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HAMBURG UNIVERSITY RADIOCARBON DATES II

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Radiocarbon measurements mainly on soil samples and soil organic matter fractions are being continued. Sample benzene preparation follows Scharpenseel & Pietig (1969; 1970a). Radioactivity is measured in single screw cap quartz vials using a Packard Tri-Carb 3075 as well as a Berthold Betaszint BF 5000.

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SAMPLE DESCRIPTIONS

I. SOIL SAMPLES

Pretreatment of soil samples described in Scharpenseel & Pietig (1969), and Scharpenseel (1972).

A. Germany

Sequence of mud, topped by low moor peat and sand cover at fringes of refilled old river bed of Ems R. In adjacent sandy bank of Ems R artifacts of ren hunter group (Ahrensberg culture) dated ca 9000 BC. Samples to determine approx age of low moor.

HAM-280. Rietberg (51° 48′ N, 8° 25′ E), mud, 30.3% organic — 6680 ± 90

HAM-281. Rietberg, low moor, 80% organic — 4540 ± 70

Samples coll and subm 1975 by H Mertens, Geol Landesamt NRW, Krefeld. *Comment*: dates indicate time of development of mud and low moor, which overlie archaeol predated river bank planum.

Brown earth (ochrept) profile rich in humus down to deep layers on terrace gravel.

HAM-631. Holzkirchen, near Munich-Salzburg Hwy, 47° 55′ N, 11° 43′ E), Ah1 0 to 5cm — 117.3 ± 0.6%

HAM-632. Ah2 5 to 25cm — 105.1 ± 0.5%

HAM-633. Ah3 25 to 45cm — 2510 ± 50

HAM-634. Bt 45 to 65cm — 123.8 ± 0.8%

Samples coll and subm 1975 by H Grottenthaler, Bayer Geol Landesamt, Munich, FRG. *Comment*: samples reworked or contaminated, bomb C at depth of 45 to 65cm.

B. Argentina

Brunizem soils from Argentina (Udolls with argillic horizon)

HAM-231.	Brunizem, Profile B 5, Rafaela 96m alt, (31° 15′ S, 61° 27′ W), typical Brunizem with B_2-horizon, sampling after crop of corn, Ap 0 to 15cm	110.0 ± 0.5%
HAM-232.	Ah/AhBv 15 to 30cm	320 ± 60
HAM-233.	Bt1 30 to 40cm	114.7 ± 0.5%
HAM-234.	Bt1 40 to 50cm	101.1 ± 0.4%
HAM-235.	Bt1 50 to 60cm	260 ± 70
HAM-236.	Bt2 60 to 70cm	104.3 ± 0.5%
HAM-237.	Bt2/Bt3 70 to 80cm	480 ± 80
HAM-238.	Typical Brunizem, profile B 7, Esperanza 38m alt (31° 26′ S, 61° 87′ W), experimental plot, Ap 0 to 13cm	113.8 ± 0.6%
HAM-239.	Ah 15 to 30cm	200 ± 60
HAM-240.	AhBv 30 to 40cm	100.2 ± 0.3%
HAM-241.	Bt1 40 to 50cm	480 ± 60
HAM-242.	Bt1 50 to 60cm	1100 ± 60
HAM-243.	Bt2 60 to 70cm	2000 ± 80
HAM-244.	Bt2 70 to 80cm	2030 ± 80
HAM-245.	Slightly planosolic Brunizem, profile B 8, Angel Gallardo, 16m alt (31° 33′ S, 60° 43′ W) weed covered fallow, Ap 0 to 10cm	112.5 ± 0.4%
HAM-246.	Ap/P/Ah 10 to 30cm	101.1 ± 0.4%
HAM-247.	AlBv 30 to 40cm	980 ± 60
HAM-248.	Bt1 40 to 50cm	1930 ± 140
HAM-249.	Bt1 50 to 60cm	2110 ± 80
HAM-250.	Bt1 60 to 70cm	2420 ± 80
HAM-251.	Bt1 70 to 80cm	2550 ± 70
HAM-252.	Bt2 80 to 90cm	2780 ± 80
HAM-253.	Brunizem under cropping pattern, till 30cm rooted, fragipan, Profile B 9, Villa Conception des Tio, 110m alt (31° 33′ S, 60° 43′ W), Ap 0 to 15cm	112.8 ± 0.5%
HAM-254.	Ah/B 18 to 27cm	460 ± 60

HAM-255.	Bt	27 to 35cm	1080 ± 100
HAM-256.	Bv	35 to 45cm	1370 ± 90
HAM-257.	Bv	45 to 55cm	1870 ± 90

Samples coll and subm 1974 by S Stephan, Inst Soil Sci, Bonn Univ, FRG. *Comment*: dates of deepest humus containing fringes younger than 5000 to 6000 BP as found in Holocene Mollisols of N Europe (Scharpenseel, 1972). Pronounced clay infiltration carrying organic matter could be responsible for some rejuvenation.

C. Tunisia

Fossil soil horizons in Bou Huertma alluvium (36° 37′ N, 8° 55′ E).

HAM-258.	Pit hole in alluvium 2km N Hwy, 1% C, 110cm	3400 ± 80
HAM-259.	Same site, 1.1% C, 160cm	4930 ± 80

Samples coll and subm 1974 by K Kirschey, Ordinariat f Bodenkunde, Hamburg Univ, FRG. Supporting samples for series HAM-157-174 (R, v 18, p 282-283). *Comment*: samples indicate time of soil formation in Medjerdah-Bou Huertma alluvial deposits.

D. Humic acid samples of Lower Saxonian soils

Humic acid samples, produced by continuous extraction from various soil materials (especially from peaty, podzolic or chernozemic soil materials) using alkaline and neutral extractants. Peat samples of surface near origin from spots unaltered by recent human activities (peat cutting, recultivation). All soils sampled within boundaries of Lower Saxonia-state, between Elbe R and Ems R.

HAM-260.	Humic acid sample, Sonnenberger Moor, high moor, Harz, *Vaccinium* vegetation.	180 ± 70
HAM-261.	Fringes of Sonnenberger Moor, high moor, *Picea* vegetation.	1210 ± 100
HAM-262.	Teufelsmoor near Bremen, high moor, "white peat".	3210 ± 100
HAM-263.	Gnarrenburger Moor, highly decomposed "black peat".	1610 ± 80
HAM-264.	Königsmoor near Bremen, high moor, "white peat", 30 cm.	2430 ± 80
HAM-265.	Königsmoor near Bremen, albic horizon in sand below peat of high moor	2350 ± 70
HAM-266.	Königsmoor near Bremen, spodic horizon in sand and peat, spodosol underneath high moor	2770 ± 100
HAM-267.	Kolbecksmoor, highly decomposed low moor peat	4200 ± 110

HAM-268.	Highly decomposed low moor peat from Lake Dümmer near Hannover	3030 ± 110
HAM-269.	Moderately decomposed low moor peat near Stade I	3330 ± 90
HAM-270.	Highly decomposed low moor peat near Stade II	2670 ± 80
HAM-271.	Highly decomposed low moor peat from "groβer Bruch" near Jerxheim, calcareous site (30% $CaCO_3$)	2480 ± 100
HAM-272.	Erica Podzol, spodic horizon, Vogtei, pH 7-extract	730 ± 80
HAM-273.	Erica Podzol, spodic horizon, Vogtei, pH 14-extract	650 ± 80
HAM-274.	Calluna Podzol, spodic horizon, Steyerberg, pH 14-extract	230 ± 90
HAM-275.	Brown coal (Kasseler Braun) Steinberg, Hannoversch Münden	19,800 ± 710
HAM-276.	Peaty sand from sand pit Honerdingen near Walsrode, Südheide	18,210 ± 670
HAM-277.	Argiudoll near Hildesheim, field culture, Ap 10cm	340 ± 80
HAM-278.	Argiudoll near Hildesheim, forest, Ah 10cm	230 ± 80
HAM-279.	Argiudoll near Hildesheim, forest, Ah 35cm	103.6 ± 0.6%

Samples coll and subm 1974 by W Rochus, Interfak Lehrgebiet Chemie, Göttingen Univ, FRG. *Comment*: near surface samples from Sonnenberger High Moor seem to be influenced by contemporary and bomb carbon sources. The Königsmoor samples (HAM-264-266) belong to high moor superimposed on pronounced Spodosol. Peat and albic horizon-C are slightly younger than carbon of the accumulating spodic horizon. This is a "wurzelechtes Hochmoor," which means that plants producing peat are still rooted in mineral soil. Almost equal age of peaty, albic and spodic horizon confirms this model; equal age reflects uniform supply to all horizons with modern C by deeply rooting plants. Among the low moor peats the one from the calcareous Jerxheim site with the fastest turnover of organic matter is dated youngest. The Podzol samples are all highly rejuvenated by organic leachates. Organic matter in basal sands of sand pit Honerdingen is relic of former patches of peat, covered by Pleistocene fine sands. If no leaching of organic matter through 6 to 8m dune sand did occur, date indicates age of dune sand deposition (Rochus, 1975). Brown coal from Steinberg should consist of dead carbon. Date indicates admixture of younger organic constituents. Humic acid

from Chernozem near Hildesheim originates from near surface samples, rejuvenated with modern C and influenced by bomb carbon.

II. FRACTIONS OF SOIL ORGANIC MATTER

Podzol (Spodosol) from Gravel pit Weber, Scherpenseel, near Dutch border (50° 56′ N, 6° 1′ E). Fractionation of Na–pyrophosphate/NaOH extract by Sephadex G 50 gel permeation.

HAM-282.	Podzol Scherpenseel, average sample, Bh 105 to 130cm	2470 ± 70
HAM-283.	Total Na–pyrophosphate/NaOH extract of same sample, extracted under protective gas and precipitated by HCl	2940 ± 60
HAM-284.	Same sample eluate after passage through 100cm column of Sephadex G 50	2230 ± 70
HAM-285.	Same sample, Sephadex G 50, retained/ delayed fraction	5410 ± 90

Samples prepared and subm 1975 by H W Scharpenseel and E Kruse, Inst Soil Sci, Bonn Univ, FRG. Related samples: BONN-90 (R, v 10, p 20), BONN-1688-1698 (R, v 15, p 267). *Comment*: Sephadex fractionation indicates selective enrichment of smaller-sized retained fraction with older C compared to larger-sized passing fraction with relatively younger C.

Chernozem (Mollisol) from Aseler Wald near Hildesheim (52° 10′ N, 10° 1′ E). Production of organic matter fractions by benzene extraction, classical fractionation according to Flaig *et al* (1955), Sephadex gel permeation and acid hydrolysis.

HAM-286.	Aseler Wald, C of soil in total, AC 55 to 65cm	2470 ± 60
HAM-287.	Benzene extracted lipids, waxes	3220 ± 80
HAM-288.	Fulvic acids, undialized	370 ± 70
HAM-289.	Fulvic acids, dialized	380 ± 70
HAM-290.	Humic acids	2100 ± 70
HAM-291.	Humic acid, Sephadex G 50, passing fraction	1480 ± 60
HAM-292.	Humic acid, Sephadex G 50, retained/ delayed fraction	2940 ± 90
HAM-293.	Humines	2460 ± 60
HAM-294.	Humines, Sephadex G 75, passing fraction	151.6 ± 0.8%
HAM-299.	Humines, Sephadex G 75, retained/ delayed fraction	124.8 ± 0.6%
HAM-295.	Humus coal	2920 ± 70

HAM-296. 6 N HCl hydrolysis of whole soil, dissolved part — 104.4 ± 0.5%

HAM-297. 6 N HCl hydrolysis of whole soil, residue — 3160 ± 70

Samples and fractions prepared and subm 1975 by H W Scharpenseel and E Kruse. Related samples from a site nearby. BONN-1809-1811 (R, v 15, p 266). *Comment*: as expected, age of fulvic acids is lower than of humic acids and humines. The retained fraction due to Sephadex G50 permeation is older than leaching fraction. Sephadex fractionation of humines in Sephadex G 75 failed. Some of the column filling of G 75 was not quite new. Microbial decay products apparently transferred bomb carbon into sample fractions. Humus coal is oldest of classical fractions. Benzene extracted lipids are older as Grant-Taylor (1972) reported before. The gap between hydrolysate and hydrolysis residue, found already by Paul *et al* (1964) seems most encouraging to do more hydrolysis fractionation work with other soil materials in order to establish a correction method for rejuvenated soil samples.

Fossil A horizon in Würmian loess, on top trachyt tuff from Alleröd volcanism, Mendig, near Laach L (50° 24′ N, 7° 17′ E). Some rejuvenation by deep roots. Production of organic matter fractions by classical fractionation (Flaig *et al,* 1955), Sephadex gel permeation, benzene extraction and acid hydrolysis.

HAM-298. Mendig, gravel pit Xaver Michels, fA 180 to 190cm, C of soil in total — 10,600 ± 120

HAM-300. Benzene extracted lipids and waxes — 4130 ± 100

HAM-301. Fulvic acids, undialized — 1140 ± 200

HAM-302. Fulvic acids, dialized — 136.3 ± 0.8%

HAM-303. Humic acids — 6970 ± 210

HAM-304. Humic acids, Sephadex G 50, passing fraction — 6110 ± 100

HAM-305. Humic acids, Sephadex G 50, retained/ delayed fraction — 6830 ± 130

HAM-306. Humines — 10,320 ± 140

HAM-307. Humus coal — 9940 ± 140

HAM-308. 6 N HCl hydrolysis of whole soil, dissolved part — 2510 ± 100

HAM-309. 6 N HCl hydrolysis of whole soil, residue — 11,360 ± 150

HAM-310. Charcoal — 10,330 ± 120

Samples and fractions prepared and subm 1975 by H W Scharpenseel and E Kruse. Samples dated from pedogenetically same horizon few km apart: BONN-96 (R, v 10, p 16), BONN-763 (R, v 12, p 35), BONN-1681-1684 (R, v 15, p 266). *Comment*: ages of fulvic acids and soil hy-

drolysate are youngest. Dialized fulvic acids seem to be contaminated. Benzene extracted lipids did not show older age as in preceding sample from Aseler Wald (HAM-287). Humines, humus coal and charcoal are distinctly older than other samples. Widest gap is between carbon from acid hydrolysate and hydrolysis residue. Latter fraction is relatively oldest of the whole series.

Highly clayey low moor soil, vertic during very dry summers, Koislhof, lower terrace of Isar R. Production of organic matter fractions by stepwise extraction of soil in Soxhlet-extractors by means of solvents with increasing polarity, by clasical fractionation (Flaig *et al,* 1955), Sephadex gel permeation and acid hydrolysis.

HAM-318.	Low moor soil Koislhof, 38% C, Hn 50 to 80cm, total soil	7200 ± 210
HAM-311.	Petroleum benzene extracted C of same sample	3290 ± 320
HAM-312.	Benzene extracted Sample C	6630 ± 130
HAM-313.	Methanol extracted Sample C	6380 ± 90
HAM-314.	Acetone extracted Sample C (extremely small sample, questionable)	4020 ± 360
HAM-315.	Acetonitrile extracted Sample C (extremely small sample, questionable)	2240 ± 440
HAM-316.	Dimethylformamide extracted Sample C	10,760 ± 130
HAM-317.	Dimethylsulfoxide extracted Sample C	13,140 ± 200
HAM-319.	6 N HCl hydrolysis of whole soil, dissolved part	7270 ± 140
HAM-320.	6 N HCl hydrolysis of whole soil, residue	9730 ± 170
HAM-321.	Fulvic acids after previous extraction with organic solvents	6860 ± 250
HAM-322.	Fulvic acids, same origin, but dialized	7060 ± 110
HAM-323.	Humic acids	8810 ± 120
HAM-324.	Humic acids, Sephadex G 50, passing fraction	7590 ± 120
HAM-325.	Humic acids, Sephadex G 50, retained/delayed fraction	7820 ± 90
HAM-326.	Humines	7110 ± 110
HAM-327, 328.	Humines fractionated by Sephadex G 75, microbiologically contaminated just as HAM-294, 299, above.	
HAM-329.	Humus coal	7230 ± 110

Samples and fractions prepared and subm 1975 by H W Scharpenseel and E Kruse. Samples dated from same location: HAM-14-21, HAM-65

(R, v 18, pp 269, 273). *Comment*: organic solvent extraction is unrewarding for concentration of older Sample C. Tiny acetone and acetonitrile extracted C samples are unreliable. Dimethylformamide and dimethysulfoxide extracted C is contaminated with petrochemical solvent C, proven by $\Delta^{13}C$ measurement, despite thorough vacuum drying of soil after extractions ($\Delta^{13}C$ measurements were carried out by H Willkomm, Kiel Univ). In this sample classical fractionation and also Sephadex column fractionation as well as acid hydrolysis were carried out on soil material previously subjected to the stepwise extraction process by organic solvents of increasing polarity. This apparently reduced differences among other fractions. Age difference between fulvic acids and humic acids, humines, humus coal is small. For details see Scharpenseel (1976).

Chernozem (Mollisol) clay pit Asel, near Hildesheim (52° 10′ N, 10° 1′ E). Organic matter fractions obtained by repeated 6 N HCl hydrolysis. One aliquot of each repetitious hydrolysis treatment measured.

HAM-623.	Asel, whole soil, Ah 35 to 45cm	$>100\%$
HAM-624.	1. step of 6 N HCl hydrolysis, residue	$>100\%$
HAM-625.	2. step of 6 N HCl hydrolysis, residue	2530 ± 80
HAM-626.	3. step of 6 N HCl hydrolysis, residue	2410 ± 70
HAM-627.	4. step of 6 N HCl hydrolysis, residue	2340 ± 80
HAM-628.	5. step of 6 N HCl hydrolysis, residue	2770 ± 80
HAM-629.	6. step of 6 N HCl hydrolysis, residue	2560 ± 90
HAM-630.	7. step of 6 N HCl hydrolysis, residue	2960 ± 80
HAM-801.	8. step of 6 N HCl hydrolysis, residue	3260 ± 100

Samples and fractions prepared and subm 1976 by H W Scharpenseel and T Manukyan, Ordinariat f Bodenkunde, Hamburg Univ, FRG. For dates from nearby sites, see Aseler Wald series, above, HAM-286-297. *Comment*: not including the bomb-carbon-dominated samples, repeated hydrolysis treatment produced age increases of ca 30% by increasing removal of acid soluble younger components.

Gleyey transition of Mollisol to histosol Ergolding, near Landshut (48° 35′ N, 12° 12′ E). Production of organic matter fractions by repeated acid hydrolysis. One aliquot of each repetitious hydrolysis treatment subjected to dating.

HAM-782.	Ergolding, AhHn 50 to 60cm, whole soil	4640 ± 90
HAM-800.	Whole soil, but pyrolized under N_2 before combustion	4570 ± 110
HAM-783.	1. step of 6 N HCl hydrolysis, residue	5610 ± 80
HAM-784.	2. step of 6 N HCl hydrolysis, residue	5820 ± 110

HAM-785. 3. step of 6 N HCl hydrolysis, residue 5700 ± 100

HAM-786. 4. step of 6 N HCl hydrolysis, residue 5540 ± 110

HAM-787. 5. step of 6 N HCl hydrolysis, residue 6110 ± 90

HAM-788. 6. step of 6 N HCl hydrolysis, residue 5790 ± 90

Samples and fractions prepared and subm 1976 by H W Scharpenseel and T Manukyan. *Comment*: again, by repeated hydrolysis treatment ca 30% of initial age was added by removing younger acid soluble components. Pretreatment of recent soil samples by repeated acid hydrolysis appears to be a useful preparation technique.

III. GEOLOGIC AND GEOGRAPHIC SAMPLES

Loose dune material with roots of Nebka forming plants (Ziziphus spec.), from dune (Nebka), near wheat cultivation, Rabta, Ben Aoun, Tunisia (34° 47′ N, 9° 11′ E). Dead *Ziziphus* roots could indicate age of Nebka formation, which indicates desertification progress.

HAM-717. Dune sand with roots of *Ziziphus* sp, Sample 2 550 ± 90

HAM-718. Dune sand with roots of *Ziziphus* sp, Sample 3 160 ± 70

HAM-764. Dune sand with roots of *Ziziphus* sp, Sample 4 142.2 ± 0.6%

Samples coll and subm 1975 by H Mensching, Geog Inst, Hamburg Univ, FRG. *Comment*: very young ages of *Ziziphus* roots indicate desertification progress in recent period of time. More samples will be tested.

Sea level-coast line studies based on peat dating, shore of Northern Sea.

HAM-765. Start of peat growth, deepest position, −82 to −88cm, bore hole 8/74 (53° 51′ N, 8° 34′ E) 4240 ± 130

HAM-767. Start of peat growth on terrace, +101 to +89cm, bore hole 10/75 (53° 50′ N, 8° 34′ E) 4540 ± 120

HAM-768. Start of peat growth on terrace, +160 to +155cm, bore hole 4/75 (53° 50′ N, 8° 34′ E) 3850 ± 80

HAM-769. Start of peat growth on terrace, +90 to +84cm, bore hole 3/75 (53° 50′ N, 8° 34′ E) 3880 ± 80

HAM-770. Basal peat, red brown, +16 to +11cm, bore hole 8/74 (53° 51′ N, 8° 34′ E) 3650 ± 90

HAM-771. Basal peat, red brown, +30 to +23cm, bore hole 2/75 (53° 50′ N, 8° 34′ E) 3760 ± 100

HAM-772. Basal peat, red brown, +144 to +134cm, bore hole 10/75 (53° 50′ N, 8° 34′ E) 3580 ± 90

HAM-773. Basal peat, red brown, +177 to +172cm, bore hole 4/75 (53° 50′ N, 8° 34′ E) 6130 ± 240

HAM-774.	Basal peat, red brown, +107 to +109cm, bore hole 25/75 (53° 50′ N, 8° 34′ E)	4320 ± 140
HAM-775.	Highest occurrence of peat, +192 to +187cm, bore hole 4/75 (53° 50′ N, 8° 34′ E)	3820 ± 90
HAM-776.	End of peat growth, +57 to +52cm, bore hole 8/74 (53° 51′ N, 8° 34′ E)	3210 ± 80

Samples coll and subm 1975 by G Linke, Hamburg Geol Landesamt, Hamburg, FRG. *Comment*: ages of peat samples at well defined levels will be used in context with other experimental data to determine coast line chronology.

Humus containing alluvial clay from Elbe R alluvium, Billwerder-Allermöhe, S Hamburg, measurement of date of deposition.

HAM-791.	Alluvium of Elbe R, Billwerder-Allermöhe, construction pit, cross rds Marshhwy and Oberer Landweg, (53° 28′ N, 10° 10′ E), peat, 115 to 130cm below surface	1590 ± 80
HAM-792.	Same site, tree bark and branches, 115 to 130cm	1770 ± 90
HAM-793.	Same site, some leaves embedded in alluvial clay	2720 ± 100
HAM-794.	Profile pit on highest level of vaulted field, alluvium of Elbe R, Billwerder-Allermöhe (53° 28′ N, 10° 11′ E), 66 to 75cm, humus-rich alluvial clay	1650 ± 80
HAM-795.	Same site, 75 to 83cm, alluvial clay, very rich in humus	1710 ± 80
HAM-796.	Same site, 83 to 96cm, alluvial clay, very rich in humus	1870 ± 80
HAM-797.	Another profile pit on highest level of vaulted field, alluvium of Elbe R, Billwerder-Allermöhe (53° 28′ N, 10° 11′ E), 74 to 76cm, humus containing alluvial clay	3170 ± 100
HAM-798.	Same site, 76 to 79cm, humus containing alluvial clay	
HAM-799.	Same site, 79 to 82cm, humus containing alluvial clay	3370 ± 100

Samples coll, subm, prepared, and measured 1976 by B Hintze, Ordinariat Soil Sci, Hamburg Univ, FRG. *Comment*: profile HAM-797-799 overlain by shallow extremely clayey layer, impeding rejuvenation from above by root growth, animal transport, infiltration through cracks. This clay protection does not exist in profile HAM-794-796. Furthermore, humus containing alluvial clay continues below depth of profile pits.

Analogous layers in different pits need not be located at same depth. Age > 3000 indicates at least Sub-boreal deposition of those alluvial clays, now found at 70 to 85cm depth.

IV. ARCHAEOLOGIC SAMPLES

HAM-622. Wood sample of Celtic boat, from construction pit near Frankfurt, Germany (50° 4′ N, 8° 41′ E). Sample coll and subm 1975 by H Zakosek, Inst Soil Sci, Bonn Univ, FRG. — 1580 ± 60

Comment: since Celts had already left Germany at the end of La-Tène period, date is slightly younger than expected.

Inclan series, Peru

HAM-602. Charcoal, Inclan, Dist Sama Grande, Prov Tacna, Dept Tacna (17° 45′ S, 70° 15′ W), charcoal, 155cm below desert sand surface — 850 ± 60

HAM-603. Vegetable coal, 110cm below desert sand surface — 740 ± 70

HAM-604. Charcoal, 110cm below desert sand surface — 670 ± 70

HAM-605. Textile fragment, 40cm below desert sand surface — 143.6 ± 1.5%

HAM-606. Wooden remains, 90cm below desert sand surface — 400 ± 70

HAM-607. Charcoal, 100cm below desert sand surface — 124.6 ± 1.1%

HAM-608. Wooden relics, 100cm below desert sand surface — 103.3 ± 0.9%

HAM-609. Charcoal, 130cm below desert sand surface — 150.0 ± 2.0%

HAM-610. Wood, 100cm below desert sand surface next to collapsed bldg — 920 ± 80

Quebrada de la Vaca series, Peru

HAM-611. Vegetable cane, Quebrada de la Vaca, Dist Chala, Prov Caraveli, Dept Arequipa, Peru (13° 48′ S, 74° 24′ W), 80cm below floor inside storage bldg — 240 ± 70

HAM-612. Cotton and cotton seeds from sand filled storage bldg, small sample — > 100%

HAM-613.	Wood, 60cm below collapsed bldg surrounded by desert sand	600 ± 70
HAM-614.	Chili pepper, at base of stone-constructed storage bldg, locked by stones	270 ± 70
HAM-615.	Charcoal, 140cm below floor in storage bldg	130.5 ± 2.7%
HAM-616.	Wool fibers in circular storage bldg, small sample	> 100%
HAM-617.	Remains of textile fabric, 80cm below floor in sand-filled storage bldg	101.9 ± 0.9%
HAM-618.	Cotton sample in pot dug out of sand	101.2 ± 1.0%
HAM-619.	Charcoal, 50cm depth, below desert sand in rubbish pile	90 ± 110
HAM-620.	Guano (bird dung) in guano filled storage bldg	164.5 ± 1.6%
HAM-621.	Dung remains from 100cm depth in storage bldg	360 ± 80

Samples coll and subm 1975 by H Trimborn and R Santos Ramirez, Inst f Völkerkunde, Bonn Univ, FRG. *Comment*: samples of site Inclan, Sama Grande, Tacna, are from still existing supposedly pre-Spanish settlement. Dates from 670 to 920 yr confirm this supposition, some samples are modern and contain bomb carbon. Sample site Quebrada de la Vaca, Chala was previously studied: BONN-1659-1661 (R, v 16, p 163). These 3 charcoal samples were dated at AD 860 to 1130, pre-Spanish. HAM-611-621, except for HAM-613, are all younger, post-Spanish, most of them even modern with bomb carbon. Most samples > 100% are textile fabrics and fibers, seeds or dung.

References

Flaig, W, Scheffer, F, and Klamroth, B, 1955, Zur Charakterisierung der Huminsäuren des Bodens: Zeitschr Pflanzenernähr, Bodenkunde, v 71, p 33.

Grant-Taylor, T L, 1972, The extraction and use of plant lipids as a material for radiocarbon dating: 8th internatl conf on radiocarbon dating, Proc, Wellington, New Zealand, 1972, p 439-448.

Paul, E A, Campbell, C A, Rennie, D A, and McCallum, K J, 1964, Investigations of the dynamics of soil humus using carbon dating techniques: 8th internatl cong soil sci, Proc, Bucharest 1964, III, p 201.

Rochus, W, 1975, Die Zusammensetzung der organischen Substanz eines fossilen Torfsandes aus einer Sandgrube bei Walsrode in der Südheide: Telma, v 5, p 189-204.

Scharpenseel, H W, 1972, Messungen der natürlichen C-14 Konzentration in der organischen Substanz von rezenten Böden, eine Zwischenbilanz: Zeitschr Pflanzenernähr, Bodenkunde, v 133, p 241-263.

Scharpenseel, H W, 1976, The search of biologically inert and lithogenic carbon in recent soil organic matter: IAEA/FAO Internatl symposium on soil organic matter studies Proc, Brunswick FRG, 1976, in press.

Scharpenseel, H W and Pietig, F, 1969, Einfache Boden-und Wasserdatierung durch Messung der ^{14}C-und Tritium-Konzentration: Geoderma, v 2, p 273-289.

———— 1970a, Altersbestimmung mit dem Flüssigkeits Szintillations Spektrometer; Vereinfachte Benzolsynthese, auch aus kleinen CO_2-Mengen: Atompraxis, v 16, no. 2, p 1-2.

———— 1970b, University of Bonn natural radiocarbon measurements III: R, v 12, p 35.

———— 1973, University of Bonn natural radiocarbon measurements VI: R, v 15, p 266, 267.

———— 1974, University of Bonn natural radiocarbon measurements VII: R, v 16, p 163.

Scharpenseel, H W, Pietig, F, and Schiffmann, H, 1976, Hamburg University radiocarbon dates I: R, v 18, p 269, 273, 282, 283.

Scharpenseel, H W, Pietig, F, and Tamers, M A, 1968, Bonn radiocarbon measurements I: R, v 10, p 20.