm $\delta^{13}C = -27.0‰$

Cypress peat directly below bottom burn event.

3750 ± 70

UM-2303. CP3, 145-150cm $\delta^{13}C = -27.0‰$

Basal cypress peat overlying organic rich sand.

1620 ± 60

UM-2304. CP3, 79-83cm $\delta^{13}C = -26.6‰$

Water-lily peat immediately above upper burn event.

1840 ± 40

UM-2305. CP3, 84-90cm $\delta^{13}C = -28.3‰$

Water-lily peat coll directly below upper burn layer.

3500 ± 100

UM-2306. CP2, 127-135cm $\delta^{13}C = -27.5‰$

Basal peat sample, probably water-lily overlying gradational sand rich in organic matter.

3620 ± 70

UM-2308. CP2, 140-152cm $\delta^{13}C = -27.4‰$

Clayey sand rich in organic matter.

UM-2309. CP2, 152-160cm **3990 ± 80**
$\delta^{13}C = -26.6‰$

Light brown transitional sand of low organic content; below is grayish sand devoid of organics. Sample dates earliest accumulation of organics in Chesser Prairie area.

General Comment (RAJ): initial results indicate several fires at different times in different areas of this pre-prairie area were instrumental in removal of cypress vegetation with subsequent replacement by various water-lily peats.

North Carolina

Core Sound series

Peat samples from just S of Davis (34° 46′ N, 76° 23′ W). Samples related to deposition of organic matter at Cape Lookout Bight. Samples coll along erosional shoreline consisting of dark mud and plant matter. Coll and subm 1981 by C S Martens, Univ North Carolina, Chapel Hill.

UM-2290. 2-UNC-P **700 ± 70**

Peat from 0 to 20cm depth.

UM-2291. 4-UNC-P **740 ± 70**

Peat from 45 to 65cm depth.

UM-2292. 1-UNC-P **520 ± 70**

Same peat as UM-2290, except all particles >2mm were removed.

UM-2364. 4-UNC-PPT **820 ± 80**

Same peat as UM-2291, except all particles >2mm were removed and sample was treated with 6N HCl hydrolysis.

UM-2299. 6-UNC-SG **129% modern**

Terrestrial grass growing on top of peat layer.

UM-2293. 12-UNC-SG **115% modern**

Wet marine grass coll along shoreline of Big Deep Marsh I.

UM-2367. 15-UNC-SG **115% modern**

Living marine grass *Zostera marina* (eel grass) coll from within Core Sound.

II. ARCHAEOLOGIC SAMPLES

United States

Florida

Little Salt Spring series II

Peat sample coll from core GDF-141 at edge of Little Salt Spring (Zone 17 (UTM) Lat: 377710–720m E/Long: 2995180–190M N). Samples dated to correlate palynologic and hydrologic data with the two periods of human occupation at spring ca 12,000-9000 BP and 6800-5200 BP. Samples coll by J Brown and C Clausen and subm 1978 by J Brown, Univ South Carolina, Columbia, and R A Johnson.

UM-2159. GDF-141, 7.4-15cm **103% modern**

Dark brown fibrous peat from hammock area.

UM-2160. GDF-141, 37-44cm **1430 ± 70**

Sample coll from base of dark brown fibrous peat sec.

UM-2161. GDF-141, 88-96cm **5330 ± 80**

Brown fibrous peat from prehammock layers.

UM-2162. GDF-141, 110-118cm **6430 ± 90**

Brown fibrous peat.

UM-2163. GDF-141, 128-132cm **7650 ± 160**

Brown fibrous peat with fine-grained material.

UM-2164. GDF-141, 81-88cm **2790 ± 60**

Brown fibrous peat.

UM-2172. GDF-141, 59-66cm **1380 ± 70**

Red-brown coarse fibrous peat.

Rivermount series

Charcoal samples coll from excavated test pit in black dirt and shell midden along New River (26° 7′ 20″ N, 80° 9′ 00″ W). Rivermount midden is deep (basal depth: − 1.5m) for midden deposit in Glades Archaeological subarea. No stratigraphic sequence was apparent; excavation proceeded in 10cm arbitrary levels. Dates were expected to range in Glades II period (AD 500-AD 1300). Incised motifs on ceramics provide basis for expected dates. Incised pottery was recovered at Level 8 (UM-2399) as well as at surface of site, providing strong evidence for Glades II occupation. ^{14}C dates substantiate pottery age-based estimates. Samples coll by D Allerton and J Southard and subm 1981 by R Carr and R A Johnson, Univ Miami Geoarchaeol Research Center.

UM-2400. Basal level, 105cm **1550 ± 40**

UM-2402. Level 9, 95-105cm **1590 ± 40**

UM-2399. Level 8, 85-95cm **1570 ± 40**

UM-2398. Level 7, 75-85cm **1530 ± 40**

UM-2401. Level 5, 65-75cm **1280 ± 40**

UM-2403. Level 5, 55-65cm **1400 ± 400**

UM-2404. Level 4, 45-55cm **1570 ± 40**

UM-2405. Level 3, 35-45cm **1480 ± 40**

Bay West Nursery series

Samples coll from Archaic mortuary in central pond depression of cypress dome feature at fringe of Big Cypress Swamp (26° 07′ N, 81° 46′ W). Samples dated to determine chronology of human cemetery which ranks as one of earliest in S Florida. Samples coll by J Beriault, R Carr, and J Meeder and subm 1980 by J Beriault, R Carr, and R Johnson, Univ Miami Geoarchaeol Research Center.

UM-2085. FS577, Bag 18 of 25 **6520 ± 130**

Wooden fire-burned post assoc with burial.

UM-2087. FS578, Bag 14 of 14 **6670 ± 80**

Wooden fire-burned post from burial area.

UM-2088. FS578, Bag 11 of 14 **6630 ± 80**

Wooden fire-burned post from burial area.

UM-2169. FS515 **6780 ± 130**

Peat coll from interior of skull.

UM-2170. Sample #2 **5500 ± 80**

Peat encasing human bone.

UM-2226. Core #2 **5860 ± 120**

Basal peat at 121 to 131cm depth.

UM-2227. Core #1 **7550 ± 120**

Basal peat at 253 to 263cm.

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[RADIOCARBON, VOL 25, NO. 1, 1983, P 143-151]

US GEOLOGICAL SURVEY, MENLO PARK, CALIFORNIA RADIOCARBON MEASUREMENTS III

STEPHEN W ROBINSON and DEBORAH A TRIMBLE

US Geological Survey, Menlo Park, California 94025

The analyses in this list were performed between 1977 and 1979. The laboratory utilizes gas counting of carbon dioxide in counters installed 9.5 meters below the ground surface for background reduction. The reported results closely follow the guidelines of Stuiver and Polach (1977), although the standard error for analyses earlier than USGS-500 are based solely upon counting statistics and do not include uncertainty in voltage, pressure, temperature, and $\delta^{13}C$.

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GEOLOGIC SAMPLES

Alaska

820 ± 90

USGS-48. Yukon Delta *Est $\delta^{13}C = -25‰$*

Basal peat ca 1.5m below surface; E bank of Kawanak Pass (62° 55′ N, 164° 06′ W). Dates older part of modern lake of Yukon delta. Coll 1976 and subm by W R Dupré, Univ Houston, Texas.

1350 ± 80

USGS-49. Black River *Est $\delta^{13}C = -25‰$*

Basal peat from outcrop along Black R (62° 09′ N, 164° 59′ W), ca 5km NW of village of New Knockhock. Dates time when Black R was main course of Yukon R. Coll 1976 and subm by W R Dupré.

>34,400

USGS-50. Melatolik Creek *Est $\delta^{13}C = -25‰$*

Basal peat from abandoned mid-channel bar along Melatolik Creek (62° 02′ N, 165° 14′ W). Dates time when Melatolik Creek was main course of Yukon R. Coll 1976 and subm by W R Dupré.

1200 ± 60

USGS-51. Kashunuk River *Est $\delta^{13}C = -25‰$*

Log in basal peat exposed along S bank of Kashunuk R (61° 32′ N, 164° 46′ W), ca 1km W of Nuigalak Lake. Dates time when Kashunuk R was main course of Yukon R. Coll 1976 and subm by W R Dupré.

Modern

USGS-52. Panawat Spit *Est $\delta^{13}C = -25‰$*

Wood fragment from near base of sea cliff where Pleistocene marine terrace deposits are exposed, ca 4km N of Dall Pt (61° 36′ N, 166° 10′ W). Date indicates contamination by modern roots. Coll 1976 and subm W R Dupré.

5070 ± 60

USGS-215. Panawat Spit *Est* $\delta^{13}C = -25‰$

Peat ca 2m from top of sea cliff, ca 4km N of Dall Pt (61° 36′ N, 166° 10′ W). Probably dates filling of thaw lake on uplifted marine terrace deposits exposed in lower part of sea cliff. Coll 1977 and subm by W R Dupré.

1930 ± 70

USGS-217. Manokinak River *Est* $\delta^{13}C = -25‰$

Basal peat ca 1.2m below top of cut bank along N side of Manokinak R (63° 23′ 32″ N, 164° 31′ 41″ W). Dates time when Manokinak was major course of Yukon R. Coll 1977 and subm by W R Dupré.

1800 ± 90

USGS-218. Kwikiuak *Est* $\delta^{13}C = -25‰$

Peat ca 1.5m from top of cut bank along S side of Kwikiuak Pass (62° 37′ 06″ N, 164° 41′ 10″ W). Dates min age of intermediate age beach ridge/chenier plain S of modern Yukon delta (compare with USGS-53, below: 1890 ± 85). Coll 1977 and subm by W R Dupré.

1550 ± 80

USGS-225. Black River *Est* $\delta^{13}C = -25‰$

Basal peat ca 1.7m below top of cut bank on N side of Black R (62° 18′ 32″ N, 164° 59′ 22″ W). Dates relatively young truncation of beach ridges within chenier plain S of modern Yukon delta (approx correlative with USGS-212, below: 1430 ± 50). Coll 1977 and subm by W R Dupré.

2570 ± 70

USGS-226. Eleutak *Est* $\delta^{13}C = -25‰$

Basal peat ca 0.8m below top of cut bank on SW side of Kwemeluk Pass (62° 29′ 08″ N, 164° 51′ 45″ W), ca 6km S of Sheldon Pt. Dates one of oldest beach ridges in chenier plain S of modern Yukon delta (compares with USGS-214, below: 2420 ± 80). Coll 1977 and subm by W R Dupré.

1890 ± 90

USGS-53. Black River *Est* $\delta^{13}C = -25‰$

Basal peat along SW side of Black R, ca 2.5km NW of Uksuk (62° 19′ N, 165° 12′ W). Dates middle of chenier plain/beach ridge complex that postdates most of time Black R was main course of Yukon R. Coll 1976 and subm by W R Dupré.

1430 ± 50

USGS-212. Sheldon Point *Est* $\delta^{13}C = -25‰$

Log in basal peat ca 2m below surface, exposed on S bank of Kwemeluk Pass (62° 32′ 08″ N, 164° 52′ 37″ W) at village of Sheldon Point. Dates age of one of youngest well-developed beach ridges in chenier plain S of modern Yukon delta. Coll 1977 and subm by W R Dupré.

600 ± 70

USGS-213. Emmonak *Est* $\delta^{13}C = -25‰$

Wood ca 1.5m from top of cut bank, N side of Kwiguk Pass (62° 45′ 30″ N, 164° 30′ W) at village of Emmonak. Dates intermediate age part of modern Yukon delta, indicating it is relatively young geol feature (cf USGS-48). Coll 1977 and subm by W R Dupré.

2420 ± 80

USGS-214. Kwikiuak Pass *Est* $\delta^{13}C = -25‰$

Wood from SE side of Kwikiuak Pass (62° 37′ 20″ N, 164° 40′ 22″ W), ca 13km NE of Sheldon Pt. Dates one of oldest beach ridges in chenier plain S of modern Yukon delta. Also marks period of max transgression of Holocene shoreline in area. Coll 1977 and subm by W R Dupré.

13,770 ± 210

USGS-352. Norton Sound *Est* $\delta^{13}C = -25‰$

Lenses of peat, from 1.4m below top of vibracore taken 20m below msl, 40km S of Nome (64° 10′ 6″ W, 165° 27′ 45″ N). Dates top of Pleistocene freshwater sediment, below Holocene marine transgressive sediment. Coll 1977 and subm by C H Nelson, USGS.

3070 ± 40

USGS-353. Norton Sound *Est* $\delta^{13}C = -25‰$

Peat laminations, 3 to 9cm below top of boxcore taken 10m below msl, 30km W of Yukon R delta (62° 58′ 12″ W, 165° 16′ 15″ N). Dates storm surges in N Bering Sea near Yukon delta. Date may be anomalously old due to epiclastic nature of peat recycled to offshore locations from original onshore delta sources. Coll 1977 and subm by C H Nelson.

3590 ± 140

USGS-354. Norton Sound *Est* $\delta^{13}C = -25‰$

Peat layers, interbedded with silt, from 13 to 16cm below top of boxcore taken 10m below msl, 40km NW of Yukon R delta (63° 31′ 30″ W, 165° 43′ 37″ N). Dates storm surges in N Bering Sea near Yukon delta. Date may be anomalously old due to epiclastic nature of peat recycled to offshore locations from original onshore delta sources. Coll 1977 and subm by C H Nelson.

16,540 ± 200

USGS-356. Northern Bering Sea *Est* $\delta^{13}C = -25‰$

Peat layer with wood fragments, from 120cm below top of vibracore taken 28m below msl 30km W of Port Clarence spit (65° 7′ 14″ W, 167° 30′ 49″ N). Dates top of Pleistocene freshwater sediment, below Holocene marine sediment in region subject to uplift. Coll 1977 and subm by C H Nelson.

15,450 ± 250

USGS-357. Northern Bering Sea *Est* $\delta^{13}C = -25‰$

Peaty silt, 40cm below top of vibracore taken 31m below msl, 35km W of Port Clarence spit (65° 7′ 51″ W, 167° 35′ 45″ N). Dates top of Pleistocene freshwater sediment, below Holocene marine sediment in region subject to uplift. Coll 1977 and subm by C H Nelson.

11,570 ± 130
USGS-358. Norton Sound *Est* $\delta^{13}C = -25‰$

Peat layers, 85 to 90cm below top of vibracore taken 17m below msl, 35km NW of Stuart I. (63° 53′ 6″ W, 163° 1′ 26″ N). Dates top of Pleistocene freshwater sediment, below Holocene marine transgressive sediment. Coll 1977 and subm by C H Nelson.

Kealok Creek series

From bluff 27m high on Kealok Creek in eolian sand (70° 22′ 18″ N, 153° 12′ 12″ W). Dates episodes of dune activity and stabilization. USGS-377 and -378 date rapid eolian accretion; USGS-448 and -379 bracket episode of stabilization; USGS-380 dates brief interval of stabilization following renewed activity. Coll 1977 and subm by L D Carter, USGS.

940 ± 110
USGS-380. *Est* $\delta^{13}C = -25‰$

Peaty sand from bed, 15cm thick, 2m below top of bluff.

5250 ± 80
USGS-379. *Est* $\delta^{13}C = -25‰$

Peat from top of peat bed, 50cm thick, that occurs 4m below top of bluff.

8180 ± 80
USGS-448. *Est* $\delta^{13}C = -25‰$

Peat from base of peat bed, 50cm thick, that occurs 4m below top of bluff.

10,700 ± 120
USGS-378. *Est* $\delta^{13}C = -25‰$

Salix sp (willow) wood in growth position 6m below top of bluff.

10,980 ± 80
USGS-377. *Est* $\delta^{13}C = -25‰$

Salix sp (willow) wood from 10m below top of bluff.

Chipp River series

From bluff 15m high on Chipp R (70° 22′ 30″ N, 155° 03′ W). Dates alluvium of former flood plain of Chipp R. Coll 1977 and subm by L D Carter.

10,670 ± 80
USGS-449. *Est* $\delta^{13}C = -25‰$

Wood in growth position 9m above base of bluff.

10,030 ± 40
USGS-456. *Est* $\delta^{13}C = -25‰$

Detrital wood (*Salix* sp) 12.5m above base of bluff.

Ikpikpuk River series

From alluvium exposed in bluff 16m high on Ikpikpuk R (69° 42′ 36″ N, 154° 52′ 36″ W). Dates periods of alluviation and alluvial terrace formation. Coll 1977 and subm by L D Carter.

13,570 ± 120
USGS-457. *Est* $\delta^{13}C = -25‰$

Detrital wood 4.5m below top of bluff.

>49,000
USGS-632. *Est* $\delta^{13}C = -25‰$

Detrital wood 1m above base of bluff.

36,400 ± 560
USGS-807. $\delta^{13}C = -21.8‰$

Limb element of *Mammuthus* sp 2m above base of bluff; one of many bones from single individual of this sp that were present over lower 3m of surface of bluff.

6040 ± 80
USGS-316. Hidden Lake, Kenai Peninsula *Est* $\delta^{13}C = -25‰$

Carbonaceous sediments from core HL-4-M between 122 to 130cm below bottom of Hidden Lake (60° 29′ 37″ N, 150° 22′ 38″ W). Calibrates varve counts in older part of core and dates volcanic ash beds derived from volcanoes on Alaskan Peninsula. Sample helps date time of deglaciation of area. Coll 1977 by J D Sims and M J Rymer; subm by J D Sims, USGS.

10,380 ± 240
USGS-317. Hidden Lake, Kenai Peninsula *Est* $\delta^{13}C = -25‰$

Carbonaceous sediments from core HL-4-M between 205 and 215cm below bottom of Hidden Lake (60° 29′ 37″ N, 150° 22′ 38″ W). Calibrates varve counts in older part of core and dates volcanic ash beds derived from volcanoes on Alaska Peninsula. Sample helps date time of deglaciation of area previously thought to be much earlier (Karlstrom, 1964). Coll 1977 by J D Sims and M J Rymer; subm by J D Sims.

4560 ± 170
USGS-338. Tangle Lake *Est* $\delta^{13}C = -25‰$

Peaty sediments from core TNG-1 between 518 to 523cm below bottom of Tangle Lake (63° 1′ 42″ N, 146° 3′ 24″ W). Dates Holocene sedimentation and pollen accumulation in this area to S of Alaska Range that has adjacent archaeol sites. Coll 1977 by J D Sims and M J Rymer; subm by J D Sims.

2880 ± 70
USGS-339. Tangle Lake *Est* $\delta^{13}C = -25‰$

Peaty sediments from core TNG-1 between 233 or 237cm below bottom of Tangle Lake (63° 1′ 42″ N, 146° 3′ 42″ W). Dates Holocene sedimentation and pollen accumulation in this area to S of Alaska Range that has adjacent archaeol sites. Coll 1977 by J D Sims and M J Rymer; subm by J D Sims.

2730 ± 40
USGS-431. Hidden Lake, Kenai Peninsula *Est* $\delta^{13}C = -25‰$

Carbonaceous sediments from core HL-1-D between 74 and 79cm below bottom of Hidden Lake (60° 29′ 37″ N, 150° 22′ 38″ W). Calibrates varve counts in older part of core and dates volcanic ash beds derived from volcanoes on Alaska Peninsula. Coll by J D Sims and M J Rymer; subm by J D Sims.

California

1440 ± 130

USGS-68. Little Lake *Est* $\delta^{13}C = -25‰$

Charcoal picked from hearth exposed on S side of gravel pit near Little Lake Hotel, Little Lake (36° 56′ 12″ N, 117° 54′ 24″ W). Sample found 0.75m below surface of alluvial gravels and indicates time when this horizon was at surface and occupied by man. Coll 1976 and subm by G I Smith, USGS.

2060 ± 60

USGS-70. Mono Lake $\delta^{13}C = +6.6‰$

Tufa on wood coll on S shore Mono Lake ca 1.5km N of Lee Vining (37° 58′ 42″ N, 119° 67′ W). Sample was 3m above present lake level and gives indication of pre-nuclear era concentrations of ^{14}C in lake water. Coll 1976 and subm by G I Smith.

1090 ± 40

USGS-222. Mecca $\delta^{13}C = +2.1‰$

Freshwater gastropods from drainage ditch bank in Lake Cahuilla (33° 32′ 30″ N, 116° 5′ W) sediments. Dates probable earthquake-induced deformational structures. Coll 1977 and subm by J D Sims.

1300 ± 50

USGS-223. Mecca $\delta^{13}C = +2.2‰$

Freshwater gastropods from bank of drainage ditch in Lake Cahuilla sediments (33° 32′ 7″ N, 116° 3′ 38″ W). Dates lacustrine sediments that contain penecontemporaneously-formed probable earthquake-induced deformational structures. Coll 1977 and subm by J D Sims.

2900 ± 130

USGS-315. Blue Lakes, Lake County *Est* $\delta^{13}C = -25‰$

Carbonaceous sediments from core BL-2-M between 555 and 557.5cm below lake bottom of upper Blue Lakes (39° 10′ 15″ N, 123° 00′ 37″ W); date level in core and provide estimate of sedimentation rate in this tectonically-controlled lake near Clear Lake, Lake Co. Coll 1977 by J D Sims.

4590 ± 120

USGS-607. Willow Springs Fault *Est* $\delta^{13}C = -25‰$

Charcoal from colluvial deposits displaced ca 70cm on steep reverse fault near Willow Springs (34° 52′ 43″ N, 118° 17′ 50″ W). Coll 1978 by D B Burke; subm by C W Hedel, USGS.

Koehn Lake series

Lithoid tufa in near-surface gravel of pluvial lake shoreline bar in Fremont Valley (35° 22′ 40″ N, 117° 48′ 55″ W), offset left-laterally ca 80m along Garlock fault. Date is apparently that of most recent high-lake stand, but soil development in bar gravels indicates that bar construction was more than 100,000 yr ago. Coll 1978 by M M Clark; subm by D B Burke, USGS.

12,700 ± 100
USGS-634. *Est $\delta^{13}C = 0‰$*

Outermost rind, ca 2 to 4mm thick.

13,460 ± 80
USGS-635. *$\delta^{13}C = 3.0‰$*

Inner rind, ca 3 to 5mm thick.

14,700 ± 130
USGS-388. Koehn Lake *$\delta^{13}C = 4.6‰$*

Surface-water ostracodes from interstratified mud and fine sand in unoxidized deep-water deposits of most recent deep pluvial lake stand in Fremont Valley (35° 22′ 00″ N, 117° 51′ 30″ W). Ostracode-bearing deposits have been deformed at least 9 and possibly as many as 17 times where they are offset by Garlock fault. Coll 1977 by M M Clark and D B Burke; subm by C W Hedel.

10,260 ± 70
USGS-337. Livermore Landslide, Napa Co *Est $\delta^{13}C = -25‰$*

Peat, from 5.3m below surface of sag pond on landslide (38° 40′ 17″ N, 122° 34′ 14″ W). Date is min for last occurrence of slide movement. Coll 1977 and subm by R Witham, USGS.

18,500 ± 230
USGS-381. Clear Lake, Lake Co *Est $\delta^{13}C = -25‰$*

Carbonaceous sediments from Clear Lake Core 8 between 2037 and 2047cm (lowermost 10cm) below base of Clear Lake (39° 5′ 48″ N, 122° 51′ 42″ W). Dates level in core that has paleomagnetic stratigraphy and tephrachronology (Sims, 1976) and is correlated with seven other cores from lake. Coll 1977 and subm by J D Sims.

13,070 ± 180
USGS-382. Clear Lake, Lake Co *Est $\delta^{13}C = -25‰$*

Carbonaceous sediments from Clear Lake Core 3 between 890 and 900cm below base of Clear Lake (39° 2′ 54″ N, 122° 50′ 24″ W). Dates sedimentation rates and volcanic ash beds and helps correlate seven other cores from lake. Coll 1977 and subm by J D Sims.

pM = 2.9 ± 0.16%
USGS-385. Castle Crag Soda Spring *$\delta^{13}C = -10.2‰$*

Strontium carbonate precipitate formed by adding ammonical strontium chloride to CO_2-charged spring water. Precipitation of strontium carbonate carried out at field site (41° 8′ 7″ N, 122° 17′ 49″ W). Coll by R Mariner 1977; subm by Ivan Barnes, USGS.

Oregon

4300 ± 100
USGS-343. Newberry caldera *Est $\delta^{13}C = -25‰$*

Silicified wood in pumiceous silicified lakeshore sediment ca 50m S of interlake basaltic andesite flow along E shore of Paulina Lake at Little

Crater campground (43° 00′ N, 121° 14′ 24″ W). Sediment is younger than palagonite tuff of Little Crater and interlake basaltic andesite flow and older than Mazama ash. Age is too young, based on presence of primary deposits of Mazama ash (6700-7000 BP) overlying sediment. Coll 1977 and subm by N S MacLeod, USGS.

1550 ± 120

USGS-344. Newberry volcano *Est $\delta^{13}C = -25‰$*

Charcoal directly underlying youngest pumice fall on E flank of volcano (43° 42′ 6″ N, 121° 8′ 23″ W). Coll from hole dug adjacent to Cinder Hill Rd, 400m N of small spatter cone on NE side of Red Hill. Carbon is overlain by 2m of pumice fall and underlain by 0.8m of Mazama ash. Date agrees with other date on pumice fall from near The Dome (W-2168, 1720 ± 200 BP, Spiker, Kelley, and Rubin, 1978). Coll 1977 and subm by N S MacLeod.

1340 ± 60

USGS-755. Newberry caldera *Est $\delta^{13}C = -27‰$*

Charcoal from burned trees incorporated in Paulina Lake ash flow (43° 42′ 36″ N, 121° 15′ W). Coll at same site, marked by concrete enclosure, from which previous samples were coll, C-657, 2054 ± 230 BP (Libby, 1952); W-2777, 1390 ± 200 BP (Kelley, Spiker, and Rubin, 1978); Tx-245, 1270 ± 60 BP (Pearson, Davis, and Tamers, 1966). Ash flow is virtually identical in major-# and trace-element composition to youngest pumice fall on E flank of volcano (see USGS-344) and to Big Obsidian flow, and was redated to determine if pumice fall and ash flow are essentially same age or if ash flow is significantly younger; small age difference is suggested. Coll 1977 and subm by N S MacLeod.

Washington

pM = 4.13 ± 0.14%

USGS-387. Garland Mineral Spring *Est $\delta^{13}C = 0‰$*

Strontium carbonate precipitate formed by adding ammonical strontium chloride to CO_2-charged spring water. Precipitation of strontium carbonate carried out at field site (47° 53′ 21″ N, 121° 20′ 31″ W). Coll 1977 by R Mariner; subm by Ivan Barnes.

pM = 1.78 ± 0.12%

USGS-386. Longmire Mineral Spring *Est $\delta^{13}C = 0‰$*

Strontium carbonate precipitate formed by adding ammonical strontium chloride to CO_2-charged spring water. Precipitation of strontium carbonate carried out at field site in Mt Rainier Natl Park (46° 45′ 6″ N, 121° 48′ 48″ W). Coll 1977 by R Mariner; subm by Ivan Barnes.

Nevada

Steamboat Springs series

Bicarbonate and carbonate from thermal spring waters at Steamboat Springs (39° 23′ 18″ N, 119° 44′ 25″ W). Values determined are used to study reservoir processes and flow patterns within geothermal system.

USGS-350. Near Spring 27 **pM = 1.64 ± 0.16%**
$\delta^{13}C = -5.9‰$

USGS-365. Spring 26 **pM = 0.46 ± 0.16%**
Est $\delta^{13}C = 0‰$

USGS-366. Spring 5 **pM = 1.21 ± 0.12%**
Est $\delta^{13}C = 0‰$

USGS-367. Spring 8 **pM = 0.97 ± 0.13%**
Est $\delta^{13}C = 0‰$

Idaho

USGS-318. Wapi Park **2270 ± 50**
Est $\delta^{13}C = -25‰$

Charcoal from charred roots of sagebrush found ca 2m under edge of Wapi Lava Field at Wapi Park (42° 55′ N, 113° 15′ W). Date agrees well with mean of previous dates on Kings Bowl Lava Field: Tx-1164, 2090 ± 470; Tx-1165, 2360 ± 150; X-1001, 2130 ± 130 (Valastro, Davis, and Varela, 1978); Tx-1736, 2170 ± 90 (Valastro, Davis, and Varela, 1972) on charred material of similar origin. Combined with information that Wapi and Kings Bowl Lava Fields have identical directions of magnetization, dating suggests two eruptions occurred simultaneously. Coll 1977 by Ron Popson, Univ Arizona and subm by D Champion, USGS.

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[RADIOCARBON, VOL 25, NO. 1, 1983, P 152-168]

UNIVERSITY OF WISCONSIN RADIOCARBON DATES XX

RAYMOND L STEVENTON and JOHN E KUTZBACH

Center for Climatic Research, Institute for Environmental Studies,
University of Wisconsin-Madison, 1225 West Dayton Street,
Madison, Wisconsin 53706

Procedures and equipment have been described in previous date lists. Except as otherwise indicated, wood, charcoal, and peat samples are pretreated with dilute $NaOH-Na_4P_2O_7$ 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. Pretreatment of bone varies with the condition of the bone sample; solid bone with little deterioration is first cleaned manually and ultrasonically. The bone is treated with 8% HCl for 15 minutes, then dilute $NaOH-Na_4P_2O_7$ for 3 hours at room temperature, washed until neutral, and the collagen extracted according to Longin (1971). Charred bone is treated with dilute HCl, $NaOH-Na_4P_2O_7$, and then dilute HCl again.

The dates reported have been calculated using 5568 as the half-life of ^{14}C. The standard deviation quoted includes only 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 δ^{13} values are listed have been corrected to correspond to a $\delta^{13}C$ value of −25‰; the activity of the standard methane has been corrected to −19‰.

Sample descriptions are based on information supplied by those who submitted samples.

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I. ARCHAEOLOGIC SAMPLES

United States

Missouri

Feeler site (23Ms12) series

Samples from Feeler site in Maries Co (38° 07′ 30″ N, 91° 52′ 30″ W) coll 1978 and 1981 and subm by R L Reeder, Univ Missouri, Columbia. Samples date Late Woodland village at which wide range of cultigens were found.

WIS-1400. **920 ± 70**

Oak wood charcoal from Feature 76, small hearth 45cm diam and 15cm deep. Hearth matrix consisted of mixed rock, silt, charcoal flecks, and chunks. Top of hearth was ca 5cm below base of plow zone. Sample was 8 to 9cm below base of plow zone.

WIS-1402. **860 ± 70**

Oak wood charcoal from Feature 37, Level 4, large cylindrical trash pit, 80cm diam, depth 56cm from base of plow zone. Level 4 was a black moist soil of silt and large amounts of charcoal, rich in cultural material.

South Dakota

Smiley-Evans site (39Bu2) series

Samples from Smiley-Evans site, large fortified campsite in Butte Co (44° 40′ N, 103° 50′ W) coll in 1979 and 1980 and subm by L M Alex, South Dakota Archaeol Research Center, Ft Meade. Excavation revealed fortification stockade and ditch with peripheral structure and over 20 features of hearth/roasting/cooking pit variety. Artifacts and features suggest some resemblance to those of Initial Variant of Middle Missouri tradition (Alex, 1979).

WIS-1346. **1070 ± 70**

Wood charcoal from Feature 14a-1, Level 5 of large, fired, bell-shaped roasting pit containing much faunal material, fire-cracked rock, burned earth, and charcoal in Sq E45N5.

WIS-1347. **900 ± 70**

Wood charcoal from Feature 18, Level 3 of large, fired, slightly bell-shaped roasting pit containing faunal material, fire-cracked rock, burned earth, and charcoal in Sq E14S22.

WIS-1348. **1190 ± 70**

Wood charcoal from Feature 12, Level 2 of large, straight-sided pit containing faunal material, fire-cracked rock and some charcoal in Sq E26N7.

WIS-1349. **980 ± 70**

Wood charcoal from Feature 14a-2, Level 5 of large, fired, bell-shaped roasting pit containing much faunal material, fire-cracked rock, burned earth, and charcoal in Sq E45N5.

WIS-1350. **960 ± 70**

Charred wood and charcoal from Level 4 at base of man-made ditch in Sq W4S0. Level 4 consisted of concentrated midden in dark organic matrix overlain by sandy fill and underlain by white sand containing caliche.

WIS-1351. **810 ± 70**

Twelve cm segment cut from wooden post (Post G) in postulated stockade at W edge of site, from Sq W0S4. Post contained 15 rings, no bark remaining.

WIS-1352. **930 ± 70**

Ten cm sample cut from center of wooden post (Post S) found in structure peripheral to postulated stockade at W edge of site, from Sq

E0S6. Rock wedge occurred adjacent to post remnant. Post contained 18 rings, no bark remaining.

Winter site (39De5) series

Samples from Winter site at Coteau Lake, Deuel Co (44° 50′ N, 96° 43′ W) coll 1980 and 1981 by Betty Sterner and J K Haug; subm by J K Haug, South Dakota Archaeol Research Center. Artifacts and features recovered suggest numerous occupations, from Paleo-Indian through late prehistoric. Excavations concentrated largely on Middle and Late Woodland cultures.

WIS-1358. **400 ± 70**

Wood charcoal from Feature 1, large conoidal cache pit at 1N 6E, containing fire-cracked rock, faunal material, and ceramics.

WIS-1359. **1180 ± 70**

Wood charcoal from Feature 2, shallow rock-filled hearth 50 to 60cm below ground surface, 3m S, 5m E of datum site. Feature contained faunal material, fire-cracked rock, ceramics, and lithic artifacts.

WIS-1371. **1110 ± 70**

Wood charcoal from Feature 4a, part of Feature 4, Level 2, large cache pit 11m N, 18m W of site datum. Sample taken from 62 to 92cm below surface.

WIS-1372. **1250 ± 70**

Wood charcoal from Feature 4, Level 2, large cache pit. Sample from 52 to 62cm below surface. Feature contained faunal remains, ceramics, fire-cracked rock, and lithic materials.

WIS-1373. **1950 ± 70**

Wood charcoal from Feature 3, Level 2, shallow rock-filled basin 10.5m N, 15m W of site datum. Feature contained faunal remains, ceramics, fire-cracked rock, and lithic materials.

WIS-1369. Miner Rattlesnake site (39Cu417) **2370 ± 70**

Wood charcoal from hearth in stone circle #2, Custer Co (43° 49′ 30″ N, 103° 12′ 55″ W) coll 1981 and subm by D M Hovde, South Dakota Archaeol Research Center. Sample recovered from basin-shaped hearth, 7cm deep, in center of stone circle. Highly friable large mammal long-bone was found near hearth and is assoc with occupation of stone circle (Hovde, 1981).

Hartford Beach Village site (39Ro5) series

Samples from Hartford Beach Village site, Robert Co (45° 24′ N, 96° 41′ W) coll 1981 and subm by J K Haug. Site is small fortified village on high bluff above Big Stone Lake. Evidence of bastioned fortification and palisade was uncovered. Earth lodge depressions were not present, but cache pit, hearths, and isolated post holes were found. Ceramics and other elements suggest similarities to Initial Variant of Middle Missouri tradition. Samples are from large bell-shaped cache pit 23 to 120cm below surface, 10m N, 5m W of site datum.

WIS-1368. **830 ± 70**

Wood charcoal from Feature 3, Level 2, 33 to 120cm below surface.

WIS-1370. **650 ± 70**

Wood charcoal from Feature 3, Level 1, 23 to 33cm below surface.

Dirt Lodge Village site (39Sp11) series

Samples from Dirt Lodge Village site on James R in Spink Co (44° 55′ N, 98° 29′ W) coll in 1980 and 1981 and subm by T W Haberman, South Dakota Archaeol Research Center. Three major components are present including occupations by Woodland, Plains Village, and Historic Dakota populations. Dates are expected to correspond with those from Initial Middle Missouri tradition sites further S on James R (R, 1973, v 15, p 235, 618).

WIS-1374. **770 ± 70**

Wood charcoal from Feature 16, Levels 4 and 5, refuse-filled cache pit.

WIS-1375. **920 ± 70**

Wood charcoal from Feature 6, refuse-filled cache pit.

WIS-1376. **700 ± 70**

Wood charcoal from Feature 16, Levels 7 and 8, refuse-filled cache pit.

WIS-1377. **1410 ± 70**

Wood charcoal from Feature 125, Level 3, roasting hearth.

Tennessee

Tuskegee Pond series

Core coll from Tuskegee Pond, Monroe Co (35° 35′ N, 84° 12′ W) by P A Delcourt; subm by P A Delcourt, Univ Tennessee, Knoxville. Dates provide chronologic context for fossil-pollen sequence obtained from Tuskegee Pond for correlation with the archaeol record of human occupation at nearby Icehouse Bottom site (Delcourt, 1980; Chapman and Shea, 1981). Samples were slightly calcareous and were acid treated only.

WIS-1306. **250 ± 70**
$\delta^{13}C = -25.7‰$

Clayey silt, 170 to 175cm below water surface.

WIS-1307. **200 ± 70**
$\delta^{13}C = -26.2‰$

Silty clay, 130 to 136cm below water surface.

WIS-1313. **1630 ± 80**

Clayey sandy silt, 195 to 212cm below water surface.

Wisconsin

WIS-1272. Ambro I site (47Cr350) **960 ± 80**

Charcoal from site in Crawford Co (43° 04′ N, 91° 09′ W) coll Aug 1980 and subm by J B Stoltman, Univ Wisconsin-Madison. Sample was taken from Shell Lens A, 48 to 66cm below surface. Date should apply to shellfish gathering of early participants in Effigy Mound culture in Prairie du Chien area. Directly assoc is uncollared vessel of Madison Cord-Impressed type.

WIS-1312. Hunter Channel II (47Cr313b) **1790 ± 90**

Charcoal from site in Crawford Co (43° 04′ N, 91° 09′ W) coll Oct 1979 by J Theler; subm by J B Stoltman. Sample was from Feature 1, triangular pit in plain view, exposed by erosion, 130cm below top of river bank on Hunter Channel on Mississippi R. Top of eroded feature contained Lane Farm (rocker) stamped rimsherd.

Mill Pond series (47Cr186)

Samples from site in Crawford Co (43° 04′ 30″ N, 91° 09′ 45″ W) coll Aug 1980 by J Theler and C Arzigian; subm by J B Stoltman.

1880 ± 80
WIS-1276. $\delta^{13}C = -27.1‰$

Charcoal from Feature 21, 90cm below surface, 2m N of exposed Early Woodland shell midden. Date applies to newly defined Prairie phase, local manifestation of Black Sand culture (WIS-1291: R, 1982, v 24, p 86).

860 ± 80
WIS-1310. $\delta^{13}C = -26.3‰$

Charcoal from Feature 23, 98cm below surface, 30cm diam, 20 to 30cm deep. Date applies to 1st occurrence of corn with Late Woodland ceramics, not only in Prairie du Chien area, but in Upper Mississippi Valley outside of Illinois. Assoc ceramics, with slightly thickened lips and cord-impressing on both interior and exterior lip/rim junctures, look typologically later than comparable rims from 47Cr350 (WIS-1272).

WIS-1311. **1030 ± 80**

Charcoal from Feature 13, 84cm below surface overlying Middle Woodland shell lens. Feature contained burned floral and faunal remains, including charred corn and Madison Ware ceramics. Sample dates unusual occurrence of corn and Late Woodland ceramics in Prairie du Chien area.

Mill Coulee Shell Heap (47Cr100) series

Charcoal from site in Crawford Co (43° 04′ N, 91° 09′ W) coll 1980 by J Theler and C Arizigian; subm by J B Stoltman. Dates provide earliest evidence of seasonally sedentary habitation in terrace settings above flood plain in Prairie du Chien area. Ceramics and projectile points coll from surface and features place site in Millville phase (Stoltman, 1979) (WIS-1249, -1290, R: 1982, v 24, p 86).

WIS-1308. **1620 ± 70**
$\delta^{13}C = -25.8‰$

Sample from Feature 4 immediately adjacent to large clamshell pit (Feature 3), feature is 5cm below plow zone in Sq 3.

WIS-1335. **1670 ± 70**

Sample from Feature 3, basin-shaped feature filled with naiad shells, bones, charcoal, and burned rock.

WIS-1309. Dillman I (47Cr348) **1890 ± 80**

Charcoal from site in Crawford Co (43° 04′ N, 91° 09′ W) coll July 1980 by R Boszhardt; subm by J B Stoltman. Sample was coll from soil surrounding vessel that had collapsed upon itself. Silty loam soil contained charcoal and ceramic sherds all from vessel. Date applies to newly defined Prairie phase, local manifestation of Black Sand culture (WIS-1291: R, 1982, v 24, p 86).

WIS-1336. Quarter Mile Shell Midden (47Cr310) **1150 ± 70**

Charcoal from site in Crawford Co (43° 04′ N, 91° 09′ W) coll Aug 1980 by R Boszhardt; subm by J B Stoltman. Sample from base of extensive shell midden, 120cm below surface. Date should approximate beginnings of shift from small-scale shellfish collecting to intensive, large-scale exploitation. Apparently assoc with this shift was settlement change from low floodplain camps to residential terrace villages and affiliated, non-residential extraction stations (for shell fish) in low flood plain. This date is also of geol significance in that it is assoc with shell fish derived from active river channel that is now backwater slough.

Oak Lake site (47Fr143) series

Charcoal from site in Forest Co (45° 28′ 32″ N, 88° 55′ 57″ W) coll Oct 1981 by D Overstreet; subm by D Overstreet and L Brazeau, Great Lakes Archaeol Research Center, Waukesha. Samples were from sealed pit lenses assoc with lithic materials attributed to single component Lakes phase occupation (Salzer, 1969; 1974). Two of 43 refuse/storage pits were sampled. Site (47Fr143) is undisturbed; origins of pits are still visible on surface. Large storage facility areas have not been heretofore reported for Lakes phase sites (Overstreet, 1981).

WIS-1339. **750 ± 70**

Sample from Pit 6 at interface between burned pit fill and ash sand layer forming pit boundaries.

WIS-1340. **830 ± 70**

Sample from Pit 8 at uppermost burned layer of pit fill. Profile suggests this is intrusive episode into earlier use of pit. Burned layer is stratigraphically above 3 additional burned layers that are separated by ashy sand layers.

WIS-1378. Poor Man's Farrah site (47Gt366) 1030 ± 70

Wood charcoal from Poor Man's Farrah site (42° 30′ 55″ N, 90° 37′ 31″ W) coll by C Erickson and J Penman; subm by J Penman, State Hist Soc Wisconsin, Madison. Site is one of several Late Woodland mound groups on bluff tops above Mississippi R ca 2km N of Illinois state line. Sample is from feature below mound fill and may provide date of mound construction.

II. GEOLOGIC SAMPLES

United States

Connecticut

Lantern Hill Pond series

Core coll Sept 1980 from Lantern Hill Pond, New London Co (41° 27′ 30″ N, 71° 57′ W) by K McGown *et al.* Subm by T Webb, III, Brown Univ, Providence, Rhode Island. Water depth 10m. Dates previously reported (R, 1982, v 24, p 89).

WIS-1344. 6220 ± 80

Gyttja, 607 to 613cm below sediment surface.

WIS-1345. 4000 ± 80

Gyttja, 377 to 383cm below sediment surface.

WIS-1405. Mohawk Pond 12,460 ± 110

Livingstone core, 5cm diam, coll Jan 1982 from Mohawk Pond, Litchfield Co (41° 49′ N, 73° 17′ W) by D C Gaudreau *et al,* subm by D C Gaudreau, Brown Univ. Gyttja 1179 to 1183cm. Basal date for Holocene pollen analysis.

Massachusetts

Duck Pond series

Core 4.5m, coll June 1980 from Duck Pond, Barnstable Co (41° 50′ N, 70° 00′ W), subm by M Winkler, Univ Wisconsin-Madison. Water depth 18.2m. Dates previously reported on this site (R, 1981, v 23, p 153-154) (R, 1982, v 24, p 90).

WIS-1318. 9140 ± 100

Gyttja, 2138 to 2142cm below water surface.

WIS-1391. 8230 ± 90

Gyttja, 2070 to 2075cm below water surface.

Tom Swamp series

Core coll Nov 1979 from Tom Swamp, Harvard Forest, Worchester Co (42° 31′ N, 62° 13′ W) by C Lenk *et al,* subm by T Webb. Pollen diagram from Tom Swamp was pub (Davis, 1958). Dates on other levels were reported (R, 1982, v 24, p 89).

WIS-1321. **6920 ± 80**

Herbaceous peat with some ligneous detritus, 465 to 469cm deep, dates events in "oak" zone.

WIS-1322. **7280 ± 80**

Herbaceous peat with some ligneous detritus, 565 to 569cm deep, dates events in "oak" zone.

WIS-1323. **6080 ± 80**

Herbaceous and ligneous peat, 336 to 340cm deep, dates events in "oak" zone.

Minnesota

WIS-1303. Wentzel's Pond **800 ± 80** $\delta^{13}C = -29.6‰$

Livingstone core, 5cm diam, from Wentzel's Pond, Hubbard Co (46° 57′ N, 94° 57′ W). Coll March 1980 by J C Almendinger *et al*; subm by J C Almendinger, Univ Minnesota, Minneapolis. Slightly calcareous algal copropel with occasional snail shell, 75 to 80cm below sediment surface. Water depth 157cm; sediment thickness 4m over glacial outwash. Increase of pine pollen at this level marks development of jack pine forest on this sec of Park Rapids-Staples outwash plain. Dates from several sites will be compared to test hypothesis that jack pine forests invaded patches of Minnesota's outwash plains at various times throughout Holocene. Acid treatment only.

WIS-1304. Lake Moran **2460 ± 80** $\delta^{13}C = -24‰$

Livingstone core, 5cm diam, from Lake Moran, Hubbard Co (46° 51′ N, 95° 04′ W). Coll March 1980 by J C Almendinger *et al*; subm by J C Almendinger. Algal copropel, 280 to 290cm below sediment surface. Water depth 471cm; sediment thickness 14m over glacial outwash. Same observations as for WIS-1303, above. Acid treatment only.

WIS-1305. Mud Lake **3060 ± 80** $\delta^{13}C = -27.9‰$

Livingstone core, 5cm diam, from Mud Lake, Hubbard Co (46° 52′ N, 94° 45′ W). Coll March 1980 by J C Almendinger *et al*; subm by J C Almendinger. Algal copropel, 330 to 340cm below sediment surface. Water depth at 827cm; sediment thickness 10m over glacial outwash. Same observations as for WIS-1303, above. Acid treatment only.

WIS-1314. Hostage Lake **1870 ± 80**

Livingstone core, 5cm diam, from Hostage Lake, Crow Wing Co (46° 33′ N, 94° 08′ W). Coll March 1981 by J C Almendinger *et al*; subm by J C Almendinger. Algal copropel, 215 to 225cm below sediment surface. Water depth 151cm; sediment thickness 7m over glacial outwash. Increase of pine pollen at this level marks development of jack pine forest on this sec of Crow Wing outwash plain. Same observations as for WIS-1303, above. Acid treatment only.

WIS-1315. Big John Pond **1700 ± 80**

Livingstone core, 5cm diam, from Big John Pond, Beltrami Co (47° 33′ 30″ N, 94° 58′ W). Coll Feb 1981 by J C Almendinger *et al*; subm by J C Almendinger. Calcareous algal copropel with occasional shell, 60 to 65cm below sediment surface. Water depth measured at 60cm and sediment thickness 450cm over glacial outwash. Increase of pine pollen at this level marks development of jack pine forest on this sec of Bemidji sand plain. Same observations as for WIS-1303, above. Acid treatment only.

WIS-1316. Peterson Slough **840 ± 80**

Livingstone core, 5cm diam, from Peterson Slough, Becker Co (46° 58′ N, 95° 19′ W). Coll Feb 1981 by J C Almendinger *et al*; subm by J C Almendinger. Calcareous algal copropel with occasional shell, 40 to 50cm below sediment surface. Water depth 390cm; sediment thickness 12m over glacial outwash. Same observations as for WIS-1303, above. Acid treatment only.

WIS-1317. Lydick Lake **3760 ± 90**

Livingstone core, 5cm diam, from Lydick Lake, Cass Co (47° 23′ 30″ N, 94° 25′ W). Coll Feb 1981 by J C Almendinger *et al*; subm by J C Almendinger. Algal copropel, 300 to 310cm below sediment surface. Water depth 482cm; sediment thickness 5m over glacial outwash. Same observations as for WIS-1315, above. Acid treatment only.

Swift site series

Livingstone core, 5cm diam, from Swift, Roseau Co (48° 49′ N, 95° 14′ W). Coll Aug 1981 by Svante Bjorck; subm by H E Wright, Jr, Univ Minnesota, Minneapolis. Area is covered with 2m beach gravel underlain by 40cm peat over lacustrine silt. Dates water level changes in Glacial Lake Agassiz (Prest, 1970). Acid treatment only.

WIS-1324. **9350 ± 100**

Peat from 2 to 5cm below beach gravel.

WIS-1325. **10,050 ± 100**

Peat from 33 to 38cm below beach gravel.

Irvin Lake series

Livingstone core, 5cm diam, from Irvin Lake, Itasca Co (47° 08′ N, 93° 38′ W). Coll Dec 1980 by B C Alwin and E J Cushing; subm by E J Cushing, Univ Minnesota. Depths are measured from water surface. Water depth at coring site was 540cm. Acid treatment only.

WIS-1337. **1540 ± 60**

Algal copropel from 580 to 590cm depth. Dates second increase of birch pollen and decrease of white pine pollen.

WIS-1338. **1950 ± 70**

Algal copropel from 660 to 670cm depth. Dates shift to higher values of birch pollen and lower values of white pine pollen.

WIS-1341. **3170 ± 80**

Algal copropel from 810 to 820cm depth. Dates shift in pine assemblage from higher values of oak and herb pollen to high values of white pine and birch pollen.

WIS-1342. **5890 ± 80**

Algal copropel from 987 to 997cm depth. Dates increase in pine pollen and decrease in oak pollen.

WIS-1343. **7500 ± 80**

Silty algal copropel, calcareous with some shell fragments from 1110 to 1115cm depth. Date marks decrease in red/jack pine pollen and increase in oak pollen.

Billy's Lake series

Livingstone core, 2.5cm diam, from Billy's Lake, Morrison Co (46° 16′ N, 94° 33′ W) coll by G L Jacobson, Jr; subm by E J Cushing. Depths are measured from water surface. Water depth at core site 180cm. Series will provide dates of Holocene movement of prairie-forest border through site (Jacobson, 1979).

WIS-1364. **2960 ± 70**

Marly copropel from 400 to 410cm depth.

WIS-1365. **4590 ± 70**

Marly copropel with fine plant detritus from 600 to 610cm depth.

WIS-1366. **6870 ± 80**

Marly copropel with fine plant detritus (*Ceratophyllum* leaves) from 800 to 810cm depth.

WIS-1367. **10,650 ± 100**

Silty copropel from 1000 to 1010cm depth.

New York

Burden Lake series

Livingstone core, 5cm diam, from Burden Lake, Rensselaer Co (42° 36′ 16″ N, 73° 34′ W) coll by D C Gaudreau *et al*; subm by T Webb, III and D C Gaudreau. Depths are measured from sediment surface, water depth 11.2m.

WIS-1360. **2870 ± 70**

Gyttja from 250 to 256cm depth. Dates appearance of *Castarea* (chestnut) pollen.

WIS-1361. **4630 ± 70**

Gyttja from 520 to 526cm depth. Dates decline in *Tsuga* (hemlock) pollen.

WIS-1362. **6700 ± 80**

Gyttja from 750 to 756cm depth. Dates appearance of *Carya* (hickory) pollen.

WIS-1363. **8730 ± 90**

Gyttja from 980 to 986cm depth. Dates base of core.

Wisconsin

Lima Bog series

Core coll Jan 1980 from Lima Bog, Rock Co (42° 48′ N, 88° 51′ W) and subm by Kent Van Zant, Earlham Coll, Richmond, Indiana. Dated to learn more of postglacial vegetation in S central Wisconsin (Van Zant and Lamb, 1980). Measurements are from bog surface. Samples were very calcareous, requiring lengthy acid treatment. Previous dates from site were reported, WIS-1045 (R, 1980, v 22, p 121), WIS-1131, -1134, -1135 (R, 1981, v 23, p 156-157).

WIS-1275. **10,180 ± 110**
$\delta^{13}C = -32.2‰$

Calcareous gyttja with a few snail shells, 1238 to 1248cm depth. Color changed from brown to black from top to bottom in this 10cm. *Picea* pollen decreased from 20% to 5% during this interval. *Pinus* pollen peaked at 24% at base of sample. *Quercus* pollen increased to 25%.

WIS-1278. **25,700 ± 460**

Calcareous varved silt banded yellowish brown and black, 1934 to 1967cm depth. Basal 33cm in core, dating beginning of sedimentation in basin. (1 5-day count.)

WIS-1319. Morris Creek Site A **1480 ± 80**

Wood, 200cm depth, from site in Monroe Co (43° 48′ N, 90° 36′ W). Coll Aug 1981 and subm by J C Knox, Univ Wisconsin-Madison. Dates late Holocene river channel system that was adjusted to flood and erosional processes representative of very late Holocene climate and vegetation conditions (Knox, McDowell, and Johnson, 1981).

WIS-1320. LaFarge Dam Site I **5620 ± 90**

Wood, 305cm depth, from site in Vernon Co (43° 36′ N, 90° 38′ W). Coll July 1981 and subm by J C Knox. Date is max age for relict paleochannel and demonstrates that in larger valley floors of Kickapoo drainage system, much of early Holocene alluvium was removed by late Holocene channel lateral migration (Knox, McDowell, and Johnson, 1981).

WIS-1326. McCoy Site B **7840 ± 90**

Wood, 270cm depth, from site in Monroe Co (43° 45′ N, 90° 35′ W). Coll Aug 1981 and subm by J C Knox. Dates early Holocene river channel system. Small capacity of channel cross-sec indicates that high-frequency floods were significantly smaller than prevailing flood conditions that occurred after ca 6000 yr BP (Knox, McDowell, and Johnson, 1981).

WIS-1332. Cox Site C **2540 ± 70**

Wood, 245cm depth, from site in Monroe Co (43° 46′ N, 90° 33′ W). Coll Aug 1981 and subm by J C Knox. Dates very late Holocene river channel system that was apparently adjusted to frequent large floods (Knox, McDowell, and Johnson, 1981).

WIS-1333. Warner Creek Site A **6180 ± 80**

Wood, 155cm depth, from site in Vernon Co (43° 38′ N, 90° 32′ W). Coll Aug 1981 and subm by J C Knox. Dates late Holocene river channel system that was adjusted to frequent large floods (Knox, McDowell, and Johnson, 1981).

WIS-1334. Powell Site 2 **1110 ± 70**

Wood, 196cm depth, from site in Monroe Co (43° 44′ N, 90° 36′ W). Coll Aug 1981 and subm by J C Knox. Dates very large capacity late Holocene river channel system. Large capacity implies adjustment to frequent large floods that approach magnitude of large contemporary floods adjusted to agricultural land use.

Platte R series

Samples taken from Bollant site, on bank of Platte R, Grant Co (42° 55′ 26″ N, 90° 30′ 15″ W). Coll 1981 and subm by J C Knox (Knox, McDowell, and Johnson, 1981).

WIS-1380. **6000 ± 90**

Woody fragments, from core 152 to 168cm below surface, 90m from river bank (Bollant 1). Dates relatively large river channel adjusted to climatic episode with relatively frequent large floods.

WIS-1381. **1200 ± 70**

Small log, 7.5cm diam, from bank exposure, 195cm below bank surface (Bollant 2). Dates period of active lateral erosional activity by late Holocene channel system.

WIS-1383. Kickapoo Cemetery **28,900 ± 650**

Silty peat, 1390 to 1440cm taken near NE corner of Kickapoo Center Cemetery, Vernon Co (43° 29′ N, 90° 42′ W). Coll July 1981 and subm by J C Knox. Date supports interpretation that Woodfordian substage (20,000 + to ca 12,000 yr BP) was time of major hillslope erosion and basal hillslope colluviation in Driftless Area of SW Wisconsin. Peat growth and hillslope stability between 20,000 to 40,000 yr BP is also consistent with observation in Pecatonica valley on SE margin of Driftless Area (Knox, Clayton, and Mickelson, 1982; Wittecar and Davis, 1982). (1 6-day count.)

WIS-1397. White Clay Lake Marsh **620 ± 70**

Wood (*Thuja occidentalis*) from White Clay Lake Marsh (44° 47′ N, 88° 24′ W) in Shawano Co. Coll by F Madison; subm by A M Swain, Univ Wisconsin-Madison. From marl sediment 35 to 45cm below base of beach ridge and 75 to 85cm from ridge surface. Date helps establish chronology for pollen diagram from this site.

Lake Mendota series

Livingstone core, 5cm diam from Lake Mendota, Dane Co (43° 06′ N, 89° 25′ W). Coll Feb 1982 and subm by A M Swain. Dates from 3 of 4 cores coll along transect of varying water depth in University Bay should indicate times of low and high water levels during Holocene. Acid treatment only.

WIS-1382. 11,400 ± 100

Decomposed peat from 26 to 32cm in 70cm core (Core A) coll at water depth 70cm. Peat was covered by sand and organic lake sediment. Date marks end of high-water level of Lake Mendota.

WIS-1386. 3430 ± 70

Sandy marl sediment from 53 to 73cm in 130cm core (Core B) coll at water depth 2.7m. Sample overlies transition from sandy to silty sediment. Date marks return of higher water level in lake.

WIS-1387. 11,100 ± 110

Silty marl sediment from 73 to 93cm in same core as WIS-1386, immediately underlying change from sandy to silty sediment. Sample should date end of high water level of lake.

WIS-1406. 3240 ± 80

Marl lake sediment from 50 to 60cm in 5m core (Core D) coll at water depth 3.7m, overlying 10cm layer of sandy marl. Date is estimate of return of higher lake level.

WIS-1407. 6980 ± 80

Marl lake sediment from 80 to 90cm in 5m core (Core D), underlying 10cm layer of sandy marl. Date from this level should mark end of higher lake level.

Argentina

WIS-1384. Caballo Muerto 3410 ± 70

Peat from Caballo Muerto, S of Laguna Guayatoyoc, alt 3800m, Jujuy prov (24° 00′ S, 66° 00′ W). Coll April 1981 and subm by Vera Markgraf, Inst Arctic and Alpine Research, Boulder, Colorado. Sample at 60 to 70cm depth, interbedded with sand layers underlying artifacts. Date to be used in paleoclimatic analysis of Holocene sec.

WIS-1385. Guayantayoc 2540 ± 70

Peat from Guayantayoc, W of Laguna Pozuelos, alt 3750m, Jujuy prov (22° 20′ S, 66° 10′ W). Coll April 1981 and subm by V Markgraf. From peat sec eroded by arroyo underlain by lacustrine sediments. Date to be used in paleoclimatic analysis of lacustrine and peat sec.

WIS-1388. Cumbres Calchaquies 1190 ± 70

Peat from Cumbres Calchaquies, Lagunas Huaca Huasi, alt 4250m, Tucuman prov (26° 44′ S, 65° 44′ W). Coll May 1981 by Stephen Halloy, Inst Lillo, Tucuman, and subm by V Markgraf. From peat sec at 100 to

110cm depth near small lakes of glacial origin. Date to be used in paleoclimatic analysis of peat sec.

WIS-1389. El Aguilar Mine **2120 ± 70**

Peat from El Aguilar Mine, alt 3900m, Jujuy prov (23° 05′ S, 65° 45′ W). Coll April 1981 and subm by V Markgraf. From 140 to 150cm in peat sec cut by arroyo. Date to be used along with previous dates for paleoclimatic profile from area on which there is no information on 10,000-yr history.

WIS-1390. La Mejicana Bog **9490 ± 100**

Peat from La Mejicana Bog and E slope of Sierra Famatina, alt 2450m, La Rioja prov (28° 44′ S, 67° 37′ W). Coll April 1981 and subm by V Markgraf. From peat sec cut by arroyo. Date to be used in paleoclimatic analysis.

Canada

Rattle Lake series

Three Livingstone cores, 5cm diam, from Rattle Lake, Kenora dist, Ontario (49° 21′ N, 92° 42′ W). Coll by S Bjorck; subm by H E Wright, Jr, Univ Minnesota. Water depth 525cm. All measurements from water surface. Dates will be used to calculate deglaciation, early plant migration, and possible effects during hypsithermal (Prest, 1970). Acid treatment only.

WIS-1327. **11,110 ± 110**

Clay gyttja with some coarse organic matter from 1266 to 1271cm depth.

WIS-1328. **10,150 ± 100**

Clay gyttja from 1242 to 1245cm depth.

WIS-1379. **10,850 ± 100**

Clay gyttja from 1255 to 1260cm depth.

WIS-1395. **6500 ± 80**

Gyttja, blackish brown to rust-colored, from 1025 to 1030cm depth. Dates highest abundance of white pine pollen.

WIS-1396. **7150 ± 80**

Gyttja, brownish-black, from 1070 to 1075cm depth. Dates immigration of white pine.

WIS-1398. **8420 ± 90**

Gyttja, dark brown from 1205 to 1210cm depth. Dates immigration of white pine.

Sioux Pond series

Three Livingstone cores, 5cm diam, from Sioux Pond, Kenora dist, Ontario (49° 56′ N, 91° 34′ W). Coll Aug 1981 by S Bjorck; subm by H

E Wright, Jr. Dates will be used in same way as for Rattle Lake series, above. Acid treatment only.

WIS-1329. **9740 ± 100**

Clayey gyttja with shell fragments from 549 to 552cm below peat surface.

WIS-1393. **6690 ± 80**

Coarse-detritus gyttja, dark brown, from 430 to 435cm below peat surface. Dates immigration of white pine.

WIS-1394. **5470 ± 80**

Fine to coarse detritus gyttja with brown and dark-brown lamina, from 395 to 400cm below peat surface. Dates highest abundance of white pine pollen.

Cristal Lake series

Livingstone core, 5cm diam, from Cristal Lake, Kenora dist, Ontario (52° 07′ N, 90° 05′ W). Coll by S Bjorck, subm by H E Wright, Jr. Water depth 260cm. Dates will be used in same way as for Rattle Lake series, above. Acid treatment only.

WIS-1330. **6720 ± 80**

Gyttja with shell fragments from 786 to 791cm below water surface.

WIS-1392. **6370 ± 70**

Dark-brown gyttja, from 760 to 765cm below water surface. Dates hypsithermal max.

Indian Lake

Three Livingstone cores, 5cm diam, from Indian Lake, Kenora dist, Ontario (50° 56′ N, 90° 27′ W). Coll Aug 1981 by S Bjorck; subm by H E Wright, Jr. All measurements from water surface. Water depth 2m. Dates will be used in same way as for Rattle Lake series, above. Acid treatment only.

WIS-1331. **9140 ± 100**

Clayey gyttja from 884 to 887cm depth.

WIS-1399. **6560 ± 80**

Algal gyttja, greenish brown from 730 to 735cm depth. Dates hypsithermal max.

WIS-1401. **7300 ± 80**

Algal gyttja, dark brown, from 810 to 815cm depth. Dates immigration of white pine.

Leech Fen series

Livingstone cores, 5cm diam, from Leech Fen, Labrador North dist, Labrador (53° 10′ N, 58° 45′ W) by G A King and D R Foster; subm by G A King, Univ Minnesota. String fen is 200m long, with rise of 180cm from fen base to top. Cores were taken at various intervals up fen to determine its stratigraphic relationships. Acid treatment only.

WIS-1353. 1210 ± 70

WIS-1353 to -1355 are from core taken from 1st pool at lower end of Leech Fen. Core consists of 50cm of peat overlying 90cm of lake sediment. This sample, 15 to 19cm below water surface in pool, and 3 to 7cm below top of peat surface, dates top of peat deposit in pool.

WIS-1354. 4530 ± 70

58 to 63cm below water surface in Pool 1, dating transition from lake sediment to peat.

WIS-1355. 4440 ± 60

Basal wood and woody peat, from 73 to 76cm in core from pool 2/3 of distance up fen, dates initiation of peat deposition at this loc (Core 25).

WIS-1356. 2900 ± 70

Sample from basal peat layer, 75 to 79cm deep, of uppermost pool in fen; dates initiation of peat deposition at this loc (Core 17).

WIS-1357. 7110 ± 80

Final date from Pool 1 core from base, 144 to 148cm below water surface. Date indicates when lake sediment deposition began within this shallow bay of Leech Lake.

WIS-1403. 760 ± 70

Sedge peat from base, 27 to 32cm, of Core 20 coll in transition area between fen and forest vegetation at upslope end of fen; dates beginning of peat deposition at this loc.

WIS-1404. 410 ± 70

Sample from 31 to 36cm below water surface and 1cm below water-peat interface (Core 24). Core was coll from pool 2/3 of distance up fen.

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ERRATUM

SOLAR MODULATION EFFECTS IN TERRESTRIAL PRODUCTION OF CARBON-14

GIULIANA CASTAGNOLI

Laboratorio de Cosmo-geophysica, Torino 10133, Italy

and

DEVENDRA LAL

Physical Research Laboratory, Ahmedabad-380009, India

In Radiocarbon, 1980, v 22, no. 2, p 133-158, the equation (1) on page 141 should read as follows:

$$g\,(T, \phi) = A\,\frac{T\,(T + 2E_o)\,(T + \phi + m)^{-\gamma}}{(T + \phi)\,(T + 2E_o + \phi)} \tag{1}$$

The term ϕ was missed in the $(T + m)^{-\gamma}$ term in the numerator.

ERRATUM

SIMON FRASER UNIVERSITY RADIOCARBON DATES I

D E NELSON and K A HOBSON

In Radiocarbon, 1982, v 24, p 344-351, the $\delta^{13}C$ values quoted throughout should appear as parts per mil (‰) rather than as per cent (%).

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

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

NOTICE TO READERS AND CONTRIBUTORS

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

In recent years, Radiocarbon has also been publishing technical and interpretative articles on all aspects of ^{14}C. The editors and readers agree that this expansion is broadening the scope of the Journal. This year we will publish the Proceedings of the Eleventh International Radiocarbon Conference in Vol 25, No. 2, 1983.

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

Manuscripts of radiocarbon papers should follow the recommendations in *Suggestions to Authors.** All copy (including the bibliography) must be typewritten in *double space*. Our deadline schedule is:

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General or technical articles should follow the recommendations above and the editorial style of the *American Journal of Science* or the Proceedings of the Tenth International Radiocarbon Conference. Date lists should follow the format shown in the most recent issue of RADIOCARBON. More detailed instructions are available upon request. Separate mailings have been discontinued.

Half life of ^{14}C. In accordance with the decision of the Fifth Radiocarbon Dating Conference, Cambridge, 1962, all dates published in this volume (as in previous volumes) are based on the Libby value, 5570 ± 30 yr, for the half life. This decision was reaffirmed at the 9th International Conference on Radiocarbon Dating, Los Angeles/La Jolla, 1976. Because of various uncertainties, when ^{14}C measurements are expressed as dates in years BP the accuracy of the dates is limited, and refinements that take some but not all uncertainties into account may be misleading. The mean of three recent determinations of the half life, 5730 ± 40 yr, (Nature, v 195, no. 4845, p 984, 1962), is regarded as the best value presently available. Published dates in years BP, can be converted to this basis by multiplying them by 1.03.

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

Meaning of $\delta^{14}C$. In Volume 3, 1961, we endorsed the notation Δ (Lamont VIII, 1961) for geochemical measurements of ^{14}C activity, corrected for isotopic fractionation in samples and in the NBS oxalic-acid standard. The value of $\delta^{14}C$ that entered the calculation of Δ was defined by reference to Lamont VI, 1959, and was corrected for age. This fact has been lost sight of, by editors as well as by authors, and recent papers have used $\delta^{14}C$ as the observed deviation from the standard. At the New Zealand Radiocarbon Dating Conference it was recommended to use $\delta^{14}C$ only for age-corrected samples. Without an age correction, the value should then be reported as percent of modern relative to 0.95 NBS oxalic acid (Proceedings 8th Conference on Radiocarbon Dating, Wellington, New Zealand, 1972). The Ninth International Radiocarbon Conference, Los Angeles and San Diego, 1976, recommended that the reference standard, 0.95 times NBS oxalic acid activity, be normalized to $\delta^{13}C = -19‰$.

In several fields, however, age corrections are not possible. $\delta^{14}C$ and Δ, uncorrected for age, have been used extensively in oceanography, and are an integral part of models and theories. For the present, therefore, we continue the editorial policy of using Δ notations for samples not corrected for age.

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

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