

## UNIVERSITY OF KIEL RADIOCARBON MEASUREMENTS III

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Most of the measurements have been obtained with a 4.5-L  $CO_2$  counter (Kiel I). Dates given are not corrected for  $C^{13}/C^{12}$  except *Ulmus* series. Error corresponds to  $1\sigma$  of statistical variations of sample net counting rate including variance of reference and background, but does not include the uncertainty in  $C^{14}$  half-life and in secular  $C^{14}$  variations. Half-life is 5570 yr and A.D. 1950 is zero point of B.P. scale.

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## I. BOMB PRODUCED RADIOCARBON

To get some more information about the distribution of bomb produced  $C^{14}$ , we measured the last 17 tree-rings of an *Ulmus* cut 1965 in Kiel ( $54^\circ 19' 55''$  N Lat,  $10^\circ 7' 30''$  E Long). The  $C^{13}/C^{12}$  ratio was measured with an Atlas CH4 mass spectrometer against NBS standard oxalic acid which was prepared in the same manner as tree samples. For the oxalic acid we assumed  $\delta C^{13} = -19.3\text{‰}$  (Craig, 1961). In this assumption, there can be a systematic error, which is too small to affect the  $\Delta$ -values seriously.  $\delta C^{13}$  values in parenthesis were not measured. For calculation of  $\Delta$  we used in these cases the mean value  $-25.5\text{‰}$ .

Sample	Year of tree-ring growth	$\delta C^{14} \text{‰}$	$\delta C^{13} \text{‰}$	$\Delta$
KI-141/1	1964	$908 \pm 15$	$-24.4$	$906 \pm 15$
KI-141/2	1963	$842 \pm 10$	( $-25.5$ )	$844 \pm 10$
KI-141/3	1962	$405 \pm 22$	$-25.6$	$407 \pm 22$
KI-141/4	1961	$233 \pm 7$	$-27.0$	$238 \pm 8$
KI-141/5	1960	$253 \pm 9$	$-26.0$	$256 \pm 9$
KI-141/6	1959	$292 \pm 7$	( $-25.5$ )	$293 \pm 7$
KI-141/7	1958	$171 \pm 6$	$-25.2$	$171 \pm 6$
KI-141/8	1957	$116 \pm 9$	( $-25.5$ )	$117 \pm 9$
KI-141/9	1956	$26 \pm 10$	$-25.3$	$27 \pm 10$
KI-141/10	1955	$18 \pm 6$	$-24.2$	$16 \pm 6$
KI-141/12	1953	$-6 \pm 7$	$-25.1$	$-6 \pm 7$
KI-141/13	1952	$-5 \pm 9$	$-25.4$	$-4 \pm 9$
KI-141/14	1951	$-20 \pm 6$	$-26.2$	$-18 \pm 6$
KI-141/15	1950	$-21 \pm 5$	$-25.5$	$-20 \pm 5$
KI-141/16	1949	$-37 \pm 5$	$-25.3$	$-36 \pm 5$
KI-141/17	1948	$-41 \pm 6$	$-26.6$	$-38 \pm 6$

## II. GEOLOGIC SAMPLES

**Dahldorf series**

Peat samples from N part of "Teufelsmoor," 2 km SW of Gnarrenburg (53° 22.1' N Lat, 8° 58.7' E Long), Germany. Coll. 1963 and subm. 1965 by F. Overbeck, Botanisches Inst., Univ. Kiel, who also made pollen analysis. Series aids investigation of history of settlement in N Germany. Samples KI-135, KI-136, and KI-137 contained large amounts of rootlets, most of which were removed before chemical treatment. Some dates were listed earlier in Kiel I and Kiel II. The completed series is given now.

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
|                                                                                                                                                                                                                                                                                        | <b>2160 ± 80</b> |
| <b>KI-23. Dahldorf II-1, 30 cm depth</b>                                                                                                                                                                                                                                               | <b>210 B.C.</b>  |
| Sphagnum peat from upper part of highly humified peat layer. From this level upward <i>Carpinus</i> exceeds 1%. <i>Fagus</i> is 5% and more (Kiel I).                                                                                                                                  |                  |
|                                                                                                                                                                                                                                                                                        | <b>2530 ± 50</b> |
| <b>KI-133. Dahldorf II-2, 50 cm depth</b>                                                                                                                                                                                                                                              | <b>580 B.C.</b>  |
| <i>Plantago lanceolata</i> , <i>Rumex</i> , <i>Artemisia</i> at minimum show lack of agriculture. No cereal-type pollen found. <i>Fagus</i> at minimum. <i>Corylus</i> is dropped to 10%.                                                                                              |                  |
|                                                                                                                                                                                                                                                                                        | <b>2550 ± 50</b> |
| <b>KI-24. Dahldorf II-3, 70 cm depth</b>                                                                                                                                                                                                                                               | <b>600 B.C.</b>  |
| Maximum of humification. <i>Corylus</i> at 5 to 10%. No agriculture at this time (Kiel I).                                                                                                                                                                                             |                  |
|                                                                                                                                                                                                                                                                                        | <b>2960 ± 40</b> |
| <b>KI-135. Dahldorf II-4, 98 cm depth</b>                                                                                                                                                                                                                                              | <b>1010 B.C.</b> |
| Sample from just above contact between black and light peat.                                                                                                                                                                                                                           |                  |
|                                                                                                                                                                                                                                                                                        | <b>3110 ± 70</b> |
| <b>KI-136. Dahldorf II-5, 100 cm depth</b>                                                                                                                                                                                                                                             | <b>1160 B.C.</b> |
| 0 to 1 cm below contact between dark and light peat, just below 1st indication of cereal-type pollen. <i>Comment</i> : date includes previous measurement (KI-25, Kiel II). KI-135 and KI-136 indicate no great interval of reduced growth rate during change from dark to light peat. |                  |
|                                                                                                                                                                                                                                                                                        | <b>3050 ± 60</b> |
| <b>KI-137. Dahldorf II-6, 105 cm depth</b>                                                                                                                                                                                                                                             | <b>1100 B.C.</b> |
| Above this level <i>Fagus</i> is less than 1%.                                                                                                                                                                                                                                         |                  |
|                                                                                                                                                                                                                                                                                        | <b>3510 ± 65</b> |
| <b>KI-138. Dahldorf II-7, 130 cm depth</b>                                                                                                                                                                                                                                             | <b>1560 B.C.</b> |
| Maximum of <i>Corylus</i> (up to 38%). <i>Tilia</i> less than 1%. <i>Plantago lanceolata</i> beginning of strong increase (Kiel II).                                                                                                                                                   |                  |
|                                                                                                                                                                                                                                                                                        | <b>4710 ± 45</b> |
| <b>KI-139. Dahldorf II-8, 187 cm depth</b>                                                                                                                                                                                                                                             | <b>2760 B.C.</b> |

**KI-140. Dahldorf II-9, 195 cm depth** **4600 ± 100**  
**2650 B.C.**

From this level upward *Plantago* curve is continuous and *Ulmus* is less than 5.2% (Kiel II).

#### **Esterweger series**

Peat samples from "Esterweger Dose," bog near Burlage (53° 3.2' N Lat, 7° 34.5' E Long, Messtischblatt Burlage Nr. 2911 r 3408680 h 5878340), Germany. Coll. 1963 and subm. 1965 by R. Wiermann, Botanisches Inst., Univ. Münster, Germany. *Comment*: this series aids investigation of development of vegetation in N Germany and helps date some significant horizons in history of propagation of *Fagus* (KI-177-179) and *Carpinus* (KI-175, 176). Other samples give dates of special events in history of agriculture (lack of agriculture) KI-169-170; KI-172; KI-174 and KI-177-179).

<b>KI-169. ED-II, 1, 5.0 to 9.5 cm</b>	<b>210 ± 40</b> <b>A.D. 1740</b>
<b>KI-170. ED-II, 2, 9.5 to 14.0 cm</b>	<b>410 ± 35</b> <b>A.D. 1540</b>
<b>KI-172. ED-II, 4, 24.5 to 28.0 cm</b>	<b>680 ± 35</b> <b>A.D. 1270</b>
<b>KI-173. ED-II, 5, 38.3 to 42.0 cm</b>	<b>800 ± 55</b> <b>A.D. 1150</b>
<b>KI-174. ED-II, 6, 49.5 to 54.0 cm</b>	<b>1050 ± 40</b> <b>A.D. 900</b>
<b>KI-175. ED-II, 7, 75 to 80 cm</b>	<b>1560 ± 50</b> <b>A.D. 390</b>
<b>KI-176. ED-II, 8, 80 to 85 cm</b>	<b>1450 ± 60</b> <b>A.D. 500</b>
<b>KI-177. ED-II, 9, 85 to 90 cm</b>	<b>1490 ± 55</b> <b>A.D. 460</b>
<b>KI-178. ED-II, 10, 90 to 95 cm</b>	<b>1620 ± 50</b> <b>A.D. 330</b>
<b>KI-179. ED-II, 11, 95 to 100 cm</b>	<b>1730 ± 50</b> <b>A.D. 220</b>

#### **Kubitzberg**

Peat from Kubitzberger Moor, bog (54° 24' N Lat, 10° 7' E Long), 1 km NW of Altenholz near Kiel, Germany. Coll. by Usinger; subm. 1967 by L. Aletsee and J. Gehl, Botanisches Inst., Univ. Kiel. Samples record development of forests in N Germany. Height difference between samples is 35 cm.

**KI-94. Kub B II — a** **8200 ± 160**  
**6250 B.C.**  
Maximum of *Corylus*; 1st *Fagus* pollen.

**KI-219. Kub B II — b** **8530 ± 70**  
**6580 B.C.**  
First increase of *Corylus*.

## III. ARCHAEOLOGIC SAMPLES

**Möllenknob series**

Samples from excavations of "Möllenknob" settlement near Archsum on Sylt island, Schleswig-Holstein (54° 52.7' N Lat, 8° 22.5' E Long, Topographische Karte 1116 Morsum r 3460 760 h 6082 360), Germany.

Rural settlement in form of "Tell" at border of sandy moraine ("Geest") to marsh ("Marsch") with 7 phases of late Bronze age to 4th century A.D.

Excavations directed by G. Kossack, Inst. für Ur-und Frühgeschichte, Univ. Kiel. Coll. 1963, 1964 by R. Kenk; subm. 1965 by G. Kossack and F. R. Averdieck, Univ. Kiel. Excavations are being conducted now; a complete treatise on "Möllenknob" is to be published.

Archaeologic dating will not be exact until material is studied in detail.

**KI-144. Möllenknob 25, 6** **1650 ± 35**  
**A.D. 300**  
Carbonized barleycorns from rubble of burned dwelling house; 100 cm below surface (3.90 m NN); preliminary archaeol. estimate 200-300 A.D.

**KI-145. Möllenknob 13, 1** **1910 ± 45**  
**A.D. 40**  
Charcoal of *Fraxinus* root 30 to 40 cm below surface; archaeol. dated ca. 4th century A.D.

**KI-146. Möllenknob 28, 3** **1920 ± 60**  
**A.D. 30**  
Charcoal (*Quercus*) of house post; 100 cm below surface; preliminary archaeol. estimate 200-400 A.D.

**KI-147. Möllenknob 64, 5** **2030 ± 70**  
**80 B.C.**  
Wood (*Quercus*); 150 cm below surface; preliminary archaeol. estimate 0-200 A.D.

**KI-148. Möllenknob 68, 3** **1940 ± 40**  
**A.D. 10**  
Wood (*Alnus*) from pile, 160 m below surface; preliminary archaeol. estimate 0-200 A.D.

- 3060 ± 50**  
**1110 B.C.**
- KI-149. Möllenknoib 98, 11**  
Charcoal (*Quercus*); 120 cm below surface; supposedly belongs to late Bronze age grave.
- 1920 ± 60**  
**A.D. 30**
- KI-150. Möllenknoib 101, 4**  
Charcoal (*Quercus*); 100 cm below surface; parts of burned house; preliminary archaeol. estimate 0-200 A.D.
- 1980 ± 60**  
**30 B.C.**
- KI-151. Möllenknoib 123, 5**  
Charcoal (*Quercus*) from rubble of burned dwelling; preliminary archaeol. estimate 200-400 A.D.
- 1830 ± 60**  
**A.D. 120**
- KI-74. Möllenknoib**  
Wattle and daub in stratum of dung; preliminary archaeol. estimate ca. 2nd century A.D.  
*General Comment* (F.R.A.): there seems to be a systematic difference between C<sup>14</sup> dates and archaeological dates, which cannot be explained by variations of C<sup>14</sup> content of atmosphere. Possibly on this island without trees the same wood was used more than once, and therefore was cut long before it reached discovery site.  
Cereals and wattle, expected to have grown a short time before their carbonization, give same age as expected archaeologically (KI-144, KI-74).
- Dätgen, mummified human body**  
*Sphagnum cuspidatum* peat, Grosses Moor, Dätgen, (54° 10 N Lat, 9° 56' E Long), Germany. Subm. 1966 by L. Aletsee, Botanisches Inst., Univ. Kiel, now at Technische Hochschule Aachen.
- 2055 ± 50**  
**105 B.C.**
- KI-86. Dätgen — upper layer**  
Peat from hollow mummified body was lying in. According to stratigraphical position peat should give lower age limit. Date given in Kiel I (KI-17, 2065 ± 90) should be upper age limit.
- 2030 ± 60**  
**80 B.C.**
- KI-92. Dätgen — medium layer**  
Third peat sample from another part of hollow. *Comment*: there is no significant difference among the 3 dates.

## REFERENCES

## Date lists:

Kiel I	Willkomm and Erlenkeuser, 1966
Kiel II	Willkomm and Erlenkeuser, 1967

Craig, Harmon, 1961, Mass-spectrometer analyses of radiocarbon standards: Radiocarbon, v. 3, p. 1-3.