

## UNIVERSITY OF KIEL RADIOCARBON MEASUREMENTS I

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The  $C^{14}$  Laboratory at Kiel University was established in 1963. It continues measurements, which were made at the Institut für Kernphysik, Kiel, on age determination with Chlorine 36, which is produced by cosmic ray neutrons (Bagge and Willkomm, 1963, 1966). The first  $C^{14}$ -counting apparatus was completed in 1964 and dating work started at the end of 1964 after extensive general tests of counter working conditions (Erlenkeuser, 1965). The data reported here have been obtained during the first half of 1965. During this period the dating measurements were interrupted on numerous occasions by measurements of background and the oxalic standard in order to check long-time variations of the apparatus.

The counter in use is built of commercially available copper. Outer dimensions are: length 950 mm, diam 104 mm. The sensitive counter volume is screened by a tube of highly purified quartz material in order to eliminate wall contamination (Scholz, 1961). The background due to wall contamination is less than 1 cpm. The sensitive volume amounts to 4.5 L, its surface is 2270  $cm^2$ , the wire diam is 0.05 mm. The counter is surrounded by 4.5 cm of selected lead followed by 36 Geiger-Müller anticoincidence counters arranged in a double ring and finally by 10 cm of old lead.

The counter gas is carbon dioxide usually filled to 500 torr. Pressures up to 3 atm are possible. The high voltage at 500 torr is 3600 v. The sample is counted for at least 48 hours. The background is ca. 20 cpm and gives a plateau slope of 2.5%/100 v for at least 600 v. The barometric pressure coefficient amounts to  $-1.8\%$  torr. However, gross counting rates are corrected using the coincidences between the counter and the anticoincidence ring, and not using the atmospheric pressure directly, since the background counting rate shows a closer proportionality to these coincidences than to the atmospheric pressure. The background may be reduced to ca. 10 cpm if some gaps in the anticoincidence ring are closed; these are now due to an unexpected thickness of the glass-walls of the GM-tubes in use (Trondheim I, 1959).

Modern activity is given by 95% of NBS oxalic-acid standard activity. This standard gives a net counting rate (at a pressure of 500 torr) of  $22.07 \pm 0.05$  cpm. A second standard is given by rings of an oak tree, 280 yr old. The rings of the years 1845 to 1850 give an age-corrected activity of  $95.2 \pm 1\%$  of oxalic standard (see KI-6, 7, 10).

Organic samples such as wood or peat are usually boiled with dilute HCl, washed with distilled water, boiled with dilute NaOH, carefully washed again and then dried at 150°C. This treatment removes carbonate and most of the humus. The dry substance is then burned to  $CO_2$ . When combustion is finished,  $CO_2$  is absorbed in a  $NH_4OH-CaCl_2$

solution. Within ca. 6 hours at 80°C, CaCO<sub>3</sub> is precipitated quantitatively, and after intensive washing, CO<sub>2</sub> is liberated by sulfuric acid. This method, described by Münnich (1957) gives a very pure counting gas free of radon.

Dates given are not corrected for the C<sup>13</sup>/C<sup>12</sup> ratio. The error quoted here corresponds to 1σ. No account has been taken of the error in the C<sup>14</sup> half-life and of the de Vries effect. Our dates are based on the Libby half-life and A.D. 1950 as zero B.P.

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## I. CHECK SAMPLES

**KI-6. Oak-standard** **mean: 95.2 ± 1% of**  
**KI-7.** **NBS standard activity**  
**KI-8.**

Slice of oak tree grown near Ratzeburg, Schleswig-Holstein, Germany (53° 42' N Lat, 10° 47' E Long), felled 1954. The 280 rings of slice cover period from 1674 to 1954. Subm. F. Overbeck, Botanisches Inst., Kiel Univ., Germany. Tree is to give a second standard in addition to NBS standard. Rings grown between 1845 to 1850 give average age-corrected activity of 95.2 ± 1% of the NBS activity.

**2700 ± 200**  
**750 B.C.**

**KI-11. Dätgen A-III/2**

Peat from Grosses Moor near Dätgen (54° 9.7' N Lat, 9° 55.2' E Long), 0 to 2 cm below contact between dark and light peat, pollen analyzed by L. Aletsee (1959). Coll. 1963 and subm. 1964 by L. Aletsee. Samples of same stratigraphic position located a few cm away from A-III/2 dated by Heidelberg (A-III/1, subm. 1961 by L. Aletsee, 2965 ± 60, H-1590b-1257, unpub.) and by Hannover (A-III/3, coll. and subm. 1964, 2935 ± 80, Hv-678-BV, unpub.).

**3090 ± 200**  
**1240 B.C.**

**KI-12. Vierthmoor, Gnutz**

**2970 ± 80**  
**1020 B.C.**

**KI-18.**

Wood of *Betula* stump, diam 9 cm, from Vierthmoor near Gnutz,

Germany (54° 6.8' N Lat, 9° 49.1' E Long). Subm. 1964 by L. Aletsee. Stump found in basal peat of bog, a few m away from section G-2 (see Aletsee, 1959, for stratigraphical and pollenanalytical comment). Sample dated second time with increased accuracy. Wood of same sample dated by Hannover to 2940 ± 60 (Hv-477, unpub.). Peat of same stratigraphic position as the *Betula* stump (subm. 1961 by L. Aletsee) dated by Heidelberg to 2990 ± 70 (H-1589-1136, unpub.).

## II. GEOLOGIC SAMPLES

### Nitrogen series, Dätgen

Peat samples D-N/1, D-N/2 from Grosses Moor at Dätgen, Germany (54° 9.7' N Lat, 9° 55.7' E Long), are from upper and lower surface of a monolith that was used to estimate nitrogen content of light peat (Aletsee, 1966). Coll. 1961, subm. 1964 by Aletsee. Each sample dated twice within two months. Error includes some technical difficulties and may be too high.

**KI-8. Dätgen D-N/1** **1530 ± 200**  
**A.D. 420**  
Sample D-N/1, 29 to 31 cm below surface.

**KI-14.** **1506 ± 200**  
**A.D. 444**

**KI-9. Dätgen D-N/2** **2340 ± 200**  
**390 B.C.**  
Sample D-N/2, 121 to 123 cm below surface.

**KI-15.** **2330 ± 200**  
**380 B.C.**

**KI-26. Segeberg** **5270 ± 120**  
**3320 B.C.**

Highly humified peat from bottom of Kleiner Segeberger See, Segeberg, Germany (53° 56.2' N Lat, 10° 18.9' E Long), 25 to 25.10 m below lake level. *Ulmus* starts decreasing, beginning of *Plantago* just above. Coll. 1963 and subm. 1965 by L. Aletsee. *Comment:* sample also useful for investigation of age of stalactite cavern at Segeberg.

## III. DAHLDORF DATES

Dahldorf samples are collected at 53° 22.1' N Lat, 8° 58.7' E Long. Subm. by F. Overbeck. Series contributes to continuing investigation of younger history of settlement in northern Germany.

**KI-23. Dahldorf II-1, 30 cm depth** **2160 ± 80**  
**210 B.C.**

Sphagnum peat from upper part of highly humified peat layer. From this level upward *Carpinus* exceeds 1%, *Fagus* is 5% and more.

**KI-24. Dahldorf II-3, 70 cm depth** **2550 ± 60**  
**600 B.C.**

Maximum of humification. From this level upward *Corylus* is below 10%. Agricultural activity decreasing.

**KI-25. Dahldorf II-5, 100 cm depth** **3110 ± 70**  
**1160 B.C.**

0 to 1 cm below contact between dark and light peat (depth of contact: 100 cm), just below first indication of pollen of cereal type. *Comment*: numerous rootlets had to be removed before chemical treatment. They will be dated later.

#### IV. ARCHAEOLOGIC SAMPLES

**KI-17. Dätgen, mummified man's body** **2065 ± 90**  
**115 B.C.**

*Sphagnum cuspidatum* peat, Grosses Moor, Dätgen, Germany (54° 10' N Lat, 9° 56' E Long). Peat from a hollow, 114 to 116 cm below surface; from this level upward *Fagus* exceeds 5%. Coll. 1959 and subm. 1964 by L. Aletsee. Peat gives minimal date for mummified man's body lying in the hollow.

**KI-20. Gernsbach** **385 ± 80**  
**A.D. 1565**

Wood of coffin found in crypt of Evangelische Stadtkirche, Gernsbach, Germany. Subm. 1964 by U. Schaefer, now of Univ. of Giessen, Germany.

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