

HANNOVER RADIOCARBON MEASUREMENTS III

MEBUS A. GEYH and HEINRICH SCHNEEKLOTH

Niedersächsisches Landesamt für Bodenforschung, Hannover

The following list covers the measurements in our institute from January 1962 to March 1963. Sample preparation and conversion into acetylene are described by Wendt, Schneekloth and Budde (1962).

An Oeschger counter with an effective volume of 1.5 L came into operation in 1962. It is shielded by 4 cm of iron and 10 cm of lead. The background amounts to 2.24 cpm, the standard C^{14} counting-rate 17.05 cpm. In routine measurements, the impure acetylene, after a four-week storing period, is put into the counters. Examination of purity of the gas is carried out by means of an external Cs^{137} source. In case the gas shows bad plateau characteristics, it is converted by a new process into ethane, using H_2 and a palladium catalyst. Thereby, the plateau characteristics improve considerably. The 50%-voltage then is 200 v lower, the slope of the plateau only amounts to 0.2 %/100 v (with external source), and the plateau length increases from 600 v to 1200 v. The additional work amounts to $\frac{1}{2}$ hour.

After the midpoint of the plateau is chosen by use of the external source, measurements are made at two different voltages, 100 v above and below the midpoint. The slope of the plateau for all pulses counted, including coincidences, is estimated in this way and is taken into account in calculating errors. Replicate measurements are compared by calculating χ^2 , and are not averaged unless the probability of a real difference is less than 0.99; a confidence limit of 0.95 is required for combination of replicates of background and of reference standard counts. Infinite ages are stated on a criterion of $+ 2\sigma$ above background.

Age determinations of spring water were carried out on assumptions discussed by Münnich (1957). The recent activity was assumed to be 70% of the C^{14} activity of recent wood. Results from water samples are dependent on unknown changes in the C^{14} activity of modern reservoirs. The stated limits of error do not include the deviations caused thereby, which may amount to at least ± 1000 yr. Values of δC^{13} , though measured, were not used as corrective factors.

Abbreviations in the following text are N.L.f.B. for Niedersächsisches Landesamt für Bodenforschung, Hannover (Germany); B.f.B. for Bundesanstalt für Bodenforschung, Hannover, (Germany); and D.G.M. for Deutsche Geologische Mission.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

*A. Germany***Hv-173. Heseperst, Niedersachsen****8400 ± 340
6450 B.C.**

Charcoal from surface digging near Heseperst, depth 250 cm (52° 36' 55" N Lat, 7° 07' 27" E Long), on podsolc soil, overlain by raised bog 250 cm thick. Coll. 1960 and subm. by Christian Ullrich, N.L.f.B. *Comment:* beginning of bog growth obtained by pollen analysis was in Zone IX (3000 to 1000 B.C.) according to Overbeck and others (1957). Pollen analysis by Heinrich Schneekloth, N.L.f.B.

Wanna series, Niedersachsen

Peat samples from coastal bog in marshy area near Wanna. Typical profiles of bog display, as result of postglacial sealevel changes, repeated oscillation between growth of highmoor peat and sedimentation below water table. Intercalated nonpeaty sediments include marine clay up to 5 m thick, age of which is bracketed by dates of over- and underlying peat. Episodes of growth and non-growth in bogs situated further inland are connected to the oscillations of sealevel. Samples are from 11 profiles. Two of them (Wanna 436 and Wanna 437) were investigated palynologically by H. Schneekloth (1963a), and geology is described by Schneekloth (1963b). Altitudes in following descriptions are related to sealevel (NN = Normal Null). Coll. and subm. 1962 by H. Schneekloth.

Hv-281. Wanna, Profile 423, 180 to 190 cm**3490 ± 80
1540 B.C.**

Valley-bog peat overlying marine clay 250 cm thick, 1.3 m below NN (53° 46' 40" N Lat, 8° 43' 30" E Long).

Hv-282. Wanna, Profile 436, 110 to 120 cm**1540 ± 90
A.D. 410**

Slightly decomposed Sphagnum peat directly above a recurrence horizon (SWK = Schwarz-/Weisstorfkontakt), 1.3 m above NN (53° 45' 45" N Lat, 8° 43' 01" E Long).

Hv-283. Wanna, Profile 436, 240 to 250 cm**2590 ± 90
640 B.C.**

Valley-bog peat directly overlying marine clay 80 cm thick in same boring as Hv-282, alt about NN.

Hv-196. Wanna, Profile 436, 390 to 400 cm**4340 ± 230
2390 B.C.**

Valley-bog peat, 40 cm above base of bog, in same boring as Hv-282, 1.6 m below NN.

Hv-284. Wanna, Profile 453, 145 to 155 cm**4230 ± 80
2280 B.C.**

Valley-bog peat directly overlying marine clay 350 cm thick, 0.2 m above NN (53° 46' 00" N Lat, 8° 45' 18" E Long).

Hv-285. Wanna, Profile 456, 115 to 120 cm **4190 $\pm$ 80**
2240 B.C.

Valley-bog peat layer 30 cm thick is intercalated within raised-bog peat ca. 250 cm thick. Sample was strongly decomposed Sphagnum peat directly above valley-bog peat layer, 0.4 m above NN (53° 45' 40" N Lat, 8° 44' 38" E Long).

Hv-286. Wanna, Profile 458, 180 to 190 cm **3290 $\pm$ 60**
1340 B.C.

From valley-bog peat layer 25 cm thick, intercalated within raised-bog peat ca. 250 cm thick, 0.1 m above NN (53° 45' 43" N Lat, 8° 45' 18" E Long).

Hv-287. Wanna, Profile 458, 330 to 350 cm **4230 $\pm$ 60**
2280 B.C.

Valley-bog peat directly overlying marine clay 170 cm thick, 1.45 m below NN. From same boring as Hv-286.

Hv-288. Wanna, Profile 460, 160 to 170 cm **5120 $\pm$ 70**
3170 B.C.

Birch-wood peat directly overlying clay layer 10 cm thick, overlain and underlain by raised-bog peat, 0.5 m above NN (53° 45' 15" N Lat, 8° 45' 18" E Long). *Comment:* clay at this alt is unlikely to be marine, and has probably been washed in from adjoining boulder-clay slopes. Date also shows the section to be anomalous; comparison with other Wanna samples cannot yet be made.

Hv-290. Wanna, Profile 474, 75 to 85 cm **3390 $\pm$ 70**
1440 B.C.

Stratigraphic sequence in profile 474 (53° 45' 07" N Lat, 8° 48' 04" E Long): down to 85 cm, valley-bog peat; 85 to 110 cm, transition-bog peat; 110 to 160 cm, valley-bog peat (lower part slightly clayey); 160 to 175 cm, marine clay; 175 to 210 cm, raised-bog peat; 210 to 215 cm, valley-bog peat; 215 to 275 cm, marine clay; 275 to 360 cm, transition-bog peat with thin layers of clay; Pleistocene sand below. Sample was valley-bog peat from directly above uppermost transition-peat layer, 0.7 m below NN.

Hv-289. Wanna, Profile 474, 150 to 160 cm **4080 $\pm$ 70**
2130 B.C.

From same profile as Hv-290; valley-bog peat overlying upper marine clay layer, 1.5 m below NN.

Hv-291. Wanna, Profile 477, 135 to 145 cm **2630 $\pm$ 70**
680 B.C.

Stratigraphic sequence in profile 477 (53° 44' 50" N Lat, 8° 48' 20" E Long): down to 120 cm, slightly decomposed Sphagnum peat; 120 to 150 cm, valley-bog peat; 150 to 180 cm, transition-bog peat; 180 to 250 cm, raised-bog peat; 250 to 265 cm, valley-bog peat; 265 to 270 cm, marine clay; 270 to 340 cm, raised-bog peat; 340 to 380 cm, transition-bog peat; Pleistocene sand below. Sample was from upper layer of valley-bog peat, alt ca. NN.

Hv-292. Wanna, Profile 477, 250 to 260 cm **4910 $\pm$ 90**
2960 B.C.

From same profile as Hv-291; valley-bog peat overlying layer of marine clay, 1.2 m below NN.

Hv-340. Wanna, Profile 428, 50 to 60 cm **1920 $\pm$ 70**
A.D. 30

Valley-bog peat directly overlying marine clay, 0.8 m above NN (53° 36' 30" N Lat, 9° 24' 59" E Long). *Comment:* same age as Hv-283 was expected.

Hv-341. Wanna, Profile 451, 100 to 110 cm **3670 $\pm$ 80**
1720 B.C.

Valley-bog peat, directly overlying marine clay 400 cm thick, 0.9 m above NN (53° 46' 12" N Lat, 8° 44' 56" E Long).

Hv-342. Wanna, Profile 452, 220 to 230 cm **3965 $\pm$ 90**
2015 B.C.

Valley-bog peat, overlying marine clay 50 cm thick, 0.3 m below NN (53° 45' 55" N Lat, 8° 44' 50" E Long).

General Comment: dates prove that sedimentation of marine clay in area had mainly ended ca. 2200 B.C.; younger deposits occur only rarely. Probably because of later subsidence or compaction, contemporaneous peat directly overlying marine clay is found, somewhat unexpectedly, to lie at various altitudes (from ca. 1.5 below to 1.0 m above NN). In the raised bog of investigation area periods of rising sealevel effected a developmental change from oligotrophic to eutrophic conditions by forming valley-bog peat layers within raised-bog peat. On the whole, palynological dates in Profiles Wanna 436 and 477 agree with C¹⁴ dates.

Hv-197. Falkenberger Moor, Niedersachsen **2140 $\pm$ 190**
190 B.C.

Slightly decomposed Sphagnum peat from depth of 90 to 100 cm, from a boring in Falkenberger Moor (53° 43' 01" N Lat, 8° 46' 11" E Long), directly above recurrence surface overlying strongly decomposed Sphagnum peat. Coll. 1962 and subm. by H. Schneekloth. *Comment:* profile has been pollenanalytically dated by H. Schneekloth. Sample dates the recurrence horizon and characteristic features of pollen diagram. Results of both dating methods show correlation.

Gifhorn series, Niedersachsen

Sphagnum peat samples from Grosse Moor, near Gifhorn. Coll. and subm. 1963 by H. Schneekloth. Age determinations of recurrence horizon from different profiles, within region of same bog, were made both by C¹⁴ and by pollen analysis. Stratigraphy of raised bog of ca. 60 km² shows strongly decomposed Sphagnum peat overlain by slightly decomposed Sphagnum peat. Contact between these two peat layers (SWK, see Hv-282) is seen nearly everywhere in the bog. Within the strongly decomposed peat is an extensive layer of less decomposed Sphagnum peat (*Brauntorf*), described by Potonie (1912) already. Developmental history of Grosse Moor near Gifhorn has been treated by Overbeck (1952). Samples are from six profiles, pollenanalytically dated by H. Schneekloth (preliminary report, 1963c; a full account in "Geologisches Jahrbuch" is in preparation).

Hv-404. Gifhorn, Profile 1, 70 to 75 cm **1850 $\pm$ 60**
A.D. 100

Sphagna-Acutifolia peat, moderately decomposed, directly above SWK (52° 33' 39" N Lat, 10° 38' 31" E Long).

- Hv-405. Gifhorn, Profile 1, 110 to 115 cm** **2820 $\pm$ 60**
870 B.C.
Sphagna-Cymbifolia peat, slightly decomposed, from uppermost layer of *Brauntorf*, from same boring as Hv-404.
- Hv-418. Gifhorn, Profile 1, 125 to 130 cm** **2910 $\pm$ 80**
960 B.C.
Sphagna-Cymbifolia peat, slightly decomposed, from middle of *Brauntorf* layer, from same boring as Hv-404.
- Hv-415. Gifhorn, Profile 1, 150 to 155 cm** **3605 $\pm$ 60**
1655 B.C.
Sphagnum peat, strongly decomposed, directly beneath *Brauntorf*, from same boring as Hv-404.
- Hv-462. Gifhorn, Profile 2, 45 to 50 cm** **2345 $\pm$ 110**
395 B.C.
Sphagna-Acutifolia peat, slightly decomposed, directly above SWK (52° 34' 40" N Lat, 10° 39' 35" E Long).
- Hv-407. Gifhorn, Profile 2, 95 to 100 cm** **3500 $\pm$ 100**
1550 B.C.
Sphagnum peat, moderately decomposed, from uppermost layer of *Brauntorf*, from same boring as Hv-462.
- Hv-416. Gifhorn, Profile 2, 120 to 125 cm** **5240 $\pm$ 120**
3290 B.C.
Sphagnum peat, moderately decomposed, from lowermost layer of *Brauntorf*, from same boring as Hv-462.
- Hv-408. Gifhorn, Profile 3, 25 to 30 cm** **2000 $\pm$ 70**
50 B.C.
Sphagna-Cymbifolia peat, slightly decomposed, directly above SWK.
- Hv-417. Gifhorn, Profile 3, 105 to 110 cm** **4330 $\pm$ 110**
2380 B.C.
Sphagna-Acutifolia peat, moderately decomposed, from lowermost layer of *Brauntorf*, from same boring as Hv-408.
- Hv-463. Gifhorn, Profile 4, 75 to 80 cm** **1510 $\pm$ 110**
A.D. 440
Sphagna-Acutifolia peat, slightly decomposed, directly above SWK (52° 32' 46" N Lat, 10° 35' 25" E Long).
- Hv-410. Gifhorn, Profile 4, 105 to 110 cm** **3350 $\pm$ 80**
1400 B.C.
Sphagnum peat, moderately decomposed, from uppermost layer of *Brauntorf*, from same boring as Hv-463.
- Hv-411. Gifhorn, Profile 5, 65 to 70 cm** **1400 $\pm$ 75**
A.D. 550
Sphagna-Acutifolia peat, slightly decomposed, directly above SWK (52° 32' 27" N Lat, 10° 38' 56" E Long).
- Hv-412. Gifhorn, Profile 5, 100 to 105 cm** **2690 $\pm$ 80**
740 B.C.
Sphagna-Acutifolia peat, moderately decomposed, from uppermost layer of *Brauntorf*, from same boring as Hv-411.

Hv-465. Gifhorn, Profile 5, 155 to 160 cm **2940 ± 170**
990 B.C.

Sphagna-Cuspidata peat, moderately to strongly decomposed, from lower-most layer of *Brauntorf*, from same boring as Hv-411.

Hv-413. Gifhorn, Profile 6, 85 to 90 cm **1560 ± 80**
A.D. 390

Sphagna-Cuspidata peat, moderately decomposed, directly above SWK (62° 31' 35" N Lat, 10° 37' 33" E Long).

Hv-414. Gifhorn, Profile 6, 110 to 115 cm **2225 ± 80**
275 B.C.

Sphagnum peat, moderately decomposed, from same boring as Hv-413, uppermost layer of *Brauntorf*. *Comment*: *Brauntorf* not clear in this profile; low age indicates that it was incorrectly identified, and sample should be rejected.

General Comment: considering these dates and Heidelberg dates from the same bog (Overbeck *et al.*, 1957; samples H-72/88, H-71/85, H 119/105), it is clear that a single recurrence surface can have distinctly different ages, probably because local hydrographic conditions differed. In Grosse Moor near Gifhorn, the differences are regionally grouped. The maximum age difference between profiles is ca. 1000 yr for the SWK and ca. 500 yr for the contact between *Brauntorf* and overlying black peat. The C¹⁴ age differences for the SWK are confirmed by pollen analysis, but the contact between *Brauntorf* and the younger dark peat appears younger by pollen analysis than by C¹⁴. The pollen dating is less reliable here, as the pollen percentages are atypical and difficult to interpret.

Hv-158. Wremer Specken, Niedersachsen **3640 ± 125**
1690 B.C.

Clayey valley-bog peat from depth of 80 cm (53° 39' 21" N Lat, 8° 32' 58" E Long). Sample is underlain and overlain by brackish water sediments from influencing area of ancient estuary of Weser river. Coll. 1960 and subm. by H. A. Schneeberg. *Comment*: the aim was to delimit age of this brackish marsh and of younger marine cover. Age is as expected according to stratigraphy.

Weserauelehm series, Niedersachsen

Wood and humic loam from borings in Weser river area. Coll. 1961 and subm. by Gerd Lüttig, N.L.f.B. Dates serve the stratigraphical division of high-flood loam in district of the Weser.

Hv-127. Landesbergen, 2 m **370 ± 110**
A.D. 1580

Wood bedded on gravel, overlain by high-flood loam (52° 36' 22" N Lat, 9° 09' 26" E Long). *Comment*: result corresponds to geological observation and findings of human settlements.

Hv-157. Leeseringen, 3 m **435 ± 200**
A.D. 1515

Drifted trunk on gravel, overlain by youngest high-flood loam (52° 36' 22" N Lat, 9° 08' 42" E Long).

Hv-195. Oppermann, 4 m **1900 $\pm$ 120**
A.D. 50

Wood imbedded in gravel, overlain by high-flood loam 2 m thick (52° 15' 16" N Lat, 9° 49' 55" E Long). *Comment:* according to remains of vertebrates, sample is too young.

Hv-198. Gleidingen, 4 m **2130 $\pm$ 80**
180 B.C.

Wood sample bedded like Hv-195 (52° 16' 77" N Lat, 9° 49' 23" E Long). *Comment:* according to probable age of vertebrates, age of sample expected to be 4500 yr B.C. or younger.

Hv-199. Ruthe, 2.5 m **<150**

Driftwood sample bedded like Hv-195 (52° 15' 01" N Lat, 9° 49' 11" E Long). *Comment:* dates (see also Hv-102) permit correlation with Schulenburg complex.

Hv-201. Gleidingen, 6 m **1850 $\pm$ 80**
A.D. 100

Wood, underlain by gravel and overlain by high-flood loam (52° 16' 30" N Lat, 9° 49' 26" E Long).

Hv-203. Ruthe, 0.8 m **>30,000**

Fossil, humic loam imbedded in loess (52° 15' 10" N Lat, 9° 48' 57" E Long). *Comment:* date aids subdivision of loess in Lower Saxony. See also Lüttig (1960).

Hv-202. Grabstede, Niedersachsen **400 $\pm$ 40**
A.D. 1550

Wood from 180 cm depth, from digging near clay pit of Grabstede (53° 22' 27" N Lat, 8° 00' 18" E Long), from *Lauenburger Ton*. Coll. 1961 and subm. by Arnim Graupner, N.L.f.B. *Comment:* dates recent wood on upper part of *Lauenburger Ton*.

Salzderhelden series, Niedersachsen

Wood from borings near Salzderhelden. The profile shows layers of fine sandy silt, 3.50 to 4.50 m thick, resting on coarse sand and gravel, in which pieces of wood were found. Coll. 1961 and subm. by Otto Sickenberg, N.L.f.B. Samples dated to get age of high-flood loam that fills Leine River valley.

Hv-376. Salzderhelden, 3.5 m **2645 $\pm$ 80**
695 B.C.

Wood from a coarse sand layer (51° 45' 00" N Lat, 9° 57' 37" E Long).

Hv-377. Salzderhelden, 4.0 m **3350 $\pm$ 100**
1400 B.C.

Wood from same coarse sand layer as Hv-376 (51° 44' 42" N Lat, 9° 57' 33" E Long).

Hv-296. Drüber, 5.5 m **3430 $\pm$ 70**
1480 B.C.

Wood from coarse sand layer (51° 45' 48" N Lat, 9° 06' 08" E Long). *Comment:* result agrees with expectations about age of younger high-flood loam in upper Leine River district.

Hv-82. Nesselröden, Niedersachsen **850 ± 100**
A.D. 1100

Charcoal from a boring, interbedded between Younger Loess 1 and Younger Loess 2, from depth of 3 m (51° 35' 40" N Lat, 10° 14' 55" E Long). Coll. 1959 and subm. by G. Lüttig. *Comment*: date permits the stratigraphic subdivision of Leine River loess near Duderstadt.

Hv-204. Helsdorf, Niedersachsen **930 ± 50**
A.D. 1020

Charcoal from depth 70 to 105 cm, from digging near Helsdorf (52° 35' 58" N Lat, 9° 35' 28" E Long), imbedded in high-flood loam 2 m thick. Coll. 1961 and subm. by Kurt Genieser, N.L.f.B. *Comment*: dates high-flood loam of Leine River; which probably started ca. 4000 B.C. and is still going on (Beschoren, 1936). See also Hv-82.

Wurthfleth series, Niedersachsen

Peat from borings in marshy area near mouth of Weser River. Peat layer 1 m thick is interbedded between marine sediments. Coll. 1960 and subm. by J. H. Benzler, N.L.f.B. Samples date sealevel changes of North Sea.

Hv-163. Wurthfleth, 1.1 to 1.2 m **2580 ± 200**
630 B.C.

Clayey valley-bog peat from uppermost part of peat layer (53° 51' 50" N Lat, 8° 32' 50" E Long).

Hv-164. Wurthfleth, 2.2 to 2.3 m **4090 ± 220**
2140 B.C.

Clayey valley-bog peat from lowermost part of peat layer (53° 52' 10" N Lat, 8° 32' 20" E Long). *Comment*: date confirms assumption of peat growth during whole Sub-Boreal period (Benzler, 1963).

Hv-300. Isle of Wangerooge, North Sea **1450 ± 80**
A.D. 500

Shell from depth 0.2 to 0.5 m, from digging at NW beach of Wangerooge (53° 47' 48" N Lat, 7° 51' 06" E Long), from layer of marine clay, 1 m thick, in which numerous Scrobicularia shells are imbedded in life-like position. Layer occurs throughout the whole island. Coll. 1962 and subm. by Heinz Sindowski, N.L.f.B. *Comment*: geological situation supports age of less than 2000 yr.

Bartshausen series, Niedersachsen

Peat from boring of Bartshausener marshy area (53° 22' 51" N Lat, 7° 06' 00" E Long). Profile shows four alternating sequences of silty clay and valley-bog peat down to 6.25 m depth. Samples date flooding phases of North Sea. Coll. 1961 and subm. by H. Voigt, N.L.f.B.

Hv-245. Bartshausen, 2.1 to 2.2 m **3250 ± 75**
1300 B.C.

Peat from upper part of second valley-bog peat layer.

Hv-246. Bartshausen, 3.7 to 3.8 m **3660 ± 60**
1710 B.C.

Peat from base of second peat layer.

Hv-247. Bartshausen, 4.2 to 4.3 m **4140 $\pm$ 65**
2190 B.C.

Peat from upper part of third peat layer.

Hv-248. Bartshausen, 4.65 to 4.75 m **4280 $\pm$ 65**
2330 B.C.

Peat from base of third peat layer. *Comment*: date confirms peat growth during whole Sub-Boreal as expected (see also Hv-163 and Hv-164).

Hv-381. Urberach, Hessen **1360 $\pm$ 90**
A.D. 590

Charcoal from a depth 50 to 80 cm, from profile near Urberach (49° 58' 35" N Lat, 8° 46' 12" E Long), from base of charcoal-bearing layer of minor thickness, imbedded in eolian sand. Coll. 1962 and subm. by Ernst Schönhals, N.L.f.B. *Comment*: date proves blown-sand deposits in this region formed during historical times.

Hv-393. Hopsten, Nordrhein-Westfalen **10,850 $\pm$ 600**
8900 B.C.

Wood from 80 cm depth, from digging near Hopsten (52° 19' 38" N Lat, 7° 33' 10" E Long), imbedded in colluvial, eolian sand of low-terrace of Ems River. Coll. 1963 and subm. by F. J. Braun, Geol. Landesamt Nordrhein-Westfalen, Krefeld. *Comment*: sample was assumed to originate either from the Alleröd (8000 to 10,000 B.P.) or the Bölling (12,000 to 14,000 B.P.).

Hv-331. Mühlheim, Nordrhein-Westfalen **3430 $\pm$ 70**
1480 B.C.

Wood from depth 6 to 7 m, from digging near Oberhausen, imbedded in sand and gravel. Coll. 1962 and subm. by F. J. Braun. *Comment*: sample expected to be post-Atlantic and to belong to low terrace of Ems River.

Hv-174. Dortmund-Wickede, Nordrhein-Westfalen **1820 $\pm$ 180**
A.D. 130

Humic acid from depth of 105 to 130 cm, from a humous soil (2.7% organic matter) (51° 32' 18" N Lat, 7° 37' 22" E Long). Profile shows a fossil gley in loess, covered by reworked loess 105 cm thick. Coll. 1960 and subm. by H. O. Dahm, Geol. Landesamt Nordrhein-Westfalen, Krefeld. *Comment*: loess sedimentation may correlate with a land-clearing phase although pollen analysis by G. von der Brelie indicated Pre-Boreal period (7000 to 8000 B.C.).

Hv-274. Karlsruhe, Baden-Württemberg **5425 $\pm$ 80**
3475 B.C.

Wood from a boring, 12 m depth, at Karlsruhe oil harbor (49° 03' 34" N Lat, 8° 19' 20" E Long), imbedded in river gravel. Coll. 1961 and subm. by Kurt Bartz, Geol. Landesamt Baden-Württemberg, Freiburg. *Comment*: gravels down to 12 m belong to Holocene valley fill.

Hv-275. Würmersheim, Baden-Württemberg **>43,000**

Wood from 11.50 to 13.70 m depth, from a boring near Würmersheim (48° 54' 11" N Lat, 8° 13' 46" E Long), imbedded in gravel and sand. Coll. 1961 and subm. by K. Bartz. *Comment*: gravel is Pleistocene but otherwise undated.

Hagsfeld series, Baden-Württemberg

Peat and wood from diggings in Kinzig-Murg canyon. Coll. 1961 and subm. by K. Bartz.

Hv-277. Karlsruhe, Baden-Württemberg **250 ± 70**
A.D. 1700

Wood from 8 to 12 m depth, from a boring near Karlsruhe oil harbor (49° 04' 26" N Lat, 8° 20' 22" E Long), imbedded in Rhine River gravel. *Comment*: Rhine valley in this area was filled during historic time.

Hv-279. Hagsfeld, 100 to 200 cm **2230 ± 70**
280 B.C.

Wood, overlain by clayey loam (49° 01' 23" N Lat, 8° 27' 45" E Long).

Hv-276. Hagsfeld, 205 to 220 cm **2460 ± 100**
510 B.C.

Peat sample overlain by clayey loam (49° 00' 55" N Lat, 8° 27' 44" E Long). *Comment*: geology indicates canyon fill is Holocene.

B. Foreign Samples

Hv-156. Kerman, Iran **>25,000**

Peaty marl from a well digging, depth 9.8 to 10.4 m, near Kerman (30° 15' N Lat, 56° 58' E Long), overlain by partly humous marly lake deposits, 2.05 m thick, and by limy loess-like silt, 7.75 m thick. Coll. 1960 by Reinhold Huckriede; subm. by Helmut Venzlaff, N.L.f.B. *Comment*: date is compatible with a latest-Pluvial age (according to Huckriede, 1961).

Hv-191. Qunduz, N Afghanistan **>32,000**

Piece of root, depth 47.5 to 50 m, from a boring near Qunduz (36° 45' N Lat, 68° 52' E Long). Overlain by loess, 20 m thick, and sand, 27.5 m thick, in bed of Taluquan River. Coll. 1961 by K. Rudolph; subm. by D. Wirtz, D.G.M., Afghanistan, Kabul. *Comment*: the 25-m terrace may have been formed in a pluvial-glacial phase during younger Pleistocene.

Ilobasco series, El Salvador

Bituminous samples of lignite from outcrops in Ilobasco basin in El Salvador. From lignite seams imbedded in Pleistocene bituminous tuffs. Samples date age of basin fill. Coll. 1962 and subm. by Karl Rode, Geol. Inst. of the Aachen College of Tech.

Hv-265. Ilobasco-Veta, 4 to 5 m depth **>43,000**

Lignite overlain by tuffs and underlain by clay (13° 51' 22" N Lat, 88° 51' 50" W Long).

Hv-266. Ilobasco-Veta, 4 to 5 m depth **>32,000**

Lignite overlain by tuffs and underlain by clay.

Hv-267. Ilobasco-Veta South, 2 m **>43,000**

Bituminous lignite underlain by clay and overlain by tuffs. *Comment*: according to Meyer-Abich (1960), basin fill is Pleistocene. Results do not contradict geologic observations (Grebe, 1954).

Boquerón series, El salvador

Wood from recent barrancos, at toe of Boquerón volcano. Coll. 1962 and subm. by K. Rode. *Comment*: date expected to correlate young pumice tuffs of San Salvador with those of upper sediments of Lampa basin.

Hv-264. Los Choros, 1 to 3 m **1690 ± 85**
260 B.C.

Charcoal imbedded in pumice tuff from a young barranco (13° 41' 36" N Lat, 89° 19' 16" W Long).

Hv-330a. Escalon, 5 m **>30,200**

Charcoal imbedded in pumice tuff (13° 41' 25" N Lat, 89° 14' 55" W Long).

Hv-330b. Escalon, 5 m **33,300 ± 1200**
31,350 B.C.

Charcoal from same place as Hv-330a. *Comment*: young pumiceous deposits as well as several prehistoric finds caused Weyl (1955) to assume age of 1000 to 1800 B.P. The difference between Hv-330a and Hv-330b remains unclear.

II. ARCHAEOLOGIC SAMPLES

A. Germany

Hv-153. Hohe Schanze, Niedersachsen **840 ± 110**
A.D. 1110

Charcoal from excavation of a pile, 60 to 80 cm depth, near Alfeld (51° 56' 25" N Lat, 9° 57' 52" E Long), underlain by flammenmergel and overlain by forest humus. Coll. 1960 and subm. by Wilhelm Barner, Local Mus., Alfeld/Leine. *Comment*: pile could be from the La Tène period or could be built for a Frankish fortification between 800 and 1000 A.D.

Hv-154. Hohe Schanze, Niedersachsen **2425 ± 110**
475 B.C.

Carbonized wood from gate construction from a 1-m excavation, near Alfeld (51° 56' 35" N Lat, 9° 58' 03" E Long), imbedded in flammenmergel. Coll. 1960 and subm. by W. Barner. *Comment*: according to their shape, the earth walls on the "Hohe Schanze" were built during the La Tène period (400 to 300 B.C.). Fragments of pottery found there confirm this.

Hv-328. Stolzenau, Niedersachsen **920 ± 60**
A.D. 1030

Wood from canoe, 4 to 5 m depth, from an outcrop near Stolzenau (52° 30' N Lat, 9° 05' E Long), overlain by high-flood loam 4 m thick. Coll. 1962 by Wilhelm Lohmeyer; subm. by Heinrich Wortmann, Geol. Landesamt Nordrhein-Westfalen, Krefeld. *Comment*: age of canoe, according to its position in the profile and manner of construction, estimated to be 1000 B.P.

Hv-192. Hameln, Niedersachsen **1020 ± 70**
A.D. 930

Wood from a pile foundation from excavation at 1.90 to 2.50 m depth, near Hameln (52° 06' 21" N Lat, 9° 21' 35" E Long), overlain by waste material from buildings, underlain by mud. Coll. 1961 and subm. by G. Frhr. v. Ulmenstein, Local Mus., Hameln. *Comment*: according to construction of build-

ings, the old market settlement's foundation at Hameln was expected to be of 11th century or even before.

Hv-170. Wingst, Niedersachsen **2800 ± 200**
850 B.C.

Charcoal from 0.75 m depth, from a digging in Wingst (53° 43' 13" N Lat, 9° 04' 52" E Long), overlain by rubble and sand. Coll. 1960 and subm. by Günter Möller, Wingst. *Comment*: charcoal found at a fireplace covered with fragments of pottery. Age determination of the ornamented fragments indicates Stage IV or V (Montelius). According to C¹⁴ dating, fireplace belongs to Stage V (2900 to 2700 B.P.).

Hv-280. Weeze, Nordrhein-Westfalen **1300 ± 50**
A.D. 650

Thick board from 4 to 6 m depth, from a dredging lake, near Weeze (51° 36' 45" N Lat, 6° 15' 25" E Long), from old well imbedded in gravels below water level. Coll. 1962 and subm. by F. J. Braun. *Comment*: well could not be dated archaeologically. Roman period or early Middle Ages was assumed.

Hv-324. Moers, Nordrhein-Westfalen **2970 ± 80**
1020 B.C.

Charcoal from 0.3 to 0.8 m depth, from a settlement pit at the Daubenspeckhof near Moers (51° 27' 37" N Lat, 6° 36' 30" E Long), underlain by coarse gravels. Coll. 1962 and subm. by Hermann Hinz, Rheinisches Landesmuseum Xanten. *Comment*: according to potsherds, age of 500 B.C. (early La Tène period) or 1000 to 500 B.C. (Hallstatt period) assumed.

Kostedt series, Nordrhein-Westfalen

Charcoal from 3.5 to 4 m depth, from digging near Minden (52° 13' 57" N Lat, 8° 50' 27" E Long), underlain by sandy gravels and overlain by high-flood loam. Coll. 1961 and subm. by H. Wortmann.

Hv-244. Kostedt, 3.5 to 4.0 m depth **185 ± 100**
A.D. 1765

Pointed post rammed in Holocene terrace sand.

Hv-392. Kostedt, 3.5 to 4.0 m depth **340 ± 100**
A.D. 1610

Pointed post, ca. 5 m from Hv-244, rammed in Holocene terrace sand.

General Comment: considering conditions of layering and working of the posts, age of 1900 to 1700 B.P. expected. Dating of Hv-392 became necessary as result of Hv-244 date.

Hv-207. Weisser Koog, Nordfriesland **750 ± 100**
A.D. 1200

Timber remnant from depth of 70 cm, from floodgate at old dike, in Weisser Koog (54° 42' 58" N Lat, 8° 51' 39" E Long), imbedded in marine clay. Coll. 1961 and subm. by Werner Prange, Geol. Landesamt Schleswig-Holstein, Kiel. *Comment*: according to archival studies, dike built in 16th century.

Federseemoor series, Baden-Württemberg

Wood and charcoal from digging of the Federseemoor-region. Coll. 1962

and subm. by K.-H. Göttlich, lecturer on bog science, Sigmaringen. Important settlements in this region were dated.

Hv-354. Riedschachen, 50 cm depth **5160 ± 110**
3210 B.C.

Timber from cottage underlain by Carex-peat, overlain by a loam floor (48° 02' 20" N Lat, 9° 40' 00" E Long).

Hv-353. Riedschachen, 90 cm depth **5130 ± 100**
3180 B.C.

2 m WNW from sample Hv-354, same situation as Hv-354.

Hv-352. Taubenried, 60 cm depth **5110 ± 110**
3160 B.C.

Timber underlain by Phragmites-Carex-peat and overlain by coarse detrite gyttja (48° 03' 07" N Lat, 9° 38' 27" E Long).

Hv-355. Dullenried, 70 cm depth **4600 ± 100**
2650 B.C.

Timber underlain by muddy loam and overlain by loam (48° 03' 51" N Lat, 9° 37' 02" E Long).

General Comment: contemporaneity of settlements of Taubenried and Riedschachen is proved by pollen analysis (Göttlich, 1963; Groschopf, 1957). However, settlement of Dullenried was assumed to differ in age (Bertsch, 1933; Rheinert, 1936; Gronbach, 1961). See also Göttlich (1962).

Hv-305. Glems, Baden-Württemberg **1450 ± 80**
A.D. 500

Charcoal from 0.10 to 0.60 cm depth from layer of iron slag (some decimeters thick) near Glems (48° 30' 31" N Lat, 9° 17' 19" E Long). Coll. 1962 and subm. by Friedrich Weidenbach, Geol. Landesamt Baden-Württemberg, Stuttgart. *Comment:* sample from an old type of iron-ore smelting works rarely found in this region. According to Dept. for Conservation of Hist. Buildings in Stuttgart, iron-ore was smelted in this manner from Celtic times till the Middle Ages. Date is reasonable.

B. Foreign Samples

Hv-356. Olympia, Greece **3920 ± 90**
1970 B.C.

Conchylia 0 to 2 m depth, from excavation near Olympia (37° 37' N Lat, 21° 35' E Long), imbedded in sandy flood marl. Coll. 1962 and subm. by Julius Büdel, Geogr. Inst. der Univ. Würzburg. *Comment:* sample from 3 m above Adrian pavement of ancient holy area of Olympia. Town was buried by river sediments during early Antiquity. Date between A.D. 600 and 1500 (Büdel, 1963).

Char-I-Mar series, Afghanistan

Charcoal samples from digging near Char-I-Mar (36° 05' N Lat, 66° 45' E Long), overlain by cave gravels. Coll. 1963 and subm. by Louis Dupree, D.G.M., Afghanistan. These dates fundamental to the prehistory of North Afghanistan.

Hv-425. Char-I-Mar, 650 cm depth **8650 $\pm$ 100**
6700 B.C.

Charcoal imbedded in cave gravels.

Hv-426. Char-I-Mar, 100 cm depth **1390 $\pm$ 60**
A.D. 560

Same layering as Hv-425.

Hv-427. Char-I-Mar, 230 cm **1340 $\pm$ 70**
A.D. 610

Same layering as Hv-425.

Hv-428. Char-I-Mar, 400 cm **7220 $\pm$ 100**
5270 B.C.

Same layering as Hv-425.

Hv-429. Char-I-Mar, 350 cm **7030 $\pm$ 110**
5080 B.C.

Same layering as Hv-425.

General Comment: age of 12,000 to 17,000 B.P. was expected for sample Hv-425, and age of 1850 to 1950 B.P. for sample Hv-426; approx. 2000 yr for Hv-427, and approx. 7000 yr B.P. for Hv-428 as well as for Hv-429. For the excavations, see Coon (1957) and Dupree (1959).

Quala Shaharak series, Central Afghanistan

Charcoal from excavation of ruin-hills and two right-angular fortifications on S bank of river Shaharak (37° 07' N Lat, 60° 25' E Long). Coll. 1961 and subm. by L. Dupree and K. Fischer, D.G.M., Afghanistan.

Hv-187. Quala Shaharak, 50 to 150 cm **600 $\pm$ 170**
A.D. 1350

Charcoal imbedded in ancient fortification walls.

Hv-188. Quala Shaharak, 150 to 200 cm **440 $\pm$ 170**
A.D. 1510

Same layering as Hv-187.

Hv-205. Pol-E-Zak, 200 to 250 cm **720 $\pm$ 110**
A.D. 1230

Same layering as Hv-187.

Hv-206. Pol-E-Zak, 250 to 350 cm **1085 $\pm$ 120**
A.D. 865

Same layering as Hv-187.

General Comment: C¹⁴ dating places deposit in early Islamic period. This is reasonable historically.

Hv-190. Cakhansur, SW Afghanistan **700 $\pm$ 80**
A.D. 1250

Peat-like sheep dung from 3 m depth, in trench at bottom of mound-like elevation, remnant of lower terrace of Seistan Lake area (31° 15' N Lat, 62° 03' E Long). Coll. 1960 and subm. by D. Wirtz, D.G.M., Afghanistan. *Comment:* on the lower terrace many ruined settlements and buildings destroyed by the Mongols; its formation is supposed older than first millenium B.C.

Hv-167. Cabecudas, Brazil **4120 $\pm$ 220**
2170 B.C.

Charcoal from 2 to 3 m depth, from prehistoric shell heap (*sambaqui*), near Cabecudas (48° 50' N Lat, 28° 20' S Long), imbedded in sandy shell layers. Coll. 1960 and subm. by Hannfried Putzer, B.f.B., Hannover. *Comment*: sample dates pre-Columbian shellheap culture as well as young Quaternary sea-level changes and tectonical movements along S Brazilian coast (Guerra, 1950; Putzer, 1957).

Lima series, Peru

Woven material from excavated mummy graves. Coll. 1962 by W. D. Loeper; subm. by Immo Wendt, B.f.B., Hannover. Samples date Inca culture.

Hv-350. Chancay **740 $\pm$ 50**
A.D. 1210

Woven material from open mummy grave (10° 18' S Lat, 75° 26' W Long).

Hv-351. Pachacamac **990 $\pm$ 40**
A.D. 960

Woven material from open mummy grave (10° 28' S Lat, 75° 20' W Long). *Comment*: according to character of weaving, age of 1400 to 500 yr B.P. expected for the two samples.

Hv-362. Kaminaljuyu, Guatemala **2300 $\pm$ 70**
350 B.C.

Charcoal from 4.5 m depth, from archaeological excavation of a Maya earth-pyramid, near Kaminaljuyu (14° 35' N Lat, 91° 26' W Long). Coll. 1961 and subm. by H. Putzer. *Comment*: sample is from the base of old temple pyramid, previously dated as pre-Classic (300 B.C. to A.D. 300). According to Museo Arqueológico de Guatemala, date of building should be 2000 B.C.

III. WATER SAMPLES

Ringelheim series, Niedersachsen

Fixed and free carbonic acid precipitated by Ba(OH)₂ from water of karstic spring near Ringelheim. Coll. 1962 and subm. by Heinrich Fauth, B.f.B., Hannover.

Hv-387. Altwallmoden, water-supply plant **72.9 $\pm$ 0.6% modern**

Sample from water conduit net (52° 00' 24" N Lat, 10° 15' 46" E Long). $\delta C^{13} = -12.2\text{‰}$; "apparent age recent."

Hv-388. Baddeckenstedt, water-supply plant **72.5 $\pm$ 0.6% modern**

Sample from water conduit net (52° 05' 17" N Lat, 10° 13' 37" E Long). $\delta C^{13} = -13.4\text{‰}$; "apparent age recent." *Comment*: both water works are supplied by a pure karstic spring.

Hildesheim series, Niedersachsen

Fixed and free carbonic acid from water of karstic spring near Hildesheim. Coll. 1962 and subm. by H. Fauth.

Hv-360. Ortschlump, water work 61.1 ± 0.6% modern

Sample from water conduit (52° 09' 11" N Lat, 9° 56' 29" E Long). $\delta C^{13} = -11.1\text{‰}$; "apparent age 1100 yr."

Hv-361. Husum, water work 58.8 ± 0.5% modern

Sample from water conduit net (52° 07' 31" N Lat, 10° 05' 50" E Long). $\delta C^{13} = -10.4\text{‰}$; "apparent age 1400 yr." *Comment:* as is usual in karstic springs, outflow depends on the amount of precipitation. Therefore, a recent water was assumed. However, the chloride concentration has been found to be independent of the quantity of outflow, implying admixture of fossil groundwater from saline Malm facies with recent karst water.

Niedersachsen series, Norddeutschland

Fixed and free carbonic acid from water samples, precipitated by $Ba(OH)_2$ from some deep and some shallow groundwaters in N Germany. Coll. and subm. by H. Fauth.

Hv-257. Wunningstedt, 32 to 33 m depth 55.7 ± 0.9% modern

Water from a boring (52° 03' 00" N Lat, 10° 47' 24" E Long). $\delta C^{13} = -11.8\text{‰}$; "apparent age 1820."

Hv-260. Isenbüttel, 40 m 44.4 ± 1.6% modern

Water from an artesian well (52° 25' 42" N Lat, 10° 31' 31" E Long). $\delta C^{13} = -14.4\text{‰}$; "apparent age 3650 yr."

Hv-383. Rheiderland, 25 to 45 m 47.8 ± 2.4% modern

Sample from 2nd aquifer below surface (53° 09' 39" N Lat, 7° 27' 27" E Long). $\delta C^{13} = -17.4\text{‰}$; "apparent age 3100 yr."

Hv-261. Tarmitz, 50 m 46.5 ± 0.7% modern

Sample from artesian well (52° 58' 50" N Lat, 11° 10' 54" E Long). $\delta C^{13} = -11.8\text{‰}$; "apparent age 3270 yr."

Hv-258. Twülpstedt, 62 to 70 m 37.6 ± 0.4% modern

Sample from water work (52° 23' 12" N Lat, 10° 53' 25" E Long). $\delta C^{13} = -11.8\text{‰}$; "apparent age 5000 yr."

Hv-385. Westrhauderfeen, 80 m 69.8 ± 0.6% modern

Water from a well (63° 08' 39" N Lat, 7° 32' 27" E Long). $\delta C^{13} = +8.5\text{‰}$; "apparent age recent."

Hv-262. Artlenburg, 120 m 36.1 ± 0.7% modern

Water from artesian well (53° 20' 52" N Lat, 10° 27' 15" E Long). $\delta C^{13} = -12.2\text{‰}$; "apparent age 5300 yr."

Hv-339. Leerheide, 81 to 134 m 43.2 ± 0.5% modern

Water from well in fine silty sands (53° 35' 57" N Lat, 8° 37' 15" E Long). $\delta C^{13} = -9.4\text{‰}$; "apparent age 4400 yr."

Hv-338. Buxtehude, 140 to 147 m $28.0 \pm 0.5\%$ modern

Water from well in early Pleistocene sand ($53^{\circ} 28' 13''$ N Lat, $9^{\circ} 41' 42''$ E Long). $\delta C^{13} = -10.3\text{‰}$; "apparent age 7400 yr."

Hv-390. Haverlahwiese, 375 m $35.6 \pm 0.5\%$ modern

Sample from well in red sandstone ($52^{\circ} 05' 51''$ N Lat, $10^{\circ} 20' 01''$ E Long). $\delta C^{13} = -11.2\text{‰}$; "apparent age 5400 yr."

Hv-391. Ohlendorf, 834 m $24.8 \pm 1.3\%$ modern

Water from of 7th hanging level of Ohlendorf mine ($52^{\circ} 03' 30''$ N Lat, $10^{\circ} 27' 33''$ E Long). $\delta C^{13} = -5.4\text{‰}$; "apparent age 8300 yr."

Comment: samples are from mainly undisturbed sources in different aquifers of the Quaternary and young Tertiary in NW Germany. Regarding the presence of relatively high sealevel a considerable movement of the groundwater cannot be expected. Thus waters are assumed to be older with increasing depth. Results confirm that water of N German aquifers is not "connate" (Martini and others, 1963).

A later mixing of the water with old CO_2 , originating from decomposition of organic matter or other causes, can be excluded by the geologic situation. The expected correlation between water hardness and C^{13} content, which would have rendered possible a correction of water age by δC^{13} , has not been found. Since the results appear geologically reasonable without such correction, and since the geochemical basis of the correction is not clear in this context, we have preferred to state the apparent C^{14} ages without adjustment (except for the assumption that "recent" = 70% of the C^{14} content of the standard).

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