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FREIBERG RADIOCARBON MEASUREMENTS I

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INTRODUCTION

This list reports the first age determinations carried out by the Freiberg Radiocarbon Dating Laboratory. The preparation of samples and radiocarbon dates were done by the first two authors, who constructed the apparatus; sample descriptions and interpretations of dates were made by the third author.

After careful selection, all organic samples, unless noted otherwise, were boiled in a water bath at the neutral point. Samples were burnt in a stream of oxygen and the released CO_2 purified following the modified method of de Vries (1956). The measurements are made with a proportional counter (active volume: 0.708 l; total volume: 0.757 l) filled with purified CO_2 to a pressure of 3 atm at 24°C. The tube is made of electrolytic copper with brass ends and teflon insulators, glued in place with araldite. The shielding consists of walls of 30 cm iron, 15 cm paraffin with boric acid, 32 commercial G. M. counters (cosmic-ray type VA-Z-232, VEB Vakutronik Dresden) arranged in a double ring, and a stainless steel vessel providing a 4.5 cm layer of Hg. The counting apparatus is installed in an underground laboratory covered by 2 m brick. At present the anticoincidence background count is (3.99 $\pm$ 0.04) cpm and the net contemporary value (95% NBS oxalic acid) is (13.42 $\pm$ 0.08) cpm. As substandard, we use tree-rings from A.D. 1816 to 1822 of an oak tree 200 years old. Activity, when corrected for age, coincides with 0.95 times the activity of NBS oxalic acid. Each sample was measured twice, more than 14 days apart, for a period of 24 hours or, if necessary, of 48 hours.

Dates are based on the Libby half-life value, 5570 $\pm$ 30 yr. Errors given together with the following results of our measurements include: the standard deviation calculated from the statistical uncertainties of the counting rates of an unknown sample, background, contemporary standard, and inaccuracy of the half-life value. Calculated errors less than 100 years are rounded off to 100 years. Mass spectrometric C^{13} measurements of some samples indicate no considerable deviations; therefore, for the following samples no correction for C^{13} content was made. Details of our apparatus, sample preparation, and measuring procedure will be published elsewhere.

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CHECK SAMPLES

Freiberg laboratory		Other laboratories		References	Sample material
Sample no.	Age (yr)	Sample no.	Age (yr)		
Fr-39	10,925 ± 220	Bln-206	11,839 ± 200	unpubl.	peat
Fr-40	5155 ± 100	Bln-54	5140 ± 80	Radiocarbon, 1964, v. 6, p. 310	wood
		Bln-71	5200 ± 100	*ibid.*	
		KN-191	5290 ± 120	Radiocarbon, 1966, v. 8, p. 244	
		H-1749/ 1201	5030 ± 80	*ibid.*	
Fr-41	28,730 ± 1280	Bln-101a	27,800 ± 600	*ibid.*, p. 43	gyttja

Ages of check samples determined in this laboratory indicate satisfactory agreement with the results of other laboratories.

SAMPLE DESCRIPTIONS

Radiocarbon age measurements were carried through at two important sections of the Late Pleistocene and Holocene eras from the N area of the German uplands. Both sections allow a closely differentiated subdivision of the Eemian interglacial, the Weichselian glacial and the Holocene, permitting interpretation of the development of climate and environment in the former regions of Weichselian periglacial events.

A. Section of the Aschersleben Lake

A sediment series 25 m thick from the basin of the Aschersleben lake in the NE foreland of the Harz Mts. (51° 50′ N Lat, 11° 25′ E Long) was exposed by open-cast mining. The series includes 11 cycles of sedimentation. Each cycle is composed of 3 parts:

1) lower part: fluviatile deposits (gravels and sands)
2) middle part: limnic and telmatic deposits (gyttja and peat)
3) upper part: solifluction deposits with frost structures (cryoturbatic involutions).

Individual cycles are separated from each other by evidence of denudation. Some of the middle parts originated during periods of thermal oscillation. Other cycles, however, belong to adjacent cold periods. The lowest cycle includes the Eemian interglacial, the upper one the Holocene period. The intermediate 9 cycles represent climatic oscillations during the Weichselian glacial. The following parts of the Weichselian glacial period may be discerned (Mania, 1967 a-d; Mania and Stechemesser, 1969 b):

a) relative moist early glacial period with 5 thermal oscillations (interstadials), 1st 2 of which can be equated with Amersfoort and Brörup interstadials (Andersen, 1961; Andersen, de Vries, and Zagwijn, 1960; Zagwijn, 1961), whereas the 5th interstadial belongs to period of Stillfried-B complex (Fink, 1964) and of the Denekamp interstadial (van der Hammen *et al.*, 1967)
b) pronouncedly dry and cold high glacial period with at least 2 thermal oscillations (1 interstadial, 1 interval; a sect. from Geisel valley near Halle shows that at the end of high glacial period 2 more slight oscillations must have taken place: "Mücheln" intervals 1 and 2; they could not be identified in sect. of Aschersleben lake);
c) moist late glacial period with Bölling and Alleröd interstadials (according to palynologic investigations by Müller, 1953).

Coll. 1966 by D. Mania and H. Stechemesser (open pit Königsaue, Georg mine near Königsaue).

1750 ± 100

Fr-45. Königsaue 9 **A.D. 200**

Timber from wooden wall from depth 4.2 m, open pit Königsaue. Up to the 18th century permanently in region of subsoil water. *Comment*: archaeologic dating (ceramic objects found) to 1st to 2nd centuries confirmed (Frühe Römische Kaiserzeit) by C^{14} dates.

8640 ± 125

Fr-32. Königsaue 8 **6510 B.C.**

Peat from depth 1 m, 11th cycle, shore of lake S of vineyard (W of Königsaue). Numerous recent roots were hand picked. *Comment*: sample belongs to Boreal period and dates beginning of marginal peat formation of Aschersleben lake.

10,490 ± 240

Fr-44. Königsaue 7 **8540 B.C.**

Moss peat from depth 2 m, 10th cycle, Georg mine. *Comment*: date is consistent with estimated classification Pleistocene/Holocene transition (late Dryas period).

12,520 ± 180

Fr-25. Königsaue 6 **10,570 B.C.**

Wood (*Salix*) from depth 3.5 m from sands of base of 10th cycle, Georg mine. Geologic and palynologic investigations indicate early Dryas period. *Comment*: former examination confirms this age: H 77/54 = 12,300 ± 260 (Naturwissenschaften, 1955, v. 42, p. 409).

Fr-24. Königsaue 5 **12,890 ± 190**
10,940 B.C.

Calcareous gyttja from depth 4 m, 9th cycle, Georg mine. With numerous plant remains. According to geologic and palynologic investigations determined as Bölling interstadial. *Comment*: determination compatible with 2 previous radiocarbon datings from base of Bölling gyttja: H 88/74 = 13,250 ± 280, H 106/89 = 12,700 ± 320 (*ibid.*, above).

Fr-23. Königsaue 4 **25,000 ± 750**
23,050 B.C.

Wood (polar shrubs—*Salix*) from depth 7 m, from fine sands within sandy gyttja of 7th cycle, Georg mine. According to geologic and malacologic investigations determined as high glacial period. *Comment*: date nearly corresponds with values attached to period of Brandenburg stage (Cepek, 1965).

Fr-22. Königsaue 3 **32,500 ± 2600**
30,550 B.C.

Wood from sandy peat from depth 9 m, middle part of 6th cycle, Georg mine. According to geologic and palynologic investigations (small woods with *Pinus silvestris, Pinus cembra, Betula, Picea*) last interstadial before high glacial period. *Comment*: date indicates beginning of interstadial. Since duration is estimated to involve several millennia, high glacial period, assumed as pronouncedly cold and dry, must begin between 28,000 and 25,000 B.C. with stadial after this thermal oscillation. Following this warm interval, border of Scandinavian glacier extends farthest to S (Brandenburg stage).

Fr-19. Königsaue 2 **>40,000**

Wood (*Pinus*) from sandy peat from depth 11.5 m, middle part of 5th cycle, Georg mine. Fourth interstadial of early glacial period. *Comment*: this interstadial possibly represents Hengelo interstadial (van der Hammen *et al.*, 1967).

Fr-17. Königsaue 1 **>40,000**

Herbaceous remains (chiefly grasses) from clay-gyttja of depth 12 m, medium part of 5th cycle, open-cast mine Königsaue. Fourth interstadial of early glacial period. *Comment*: like previous date (Fr-19), this belongs to 1st upper sedimentary cycle reaching as far as limit of 40,000 yr.

B. Section from Grosskröbitz-Plinz, district Jena, Germany (GDR)

Section is from E highlands of Thuringia (50° 50′ N Lat, 11° 30′ E Long). The filling of a valley 12 m thick, mainly consisting of paludal lime, peat, and gyttja, was cut and exposed by recent erosion. Greatest part is Holocene. However, at some places a subdeposit of late glacial series which divided by Bölling and Alleröd deposits is recognized. Holocene series begins with peat containing numerous remains of *Pinus*. Higher up it is gradually replaced by paludal and fluviatile limes. While

basal peat extends into pre-Boreal period (mainly pine forest), thin seams of peat with remains of deciduous trees (probably *Quercus*), in paludal limes belong to Boreal age (Mania and Stechemesser, 1969 a). Coll. 1966 by D. Mania and H. Stechemesser.

8340 ± 125
6390 B.C.

Fr-38. Plinz 1

Fragments of deciduous trees from layer of peat, 5 cm thick, embedded in paludal lime, interpreted as of Boreal age, at depth 6.5 m, 1 m above basal peat. *Comment*: Boreal age is confirmed.

8660 ± 125
6710 B.C.

Fr-36. Plinz 2

Fragments of deciduous trees from humus zone in paludal lime, 5 cm above basal peat, at depth 7.5 m. *Comment*: horizon in beginning of Boreal period.

9290 ± 125
7340 B.C.

Fr-37. Plinz 3

Calcareous peat (base peat) from depth 8 m. Recent roots removed by hand picking. Treatment with 20% HCl for 3 hr. *Comment*: result confirms interpretation as pre-Boreal. Dates of Fr-36 and Fr-37 indicate pre-Boreal/Boreal transition, which coincides with marked change of sedimentation.

9500 ± 135
7550 B.C.

Fr-35. Plinz 4

Cones and wood (*Pinus silvestris*) from lowest zone of basal peat, interpreted as pre-Boreal, depth 8.5 m. *Comment*: mid-pre-Boreal age is confirmed. Ca. 10 cm below peat sample a clay horizon begins, according to geologic and malacologic observations, belonging to Pleistocene/Holocene boundary. Comparable dates exist from Alperstedt Ried in Thuringian basin (Lange, 1965), Bln-242, 9975 ± 160 and from Lower Lusatia (Cepek, 1965), Bln-99, 9905 ± 200 (Radiocarbon, 1966, v. 8, p. 40).

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