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HAMBURG UNIVERSITY RADIOCARBON DATES I

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Radiocarbon measurements are carried out mainly on soil samples and soil organic matter fractions. Benzene samples are prepared as described earlier (Scharpenseel and Pietig, 1969; 1970). Radioactivity is measured in a single quartz vial, using a Packard Tri Carb Model 3075 as well as a Berthold Betascint BF 5000. Most equipment has been transferred from Bonn University Radiocarbon Dating Lab to Hamburg, where operation of former Bonn Radiocarbon Lab will be continued.

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SAMPLE DESCRIPTIONS

I. SOIL SAMPLES

Pretreatment of soil samples is described elsewhere (Scharpenseel and Pietig, 1969; Scharpenseel, 1972).

A. Germany

Humus horizons in high flood loam, Hapludalf, on nether (lowest terrace level) terrace of Rhine R, Friesdorf, from large construction pit of Fed Dept Econ Coop (50° 43′ N, 7° 8′ E).

HAM-1. **5010 ± 280**
3060 BC

Bt horizon in Hapludalf, near boundary of terrace gravel, 120cm depth.

HAM-2. **3620 ± 70**
1670 BC

Bt horizon in Hapludalf, S side of pit, 80cm depth. Samples coll and subm 1974 by H W Scharpenseel. *Comment*: dates do not measure up to fA horizon adjacent to terrace gravel 10km farther N (BONN-1653: R, 1973, v 15, p 264). HAM-1 equals BN-1652 in Hersel pit. HAM-2 at 80cm depth seems to be already in root zone and rejuvenated.

Samples of various horizons from soil formations in alluvial loess, deposited on Isar terrace, region Landshut/Ergolding (48° 35′ N, 12° 11′ E). Different genetic soil types close together in catenary relation.

HAM-4. Aquept, loessic parent material, slightly colluvial cover, nether (lowest terrace level) terrace of Isar R, SW Altheim 4.5% C, Ah 20 to 40 cm. 1070 ± 60 AD 880

HAM-5.	0.3% C, AGo 55 to 70cm	5700 ± 80 3750 BC
HAM-6.	1.1% C, AGoGr 70 to 85cm	8420 ± 100 6470 BC
HAM-7.	0.6% C, AGr 85 to 100cm	10,880 ± 140 8930 BC
HAM-8.	Udoll on high terrace of Isar R, 1.3% C, Ah 20 to 45cm	3180 ± 80 1230 BC
HAM-9.	0.6% C, $C_{ca}A$ 45 to 65cm	3190 ± 80 1240 BC
HAM-10.	0.3% C, AC 65 to 75cm	3050 ± 80 1100 BC
HAM-11.	Hapludalf on high terrace of Isar R (higher than Udoll, above), 0.9% C, Btl 40 to 60cm.	2780 ± 70 830 BC
HAM-12.	0.3% C, Bt2 60 to 75cm	3320 ± 70 1370 BC
HAM-13.	0.2% C, Bt_{ca} 75 to 90cm	2750 ± 70 800 BC
HAM-14.	Koislhof, transition between lower and upper nether (lowest terrace level) terrace of Isar R, colluvial vertic soil with >60% clay, overlying nether moor 22.5% C, I Bt 30 to 50cm.	3920 ± 80 1970 BC
HAM-15.	38.0% C, II Hnl 50 to 70cm	6540 ± 120 4590 BC
HAM-16.	38.0% C, II Hn2 70 to 90cm	8520 ± 120 6570 BC
HAM-17.	46.0% C, II Hn3 90 to 105cm	9330 ± 120 7380 BC
HAM-18.	43.0% C, II Hn4 105 to 130cm	9490 ± 100 7540 BC
HAM-19.	21.4% C, II Hn5 130 to 150cm	10,250 ± 130 8300 BC
HAM-20.	27.0% C, II Hn6 150 to 170cm	10,680 ± 140 8730 BC
HAM-21.	8.3% C, III HnC 170 to 180cm	10,600 ± 140 8650 BC

HAM-22.	Deeply humic Hapludalf, Marktschwaben, 2.3% C, AhSwdl 25 to 40cm.	4650 ± 90 2700 BC
HAM-23.	1.2% C, AhSwd2 40 to 55cm	5260 ± 80 3310 BC
HAM-24.	2.0% C, Sd 55 to 75cm	5790 ± 120 3840 BC
HAM-25.	Crotovine in Sd horizon, 55cm	3820 ± 80 1870 BC

Samples coll and subm 1974 by H W Scharpenseel and B Hofmann from Bayrisches Geol Landesamt, Munich. *Comment*: Aquept, HAM-4-7 dates to Alleröd origin; Udoll, HAM-8-10 as well as Hapludalf, HAM-11-13 are of almost uniform age throughout profile, evidently rejuvenated by root growth and animal transport; deeply humic Hapludalf, HAM-22-25 arrive at 5800 yr old, approx maximum, that recent Holocene soils with intact biodynamics will show. The Koislhof profile, HAM-14-21 with underlying low moor was expected to date to Atlantic. Dates indicate at least Alleröd age. For regional survey, see soil map 1:25000 Landshut Ost (Hofmann, 1966.)

Profiles with fossil horizons in N Bavarian landscape, S Danube.

HAM-26.	Deeply humic colluvium upon old Riss moraine, 1km N of Landsberg (48° 3′ N, 10° 53′ E), 0.5% C, Ap 15 to 30cm.	800± 60 AD 1050
HAM-27.	0.5% C, I AB 30 to 60cm	1240 ± 70 AD 710
HAM-28.	0.6% C, II Bvt1 60 to 90cm	2080 ± 70 130 BC
HAM-29.	0.7% C, II Bvt21 90 to 140cm	3080 ± 70 1130 BC
HAM-30.	1.0% C, II Bvt22 140 to 150cm	4010 ± 80 2060 BC
HAM-31.	0.7% C, III BvtCv 150 to 170cm	4340 ± 70 2390 BC

Samples coll and subm 1974 by H W Scharpenseel and H Grottenthaler, Bayrisches Geol Landesamt, Munich. *Comment*: "Ackerbrown earth", developed in loamy cover overlying old Riss moraine with humic colluvial patches in slight depressions is thought to be product of top soil material eroded during Germanic land occupation and deforestation. Considering time required for deposition of erosion product, dates fit well into theory.

HAM-32. Chernozem like Mollisol in loess in steep bank of Lech R, Kaufering (48° 5′ N, 10° 53′ O), 0.8% C, IAh1 0 to 30cm. 760 ± 70 AD 1190

HAM-33. 0.7% C, I Ah2 30 to 65cm 1160 ± 70 AD 790

HAM-34. 0.7% C, IIAC 65 to 75cm 2140 ± 70 190 BC

HAM-36. 0.3% C, IIfBt 95 to 110cm 4410 ± 80 2460 BC

Samples coll and subm 1974 by H W Scharpenseel and H Grottenthaler. *Comment*: in survey study of soils on Lech terraces, Diez (1968) estimates formation of Kaufering soil on main nether terrace at early Holocene. Maximum age of 4410 yr falls short of expectation due to rejuvenation by root growth and animal transport.

HAM-37. Neuenried near sources of Mindel R, horizons of fossil organic matter in tuffaceous limestone on top of tertiary sand and marl (47° 54′ N, 10° 27′ E), 2.7% C, fA1 60 to 90cm. 1640 ± 70 AD 310

HAM-39. 1.2% C, fA2 105 to 115cm 1070 ± 70 AD 880

HAM-40. 0.7% C, fA3 119 to 135cm 1880 ± 70 AD 70

HAM-41. 1.1% C, fA4 137 to 145cm 2460 ± 70 510 BC

HAM-42. 0.7% C, fA5 165 to 190cm 2560 ± 80 610 BC

HAM-43. 10.2% C, fA6 315 to 320cm (lignite + charcoal) 4580 ± 90 2630 BC

Samples coll and subm 1974 by H W Scharpenseel and H Grottenthaler. *Comment*: tuffaceous material believed identical to age of better studied tuff below Erdinger moos, dated to Atlantic time. fA6 horizon is lignitic. Maximum date is slightly younger than expected: 7000 to 5000 yr BP.

HAM-44. Pit of brick factory Fellheim, between Fellheim and Boos. Loess loam overlying gravel of nether terrace of Iller R, fBt near boundary between terrace gravel and loess loam (48° 4′ N, 10° 10′ E), 0.5% C, IIBvt 115 to 130cm. 4340 ± 130 2390 BC

HAM-45. Transition to nether (lowest terrace level) terrace gravel, 0.3% C, IIBC 130 to 150cm. 3850 ± 90 1900 BC

HAM-46.	Pit Heimertingen, geol as above. Fossil Bt at boundary to terrace gravel, but closer to soil surface (48° 3′ N, 10° 9′ E), 0.4% C, IIBvt 85 to 110cm.	1150 ± 80 AD 800

Samples coll and subm 1974 by H W Scharpenseel and H Grottenthaler. *Comment*: it is not known whether carbon of fossil horizon was formed *in situ* or if most of it was transported, perhaps through secondary pores, especially rain worm tubes. Dates, especially HAM-46 (Heimertingen), do not agree with origin of soil in Würm interstadial or early Holocene. Young carbon immigration from top soil seems considerable.

Soil profiles in Nördlinger Ries crater.

HAM-47.	Eutrochrept, deep humic brown earth, near Hohentrüdingen in loam on Jurassic (Dogger) bedrock, (49° 0′ N, 10° 42′ E), 3.0% C, AhBv1 25 to 40cm.	5920 ± 100 3970 BC
HAM-48.	2.7% C, AhBv2 40 to 60cm	10,360 ± 140 8410 BC
HAM-49.	1.6% C, Cv 60 to 80cm	15,730 ± 410 13,780 BC
HAM-50.	Vertisol on tertiary Ries deposits, 300m E Maihingen (48° 65′ N, 10° 31′ E), 3.8% C, BvAh 40 to 60cm.	3750 ± 80 1800 BC
HAM-51.	1.5% C, AhBv 60 to 80cm	5660 ± 90 3710 BC
HAM-52.	0.6% C, BvCv1 80 to 100cm	7060 ± 110 5110 BC
HAM-53.	0.9% C, BvCv2 100 to 120cm	5680 ± 90 3730 BC
HAM-54.	0.6% C, BvCv3 120 to 140cm	8710 ± 120 6760 BC
HAM-55.	0.5% C, IIfAh 140 to 160cm	11,820 ± 170 9870 BC
HAM-56.	Vertisol-Gley on younger Ries lake deposits, Pfäfflingen (48° 56′ N, 10° 34′ E), 2.6% C, GoAh2 30 to 50cm.	3640 ± 70 1690 BC
HAM-57.	1.7% C, AhGo1 50 to 80cm	4880 ± 80 2930 BC
HAM-58.	1.0% C, AhGo2 80 to 110cm	4840 ± 90 2890 BC

HAM-59.	0.5% C, AhGro 110 to 130cm	7590 ± 100 5640 BC
HAM-60.	4.0% C, Gor 130 to 140cm	10,470 ± 160 8520 BC
HAM-61.	Vertisol-Pseudogley, Ries lake deposits, Wechingen (48° 56′ N, 10° 36′ E), AhSw 30 to 50cm.	3300 ± 80 1350 BC
HAM-62.	SwSd 50 to 70cm	3860 ± 80 1910 BC
HAM-63.	Vertisol-Braunerde, Ries lake deposits, Munningen (48° 63′ N, 10° 35′ E), Bv 25 to 50cm.	3980 ± 70 2030 BC
HAM-64.	BvCv 50 to 70cm	4840 ± 60 2890 BC

Samples coll and subm 1974 by H W Scharpenseel and G Rückert, Bayrisches Geol Landesamt, Munich. *Comment*: geol and pedol survey (Schmidt-Kaler & Treibs, 1970; Rückert, 1975) of the Ries indicate occurrence of vertisolic soils, otherwise rare in W German climate. Vertisols are best qualified for ^{14}C-dating, especially below cracking zone (Scharpenseel, 1972) Ries samples indicate soil formation at least since Alleröd time. HAM-49 was a very small sample from a highly calcareous substrate. Age 15,730 yr needs reconfirmation. The rather shallow Wechingen, HAM-61, 62 and Munningen profiles, HAM-63, 64, apparently have not yet outgrown rejuvenated range due to root growth and animal transport. Maximum dates, ca 11,000 yr are as expected.

HAM-65.	Near Landshut nethermoor, Koislhof, Profile 2, 4.6% C, 130 to 150cm	10,960 ± 180 9010 BC

Sample coll and subm 1974 by B Hofmann, Bayrisches Geol Landesamt, Munich. *Comment*: samples serve to reconfirm findings of HAM-14 to -21 from another sampling spot of same geol situation. Reconfirmation of Alleröd age of nethermoor is perfect.

Smonica/Chernozem-like soils in Rheinhessen.

HAM-66.	Smonica, Vertisol-like soil, SW Lötzweiler, M2 Ah 60 to 80cm (R 345069, H 552938)	2740 ± 70 790 BC
HAM-67.	Smonica Lö I, fAh 95 to 115cm	5430 ± 90 3480 BC
HAM-68.	Chernozem Lö II, M 30 to 40cm	2580 ± 70 530 BC
HAM-69.	Chernozem, fAh 55 to 70cm	2010 ± 60 60 BC

Samples coll and subm 1974 by H Zakosek, Amt f Bodenforschung Wiesbaden. *Comment*: sampling spots all close together. Ham-67 indicates

supposed age of soil formation during Boreal/Atlantic periods. Others apparently rejuvenated by intact recent biodynamics. Aim of study, genetic and systematic position of Smonica in central Europe.

Steppe soils below colluvium in loess as parent material, region of Fritzlar, Hessen.

HAM-70.	Transition Mollisol-Hapludalf, Dorla I/2, Km 21 Fritzlar-Gudensberg Hwy (51° 11′ N, 9° 20′ E), fAh 90 to 110cm	3300 ± 70 1350 BC
HAM-71.	Transition Mollisol-Hapludalf, Lohne I, N village of Lohne (51° 11′ N, 9° 16′ E), Ah 40 to 50cm	2040 ± 60 90 BC
HAM-72.	Transition Mollisol-Hapludalf, Wehren I/2, Wehren-Kirchberg St, (51° 11′ N, 9° 18′ E), Ah 35 to 55cm	2890 ± 70 940 BC
HAM-73.	Transition Mollisol-Hapludalf, Wehren I/3, Wehren-Kirchberg St, (51° 11′ N, 9° 18′ E), AlBt 60 to 80 cm	4740 ± 80 2790 BC

Samples coll and subm 1974 by C Haupenthal, Amt f Bodenforschung, Wiesbaden. *Comment*: aim is systematic study of steppe soils in slight depressions; classification to Mollisols or Hapludalfs. HAM-71, 72, at 40 to 55cm depth, are rejuvenated by root growth and animal transport, HAM-70, at 90 to 110cm, is younger than expected, only HAM-73 comes close to ^{14}C age commonly found at fringes of A-horizon of Mollisols (Scharpenseel, 1972).

HAM-74.	Mollisol Heuchelheim, colluvial loess-loam on top of degraded Chernozem, (50° 23′ N, 8° 52′ E) 1.0% C, fAh 70 to 85cm	3660 ± 90 1710 BC
HAM-75.	Gleichen II, "Im Grund", middle slope, colluvium of loess loam on top of degraded Chernozem (51° 13′ N, 9° 20′ E), 1.0% C, fAh 240 to 260cm.	6480 ± 80 4530 BC

Samples coll and subm 1974 by C Haupenthal and S Schrader, Amt f Bodenforschung, Wiesbaden. *Comment*: HAM-75, an fAh outside root growth and animal transport, indicates expected age of Boreal/Atlantic origin. Aim is classification of colluvium capped steppe soils.

Soil samples from loess loam and underlying solifluction debris, Vogelsberg, Hessen.

HAM-76.	1.2km S Höingen, Vogelsberg, loess loam overlying solifluction debris, below tuffaceous pumice of lake of Laach Alleröd volcanism (50° 42′ N, 9° 55′ E), fA 120cm	10,550 ± 130 8600 BC

HAM-77. 300m E Taufstein (High Vogelsberg), upper part of solifluction debris (mixture of loess loam as well as tuffaceous pumice and basalt) (50° 31′ N, 9° 14′ E), 20 to 40 cm — 2540 ± 70 / 590 BC

HAM-78. Same spot, lower part (>40 cm) of solifluction debris. — 5360 ± 80 / 3410 BC

Samples coll and subm 1973 by E Schönhals, Inst f Bodenkunde, Univ Giessen. *Comment*: HAM-76 had to reveal, whether the fA-horizon was *in situ* below Alleröd-time trachyt ashes or transported by percolation through porous tuff material. Date confirms formation *in situ*. HAM-77-78 should determine whether the solifluction debris was uniform also in age, or deposited stepwise. Large difference in age supports the latter.

High flood loam, plane S of Main R.

HAM-79. High flood loam of Main, Kelsterbach-Lerchenberg, Kiesgrube Schmidt, loam contains charcoal particles, (R 34 67 89, H 55 49 71, sheet Kelsterbach), IIfAhBtx — 7700 ± 170 / 5750 BC

HAM-80. Same spot and horizon (IIfAhBtx), without charcoal, humus-C only — 7900 ± 100 / 5950 BC

HAM-81. Fossil A-horizon adjacent to Alleröd-time trachyt tuff of Laach-volcanism, in sandy deposits of Plane S Main R, Buchschlag III, material enriched with charcoal. — 10,000 ± 210 / 8050 BC

Samples coll and subm 1973 by W Plass, Inst Geog, Univ Frankfort. *Comment*: HAM-79-80 indicate, that in same material charcoal-C is not older than humus-C. HAM-81 falls slightly short of expected value, > 10,500 yr. Slash in age probably due to percolation of younger humus-C in rather sandy and acid substrate accompanied by some deep racination.

Colluvial loam, valley fillings, Hochheim and Waldeck.

HAM-82. Colluvial loam, Hochheim, Water Sta Hattersheim, 140cm below surface (50° 3′ N, 8° 28′ E) — 1020 ± 60 / AD 930

HAM-83. Colluvial loam, Hochheim, Hattersheim, dark horizon 50cm below surface (50° 3′ N, 8° 28′ E) — 1570 ± 70 / AD 380

HAM-84. Colluvial loam, Hochheim, slightly sandy loess loam with some humus over crude loess, 130 to 150cm below surface (50° 4′ N, 8° 28′ E) — 1760 ± 70 / AD 190

HAM-85. Colluvial loam, Hochheim, foot of slope accumulation, calcareous sandy loam, (50° 2′ N, 8° 25′ E), 140 to 150cm — 3180 ± 70 / 1230 BC

HAM-86.	Colluvial loam, Hochheim, foot of slope accumulation, (50° 2′ N, 8° 25′ E), 100 to 120cm	2450 ± 70 500 BC
HAM-87.	Colluvial loam, Hochheim, humus-rich horizon in foot of slope accumulation, 90 to 110cm, (50° 2′ N, 8° 25′ E)	6230 ± 100 4280 BC
HAM-88.	Colluvial loam, Hochheim, slopy terrace, 28° inclination, 80 to 100cm (50° 2′ N, 8° 26′ E)	2050 ± 70 100 BC
HAM-89.	Colluvial loam, Hochheim, terrace plane, < 2° inclination, 120 to 140cm, (50° 2′ N, 8° 26′ E)	2580 ± 100 630 BC
HAM-90.	Colluvial loam, Hochheim, slightly humic cover on terrace pebbles, sandy-loamy, 80 to 100cm (50° 4′ N, 8° 23′ E)	580 ± 120 AD 1370
HAM-91.	Colluvial loam, Hochheim, Delkenheim, fA 40 to 60cm below surface (50° 3′ N, 8° 22′ E)	1970 ± 70 20 BC
HAM-92.	Colluvial loam, Hochheim, Delkenheim, slopy site, between foss A-horizons, 100 to 120cm (50° 3′ N, 8° 22′ E)	2330 ± 80 380 BC
HAM-93.	Colluvial loam, Hochheim, Delkenheim, humic basis horizon over loess loam, 80 to 100cm (50° 3′ N, 8° 22′ E)	6970 ± 100 5020 BC
HAM-94.	Colluvium, Waldeck, Freienhagen, dark humic loamy sand over sandstone debris, 70 to 90cm (50° 16′ N, 9° 4′ E)	560 ± 150 AD 1390
HAM-95.	Colluvium, Waldeck, Ippinghausen, slopy part over sandstone debris, loamy sand with little humus, 50 to 80cm (50° 17′ N, 9° 9′ E)	820 ± 110 AD 1130

Samples coll and subm 1973 by J Gieβübel, Inst Geog, Univ Frankfort. *Comment*: colluvial Valley fillings rather young, but mostly older than those of medieval deforestation. Humic basis horizons with 6000 to 7000 yr apparently Boreal/Atlantic in origin (Thesis, Frankfort, in press).

Podzol-"Raseneisengley" soils of Black Forest, Rotes Meer near Altglashütten.

HAM-96.	Samples from freshly opened profiles "Rotes Meer, between Altglashütten and Bärental (47° 51.5′ N, 8° 6′ E), 20.3% C, Oh	200 ± 60 AD 1750
HAM-97.	Same sample, charcoal only	830 ± 180 AD 1120
HAM-98.	Same profile, Go II, brown	1850 ± 60 AD 100

HAM-99.	Same profile, Go II, black-brown	2130 ± 60 180 BC
HAM-100.	Same profile, sandy peaty horizon	3120 ± 90 1170 BC
HAM-101.	Same profile, Bh	580 ± 60 AD 1370
HAM-102.	Same profile, Bs	1260 ± 60 AD 690

Samples coll and subm 1974 by K Stahr, Inst Soil Sci, Freiburg Univ. *Comment*: Podzol formation expected in Alleröd time, older Dryas, or time after deforestation—17th century. Due to permanent organic matter percolation, date of Podzol is at best minimum age. Origin after deforestation, 17th century, can be excluded. Rather recent date of charcoal in Oh horizon is insignificant for origin of soil formation.

Placorthods, "Bändchen-Podsole" from Wales

HAM-103.	Hiraethog, Denbighmors, Denbigshire Mynydd Aled near Landmans Arms (53° 10′ N, 3° 30′ W) 45.0% C, Oh	580 ± 60 AD 1370
HAM-104.	Same profile, 7.7% C, Bb (ligand)	1420 ± 60 530 BC
HAM-107.	Same profile, coal-like substance BsCv	5810 ± 150 3860 BC
HAM-108.	Same profile, twig at basis of Oh	4010 ± 70 2060 BC
HAM-105.	Peny Gwrydd-pass, Snowdonia Natl Park, Caernarvonshire (53° 5′ N, 4° 2′ W), "Bändchen-Stagnogley" Oh, 13.7% C	1290 ± 60 AD 660
HAM-106.	Same profile, 5.6% Ahf	1770 ± 80 AD 180

Samples coll and subm 1974 by K Stahr. *Comment*: HAM-103-104 date Placorthod Formation, also HAM-105-106 date time for ligand formation, minimum is ca 1300 yr. Twig (HAM-108) was found at basis of Oh horizon, coal-like substance in Bs BvC horizon, where it dates erosion and settlement phase.

Comparison of humus-C and charcoal dates of Black Forest Podzol.

HAM-109.	Soil sample, S Black Forest, between Breitnau and Hollertal, Breitnau I, Podzol Oh/Ah	1120 ± 60 AD 830
HAM-110.	Same profile and sample, only charcoal	560 ± 70 AD 1390

HAM-111.	Soil sample S Black Forest, between Breitnau and Hollertal, Breitnau II, Podzol Oh/Ah	490 ± 70 AD 1460
HAM-112.	Same profile and sample, only charcoal	530 ± 80 AD 1420
HAM-113.	Charcoal pile, Trescher, 0 to 10cm, Oh/Ah, (47° 57′ N, 8° 7′ E)	103.4 ± 0.5%
HAM-114.	Same spot, charcoal, upper portion, 10 to 30cm	420 ± 50 AD 1530
HAM-115.	Same spot, charcoal, lower portion, 30 to 50cm	340 ± 60 AD 1610
HAM-116.	Fossil Brown earth, fAh 50 to 70cm	1040 ± 50 AD 910
HAM-117.	Brown earth Trescher, below rough humus cover, Ah	102.5 ± 0.4%

Samples coll and subm 1974 by K Stahr. *Comment*: since podzols have extremely strong rejuvenation due to percolation of rough humus-C, by charcoal in podzol, we hoped to find gap between charcoal and humus dates caused by rejuvenation. Breitnau I showed reverse trend, humus-C being older than charcoal-C, which apparently entered soil later. Breitnau II gives equal results for humus-C and charcoal-C. Charcoal pile Trescher was army camp at beginning of 18th century. Charcoal reflects tree age plus time after conversion into charcoal. Humus-C age in Ah-horizons affected by bomb-C, fAh of Brown earth in subsoil relatively oldest, old land surface before charcoal pile construction and army lodging. Parallel dating of charcoal and humus-C of same horizon for estimate of rejuvenating effect on humus-C is disappointing with humus-podzols due to their young age.

Low moor peat, charcoal and fossil soil on Riss boulder marl, Altenerding, Bavaria.

HAM-118.	Charcoal, old fireplace, in loess Brown earth 40 to 50cm (H 53 45 05, R 44 92 95)	1920 ± 160 AD 30
HAM-119.	Low moor peat in between loess and Riss boulder marl, 4 to 5m (H 53 45 25, R 44 96 35)	30,340 ± 1130 28,390 BC
HAM-120.	Another spot of the same pit	28,840 ± 940 26,890 BC
HAM-121a.	Low moor peat below 4 to 5m tuffaceous limestone; sample contains carbonates, destroyed before sample preparation (H 53 50 0, R 44 92 5)	8470 ± 110 6520 BC

		8490 ± 100
HAM-121b.	Same sample in spot without carbonates	6540 BC
HAM-122.	Buried Ah horizon of soil, formed in Riss boulder marl below colluvium of slope (H 53 45 05, R 44 92 95)	5550 ± 100 3600 BC

Samples coll and subm 1973 by U Schwertmann, Inst Soil Sci, Tech Univ Munich. *Comment*: aim was to date low moor peat between loess and Riss boulder marl; further below 4 to 5m tuffaceous limestone, a recent Brown Earth in loess, and buried soil below colluvium, in the Altenerding area. Peat seems to originate from Paudorf interstadial and may be Alleröd with some rejuvenation or Boreal/Atlantic time with some older materials included. Buried soil below colluvium seems to date from climatic optimum Boreal/Atlantic time with some rejuvenation due to root growth and animal transport.

Samples describing Eastern Sea coastline changes, SW Heiligenhafen

HAM-123.	Cliff wall, till 150cm below surface, 70cm below fossil beech sediment (54° 29′ N, 10° 55′ E)	4020 ± 90 2070 BC
HAM-124.	Cliff wall, 2m depth, low moor below same fossil beech sediment (54° 22′ N, 10° 55′ E)	2070 ± 70 120 BC
HAM-125.	Cliff wall, 45 to 90cm, underlying fossil beech sediment (54° 22′ N, 10° 55′ E)	1140 ± 60 AD 810
HAM-126.	Cliff wall 90 to 110cm below beech sediment (54° 22′ N, 10° 55′ E)	1990 ± 60 40 BC
HAM-127.	Cliff wall 110 to 125cm below fossil beech sediment (54° 22′ N, 10° 55′ E).	2300 ± 110 350 BC

Samples coll and subm 1974 by D Goetz, Ordinariat f Bodenkunde, Hamburg Univ. *Comment*: studied to elucidate earliest time of beech wall formation, and to estimate highest water level of Eastern Sea. Estimations of ca 2000 yr were met, except for HAM-125, in rather high position, and HAM-123, 70cm below beech sediment, where 4000 yr suggest older origin of this beech wall, closer to climatic optimum of region.

Fossil Chernozem samples

HAM-128.	Outskirts of Homberg, Kassel Co, 110 to 130cm fA (51° 2′ N, 9° 6′ E)	5650 ± 80 3700 BC
HAM-129.	Worms I, near town of Worms, fAh, 80 to 90cm	3530 ± 70 1580 BC

Samples coll and subm 1974 by C Haupenthal, Hessisches Landesamt f Bodenforschung, Wiesbaden. *Comment*: HAM-128, from Homberg, dated at 5000 BC by Fritzlar Mus based on band ceramic relics; fA-material of Worms apparently slightly rejuvenated by roots and animal transport, since soils are believed to date from Atlantic period.

Bones and wood in sediment layer believed from Roman time

HAM-130.	Bones in lower pebble layer, near Xanten (collagen date), (51° 39′ N, 6° 32′ E)	1680 ± 50 AD 270
HAM-131.	Same spot, wood buried in middle sand	1980 ± 70 30 BC
HAM-132.	Same spot, dark gray silty loam	2180 ± 60 230 BC
HAM-133.	Same spot, bluish silty fine sand between middle sand and pebbles	3150 ± 70 1200 BC

Samples coll and subm 1974 by E Mückenhausen, Inst f Bodenkunde, Bonn Univ. *Comment*: good confirmation of Roman origin, except for deepest bluish silty fine sand.

Deeply humic soils near Dutch border; organic matter in deeper part of profiles due to plaggen culture or deep plowing

HAM-134.	Walbeker Heide, gravel pit, humic eolian sand, believed from Alleröd time, 120 to 140cm (51° 30′ N, 6° 15° E)	8340 ± 90 6390 BC
HAM-135.	Same sample, 6 N HCl-hydrolysis residue only	9580 ± 100 7630 BC
HAM-136.	Sand loess in Maasaue near Velden, humic, 50 to 70cm (51° 25′ N, 6° 9′ E)	1540 ± 60 AD 410
HAM-137.	Same sample, 6 N HCl-hydrolysis residue only	2070 ± 90 120 BC
HAM-138.	Humic eolian sand, Issum, Haus Beerenbruck, 50 to 70cm (51° 32′ N, 6° 25′ E)	1440 ± 50 AD 510
HAM-139.	Same sample, 6 N HCl-hydrolysis residue only	1860 ±90 AD 90
HAM-140.	Humic sand loess, Schandelah, 45 to 60cm	1250 ± 50 AD 700
HAM-141.	Same sample, 6 N HCl-hydrolysis residue only	1440 ± 60 AD 510
HAM-142.	Humic sand loess, Walbeck, 60 to 80cm, (51° 30′ N, 6° 15′ E)	1175 ± 50 AD 775
HAM-143.	Same sample, 6 N HCl-hydrolysis residue only	1880 ± 130 AD 70

Samples coll and subm 1974 by D Schröder, Inst f Bodenkunde, Bonn Univ. *Comment*: deeply humic material could be derived from past landsurface horizons, as well as from plaggen covers or from deeply humic

horizon due to deep plowing. Total sample and 6 N HCl hydrolysis residue were parallel-dated, because hydrolysis residue samples were expected to be older. Ages older than 1500 to 2000 yr could safely be excluded from plaggen origin, since it is essentially a medieval technique of soil improvement. Since fossil carbon can be present in plaggen material, eg, from coal ashes, all samples, except for Walbeker Heide with soil formation close to Alleröd, could be due to plaggen culture (Mückenhausen *et al*, 1968).

B. Austria

HAM-144.	Low moor, Neumarkt, Am Wallersee, state of Salzburg, underneath low moor calcareous silt, 90 to 100cm (47° 40′ N, 13° 10′ E)	2790 ± 90 840 BC
HAM-145.	Same profile, 160 to 170cm	3770 ± 70 1820 BC

Samples coll and subm by F Blümel, Federal Inst Cultural Technique, Petzenkirchen. *Comment*: aim of study was to date beginning of low moor formation. Dates are somewhat younger than estimated 5000 yr.

C. USSR

HAM-146.	Southern Predkaokadzye Chernozem, ca 130km S Rostov, 1.5% C, 180 to 200cm, Profile 1	11,330 ± 980 9380 BC
HAM-147.	Chernozem of nether terrace of Don R, crotovines in C-horizon, 1.2% C, 95cm, Profile 2	5250 ± 150 3300 BC
HAM-148.	Meadow Chernozem in Asow system 0.2% C, Profile 3	6510 ± 260 4560 BC
HAM-149.	Dark Gray Forest soil on diluvium of carboniferous limestone (Zhiguli State Reserve), 0.4% C, BC, 70 to 80cm, Profile 6	5490 ± 280 3540 BC
HAM-150.	Paleohydromorphic Chernozem, Crotovine, 4.1% C, 85cm, Profile 9	4320 ± 80 2370 BC
HAM-151.	Same Profile, 8.3% C, 110cm	4750 ± 80 2800 BC
HAM-152.	Typical Chernozem from Privolzhye Upland, Karlinsky State Farm, Ulyanovsk Dist, Ulyanovsk Area, 1.4% C, BC, 100cm, Profile 14	5390 ± 120 3440 BC
HAM-153.	Normal Chernozem, near Meadow Solod, outskirts Ulyanovsk Agric Inst campus, 1.0% C, BC, 110cm, Profile 16	5550 ± 140 3600 BC

HAM-154.	Gray Forest soil, Serp-i-molot collective farm, Vysokogorsky region, Tatar ASSR 0.3% C, B3t, ca 140cm, Profile 19	7890 ± 680 5940 BC

Samples coll and subm 1974 by H W Scharpenseel. Samples coll during Wolga-Don excursion, 10th Internatl Cong Soil Sci, Moscow, 1974. Profile numbers refer to excursion guide (Ivanov, 1974). *Comment*: most samples indicate ages from 5000 to 6300 yr as usual in European chernozems, suggesting main phase of formation during Atlantic period. HAM-146 and -154 were small samples.

HAM-155.	Chernozem from Tour I, 10th Internatl Cong Soil Sci, 0.6% C, AC, 80 to 90cm, Profile 3.	4540 ± 80 2590 BC
HAM-156.	Same profile, 18 to 40cm	2350 ± 50 400 BC

Samples coll and subm by C Haupenthal, Hessisches Landesamt f Bodenforschung, Wiesbaden. *Comment*: dates agree with expected ages at sampling levels. Some rejuvenation due to root growth and animal transport is likely even in HAM-155.

D. Tunisia

Fossil horizons in steppe and alluvial soils of the semiarid region

HAM-157.	Fossil soil in pasture experimental plot, Ain Oktor, Korbous, 0.3% C, fA, 80 to 100cm (36° 48′ N, 10° 34′ E)	2250 ± 60 300 BC
HAM-158.	Three fossil horizons, Ferme near Korba, pasture experiment, 0.2% C, fA1, 48 to 60cm (36° 35′ N, 10° 53′ E)	720 ± 60 AD 1230
HAM-159.	Same profile, 0.1% C, fA2, 115 to 125cm	1300 ± 60 AD 650
HAM-160.	Same profile, 0.1% C, fA3, 160 to 175cm	2300 ± 100 350 BC
HAM-161.	Two fossil horizons near Ferme Korba, profile in plot of pasture experiments, 0.3% C, fA1, 60 to 80cm (36° 35′ N, 10° 53′ E)	1030 ± 60 AD 920
HAM-162.	Same profile, 0.4% C, fA2, 110 to 130cm	2470 ± 70 520 BC
HAM-163.	Fossil horizon, Ferme Ennasser near Bir Bou Rekba, 0.6% C, fA1, 180 to 190cm (36° 26′ N, 10° 33′ E)	4230 ± 60 2280 BC
HAM-164.	Same region profile nearby higher slope, 0.8% C, fA1, 105 to 115cm	4170 ± 70 2220 BC

HAM-165.	Fossil horizon near Enfida, Km 52, rd to Kairouan, 0.9% C, fA1, 75 to 90cm (36° 6′ N, 10° 21′ E)	4510 ± 80 2560 BC
HAM-166.	Fossil horizons in Medjerdah alluvium, near Ghardimaou bridge, fA1, 70 to 90cm (36° 26′ N, 8° 27′ E)	6450 ± 100 4500 BC
HAM-167.	Same location of alluvium, fA2, 250 to 270cm	8000 ± 180 6050 BC
HAM-168.	Fossil horizons in Medjerdah alluvium, near Bou Salem, 2.4% C, fA1, 35 to 40cm (36° 37′ N, 8° 57′ E)	670 ± 60 AD 1280
HAM-169.	Same location of alluvium, 1.5% C, fA2, 90 to 110cm	5050 ± 80 3100 BC
HAM-170.	Location nearby, 1.5% C, fA2, 85 to 95cm	4500 ± 80 2550 BC
HAM-171.	Same location, 1.2% C, fA3, 120 to 140cm	7800 ± 160 5850 BC
HAM-172.	Location nearby, near Bou Huertma R, 0.4% C, 300cm	2170 ± 170 220 BC
HAM-173.	Drainage ditch nearby, 0.8% C, 100cm	1220 ± 60 AD 730
HAM-174.	Same location 0.7% C, 150cm	2400 ± 120 450 BC

Samples coll and subm 1974 by H W Scharpenseel and K Kirschey, Ordinariat f Bodenkunde, Hamburg Univ. *Comment*: in general, samples from Cap Bon and transition to Sahel (HAM-157-165) show fA-horizons of ca 1300 yr (Islamic conquest?) 2300 yr (deforestation and alluviation due to Punic civilization?), and 4500 yr (by higher fossil horizons rejuvenated fossil soil from period of climatic optimum?). Medjerdah- and Bou Huertma R show fossil horizons from 5000 to 6000 yr and 7000 to 8000 yr; younger samples from drainage ditches are probably rejuvenated by roots or disturbed.

Soil profile of Sol Brun a Croûte with calcareous crust

HAM-175.	Soil profile with free limestone and faintly developed calcareous crust, 0 to 15cm (36° 23.5′ N, 10° 33′ E)	10,820 ± 170 8870 BC
HAM-176.	Same profile, 15 to 120cm	23,560 ± 500 21,610 BC
HAM-177.	Same profile, 120 to 130cm	25,900 ± 840 23,950 BC

HAM-178.	Same profile, 130 to 160cm	21,500 ± 410 19,550 BC
HAM-179.	Same profile, 160 to 170cm	27,160 ± 1090 25,210 BC
HAM-180.	Same profile, 170 to 190cm	12,590 ± 160 10,640 BC
HAM-181.	Same profile, 190 to 200cm	25,270 ± 610 23,320 BC
HAM-182.	Same profile, 200 to 250cm	19,230 ± 780 17,280 BC

Samples coll and subm 1974 by C Haupenthal, Hessisches Landesamt f Bodenforschung, Wiesbaden. *Comment*: ca 25,000 yr old, at the most 20,000 yr, when subtracting 50% lithic dead carbon contribution, age of faintly developed calcareous crust appears rather low. Dated for orientation, rather than for convincing evidence HAM-180 must be rejuvenated or contaminated for reasons unknown to the analyst.

II. SUBHYDRIC SOIL SAMPLES

Subhydric soil samples of artificial lake of Ruhr R

HAM-183.	Baldeney Lake Essen-Werden, S shore, ca 800m E Villa Hügel, 0 to 20cm	8480 ± 110 6530 BC
HAM-184.	Same location, ca 400m E Villa Hügel, 0 to 25cm	12,160 ± 270 10,210 BC
HAM-185.	Approx opposite Villa Hügel, 0 to 35cm	9950 ± 130 8000 BC
HAM-186.	Ca 200m W Villa Hügel, 0 to 35cm	9720 ± 130 7770 BC
HAM-187.	In front of large boating port, S shore E of HAM-183, 0 to 35cm	6180 ± 210 4230 BC
HAM-188.	Ca 200m E of boating port, E of HAM-183 and 187.	7390 ± 170 5440 BC

Samples coll and subm by H W Scharpenseel and D Schroeder, Inst f Bodenkunde, Bonn Univ. *Comment*: old ages of organic matter from young man-made lake was surprising. Investigation revealed that Ruhr R transports coal dust particles through lake bed. Old ages result of fossil carbon contamination.

III. OTHER SAMPLES

HAM-189.	Clay pit Kaerlich, wood from tree, underlying Alleröd and Holocene soil (50° 23′ N, 7° 28′ E)	29,600 ± 1150 27,650 BC

Sample coll and subm 1973 by J Frechen, Min Inst, Bonn Univ. *Comment*: sample apparently is derived from Paudorf interstadial.

HAM-190. Grass, Röttgen, near Bonn, Oct 1973 (50° 41′ N, 7° 5.5′ E) 132.9 ± 0.5%

HAM-191. Grass, same spot, Sept 1974 138.5% modern

Samples coll and subm by H W Scharpenseel as follow-up of yearly samples since 1957. *Comment*: dates in general show decreasing trend of thermonuclear bomb carbon (R, 1968, v 10, p 24-27; R, 1969, v 11, p 10-13; R, 1970, v 12, p 38; R, 1971, v 13, p 212; R, 1972, v 15, p 40).

IV. ARCHAEOLOGIC SAMPLES

Iversheim, Rhineland

Charcoal and recarbonified limestone from oven remains of Roman lime furnace

HAM-192. Dry charcoal from lime furnace of Roman origin, estimated age: 1st to 2nd century AD (50° 35′ N, 06° 46′ E) 1740 ± 70 AD 210

HAM-193. Charcoal, same sample loc, on upper burning level, age estimate: AD 260 to 300 1640 ± 70 AD 310

HAM-194. Charcoal, same sample loc, on lower burning level, age estimate somewhat older than HAM-193 1820 ± 70 AD 130

HAM-195. Presumably recarbonized lime in burned dolomite fitting of oven, upper region, expected age similar to HAM-193 141.5 ± 0.4%

HAM-196. Presumably recarbonized lime in burned dolomite fitting of oven, 140cm deeper than preceding sample, expected age similar to HAM-193 1370 ± 60 AD 580

Samples coll and subm 1973 by B Sölter, Rheinisches Landesmus, Bonn. First dug-out lime burning oven of Roman origin. *Comment*: charcoal dates are close to expected ages. Recarbonized lime is obviously contaminated by bomb carbon, especially surface near HAM-195.

Au, Hallertau, Freising Co, Bavaria

Charcoal in prehistoric soil relics, dating early settlements. Archaeologic dates of line-band-ceramics and linear-band-ceramics indicate 3000 or 4000 yr BC.

HAM-197. Charcoal Hallertau (48° 33′ N, 11° 45′ E) 5990 ± 90 4040 BC

Sample coll and subm 1974 by U Schwertmann, Inst Soil Sci, Tech Univ Munich. *Comment*: date is expected.

Bulgaria

Wood and charcoal samples; mining relics

HAM-198.	Part of wooden trough in old PB-Zn mine pit, Straschimir-Rhodopen region, (41° 22′ N, 25° 00′ E)	1560 ± 120 AD 390
HAM-199.	Part of wooden trough in old mine pit, Bakadjik, 30km S Jambol, (42° 24′ N, 26° 46′ E)	1790 ± 70 AD 160
HAM-200.	Part of wooden mine support, Tscherweno Sname copper mine, S Burgas, (42° 24′ N, 27° 38′ E)	2710 ± 70 760 BC
HAM-201.	Part of wooden mine support, Bakadjik mine, 30km S Jambol, (42° 24′ N, 26° 46′ E)	1940 ± 60 AD 10
HAM-202.	Wooden double piston pump, Jambol, (42° 24′ N, 26° 46′ E)	1650 ± 60 AD 300
HAM-203.	Charcoal of old copper mine, Tscherweno Sname, S Burgas, (42° 24′ N, 27° 38′ E)	2510 ± 80 560 BC

Samples coll and subm 1974 by E Maximoff and G Weisgerber, Bergbau Mus Bochum. *Comment*: most samples date to Roman time, except wood and charcoal samples from copper mine, Tscherweno Sname, which are older, even if older mature wood was used for production of supports and for charcoal producing fuel.

Wood from gold, silver, and copper-lead mines

HAM-204.	Round wooden climbing pole of old gold mine, Jaworow Preslap near Goweschda (43° 23′ N, 22° 56′ E)	1750 ± 60 AD 200
HAM-205.	Slightly burned wood from copper mine, Plakalnitza near Vratza (43° 4′ N, 23° 30′ E)	1730 ± 50 AD 220
HAM-206.	Part of large wooden trough, silver-lead mine Tschiprowtzi (43° 4′ N, 23° 30′ E)	520 ± 60 AD 1430

Samples coll and subm 1974 by E Maximoff and G Weisgerber, Bergbau Mus, Bochum. *Comment*: HAM-204-205 date to Roman time; HAM-206 suggests medieval origin.

Israel

Charcoal from Timna mine (29° 40′ N, 34° 50′ E)

HAM-207.	Charcoal, Mine 212/1, Timna, S-Israel, site in Egyptian tunnel	2910 ± 70 960 BC

HAM-208.	Charcoal, Mine 212/1, Egyptian tunnel	2910 ± 60 960 BC
HAM-209.	Charcoal, Mine 212/1, Egyptian tunnel sample too small, discarded	—
HAM-210.	Charcoal, Mine 212/1e, Egyptian tunnel	3050 ±70 1100 BC
HAM-211.	Charcoal, Mine 212/1g, Egyptian tunnel	2640 ± 60 690 BC
HAM-212.	Charcoal, Mine 212/2, Egyptian tunnel	2780 ± 90 830 BC
HAM-213.	Charcoal, Mine 212/2, Egyptian tunnel	3890 ± 70 1940 BC
HAM-214.	Charcoal, Mine 212/2a, Egyptian tunnel	4000 ± 90 2050 BC
HAM-215.	Charcoal, mining site, slag pile (Cut 25, Layer 2)	4020 ± 100 2070 BC
HAM-216.	Charcoal, mining site, slag pile, Timna 30, Layer 1	3340 ± 60 1390 BC
HAM-217.	Charcoal, mining site, slag pile, Timna 30, Layer 1, sample too small, discarded.	—

Samples coll and subm 1974 by G Weisgerber, Bergbaumus Bochum. *Comment*: HAM-207-212 agree with estimated age ca 3000 yr, based on assumed origin at King Solomon's time. HAM-213-216 are unexplainably older.

Iran

Wood samples of ruin at E rim of oasis Shahdad, Central Iran

HAM-218.	Wooden lintel "Imamzadeh" (30° 25′ N, 57° 45′ E)	430 ± 60 AD 1520
HAM-219.	Wooden lintel, SE side base floor, apparently palm wood, (30° 25′ N, 57° 45′ E)	1150 ± 110 AD 800
HAM-220.	Wooden window lintel, E apse, same loc	430 ± 70 AD 1520

Samples coll and subm 1973 by U W Hallier, Inst Bot, Düsseldorf Univ. *Comment*: expectation, that ruins might be relics of Nesturian church building, could be confirmed by HAM-219. The other samples seem rather young.

Organic matter and wood samples, Khorasaner Kavir, Central Iran and border region along Afghanistan.

HAM-221.	Organic matter/charcoal in pre-Islamic pottery. SE rim of Tar-o-Sar, Nimrouz (30° 33′ N, 62° 6′ E)	2280 ± 300 300 BC
HAM-222.	Wooden pole of doorway, Fort Nakhlak, N Kuh-i-Nakhlak (33° 12′ N, 53° 46′ E)	1430 ± 60 AD 520
HAM-223.	Wooden pole of door construction, Fort Nakhlak N Kuh-i-Nakhlak (33° 12′ N, 53° 46′ E)	1490 ± 60 AD 460
HAM-224.	Construction wood of water tank, Qual'eh Dukhtar near Duruna (35° 17′ N, 57° 13′ E)	1030 ± 80 AD 920

Samples coll and subm by U W Hallier, Inst Bot, Düsseldorf Univ. *Comment*: HAM-221 agrees well with town Tar-o-Sar's settlement history. HAM-222-224 relate to former samples BONN-1666-1668 (R, 1973, v 15, p 278). Confirmation is needed, if samples are derived from Parther or Sasanide times. Samples are younger than BONN-1668, and just exceed age ca 1300 yr. HAM-224 dates hitherto unknown and archaeologically undescribed ruins.

Ecuador

Bone, charcoal, and wood, Cochasqui, 70km N Quito (0° 6′ N, 78° 18′ E).

HAM-225.	Bones in deeper part of trench, pyramid N highland, (rather small sample of collagen carbon)	1930 ± 70 AD 20
HAM-226.	Bones on top of burned plate, E pyramid, 1 to 3m (bones highly mineralized, very small sample, date to be discarded)	118.3 ± 0.4%
HAM-227.	Wood and earth, pyramid, Cut 28, 80 to 120cm	1020 ± 120 AD 930
HAM-228.	Wood sample in shaft, assoc with pottery of Panzaleo style	890 ± 70 AD 1060
HAM-229.	Scattered bits of wood in lower shaft	980 ± 70 AD 970
HAM-230.	Charcoal, planum 1, SE part, 3 to 5m	910 ± 60 AD 1040

Samples coll and subm 1973 by H J Wentscher, Sem Anthropol, Rheinisches Landesmus Bonn. *Comment*: bone samples were highly mineralized, small samples questionable. Other dates agree well with estimated age, ca 1000 yr.

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