LA JOLLA MEASUREMENTS OF RADIOCARBON IN SOUTH GERMAN OAK TREE-RING CHRONOLOGIES

T W LINICK*, H E SUESS

Mt Soledad Radiocarbon Laboratory, University of California, San Diego, La Jolla, California 92093

and BERND BECKER

Botanisches Institut, Universität Stuttgart-Hohenheim
7000 Stuttgart 70, West Germany

ABSTRACT. Radiocarbon measurements made by the La Jolla laboratory on tree-ring samples from South German oak chronologies are presented. Several previously separate tree-ring series have been reduced to one absolutely dendro-dated chronology spanning the period from 4066 BC to the present and one still-floating chronology which spans the approximate period 7225 to 4125 BC. Previous estimates of the dendro-years made by the authors are compared with the dendro-years now assigned.

From 1974 through 1982, the ^{14}C contents of 575 European oak tree-ring samples were determined at the La Jolla laboratory. The samples came from tree-ring chronologies established by one of us (BB) from sub-fossil oak cross sections collected from South German river deposits. The ^{14}C measurements on these samples provided a substantial basis for a preliminary estimation of the absolute ages of these then-floating Holocene oak tree-ring chronologies. This was accomplished by comparing their ^{14}C variations with those obtained for the absolutely dendro-dated bristlecone-pine chronology using wiggle-matching methods (Kruse *et al*, 1980).

During the past two years, several of the original Hohenheim Holocene oak series have been significantly enlarged and successively linked together into longer units. In cooperation with M G L Baillie and J Pilcher, Paleoecology Centre, Queen's University, Belfast, Northern Ireland, and B Schmidt, Dendrochronology Laboratory, University of Cologne, West Germany, it was possible to close the long-standing gap in the Hohenheim oak chronology. After correction by 71 years of a tentative, but incorrect, link of the South German series starting at 500 BC (Becker, 1983) and a successful cross-match between the Northern Irish, North German, and South German series from 2000 BC to AD 500 (Pilcher *et al*, in press), the absolutely dendro-dated Hohenheim oak chronology today extends continuously from the present back to 4066 BC.

Suess (1978) published ^{14}C data for the La Jolla analyses of the floating Hohenheim oak series Donau 7/9/12, Main 5, Donau 3/10, and Zug-Sumpf. In 1980 the authors published estimated absolute dendro-years of these series derived from computer-matching of their ^{14}C variations with those in the La Jolla bristlecone-pine absolute chronology (Kruse *et al*, 1980). Because of the recently established tree-ring-width matches of these individual series into a single continuous absolutely dendro-dated sequence, the accuracy of the ^{14}C wiggle-matching method can be checked. As listed in Table 1, the calibrated zero points (years of oldest rings) of the

---

*Present address: Laboratory of Isotope Geochemistry, Department of Geosciences, University of Arizona, Tucson, Arizona 85721

four previously floating series differ from their absolute dendro-years by less than 10 years, with a range of 3 to 7 years difference. This fact demonstrates once again the validity of absolute radiometric age determinations by matching short-term ^{14}C variations in floating tree-ring series with those in absolutely dated tree-ring chronologies.

Progress has also been achieved in linking together the Hohenheim oak series older than 4100 BC. The floating chronologies Donau 6-Main 4/11, Main 6/13, Donau 11, and Donau 8 have recently been cross-matched (using relative ring widths) into a continuous 3182-year series. These series were initially calibrated individually by wiggle-matching with the bristle-cone-pine chronology data. The zero point years estimated for the Donau 8 and Main 6/13 series were 4870 BC and 6457 BC, respectively. On the basis of an apparent overlap of only ca 150 years of the youngest end of the Donau 6-Main 4/11 series and the oldest end of the ^{14}C-dated bristlecone-pine series, a zero point of 7215 BC was assigned to the Donau 6-Main 4/11 series, which spans over 800 years. After the successful connection of these three series (according to ring widths) into a single continuous floating series, the previous wiggle-matching calibrations can be checked. The comparison of previous and new zero points is given in Table 2. If the single continuous floating series is assigned the zero point of the oldest series, Donau 6-Main 4/11, of 7215 BC, the revised zero points of the Main 6/13 and Donau 8 series differ by less than 20 years from their previous values.

Recent measurements made by Minze Stuiver, Quaternary Isotope Laboratory, University of Washington, Seattle, and Bernd Kromer, Institut für Umweltphysik, Universität Heidelberg, West Germany, on samples from these older Hohenheim series confirm the La Jolla calibrations; details of their calibrations will be presented by Stuiver and Kromer at the 1985 radiocarbon conference in Trondheim, Norway. The zero point of 7215 BC for the Donau 6-Main 4/11-Main 6/13-Donau 8 series can be assumed to be correct to within 20 years.

Data for many of the samples listed here were presented in a preliminary publication (Suess, 1978). The data for these samples have been recalculated using 95% of the activity of the original NBS oxalic acid standard as the reference; previously, the decay-corrected activity of mid-to late-19th century Douglas fir tree rings had been used as the reference standard at the La Jolla laboratory. Some of the data for samples from the Donau 6-Main 4/11 series, which appears to span the period 7225 to 6375 BC, were published by Bruns *et al* (1983).

The La Jolla data for the Hohenheim oak series are presented in two tables, with samples ordered from oldest to youngest. The data for the unified floating series from ca 7225 to 4125 BC are presented in Table 3, while those for the absolutely dendro-dated series covering the period from 4066 BC to AD 250 are given in Table 4. In these two tables, the columns give, from left to right, (1) the ring number, (2) the midpoint dendro-year (AD +, BC −, assigned by wiggle-matching or by absolute dendro-dating), (3) the number of tree rings in the sample, (4) the laboratory number (LJ−), (5) the $\delta^{13}C$ (‰, PDB) measured on a recombusted aliquot of the acetylene counting gas, (6) the conventional ^{14}C age (years BP, $t_{1/2}$ = 5568 years) and

its one standard deviation statistical uncertainty, and (7) the $\Delta^{14}C$ (‰, decay-corrected, based on the dendro-year, using $t_{1/2} = 5730$ years) and its one standard deviation statistical uncertainty.

TABLE 1

Comparison between ^{14}C-calibrated zero point years of the previously floating Hohenheim Neolithic and Bronze age oak series and zero points based on linkage of series into absolutely dendro-dated master chronology

Name of floating series	^{14}C-calibrated zero point	Dendro-dated zero point	Difference (yr)
Donau 7/9/12	4032 BC	4039 BC	−7
Main 5	3262 BC	3259 BC	+3
Donau 3/10	2871 BC	2875 BC	−4
Zug-Sumpf	1238 BC	1241 BC	−3

TABLE 2

Comparison between ^{14}C-calibrated zero points of the floating Hohenheim oak series older than 4100 BC and their zero points after linkage of the series into a single continuous floating chronology

Name of floating series	^{14}C-calibrated zero point	Zero point after linkage into one series starting at 7215 BC
Donau 6-Main 4/11	7215 BC	7215 BC
Main 6/13	6457 BC	6440 BC
Donau 8	4870 BC	4851 BC

TABLE 3

Floating series, ca 7225 to 4125 BC

Ring no.	Year	No. of rings	LJ no.	δ^{13}C	^{14}C age	Δ^{14}C
16	-7199	3	4471	-26.5	8184 ± 58	91.9 ± 7.9
27	-7188	3	4476	-25.9	8197 ± 59	88.7 ± 8.0
36	-7179	3	5355	-26.0	8251 ± 41	80.2 ± 5.5
46	-7169	3	4470	-26.3	8280 ± 59	75.0 ± 7.9
62	-7153	3	4477	-24.5	8231 ± 59	79.5 ± 7.9
79	-7136	3	5358	-24.9	8159 ± 58	87.0 ± 7.8
92	-7123	5	4469	-25.0	8103 ± 45	92.8 ± 6.1
104	-7111	3	5353	-25.2	8189 ± 57	79.6 ± 7.7
116	-7099	4	4472	-26.0	8182 ± 59	79.0 ± 7.9
127	-7088	5	5359	-25.2	8242 ± 57	69.6 ± 7.6
137	-7078	3	5354	-26.4	8118 ± 43	84.9 ± 5.8
153	-7062	3	4475	-26.9	8114 ± 52	83.3 ± 7.0
164	-7051	3	5360	-26.4	8072 ± 56	87.6 ± 7.6
175	-7040	3	4478	-26.1	8075 ± 59	85.7 ± 8.0
182	-7033	4	5357	-26.9	8006 ± 57	94.1 ± 7.8
198	-7017	4	4474	-26.6	8081 ± 58	81.9 ± 7.8
210	-7005	3	5356	-26.4	8035 ± 57	86.5 ± 7.7
222	-6993	4	4473	-26.8	8018 ± 60	87.2 ± 8.1
279	-6936	2	4355	-25.8	8070 ± 61	72.8 ± 8.1
287	-6928	5	4620	-25.3	8039 ± 57	75.9 ± 7.6
303	-6912	1	4354	-25.7	8001 ± 55	78.9 ± 7.4
314	-6901	2	4623	-26.0	7959 ± 55	83.1 ± 7.4
322	-6893	2	5239	-25.1	7982 ± 54	79.0 ± 7.3
331	-6884	1	4360	-25.5	8112 ± 56	60.5 ± 7.4
346	-6869	2	5251	-26.3	7888 ± 54	88.5 ± 7.3
354	-6861	2	4624	-25.1	8031 ± 55	68.3 ± 7.3
372	-6843	1	4353	-25.6	8055 ± 55	62.8 ± 7.3
380	-6835	2	5242	-25.7	8098 ± 58	56.1 ± 7.6
406	-6809	2	5252	-26.1	7943 ± 56	73.3 ± 7.5
418	-6797	2	4625	-25.3	7932 ± 55	73.2 ± 7.3
433	-6782	4	4356	-24.9	7923 ± 60	72.4 ± 8.0
444	-6771	2	5240	-25.7	7831 ± 56	83.4 ± 7.6
460	-6755	2	4359	-25.4	7909 ± 55	70.8 ± 7.3
472	-6743	5	5253	-26.7	7857 ± 59	76.2 ± 7.9
487	-6728	5	5241	-26.9	7916 ± 55	66.4 ± 7.3
501	-6714	1	4357	-24.5	7917 ± 44	64.5 ± 5.8
514	-6701	6	4372	-26.7	7914 ± 64	63.2 ± 8.5
534	-6681	6	4375	-27.6	7797 ± 55	76.2 ± 7.4
539	-6676	1	4358	-24.4	7858 ± 56	67.4 ± 7.4
566	-6649	2	4367	-26.8	7925 ± 54	55.1 ± 7.1
577	-6638	5	4622	-25.8	7914 ± 55	55.1 ± 7.2
591	-6624	1	4371	-26.5	7861 ± 55	60.3 ± 7.3
614	-6601	1	4369	-26.8	7814 ± 56	63.6 ± 7.4
632	-6583	4	5179	-26.6	7783 ± 38	65.3 ± 5.0
651	-6564	1	4370	-26.3	7754 ± 54	66.7 ± 7.2
688	-6527	1	4373	-27.2	7733 ± 60	64.8 ± 8.0
696	-6519	3	5180	-25.7	7673 ± 38	71.7 ± 5.1
717	-6498	1	4368	-26.3	7692 ± 56	66.5 ± 7.4
729	-6486	5	4621	-25.4	7687 ± 54	65.6 ± 7.2
742	-6473	2	5281	-26.3	7656 ± 56	68.0 ± 7.4
752	-6463	1	4374	-26.7	7699 ± 54	61.0 ± 7.1
755	-6460	1	5279	-26.7	7680 ± 53	63.2 ± 7.0
766	-6449	1	5282	-26.8	7645 ± 55	66.4 ± 7.3
783	-6432	1	5277	-26.3	7627 ± 44	66.6 ± 5.8
795	-6420	1	5283	-27.0	7500 ± 44	82.0 ± 5.9
809	-6406	1	5278	-26.4	7541 ± 54	74.7 ± 7.2
822	-6393	1	5280	-26.9	7485 ± 53	80.5 ± 7.1
1333	-5882	1	3315	-25.5	7040 ± 51	73.6 ± 6.8
1343	-5872	1	3305	-26.2	6976 ± 51	80.9 ± 6.9
1344	-5871	1	4977	-26.4	6995 ± 37	78.2 ± 5.0

TABLE 3 (continued)

Ring no.	Year	No. of rings	LJ no.	$\delta^{13}C$	^{14}C age	$\Delta^{14}C$
1353	−5862	1	3307	−26.1	7009 ± 55	75.1 ± 7.4
1353	−5862	1	5036	−25.8	7028 ± 37	72.6 ± 4.9
1358	−5857	1	5012	−25.7	6952 ± 36	82.1 ± 4.8
1363	−5852	1	4323	−26.8	6976 ± 52	78.2 ± 7.0
1365	−5850	1	5037	−26.2	7042 ± 37	69.2 ± 4.9
1367	−5848	1	4312	−26.6	7022 ± 52	71.6 ± 6.9
1377	−5838	1	3316	−25.3	7061 ± 52	65.1 ± 6.9
1377	−5838	1	5041	−27.5	6951 ± 36	79.8 ± 4.8
1387	−5828	1	3479	−25.2	6967 ± 51	76.3 ± 6.8
1396	−5819	1	5038	−26.8	6955 ± 36	76.8 ± 4.8
1397	−5818	1	4322	−26.0	7024 ± 52	67.4 ± 6.9
1407	−5808	1	4967	−26.1	7062 ± 38	61.1 ± 5.0
1416	−5799	3	5257	−25.7	7044 ± 52	62.3 ± 6.9
1417	−5798	1	3480	−25.3	6889 ± 52	82.9 ± 7.0
1426	−5789	3	5023	−26.1	6950 ± 37	73.5 ± 4.9
1427	−5788	1	3309	−25.9	7108 ± 52	52.5 ± 6.8
1435	−5780	4	4964	−25.7	6984 ± 38	67.8 ± 5.1
1437	−5778	1	3476	−25.8	6981 ± 52	68.0 ± 6.9
1447	−5768	1	4330	−26.2	6855 ± 51	83.5 ± 6.9
1461	−5754	1	5254	−25.1	6937 ± 52	70.7 ± 6.9
1462	−5753	11	3320	−23.6	6950 ± 52	68.9 ± 6.9
1468	−5747	3	5040	−25.3	6814 ± 38	86.3 ± 5.1
1475	−5740	6	4336	−23.9	6927 ± 51	70.2 ± 6.8
1483	−5732	4	5011	−27.5	6795 ± 51	86.9 ± 6.9
1487	−5728	4	4331	−23.7	6789 ± 51	87.2 ± 6.9
1496	−5719	3	4309	−24.6	6857 ± 51	76.9 ± 6.8
1507	−5708	3	4320	−22.9	6834 ± 51	78.5 ± 6.8
1519	−5696	2	4966	−25.7	6846 ± 37	75.4 ± 5.0
1527	−5688	1	3317	−23.7	6934 ± 52	62.6 ± 6.9
1529	−5686	1	5256	−25.0	6794 ± 54	81.0 ± 7.3
1537	−5678	1	3478	−25.3	6716 ± 51	90.5 ± 6.9
1537	−5678	1	5255	−25.5	6824 ± 51	76.0 ± 6.8
1545	−5670	1	4969	−26.0	6829 ± 36	74.2 ± 4.8
1547	−5668	1	4329	−24.1	6866 ± 52	69.1 ± 6.9
1557	−5658	2	4310	−25.9	6894 ± 52	64.0 ± 6.9
1561	−5654	1	5013	−24.7	6841 ± 44	70.6 ± 5.9
1571	−5644	10	3481	−24.8	6812 ± 52	73.1 ± 6.9
1577	−5638	1	3319	−23.3	6765 ± 51	78.7 ± 6.8
1587	−5628	1	4321	−24.3	6698 ± 39	86.4 ± 5.3
1591	−5624	2	4968	−25.5	6576 ± 54	102.5 ± 7.4
1604	−5611	1	4363	−25.3	6716 ± 51	81.7 ± 6.9
1617	−5598	1	3318	−24.1	6673 ± 50	85.8 ± 6.8
1649	−5566	6	4333	−25.4	6663 ± 50	83.0 ± 6.7
1677	−5538	1	4328	−25.4	6543 ± 50	95.5 ± 6.8
1681	−5534	4	4604	−25.2	6611 ± 50	85.8 ± 6.8
1694	−5521	5	4501	−26.3	6573 ± 49	89.2 ± 6.6
1702	−5513	1	4324	−25.0	6716 ± 50	69.0 ± 6.7
1709	−5506	5	5010	−26.6	6613 ± 35	81.8 ± 4.7
1719	−5496	5	4602	−26.0	6521 ± 44	93.0 ± 6.0
1727	−5488	1	4335	−25.2	6503 ± 50	94.4 ± 6.8
1738	−5477	3	4502	−25.2	6410 ± 42	105.6 ± 5.8
1745	−5470	3	5022	−25.2	6472 ± 46	96.2 ± 6.3
1759	−5456	5	5039	−26.4	6416 ± 35	102.0 ± 4.8
1769	−5446	5	4499	−25.8	6350 ± 51	109.8 ± 7.0
1777	−5438	1	4325	−25.2	6473 ± 39	91.8 ± 5.3
1779	−5436	5	5025	−26.0	6521 ± 39	85.1 ± 5.3
1784	−5431	5	4600	−25.7	6614 ± 51	71.9 ± 6.8
1802	−5413	1	4327	−24.2	6363 ± 49	103.6 ± 6.7
1807	−5408	2	4500	−26.9	6436 ± 48	92.9 ± 6.5
1811	−5404	2	5024	−26.0	6484 ± 49	85.9 ± 6.6
1817	−5398	2	4498	−26.4	6466 ± 51	87.5 ± 6.9

TABLE 3 (continued)

Ring no.	Year	No. of rings	LJ no.	δ^{13}C	^{14}C age	Δ^{14}C
1823	−5392	2	5033	−25.8	6459 ± 44	87.7 ± 6.0
1827	−5388	1	4334	−25.5	6369 ± 38	99.4 ± 5.2
1829	−5386	3	4601	−25.7	6467 ± 50	85.8 ± 6.8
1832	−5383	3	5034	−26.2	6360 ± 44	100.0 ± 6.0
1843	−5372	3	4497	−26.2	6461 ± 50	84.8 ± 6.8
1854	−5361	3	4525	−26.6	6451 ± 49	84.7 ± 6.6
1869	−5346	2	4606	−25.7	6364 ± 51	94.5 ± 6.9
1873	−5342	2	4496	−26.1	6369 ± 50	93.3 ± 6.8
1877	−5338	1	4326	−25.8	6426 ± 50	85.1 ± 6.8
1881	−5334	2	5035	−25.8	6416 ± 43	85.9 ± 5.8
1888	−5327	1	4492	−24.8	6416 ± 53	85.0 ± 7.2
1892	−5323	1	5032	−26.0	6382 ± 42	89.0 ± 5.7
1897	−5318	2	4605	−25.1	6424 ± 49	82.7 ± 6.6
1899	−5316	6	4332	−25.4	6274 ± 49	102.8 ± 6.7
1907	−5308	2	4495	−26.5	6304 ± 50	97.7 ± 6.8
1911	−5304	2	4505	−25.8	6322 ± 52	94.7 ± 7.1
1918	−5297	3	4493	−26.3	6359 ± 50	88.7 ± 6.8
1923	−5292	5	5284	−27.2	6309 ± 51	94.9 ± 7.0
1924	−5291	3	4504	−26.2	6208 ± 48	108.6 ± 6.6
1933	−5282	6	4494	−26.4	6274 ± 49	98.3 ± 6.7
1949	−5266	3	5286	−26.9	6332 ± 40	88.3 ± 5.4
1965	−5250	6	5287	−26.1	6372 ± 52	80.8 ± 7.0
1996	−5219	1	5285	−25.6	6183 ± 51	102.4 ± 7.0
2063	−5152	6	5376	−27.1	6218 ± 35	88.7 ± 4.7
2073	−5142	4	5413	−26.8	6191 ± 31	91.1 ± 4.2
2084	−5131	1	5403	−25.8	6241 ± 31	82.9 ± 4.2
2099	−5116	2	5431	−25.6	6165 ± 35	91.2 ± 4.8
2124	−5091	1	5379	−25.0	6108 ± 35	95.6 ± 4.8
2136	−5079	1	5414	−25.2	6121 ± 29	92.3 ± 3.9
2148	−5067	1	5401	−25.3	6176 ± 35	83.3 ± 4.7
2176	−5039	1	5432	−24.8	6163 ± 35	81.3 ± 4.7
2188	−5027	1	5375	−25.0	6048 ± 37	95.3 ± 5.0
2199	−5016	1	5415	−25.6	6068 ± 35	91.2 ± 4.8
2218	−4997	1	5402	−25.3	6113 ± 35	82.6 ± 4.7
2231	−4984	1	5433	−26.5	5973 ± 35	99.9 ± 4.8
2243	−4972	1	5377	−26.2	5980 ± 34	97.3 ± 4.6
2253	−4962	1	5434	−26.8	6031 ± 35	89.1 ± 4.7
2467	−4748	3	5446	−27.5	5864 ± 31	83.5 ± 4.2
2480	−4735	2	5312	−27.6	5864 ± 49	81.8 ± 6.6
2492	−4723	2	5474	−27.5	5774 ± 41	92.4 ± 5.6
2505	−4710	3	5334	−26.3	5813 ± 68	85.4 ± 9.2
2528	−4687	1	5447	−27.0	5853 ± 31	77.0 ± 4.2
2540	−4675	4	5314	−27.9	5753 ± 40	88.9 ± 5.4
2558	−4657	2	5475	−27.9	5806 ± 30	79.4 ± 4.0
2572	−4643	1	5337	−27.4	5761 ± 39	83.7 ± 5.3
2587	−4628	1	5450	−27.7	5821 ± 31	73.6 ± 4.1
2597	−4618	1	5309	−26.9	5737 ± 48	83.6 ± 6.5
2609	−4606	1	5476	−26.2	5760 ± 32	79.0 ± 4.3
2619	−4596	1	5331	−24.2	5745 ± 48	79.7 ± 6.5
2632	−4583	1	5448	−25.6	5870 ± 35	61.3 ± 4.6
2650	−4565	1	5313	−24.7	5696 ± 49	82.2 ± 6.6
2660	−4555	1	5477	−24.6	5648 ± 34	87.4 ± 4.6
2670	−4545	1	5330	−25.9	5810 ± 37	64.4 ± 4.9
2680	−4535	1	5451	−26.5	5719 ± 30	75.2 ± 4.0
2691	−4524	1	5308	−26.7	5683 ± 50	78.6 ± 6.7
2701	−4514	1	5478	−25.7	5648 ± 30	82.0 ± 4.0
2709	−4506	1	5336	−25.2	5658 ± 37	79.6 ± 5.0
2720	−4495	1	5449	−26.1	5674 ± 31	76.0 ± 4.2
2731	−4484	1	5311	−25.5	5591 ± 33	85.8 ± 4.5
2741	−4474	1	5479	−26.9	5523 ± 30	93.7 ± 4.1

TABLE 3 (continued)

Ring no.	Year	No. of rings	LJ no.	$\delta^{13}C$	^{14}C age	$\Delta^{14}C$
2756	−4459	1	5333	−25.7	5624 ± 39	78.0 ± 5.2
2765	−4450	1	5452	−27.3	5637 ± 31	75.1 ± 4.1
2781	−4434	1	5310	−26.0	5618 ± 46	75.6 ± 6.2
2791	−4424	1	5480	−26.6	5625 ± 30	73.3 ± 4.0
2795	−4420	1	3057	−26.4	5582 ± 47	78.6 ± 6.3
2798	−4417	1	5332	−26.5	5644 ± 48	69.9 ± 6.4
2802	−4413	1	3010	−26.4	5683 ± 45	64.2 ± 6.0
2807	−4408	1	3039	−26.7	5595 ± 47	75.3 ± 6.3
2809	−4406	1	3077	−25.5	5626 ± 47	70.9 ± 6.3
2813	−4402	1	2968	−24.9	5600 ± 46	73.8 ± 6.1
2816	−4399	1	3147	−25.8	5550 ± 47	80.1 ± 6.3
2819	−4396	1	3146	−26.1	5557 ± 48	78.8 ± 6.4
2823	−4392	1	3005	−25.6	5556 ± 47	78.4 ± 6.3
2825	−4390	1	3072	−25.5	5496 ± 47	86.2 ± 6.4
2827	−4388	1	3149	−24.3	5545 ± 47	79.4 ± 6.3
2829	−4386	1	2981	−25.1	5491 ± 63	86.4 ± 8.5
2831	−4384	1	3148	−25.2	5509 ± 47	83.7 ± 6.3
2834	−4381	1	3037	−25.0	5599 ± 70	71.2 ± 9.3
2839	−4376	1	3145	−25.0	5489 ± 47	85.4 ± 6.4
2841	−4374	1	3144	−24.1	5408 ± 47	96.1 ± 6.4
2843	−4372	1	3060	−24.9	5420 ± 46	94.2 ± 6.3
2848	−4367	1	3143	−25.2	5413 ± 47	94.5 ± 6.4
2851	−4364	1	3142	−25.3	5340 ± 47	104.1 ± 6.5
2855	−4360	1	2966	−25.7	5465 ± 46	86.5 ± 6.2
2862	−4353	1	3062	−24.5	5414 ± 46	92.5 ± 6.3
2865	−4350	5	3500	−24.7	5541 ± 47	75.0 ± 6.3
2870	−4345	6	3502	−25.8	5474 ± 47	83.3 ± 6.3
2876	−4339	4	4016	−25.7	5330 ± 49	102.1 ± 6.7
2879	−4336	4	3038	−27.5	5404 ± 46	91.6 ± 6.3
2884	−4331	3	3117	−26.7	5410 ± 46	90.1 ± 6.2
2889	−4326	3	3035	−27.9	5519 ± 46	74.8 ± 6.2
2892	−4323	1	3134	−27.1	5399 ± 46	90.6 ± 6.2
2894	−4321	1	2967	−27.2	5505 ± 46	76.0 ± 6.2
2896	−4319	1	3133	−27.8	5411 ± 45	88.4 ± 6.1
2900	−4315	3	3118	−27.4	5411 ± 46	87.9 ± 6.2
2902	−4313	1	4017	−28.1	5410 ± 50	87.8 ± 6.8
2904	−4311	6	3501	−25.4	5419 ± 47	86.3 ± 6.4
2905	−4310	1	3014	−26.3	5594 ± 46	62.7 ± 6.1
2908	−4307	1	3168	−26.8	5524 ± 46	71.7 ± 6.1
2910	−4305	1	3075	−26.9	5428 ± 46	84.3 ± 6.2
2914	−4301	1	3169	−26.7	5422 ± 46	84.6 ± 6.2
2916	−4299	1	3040	−26.9	5406 ± 46	86.5 ± 6.2
2920	−4295	1	3171	−27.1	5420 ± 47	84.0 ± 6.3
2923	−4292	1	3170	−26.4	5399 ± 47	86.5 ± 6.4
2926	−4289	1	3167	−26.6	5364 ± 47	90.8 ± 6.4
2928	−4287	1	3012	−27.2	5376 ± 45	88.9 ± 6.1
2933	−4282	1	3193	−26.4	5394 ± 47	85.8 ± 6.4
2941	−4274	1	2983	−25.9	5355 ± 45	90.1 ± 6.1
2947	−4268	1	3379	−26.4	5387 ± 45	85.0 ± 6.1
2948	−4267	9	3378	−29.6	5391 ± 45	84.3 ± 6.1
2950	−4265	1	3194	−26.6	5394 ± 47	83.6 ± 6.3
2957	−4258	8	3380	−28.3	5365 ± 45	86.6 ± 6.1
2960	−4255	1	3013	−26.5	5404 ± 45	81.0 ± 6.1
2964	−4251	1	3195	−26.9	5385 ± 47	83.0 ± 6.3
2964	−4251	7	3376	−28.3	5341 ± 46	88.9 ± 6.2
2969	−4246	1	3076	−27.2	5393 ± 46	81.3 ± 6.2
2969	−4246	3	3377	−27.9	5248 ± 45	101.0 ± 6.2
2979	−4236	1	3119	−26.4	5309 ± 46	91.3 ± 6.2
2987	−4228	5	3381	−27.7	5424 ± 46	74.8 ± 6.2
2989	−4226	1	3197	−27.8	5367 ± 46	82.1 ± 6.2

TABLE 3 (continued)

Ring no.	Year	No. of rings	LJ no.	$\delta^{13}C$	^{14}C age	$\Delta^{14}C$
2994	−4221	1	2978	−27.1	5322 ± 45	87.6 ± 6.1
2994	−4221	4	3382	−27.1	5338 ± 45	85.4 ± 6.1
2996	−4219	1	3196	−26.9	5429 ± 47	72.9 ± 6.3
2998	−4217	1	3179	−27.1	5425 ± 47	73.2 ± 6.3
2998	−4217	4	3383	−26.6	5365 ± 45	81.2 ± 6.1
3000	−4215	1	3192	−26.8	5333 ± 46	85.3 ± 6.2
3001	−4214	3	3386	−26.1	5385 ± 45	78.2 ± 6.0
3004	−4211	1	3006	−27.7	5481 ± 45	65.0 ± 6.0
3004	−4211	2	3387	−25.4	5369 ± 45	79.9 ± 6.0
3006	−4209	1	3178	−27.2	5299 ± 46	89.1 ± 6.2
3008	−4207	1	3056	−27.3	5330 ± 46	84.6 ± 6.2
3013	−4202	3	3402	−26.0	5335 ± 45	83.3 ± 6.1
3014	−4201	1	3122	−26.8	5348 ± 46	81.4 ± 6.2
3017	−4198	1	2964	−27.3	5295 ± 44	88.2 ± 6.0
3021	−4194	1	2965	−26.5	5278 ± 44	90.0 ± 6.0
3024	−4191	4	3404	−25.6	5346 ± 45	80.4 ± 6.1
3028	−4187	6	3123	−26.4	5343 ± 46	80.3 ± 6.2
3034	−4181	4	3403	−25.9	5317 ± 45	83.0 ± 6.1
3042	−4173	4	3401	−25.0	5345 ± 44	78.2 ± 5.9
3052	−4163	6	3385	−24.3	5410 ± 45	68.2 ± 6.0
3072	−4143	6	3503	−25.6	5312 ± 46	78.7 ± 6.2
3078	−4137	6	3384	−26.5	5371 ± 45	70.0 ± 6.0

TABLE 4

Absolutely dendro-dated series, 4066 BC to AD 250

Ring no.	Year	No. of rings	LJ no.	$\delta^{13}C$	^{14}C age	$\Delta^{14}C$
88	−3978	3	3610	−26.5	5207 ± 46	71.3 ± 6.1
142	−3924	2	3598	−26.3	5106 ± 46	77.8 ± 6.2
174	−3892	1	3611	−25.3	5071 ± 47	78.3 ± 6.3
197	−3869	1	3609	−25.6	5077 ± 46	74.5 ± 6.2
222	−3844	1	3614	−25.6	5024 ± 46	78.4 ± 6.2
256	−3810	2	3596	−24.5	4960 ± 46	82.5 ± 6.2
276	−3790	2	3625	−24.1	5011 ± 46	73.1 ± 6.1
298	−3768	2	3626	−24.1	4979 ± 47	74.5 ± 6.3
336	−3730	2	3608	−23.9	4921 ± 46	77.3 ± 6.2
370	−3696	6	3627	−24.5	4983 ± 46	64.6 ± 6.1
396	−3670	3	3628	−23.9	4771 ± 45	89.7 ± 6.1
422	−3644	2	3613	−24.5	4790 ± 45	83.7 ± 6.1
446	−3620	2	3615	−24.5	4775 ± 45	82.6 ± 6.1
460	−3606	1	3644	−23.6	4929 ± 46	60.2 ± 6.1
470	−3596	1	3655	−24.3	4834 ± 45	71.5 ± 6.0
480	−3586	1	3645	−24.3	4806 ± 45	74.0 ± 6.0
490	−3576	1	3667	−24.6	4814 ± 48	71.6 ± 6.4
497	−3569	2	3597	−25.9	4821 ± 45	69.8 ± 6.0
500	−3566	1	3640	−24.9	4845 ± 46	66.2 ± 6.1
510	−3556	1	3656	−24.5	4834 ± 46	66.4 ± 6.1
520	−3546	1	3643	−24.7	4821 ± 46	66.8 ± 6.1
530	−3536	1	3654	−24.6	4781 ± 45	70.8 ± 6.0
540	−3526	1	3641	−24.9	4698 ± 45	80.6 ± 6.1
550	−3516	1	3659	−24.5	4690 ± 47	80.4 ± 6.3
560	−3506	1	3646	−24.6	4721 ± 45	74.9 ± 6.0
570	−3496	1	3657	−24.8	4656 ± 45	82.4 ± 6.1
580	−3486	1	3642	−24.5	4645 ± 46	82.5 ± 6.2
590	−3476	1	3666	−24.4	4662 ± 45	79.0 ± 6.0

TABLE 4 (continued)

Ring no.	Year	No. of rings	LJ no.	$\delta^{13}C$	^{14}C age	$\Delta^{14}C$
600	−3466	1	3658	−24.7	4627 ± 44	82.4 ± 5.9
608	−3458	3	3007	−28.5	4690 ± 43	72.9 ± 5.7
614	−3452	1	2957	−28.1	4612 ± 42	82.5 ± 5.7
619	−3447	1	2956	−27.8	4660 ± 42	75.4 ± 5.6
630	−3436	1	3081	−26.8	4652 ± 44	75.1 ± 5.9
636	−3430	1	3111	−26.8	4695 ± 45	68.6 ± 6.0
643	−3423	1	3015	−26.2	4763 ± 52	58.7 ± 6.9
649	−3417	1	3938	−26.6	4703 ± 44	65.8 ± 5.8
651	−3415	1	3116	−25.8	4711 ± 44	64.5 ± 5.8
656	−3410	1	3931	−26.7	4731 ± 45	61.2 ± 5.9
670	−3396	1	3017	−26.0	4684 ± 45	65.6 ± 6.0
674	−3392	1	3078	−26.1	4675 ± 45	66.3 ± 6.0
680	−3386	1	3018	−24.5	4600 ± 45	75.5 ± 6.0
689	−3377	1	3928	−26.4	4499 ± 44	88.0 ± 6.0
693	−3373	1	2976	−26.0	4535 ± 43	82.6 ± 5.8
695	−3371	1	3930	−25.6	4581 ± 44	76.1 ± 5.9
698	−3368	1	3009	−26.0	4506 ± 42	85.8 ± 5.7
712	−3354	1	2975	−26.2	4546 ± 42	78.6 ± 5.6
727	−3339	1	3132	−25.1	4527 ± 44	79.2 ± 5.9
730	−3336	1	3082	−25.8	4453 ± 44	88.8 ± 6.0
732	−3334	1	3935	−25.4	4545 ± 44	76.1 ± 5.9
734	−3332	1	3131	−25.2	4474 ± 45	85.4 ± 6.1
751	−3315	1	3936	−25.9	4469 ± 44	83.9 ± 5.9
757	−3309	1	3113	−25.6	4521 ± 43	76.1 ± 5.8
760	−3306	1	3933	−25.8	4502 ± 44	78.3 ± 5.9
761	−3305	1	2960	−25.7	4517 ± 42	76.1 ± 5.6
767	−3299	1	3016	−24.4	4465 ± 44	82.3 ± 5.9
773	−3293	1	2958	−24.9	4487 ± 44	78.6 ± 5.9
799	−3267	1	2959	−26.2	4489 ± 42	74.9 ± 5.6
853	−3213	5	3698	−25.0	4466 ± 45	71.0 ± 6.0
906	−3160	2	3739	−26.2	4519 ± 45	57.1 ± 5.9
934	−3132	8	3591	−26.3	4523 ± 47	53.0 ± 6.2
980	−3086	1	3738	−25.0	4440 ± 44	58.1 ± 5.8
1005	−3061	1	3740	−25.2	4417 ± 45	57.9 ± 5.9
1036	−3030	1	3702	−23.8	4363 ± 44	61.1 ± 5.8
1054	−3012	2	3742	−24.9	4445 ± 45	48.0 ± 5.9
1085	−2981	1	3741	−25.8	4344 ± 44	57.3 ± 5.8
1105	−2961	1	3701	−23.8	4383 ± 44	49.6 ± 5.7
1110	−2956	2	3945	−26.2	4281 ± 49	62.4 ± 6.5
1117	−2949	1	3940	−26.2	4226 ± 67	68.8 ± 8.9
1130	−2936	1	3694	−24.1	4318 ± 45	54.9 ± 5.9
1139	−2927	1	3941	−25.9	4286 ± 44	58.0 ± 5.8
1153	−2913	1	3737	−25.9	4267 ± 44	58.7 ± 5.8
1159	−2907	1	3939	−25.5	4226 ± 44	63.4 ± 5.8
1169	−2897	1	3942	−25.1	4166 ± 45	70.0 ± 6.0
1179	−2887	1	3693	−23.2	4240 ± 44	58.9 ± 5.8
1189	−2877	1	3946	−25.4	4128 ± 45	72.5 ± 6.0
1212	−2854	8	4241	−26.2	4190 ± 43	61.3 ± 5.7
1213	−2853	1	3943	−26.1	4124 ± 43	69.9 ± 5.7
1220	−2846	2	3743	−24.5	4128 ± 44	68.5 ± 5.9
1224	−2842	2	3944	−25.1	4125 ± 45	68.4 ± 6.0
1226	−2840	4	4239	−25.4	4107 ± 43	70.5 ± 5.7
1235	−2831	2	3458	−24.9	4173 ± 43	60.6 ± 5.7
1254	−2812	2	4240	−25.8	4102 ± 44	67.6 ± 5.8
1264	−2802	1	3696	−23.9	4092 ± 44	67.6 ± 5.8
1275	−2791	1	4242	−25.5	4158 ± 44	57.5 ± 5.8
1290	−2776	1	3440	−24.6	4166 ± 43	54.5 ± 5.6
1320	−2746	1	3436	−24.7	4219 ± 43	43.8 ± 5.6
1323	−2743	1	4244	−24.9	4145 ± 43	53.0 ± 5.6
1335	−2731	1	3691	−25.7	4202 ± 44	44.1 ± 5.7
1347	−2719	1	4243	−26.8	4178 ± 44	45.7 ± 5.7

TABLE 4 (continued)

Ring no.	Year	No. of rings	LJ no.	δ^{13}C	^{14}C age	Δ^{14}C
1361	−2705	1	3692	−26.3	4173 ± 44	44.6 ± 5.7
1399	−2667	1	3464	−25.2	4136 ± 60	44.6 ± 7.8
1410	−2656	1	4250	−25.8	4075 ± 43	51.1 ± 5.6
1416	−2650	1	3465	−24.3	4120 ± 61	44.5 ± 7.9
1440	−2626	1	3457	−24.2	4089 ± 43	45.5 ± 5.6
1440	−2626	2	3695	−23.7	4088 ± 44	45.6 ± 5.7
1451	−2615	1	3699	−24.2	4154 ± 44	35.7 ± 5.7
1460	−2606	1	3437	−24.3	4124 ± 43	38.4 ± 5.6
1470	−2596	2	3703	−24.0	4026 ± 44	49.9 ± 5.8
1480	−2586	1	4846	−26.3	4090 ± 31	40.3 ± 4.0
1491	−2575	1	3294	−24.2	3988 ± 43	52.2 ± 5.6
1495	−2571	1	4249	−25.5	3989 ± 43	51.6 ± 5.6
1500	−2566	1	3700	−24.1	4165 ± 44	28.2 ± 5.6
1505	−2561	1	4251	−25.3	4005 ± 43	48.2 ± 5.6
1518	−2548	1	3290	−24.4	3978 ± 60	50.1 ± 7.8
1526	−2540	1	4847	−25.4	4074 ± 43	36.6 ± 5.5
1533	−2533	1	3291	−25.0	3966 ± 43	49.8 ± 5.6
1555	−2511	1	4848	−26.5	4052 ± 31	35.8 ± 4.0
1578	−2488	1	3704	−26.0	3959 ± 44	45.0 ± 5.7
1590	−2476	1	3706	−23.9	3866 ± 43	55.6 ± 5.7
1600	−2466	1	4068	−26.7	4016 ± 42	34.8 ± 5.4
1610	−2456	1	3705	−24.3	3872 ± 43	52.3 ± 5.6
1620	−2446	1	3776	−26.5	3836 ± 81	55.7 ± 10.6
1625	−2441	1	4058	−26.3	3964 ± 43	38.4 ± 5.6
1640	−2426	1	4850	−26.1	3891 ± 31	46.0 ± 4.0
1645	−2421	1	4059	−25.8	3888 ± 43	45.7 ± 5.6
1656	−2410	2	4069	−25.8	3860 ± 43	48.0 ± 5.6
1660	−2406	1	3774	−25.7	3839 ± 43	50.2 ± 5.6
1666	−2400	1	3773	−25.6	3871 ± 62	45.3 ± 8.1
1670	−2396	1	4060	−26.1	3917 ± 42	38.8 ± 5.4
1685	−2381	1	4063	−25.8	3856 ± 42	44.8 ± 5.5
1690	−2376	1	3292	−24.7	3890 ± 43	39.8 ± 5.6
1690	−2376	1	4062	−26.1	3914 ± 43	36.7 ± 5.5
1695	−2371	1	4061	−25.7	3962 ± 42	29.9 ± 5.4
1705	−2361	1	3779	−25.4	3867 ± 44	40.9 ± 5.7
1710	−2356	1	4064	−25.0	3833 ± 42	44.7 ± 5.5
1715	−2351	1	4849	−25.4	3917 ± 31	33.2 ± 4.0
1720	−2346	1	3793	−24.6	3869 ± 44	38.8 ± 5.7
1732	−2334	1	3293	−25.2	3864 ± 41	37.9 ± 5.3
1734	−2332	1	4067	−26.2	3830 ± 42	42.0 ± 5.4
1746	−2320	1	3985	−25.4	3858 ± 42	36.9 ± 5.4
1750	−2316	1	3778	−26.4	3802 ± 48	43.7 ± 6.2
1754	−2312	1	3974	−26.6	3847 ± 43	37.3 ± 5.6
1760	−2306	1	3791	−25.6	3855 ± 58	35.5 ± 7.5
1765	−2301	1	3792	−24.0	3876 ± 45	32.2 ± 5.8
1770	−2296	1	3983	−25.3	3786 ± 42	43.2 ± 5.5
1775	−2291	1	4066	−25.2	3842 ± 43	35.3 ± 5.5
1780	−2286	1	3813	−24.6	3843 ± 45	34.6 ± 5.8
1785	−2281	1	3976	−25.6	3845 ± 43	33.7 ± 5.5
1790	−2276	1	3981	−25.8	3788 ± 42	40.4 ± 5.4
1794	−2272	1	3439	−24.7	3903 ± 43	25.1 ± 5.5
1795	−2271	1	4065	−26.0	3746 ± 42	45.3 ± 5.5
1800	−2266	1	3977	−26.7	3762 ± 42	42.5 ± 5.5
1805	−2261	1	3787	−25.1	3716 ± 46	47.9 ± 6.0
1810	−2256	1	3979	−26.1	3794 ± 43	37.1 ± 5.6
1815	−2251	1	3790	−25.4	3806 ± 41	35.0 ± 5.3
1820	−2246	1	3980	−26.6	3786 ± 42	36.9 ± 5.4
1825	−2241	1	3786	−25.6	3712 ± 41	45.9 ± 5.3
1831	−2235	3	3982	−25.6	3820 ± 43	31.2 ± 5.5
1835	−2231	1	3807	−24.8	3771 ± 46	37.0 ± 5.9

TABLE 4 (continued)

Ring no.	Year	No. of rings	I.J no.	$\delta^{13}C$	^{14}C age	$\Delta^{14}C$
1840	−2226	1	3441	−25.3	3838 ± 42	27.7 ± 5.4
1840	−2226	1	3984	−25.1	3622 ± 42	55.7 ± 5.5
1845	−2221	1	4845	−25.0	3885 ± 43	21.1 ± 5.5
1850	−2216	1	3975	−24.9	3718 ± 43	41.9 ± 5.6
1855	−2211	1	3808	−23.5	3805 ± 60	30.1 ± 7.7
1866	−2200	1	3724	−23.9	3733 ± 43	38.0 ± 5.6
1875	−2191	1	3782	−24.5	3715 ± 44	39.2 ± 5.7
1890	−2176	1	3462	−24.5	3715 ± 42	37.3 ± 5.4
1895	−2171	1	3978	−25.4	3739 ± 42	33.6 ± 5.4
1900	−2166	1	3780	−25.4	3711 ± 45	36.6 ± 5.8
1905	−2161	1	3986	−25.7	3677 ± 42	40.3 ± 5.4
1910	−2156	1	3988	−24.9	3755 ± 42	29.7 ± 5.4
1915	−2151	1	3721	−23.8	3837 ± 43	18.6 ± 5.5
1926	−2140	1	3775	−26.4	3859 ± 43	14.4 ± 5.4
1930	−2136	1	3989	−24.8	3772 ± 43	25.0 ± 5.5
1935	−2131	1	3781	−24.9	3763 ± 44	25.5 ± 5.6
1940	−2126	1	3463	−24.7	3716 ± 42	30.9 ± 5.4
1940	−2126	1	3789	−24.3	3704 ± 45	32.5 ± 5.8
1945	−2121	1	3987	−24.8	3704 ± 41	31.8 ± 5.3
1955	−2111	1	3788	−24.8	3658 ± 45	36.5 ± 5.8
1964	−2102	1	3723	−23.8	3689 ± 43	31.4 ± 5.5
1970	−2096	1	4083	−25.8	3681 ± 42	31.7 ± 5.4
1980	−2086	1	3810	−24.1	3683 ± 41	30.2 ± 5.3
1990	−2076	1	3438	−24.6	3764 ± 42	18.6 ± 5.3
2007	−2059	1	3765	−26.0	3633 ± 43	33.2 ± 5.5
2010	−2056	1	3809	−24.9	3675 ± 40	27.5 ± 5.1
2015	−2051	1	4082	−25.6	3609 ± 48	35.3 ± 6.2
2022	−2044	1	3725	−24.5	3674 ± 42	26.1 ± 5.4
2026	−2040	1	3990	−24.9	3759 ± 42	14.8 ± 5.3
2046	−2020	1	3722	−25.1	3614 ± 42	30.8 ± 5.4
2050	−2016	1	4084	−26.3	3551 ± 45	38.4 ± 5.8
2063	−2003	1	3727	−26.2	3679 ± 43	20.4 ± 5.5
2070	−1996	1	4087	−26.2	3648 ± 38	23.5 ± 4.8
2080	−1986	1	4085	−26.4	3580 ± 42	30.9 ± 5.4
2085	−1981	1	4088	−26.2	3605 ± 42	27.1 ± 5.4
2100	−1966	1	4086	−26.2	3621 ± 42	23.2 ± 5.3
2115	−1951	1	3764	−26.1	3564 ± 42	28.6 ± 5.4
2115	−1951	1	4089	−25.9	3623 ± 41	21.1 ± 5.2
2120	−1946	1	4092	−25.4	3607 ± 41	22.5 ± 5.2
2137	−1929	1	3726	−25.2	3568 ± 42	25.4 ± 5.4
2160	−1906	1	4091	−25.4	3555 ± 42	24.2 ± 5.4
2165	−1901	1	3766	−23.9	3665 ± 43	9.6 ± 5.4
2165	−1901	1	4093	−25.2	3559 ± 43	23.0 ± 5.5
2175	−1891	1	3785	−24.9	3548 ± 42	23.2 ± 5.3
2185	−1881	1	3783	−25.3	3479 ± 41	30.8 ± 5.3
2190	−1876	1	4090	−25.0	3497 ± 42	27.9 ± 5.4
2198	−1868	1	3757	−24.2	3532 ± 42	22.4 ± 5.3
2217	−1849	3	3763	−24.6	3548 ± 42	18.0 ± 5.3
2225	−1841	1	3814	−24.1	3495 ± 44	23.8 ± 5.6
2240	−1826	1	3443	−25.3	3506 ± 42	20.5 ± 5.3
2250	−1816	1	3811	−23.6	3438 ± 44	27.9 ± 5.6
2260	−1806	2	3767	−23.6	3499 ± 42	18.9 ± 5.3
2280	−1786	1	3784	−23.0	3521 ± 41	13.7 ± 5.2
2290	−1776	1	3459	−24.4	3533 ± 42	11.0 ± 5.3
2315	−1751	1	3760	−25.0	3487 ± 42	13.7 ± 5.3
2340	−1726	1	3461	−25.3	3431 ± 59	17.7 ± 7.5
2363	−1703	1	3758	−25.3	3465 ± 42	10.6 ± 5.3
2390	−1676	1	3460	−25.6	3483 ± 42	5.0 ± 5.3
2440	−1626	1	3442	−25.4	3386 ± 41	11.1 ± 5.2
2649	−1417	3	4719	−26.2	3139 ± 41	16.7 ± 5.2

TABLE 4 (continued)

Ring no.	Year	No. of rings	LJ no.	$\delta^{13}C$	^{14}C age	$\Delta^{14}C$
2656	−1410	2	4707	−26.6	3107 ± 41	19.9 ± 5.2
2676	−1390	2	4718	−27.9	3156 ± 41	11.2 ± 5.2
2698	−1368	2	4697	−27.0	3126 ± 41	12.3 ± 5.2
2712	−1354	2	4708	−27.0	3129 ± 41	10.2 ± 5.2
2734	−1332	2	4698	−26.4	3103 ± 40	10.8 ± 5.0
2746	−1320	2	4720	−27.0	3107 ± 41	8.8 ± 5.1
2766	−1300	2	4702	−26.8	3012 ± 40	18.3 ± 5.1
2786	−1280	2	4663	−24.9	3110 ± 41	3.6 ± 5.1
2815	−1251	1	4706	−25.7	3055 ± 40	6.9 ± 5.0
2831	−1235	1	4662	−25.0	3040 ± 41	6.9 ± 5.1
2848	−1218	1	4703	−26.2	3013 ± 41	8.2 ± 5.1
2852	−1214	14	3028	−27.3	2963 ± 39	14.0 ± 4.9
2862	−1204	2	4699	−26.1	2999 ± 40	8.2 ± 5.0
2872	−1194	2	4704	−26.2	2953 ± 41	12.8 ± 5.2
2874	−1192	10	2917	−27.8	2947 ± 39	13.3 ± 4.9
2886	−1180	2	4705	−25.3	2995 ± 40	5.8 ± 5.0
2894	−1172	10	2949	−26.5	2925 ± 39	13.6 ± 4.9
2914	−1152	10	2918	−27.9	2940 ± 39	9.3 ± 4.9
2918	−1148	2	4701	−26.0	2985 ± 40	3.2 ± 5.0
2932	−1134	1	4664	−26.6	2966 ± 40	3.8 ± 5.0
2934	−1132	10	2916	−27.6	2999 ± 39	−0.5 ± 4.9
2954	−1112	10	2920	−26.4	2863 ± 39	14.1 ± 4.9
2966	−1100	2	4700	−25.2	2999 ± 40	−4.4 ± 5.0
2974	−1092	10	2919	−26.4	2933 ± 39	2.9 ± 4.9
2994	−1072	10	2915	−28.6	2810 ± 39	15.9 ± 4.9
2999	−1067	4	4659	−24.9	2759 ± 40	21.7 ± 5.1
3014	−1052	10	2939	−26.7	2890 ± 39	3.4 ± 4.9
3019	−1047	3	4670	−23.9	3022 ± 41	−13.6 ± 5.0
3034	−1032	10	2922	−25.2	2844 ± 39	6.7 ± 4.9
3046	−1020	2	4668	−24.6	2937 ± 40	−6.3 ± 4.9
3059	−1007	3	4671	−24.7	2885 ± 40	−1.5 ± 5.0
3080	−986	2	4665	−24.8	2836 ± 40	2.1 ± 5.0
3084	−982	10	2921	−26.6	2757 ± 39	11.5 ± 4.9
3104	−962	10	3025	−27.8	2771 ± 40	7.3 ± 5.0
3108	−958	3	4669	−24.8	2872 ± 40	−5.7 ± 5.0
3130	−936	2	4666	−24.4	2904 ± 41	−12.3 ± 5.0
3144	−922	2	4661	−24.9	2947 ± 40	−19.3 ± 4.9
3159	−907	3	4660	−25.2	2770 ± 40	0.8 ± 5.0
3169	−897	3	4667	−23.6	2795 ± 41	−3.6 ± 5.1
3605	−461	10	3864	−25.2	2382 ± 41	−4.9 ± 5.1
3615	−451	10	3860	−25.4	2364 ± 41	−3.8 ± 5.1
3623	−443	5	3865	−24.8	2323 ± 46	0.3 ± 5.7
3628	−438	5	3866	−25.1	2457 ± 40	−16.9 ± 4.9
3635	−431	10	3859	−25.6	2385 ± 41	−8.8 ± 5.1
3645	−421	10	3863	−25.7	2386 ± 41	−10.2 ± 5.1
3655	−411	10	3861	−25.7	2342 ± 41	−5.9 ± 5.1
3735	−331	10	3862	−25.1	2208 ± 41	1.1 ± 5.1
3755	−311	1	3341	−26.3	2189 ± 39	1.0 ± 4.9
3757	−309	1	3423	−25.4	2288 ± 39	−11.5 ± 4.8
3759	−307	1	3419	−26.0	2240 ± 38	−5.8 ± 4.7
3761	−305	1	3415	−25.5	2187 ± 38	0.5 ± 4.7
3763	−303	1	3412	−25.4	2313 ± 39	−15.3 ± 4.8
3767	−299	1	3345	−24.1	2245 ± 55	−7.4 ± 6.8
3769	−297	1	3411	−25.3	2315 ± 39	−16.2 ± 4.8
3773	−293	1	3422	−24.4	2305 ± 39	−15.5 ± 4.8
3793	−273	1	3414	−23.5	2199 ± 38	−4.8 ± 4.7
3798	−268	1	3339	−24.5	2263 ± 38	−13.3 ± 4.7
3804	−262	1	3333	−24.0	2269 ± 38	−14.8 ± 4.7
3825	−241	1	3343	−23.9	2216 ± 38	−10.8 ± 4.7
3835	−231	1	3331	−23.4	2226 ± 39	−13.2 ± 4.8

TABLE 4 (continued)

Ring no.	Year	No. of rings	LJ no.	δ^{13}C	^{14}C age	Δ^{14}C
3853	−213	1	3335	−24.6	2269 ± 38	−20.6 ± 4.6
3863	−203	1	4585	−25.6	2171 ± 39	−9.8 ± 4.8
3868	−198	1	4419	−24.4	2241 ± 39	−19.0 ± 4.8
3879	−187	1	4415	−25.7	2203 ± 30	−15.6 ± 3.7
3903	−163	1	3420	−24.4	2244 ± 38	−23.5 ± 4.6
3922	−144	1	4418	−26.4	2150 ± 39	−14.2 ± 4.8
3953	−113	1	4412	−25.3	2157 ± 39	−18.8 ± 4.8
3963	−103	1	4588	−26.1	2072 ± 39	−9.6 ± 4.8
3978	−88	1	4420	−26.2	2038 ± 39	−7.2 ± 4.8
4003	−63	1	4586	−26.2	2055 ± 38	−12.2 ± 4.7
4018	−48	1	4413	−26.3	2047 ± 39	−13.1 ± 4.8
4028	−38	1	4583	−26.3	2040 ± 39	−13.4 ± 4.7
4053	−13	1	4416	−26.2	1991 ± 39	−10.3 ± 4.8
4077	12	1	4582	−26.6	1982 ± 38	−12.2 ± 4.7
4082	17	1	4578	−26.8	1992 ± 39	−14.1 ± 4.8
4087	22	1	4414	−26.8	1989 ± 38	−14.3 ± 4.7
4093	28	1	4587	−27.2	1954 ± 38	−10.7 ± 4.7
4102	37	1	4577	−26.7	1946 ± 38	−10.8 ± 4.7
4122	57	1	4421	−26.8	1977 ± 39	−17.0 ± 4.8
4142	77	1	4579	−26.8	1919 ± 38	−12.3 ± 4.7
4162	97	1	4417	−27.0	1980 ± 39	−22.1 ± 4.7
4182	117	1	4581	−27.0	1920 ± 38	−17.1 ± 4.6
4202	137	1	4423	−26.7	1846 ± 38	−10.4 ± 4.7
4222	157	1	4584	−26.7	1809 ± 38	−8.3 ± 4.7
4237	172	1	4425	−26.8	1888 ± 42	−19.8 ± 5.1
4242	177	1	4580	−25.5	1911 ± 38	−23.2 ± 4.6
4258	193	1	4422	−25.0	1875 ± 39	−20.7 ± 4.8
4288	223	1	4426	−25.5	1876 ± 38	−24.3 ± 4.6
4310	245	6	4424	−24.8	1764 ± 38	−13.3 ± 4.7

REFERENCES

Becker, Bernd, 1983, The long-term radiocarbon trend of the absolute oak tree-ring chrono-
logy, 2800 to 800 BC, *in* Stuiver, Minze and Kra, R S, eds, International ^{14}C conf, 11th,
Proc: Radiocarbon, v 25, no. 2, p 197-203.
Bruns, M, Rhein, M, Linick, T W, and Suess, H E, 1983, The atmospheric ^{14}C level in the 7th
millenium BC, *in* Mook, W G and Waterbolk, H T, eds, ^{14}C and archeology: PACT, Stras-
bourg, v 8, p 511–516.
Kruse, H H, Linick, T W, Suess, H E, and Becker, Bernd, 1980, Computer-matched radiocar-
bon dates of floating tree-ring series, *in* Stuiver, Minze and Kra, R S, eds, International
^{14}C conf, 10th, Proc: Radiocarbon, v 22, no. 2, p 260–266.
Pilcher, J R, Baillie, M G L, Schmidt, B, and Becker, B, 1984, A 7272-year European tree-ring
chronology: Nature, v 312, p 150–152.
Suess, H E, 1978, La Jolla measurements of radiocarbon in tree-ring dated wood: Radiocar-
bon, v 20, p 1–18.