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GERMAN OAK AND PINE ^{14}C CALIBRATION, 7200–9439 BC

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INTRODUCTION

Radiocarbon calibration data derived from German oak chronologies, ranging back to 7200 BC, have been published in the previous Calibration Issue (Stuiver & Kra 1986). In recent years, the German oak chronology has been extended to 7938 BC (Becker, this issue). For earlier intervals, tree-ring chronologies must be based on pine, because oak re-emigrated to central Europe at the Preboreal/Boreal transition, at about 8000 BC. We have established a 1784-yr pine chronology centered in the Preboreal, and have linked it tentatively to the absolutely dated oak master. We present here calibration data based on this link, for the age range, 7145–9439 BC.

CHRONOLOGIES

The age range, 7145–7875 BC, is represented by the oak chronology, 'Main 9'. The ^{14}C analyses are spaced unevenly, as some of them were performed on floating sections, which later were integrated into the absolute chronology. The age range, 7833–9439 BC, is covered by the 1784-yr pine chronology. In an earlier publication, we derived a minimum absolute age of this series with respect to the absolute oak master by inspection of the century-type ^{14}C oscillation at the respective ends of the chronologies (Becker, Kromer & Trimborn 1991). Since then, a tentative link based on ring-width pattern has been found (see Becker 1992) leading to a shift of 74 yr toward older ages with respect to the minimum position. We calculated the calibration data based on this tentative link (Fig. 1, Table 1).

WOOD PRETREATMENT

All wood samples were chopped to 2–4 mm pieces and pretreated using the acid-alkali-acid (AAA) procedure; for the pine samples, resins were removed prior to the AAA treatment by an overnight soxhlet extraction (cyclohexane/methanol 2:1). Our adaption of the AAA sequence is as follows: 4% NaOH solution at 80°C overnight, 4% HCl at 80°C for 30 min, rinsing with hot water, 4% NaOH at 80°C for 30 min (rinsing and NaOH steps repeated up to three times until the solution becomes sufficiently transparent), 4% HCl at 80°C for 30 min and, finally, rinsing to pH 7. The yield of this procedure is between 40 to 60% by weight. Generally, we used 2–10 rings for a sample.

MEASUREMENTS

The samples (4g C) were counted in CO_2 proportional counters for 7–10 days. All ages are normalized to oxalic acid and are corrected for isotope fractionation (Stuiver & Polach 1977). Generally, the 1 σ error is between 20 and 30 yr.

Calibration Curves

Calibration curves based on the German oak and pine chronologies are shown in Figure 1A–E. As explained above, the calibrated ages prior to 7800 BC are tentative, as more trees are needed to improve the link of the two chronologies.

Throughout the age interval covered by the series, strong ^{14}C oscillations are apparent; the corresponding ^{14}C age plateaus occur at 8250, 8750, 9600 and 10,000 BP. The latter corresponds to the end of the Younger Dryas event, preventing an accurate calibration of this important transition to the Holocene. However, from stable isotope measurements of the pine series (Becker, Kromer & Trimborn 1991) and based on the link discussed above, we obtain an age of 11,050 cal BP for the beginning of climatic amelioration in central Europe.

Acknowledgments

C. Junghans performed the ^{13}C analyses. P. Reimer drafted the calibration curves. We thank M. Stuiver for stimulating discussions.

References

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Stuiver, M. and Kra, R. S., eds., 1986 Calibration Issue. *In* Stuiver, M. and Kra, R. S., eds., Proceedings of the 12th International ^{14}C Conference. *Radiocarbon* 28(2B): 805–1030.

Stuiver, M. and Polach, H. 1977 Discussion: Reporting of ^{14}C data. *Radiocarbon* 19(3): 355–363.

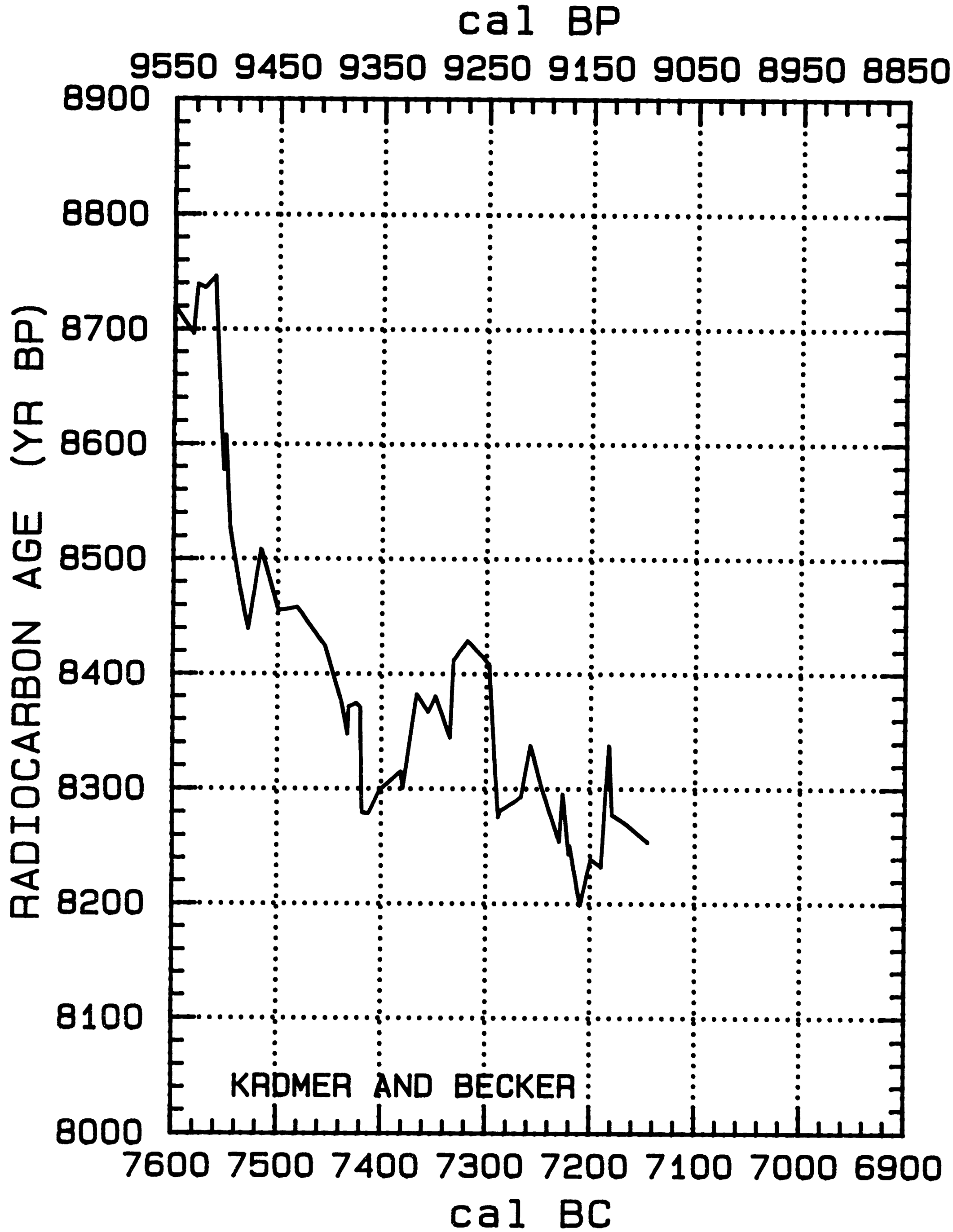

Fig. 1A–E. Calibration curves based on the German oak and pine chronologies

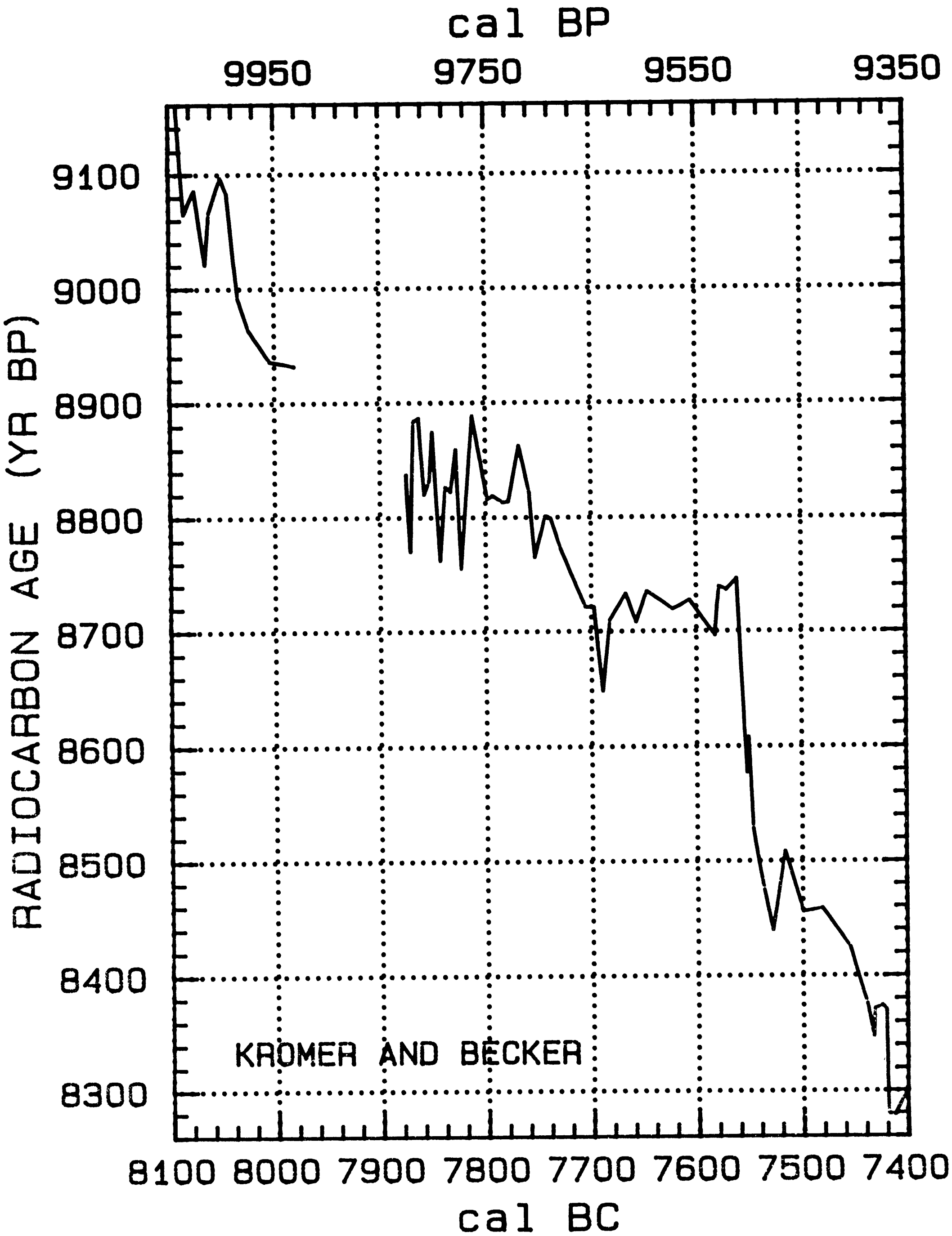
cal BP
9950
9750
9550
9350
9100
9000
8900
8800
8700
8600
8500
8400
8300
RADIOCARBON AGE (YR BP)
KROMER AND BECKER
8100 8000 7900 7800 7700 7600 7500 7400
cal BC

Fig. 1B

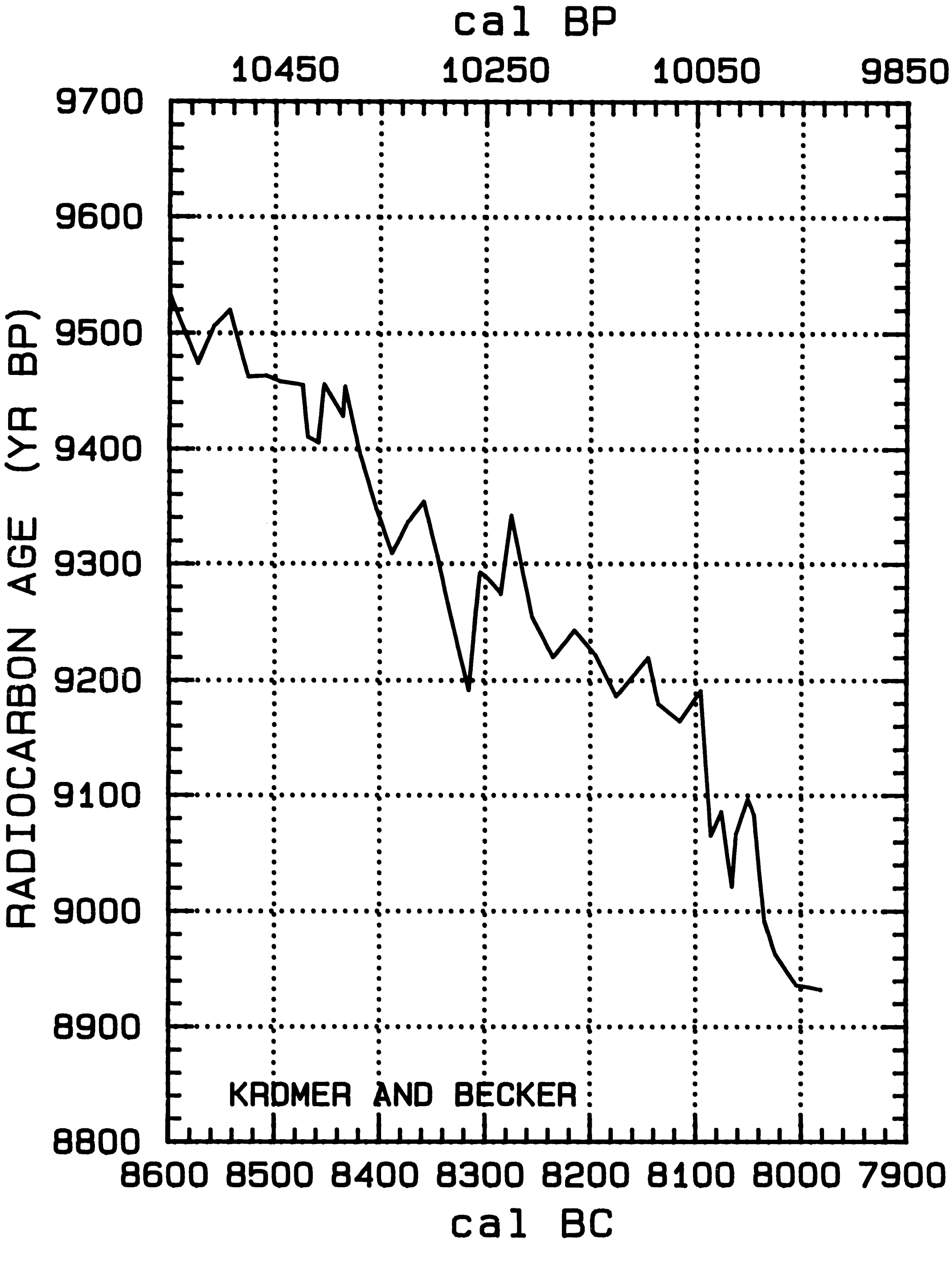
cal BP
10450
10250
10050
9850
9700
9600
9500
9400
9300
9200
9100
9000
8900
8800
RADIOCARBON AGE (YR BP)
KROMER AND BECKER
8600 8500 8400 8300 8200 8100 8000 7900
cal BC

Fig. 1C

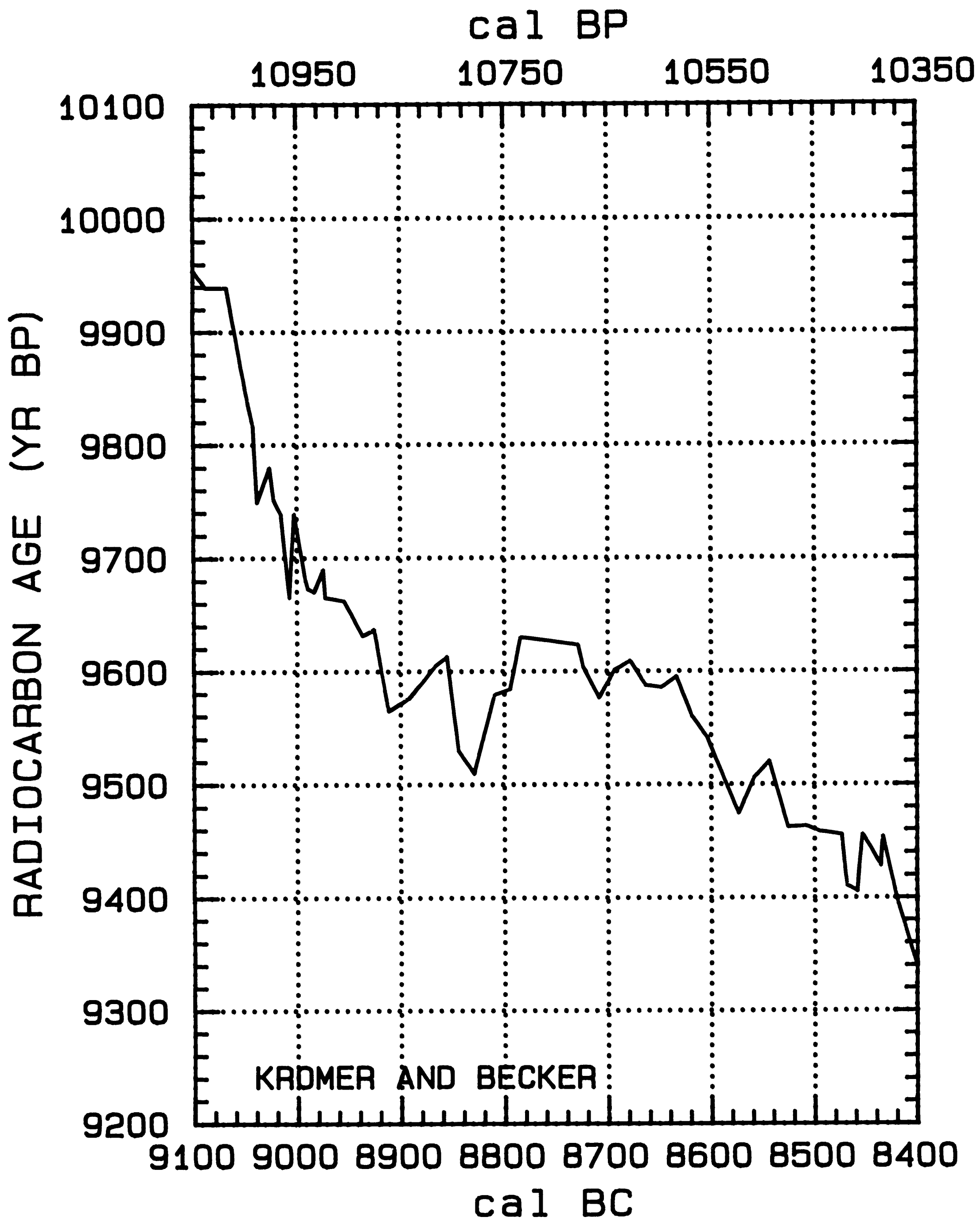
cal BP
10950
10750
10550
10350
10100
10000
9900
9800
9700
9600
9500
9400
9300
9200
RADIOCARBON AGE (YR BP)
KROMER AND BECKER
9100
9000
8900
8800
8700
8600
8500
8400
cal BC

Fig. 1D

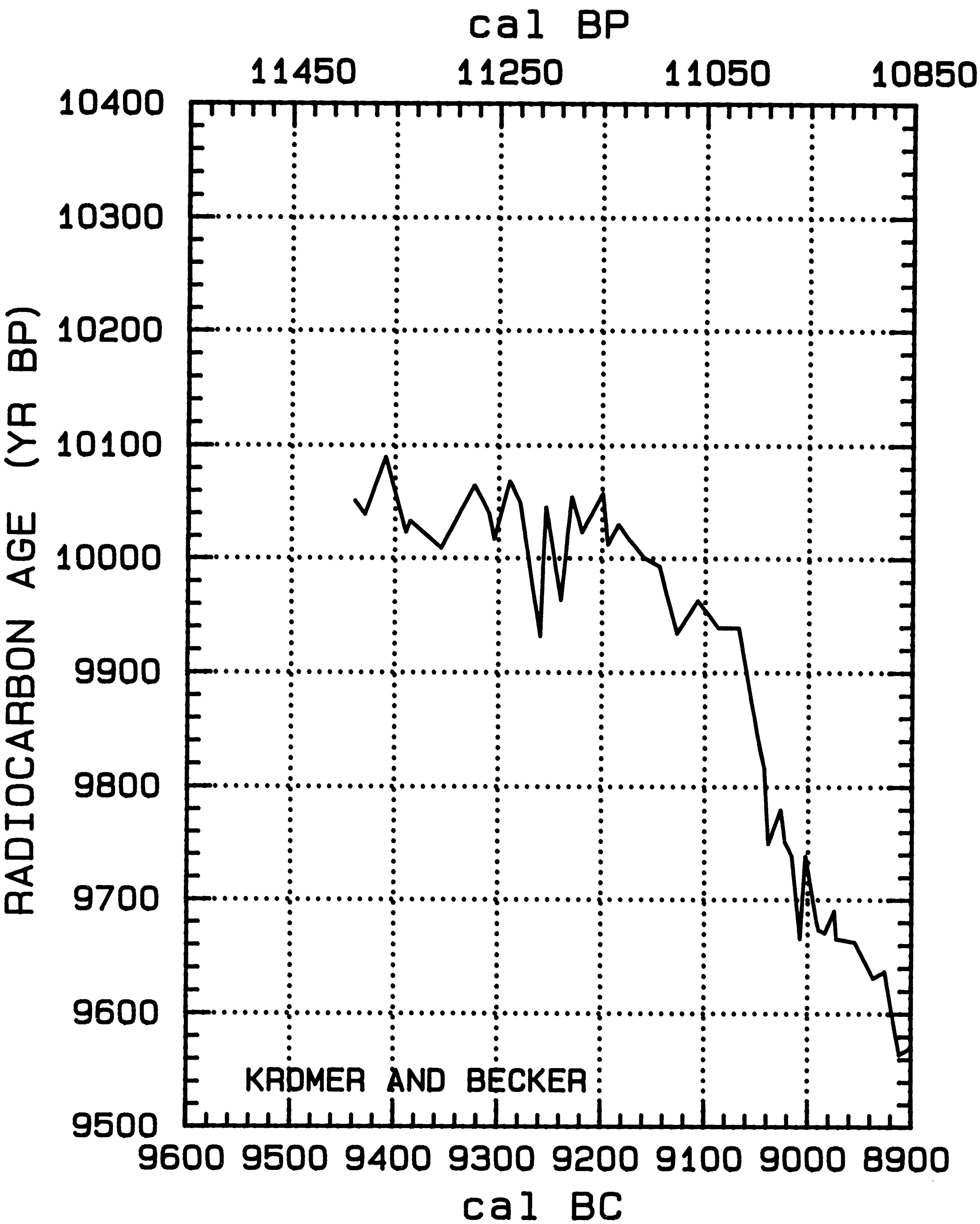
cal BP
11450
11250
11050
10850
RADIOCARBON AGE (YR BP)
10400
10300
10200
10100
10000
9900
9800
9700
9600
9500
KROMER AND BECKER
9600 9500 9400 9300 9200 9100 9000 8900
cal BC

Fig. 1E

TABLE 1. Calibration data for the age range, 7200–9400 BC. The calibrated ages prior to 7800 BC are tentative (see text).

Lab. no.	Cal BC	^{14}C BP	±	$\Delta^{14}C$	±
13511	−9439	10051	32	135	4
13512	−9429	10039	24	135	3
13525	−9409	10090	28	125	4
13526	−9389	10023	28	132	4
10567	−9385	10033	33	130	4
10568	−9355	10009	35	129	4
12888	−9323	10065	30	117	4
12945	−9309	10040	33	119	4
12959	−9304	10017	32	121	4
12960	−9289	10069	27	112	3
12964	−9279	10049	29	113	4
12987	−9259	9931	35	127	4
14220	−9254	10046	23	110	3
12988	−9239	9963	29	120	4
14159	−9229	10055	25	106	3
12999	−9219	10023	23	109	3
13000	−9199	10058	31	101	4
12967	−9194	10012	36	107	5
12968	−9184	10030	29	103	4
12981	−9174	10017	28	104	4
9097	−9159	9950	26	111	3
12982	−9159	10055	27	96	3
9098	−9144	9993	22	103	3
9118	−9127	9934	26	109	3
9119	−9107	9963	26	102	3
9126	−9087	9939	20	103	3
9127	−9067	9939	30	100	4
9134	−9047	9837	26	111	3
9810	−9042	9816	23	114	3
9969	−9038	9749	20	122	3
9811	−9026	9780	22	117	3
9135	−9022	9751	31	120	4
9970	−9015	9738	20	121	3
9807	−9007	9665	26	130	3
9153	−9002	9739	27	119	3
9808	−8991	9680	26	126	3
13009	−8989	9673	30	126	4
9836	−8983	9670	22	126	3
13010	−8974	9690	31	122	4
9837	−8972	9665	26	125	3
13059	−8954	9662	27	123	3
13087	−8936	9631	33	125	4
9844	−8925	9637	27	123	3
9853	−8911	9564	26	131	3
9864	−8891	9576	26	127	3
13088	−8866	9605	31	119	4
9865	−8855	9613	20	117	3

TABLE 1. (Continued)

Lab no.	Cal BC	^{14}C BP	±	$\Delta^{14}C$	±
13094	−8844	9529	21	127	3
13016	−8829	9509	35	128	4
13017	−8809	9579	35	115	4
13018	−8794	9584	23	112	3
14231	−8784	9630	22	105	3
9005	−8728	9623	16	98	2
8826	−8723	9603	23	100	3
8835	−8708	9576	19	102	2
8836	−8693	9601	18	97	2
8867	−8678	9609	19	93	2
8868	−8663	9587	20	94	3
8876	−8648	9585	20	93	3
8877	−8633	9595	20	89	3
8889	−8618	9559	25	92	3
8890	−8603	9540	20	93	3
8911	−8573	9474	34	98	4
8904	−8558	9506	34	92	4
8905	−8543	9520	34	88	4
8977	−8525	9462	25	93	3
8957	−8508	9463	34	91	4
8978	−8495	9458	24	90	3
8970	−8473	9455	34	87	4
9026	−8468	9410	19	93	2
8971	−8458	9405	34	92	4
9007	−8453	9456	15	85	2
8989	−8435	9428	18	86	2
9064	−8433	9454	27	82	3
9154	−8418	9394	26	88	3
9160	−8403	9348	25	93	3
9161	−8388	9309	25	96	3
9191	−8373	9336	26	90	3
9192	−8358	9354	32	86	4
9199	−8345	9307	30	91	4
10001	−8335	9266	24	95	3
10002	−8315	9191	27	102	3
10191	−8305	9293	29	87	4
10003	−8295	9285	20	87	3
10191	−8285	9274	28	87	4
10004	−8275	9342	22	77	3
10010	−8255	9254	25	86	3
10011	−8235	9220	25	88	3
10035	−8215	9243	25	82	3
10036	−8195	9222	25	82	3
10090	−8175	9186	22	85	3
10091	−8145	9220	22	76	3
10097	−8135	9179	21	80	3
10098	−8115	9164	21	80	3

TABLE 1. (Continued)

Lab no.	Cal BC	^{14}C BP	±	$\Delta^{14}C$	±
10115	−8095	9191	23	73	3
10337	−8085	9065	25	89	3
10116	−8075	9086	25	85	3
10338	−8065	9021	25	92	3
10127	−8050	9097	25	80	3
9031	−8061	9067	23	86	3
9035	−8044	9083	26	81	3
8676	−8034	8991	28	92	4
9036	−8024	8963	23	95	3
9067	−8004	8936	25	96	3
9088	−7981	8932	22	93	3
11354	−7875	8883	48	86	6
14065	−7871	8770	22	101	3
12920	−7850	8875	40	84	5
9769	−7833	8856	22	84	3
9513	−7875	8820	30	95	4
14075	−7868	8884	20	85	3
9502	−7863	8887	30	84	4
14076	−7858	8820	21	92	3
9501	−7853	8832	30	90	4
14077	−7848	8842	26	88	3
9492	−7843	8762	30	98	4
14079	−7838	8827	23	89	3
9491	−7833	8760	30	97	4
14112	−7828	8860	21	83	3
9486	−7823	8755	30	97	4
9273	−7812	8889	30	77	4
9264	−7798	8816	30	85	4
14088	−7793	8819	22	84	3
9258	−7783	8813	30	83	4
14106	−7778	8814	23	83	3
9257	−7768	8863	30	75	4
14171	−7758	8822	23	79	3
9256	−7753	8765	30	86	4
9255	−7743	8801	30	80	4
14160	−7738	8799	23	79	3
14172	−7728	8772	22	82	3
8510	−7705	8721	30	86	4
8511	−7697	8721	30	85	4
8518	−7689	8648	30	94	4
8519	−7682	8710	30	84	4
8524	−7667	8733	30	79	4
8525	−7657	8708	30	81	4
8544	−7647	8735	30	76	4
8141	−7622	8719	30	75	4
8140	−7606	8727	33	72	4
8144	−7582	8696	30	73	4

TABLE 1. (Continued)

Lab no.	Cal BC	^{14}C BP	±	Δ^{14}C	±
8091	−7578	8739	30	67	4
8286	−7571	8736	30	66	4
8145	−7561	8746	30	64	4
8295	−7552	8577	30	85	4
8244	−7550	8608	30	81	4
8127	−7546	8528	30	91	4
8151	−7536	8474	30	97	4
7758	−7528	8439	30	101	4
8171	−7516	8509	30	89	4
7759	−7499	8455	30	95	4
8273	−7481	8458	30	92	4
5768	−7454	8424	34	93	4
5173	−7438	8375	35	97	4
5429	−7432	8347	34	100	4
8304	−7431	8371	30	97	4
5453	−7424	8374	35	96	4
5430	−7420	8370	35	96	4
7760	−7418	8279	30	108	4
5057	−7412	8278	39	107	5
5058	−7401	8299	44	103	6
8086	−7381	8315	30	98	4
7757	−7379	8300	30	100	4
8306	−7366	8382	30	87	4
5469	−7355	8366	33	88	4
8117	−7348	8380	30	85	4
5494	−7334	8344	34	88	4
5400	−7331	8412	34	78	4
5115	−7318	8429	41	74	5
5170	−7297	8408	37	75	5
8247	−7288	8275	25	91	3
5121	−7286	8281	36	90	5
5264	−7266	8293	37	86	5
8248	−7257	8338	25	79	3
8190	−7247	8303	25	82	3
8191	−7229	8254	25	86	3
8689	−7226	8296	30	80	4
8285	−7220	8243	25	87	3
8717	−7219	8251	30	85	4
8718	−7209	8198	30	91	4
8719	−7199	8239	30	84	4
8720	−7189	8232	30	84	4
8248	−7182	8338	30	69	4
8750	−7179	8277	30	77	4
8751	−7168	8271	30	76	4
8181	−7145	8254	30	75	4