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UNIVERSITY OF BONN NATURAL RADIOCARBON MEASUREMENTS IV

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Radiocarbon measurements, mainly on soil and water samples have been continued. Sample preparation is carried out following methods described by the authors elsewhere (Scharpenseel and Pietig, 1968/69; 1970a, b).

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SAMPLE DESCRIPTIONS

I. GROUND WATER SAMPLES

A. Halterner/Osterfelder Sande

Samples are dated to aid investigations of aquifer spread in Halterner/Osterfelder Sande, NW fringes of main industrial area; coll. 1969 and subm. by G. Siebert, Geol. Landesamt Northrhine-Westfalia, Krefeld.

	12,150 ± 100
BONN-522. Hünxe 1	10,200 B.C.
(51° 39′ N Lat, 6° 48′ E Long)	
	16,000 ± 215
BONN-523. Hünxe 2	14,050 B.C.
(51° 39′ N Lat, 6° 48′ E Long)	
	10,550 ± 120
BONN-524. Hünxe 4	8600 B.C.
(51° 40′ N Lat, 6° 49′ E Long)	
	15,080 ± 170
BONN-525. Schwiese	13,130 B.C.
(51° 40′ N Lat, 6° 51′ E Long)	
	12,980 ± 135
BONN-526. Ziegelei Nelskamp	11,030 B.C.
(51° 40′ N Lat, 6° 50′ E Long)	

		10,585 ± 110
BONN-527. Hünxe III		8635 B.C.
(51° 40′ N Lat, 6° 49′ E Long)		
		7320 ± 80
BONN-528. Gahlen I		5370 B.C.
(51° 39′ N Lat, 6° 53′ E Long)		

Comment: except for BONN-523 and -525, carbonate correction (Tamers, 1967) shows samples are early Holocene. Tritium measurements for modern recharge check were not wanted.

B. Tunisia

Ground-water dating has been continued in Tunisia (R., 1970, v. 12, p. 22-26). Carbonates of 41 wells were coll. by distillation and precipitation as $SrCO_3$. Bicarbonate titration was carried out immediately at sampling site. C^{14} ages are indicated, uncorrected and corrected for dead carbonate-C contribution (Tamers, 1967). Tritium concentrations were also measured. Samples coll. 1968 and subm. by W. Kerpen, E. Kruse, and H. W. Scharpenseel, Inst. f. Bodenkunde, Bonn Univ., J. Ohling HER Econ. Coop. Proj., Tunis.

Sample	Measured C^{14} age	Corrected C^{14} age
	8400 ± 80	6560 ± 610
BONN-529. Ain Beda 3	6450 B.C.	4610 B.C.
(35° 30′ N Lat, 9° 43′ E Long)		
	2130 ± 60	300 ± 610
BONN-530. El Alem 2	180 B.C.	A.D. 1650
(35° 55′ N Lat, 9° 59′ E Long)		
	3560 ± 60	1890 ± 560
BONN-531. El Alem 1	1610 B.C.	A.D. 60
(35° 55′ N Lat, 10° 2′ E Long)		
	11,410 ± 80	9620 ± 600
BONN-532. Hajeb 9 Aioun	9460 B.C.	7670 B.C.
(35° 24′ N Lat, 9° 31′ E Long)		
	12,500 ± 100	10,790 ± 570
BONN-533. Hajeb 10928 Aioun	10,550 B.C.	8840 B.C.
(35° 23′ N Lat, 9° 33′ E Long)		
	8840 ± 85	7160 ± 560
BONN-534. Abdelhamid gouia	6890 B.C.	5210 B.C.
(35° 23′ N Lat, 9° 31′ E Long)		
	10,930 ± 115	9550 ± 460
BONN-535. Haffouz 2	8980 B.C.	7600 B.C.
(35° 38′ N Lat, 9° 40′ E Long)		
	14,960 ± 140	13,540 ± 470
BONN-536. Haffouz 4	13,050 B.C.	11,590 B.C.
(35° 38′ N Lat, 9° 41′ E Long)		

Sample	Measured C^{14} age	Corrected C^{14} age
BONN-537. Hajeb el Aioun 11758/4 (35° 25′ N Lat, 9° 32′ E Long)	2480 ± 50 530 B.C.	1110 ± 460 A.D. 840
BONN-538. Cherichira 3 (35° 39′ N Lat, 9° 47′ E Long)	4470 ± 60 2520 B.C.	2870 ± 530 920 B.C.
BONN-539. Cooperative Scam chez Tunis (36° 41′ N Lat, 10° 36′ E Long)	2960 ± 60 1010 B.C.	1330 ± 540 A.D. 620
BONN-540. M.B. 8983 (36° 42′ N Lat, 10° 16′ E Long)	7120 ± 120 5170 B.C.	5570 ± 520 3620 B.C.
BONN-541. Ez Zebara 12594/4 (35° 31′ N Lat, 9° 41′ E Long)	4960 ± 55 3010 B.C.	3120 ± 610 1170 B.C.
BONN-542. Zeuss III (33° 31′ N Lat, 10° 21′ E Long)	10,890 ± 110 8940 B.C.	9410 ± 500 7460 B.C.
BONN-543. Mareth 312/5 Source (33° 37′ N Lat, 10° 17′ E Long)	17,470 ± 220 15,520 B.C.	15,890 ± 530 13,940 B.C.
BONN-546. Menchia 1 9316/5 (33° 47′ N Lat, 8° 47′ E Long)	24,820 ± 700 22,870 B.C.	23,050 ± 590 21,100 B.C.
BONN-547. Maunsoura Source (33° 44′ N Lat, 8° 58′ E Long)	19,310 ± 295 17,360 B.C.	17,710 ± 530 15,760 B.C.
BONN-548. Kettaua 5547 (33° 45′ N Lat, 10° 10′ E Long)	17,900 ± 190 15,950 B.C.	16,390 ± 500 14,440 B.C.
BONN-549. Oued Akarit Source 5540/5 (34° 06′ N Lat, 9° 58′ E Long)	17,200 ± 200 15,250 B.C.	15,650 ± 520 13,700 B.C.
BONN-550. Chenini Chott el Ferik (33° 52′ N Lat, 10° 2′ E Long)	17,360 ± 210 15,410 B.C.	15,660 ± 570 13,710 B.C.
BONN-551. Bida Source (10° N Lat, 33° E Long)	17,680 ± 190 15,730 B.C.	16,170 ± 500 14,220 B.C.

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Sample	Measured C^{14} age	Corrected C^{14} age
BONN-552. Seftimi 7305/5 (33° 48′ N Lat, 9° 0′ E Long)	27,040 ± 610 25,090 B.C.	25,490 ± 420 23,540 B.C.
BONN-553. Ain Guettara (33° 45′ N Lat, 9° 7′ E Long)	14,340 ± 250 12,390 B.C.	12,740 ± 530 10,790 B.C.
BONN-554. Oun el Ferth 5918/5 (33° 47′ N Lat, 9° 14′ E Long)	24,940 ± 710 22,990 B.C.	23,440 ± 500 21,490 B.C.
BONN-555. Bordj Sai Daue 3 5821ter/5 (33° 47′ N Lat, 9° 18′ E Long)	22,620 ± 460 20,670 B.C.	21,170 ± 480 19,220 B.C.
BONN-556. Nakla 2 6664/5 (33° 51′ N Lat, 9° 29′ E Long)	21,510 ± 500 19,560 B.C.	19,490 ± 670 17,540 B.C.
BONN-557. Ain Tamra (33° 44′ N Lat, 9° 21′ E Long)	22,850 ± 435 20,900 B.C.	20,810 ± 680 18,860 B.C.
BONN-558. C.F. 1 (Saline) (33° 54′ N Lat, 9° 39′ E Long)	28,990 ± 790 27,040 B.C.	27,530 ± 490 25,580 B.C.
BONN-559. Oued el Hamma (33° 51′ N Lat, 9° 47′ E Long)	19,100 ± 230 17,150 B.C.	17,630 ± 490 15,680 B.C.
BONN-560. Oudref 2 (Oued Melak) (33° 59′ N Lat, 9° 58′ E Long)	20,690 ± 350 18,740 B.C.	19,180 ± 510 17,230 B.C.
BONN-561. El Hicha (34° 9′ N Lat, 9° 59′ E Long)	18,330 ± 230 16,380 B.C.	16,700 ± 540 14,750 B.C.
BONN-562. Dehibat Bir el ghab (32° 6′ N Lat, 10° 49′ E Long)	29,830 ± 760 27,880 B.C.	27,970 ± 620 26,020 B.C.
BONN-563. Brega Kibira No. 50 (32° 25′ N Lat, 10° 16′ E Long)	22,490 ± 350 20,540 B.C.	20,860 ± 540 18,910 B.C.
BONN-564. Quargla 1 (32° 0′ N Lat, 5° 19′ E Long)	27,710 ± 760 25,760 B.C.	26,380 ± 440 24,430 B.C.
BONN-565. Ain Louise (31° 56′ N Lat, 5° 20′ E Long)	24,280 ± 630 22,330 B.C.	23,140 ± 380 21,190 B.C.

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Sample	Measured C^{14} age	Corrected C^{14} age
BONN-566. Ain Taula Djdida (29° 18′ N Lat, 7° 1′ E Long)	23,100 ± 370 21,150 B.C.	21,280 ± 610 19,330 B.C.
BONN-567. El Oued 33 (29° 54′ N Lat, 8° 11′ E Long)	22,820 ± 650 20,870 B.C.	21,160 ± 550 19,210 B.C.
BONN-568. Bou Merdas 2 8210bis/4 (35° 31′ N Lat, 10° 42′ E Long)	7090 ± 85 5140 B.C.	5340 ± 580 3390 B.C.
BONN-569. Beni Hassen 7 Bis 8204bis/4 (35° 32′ N Lat, 10° 49′ E Long)	6410 ± 70 4460 B.C.	4690 ± 570 2740 B.C.
BONN-570. Sidi Naija 9913/4 (35° 29′ N Lat, 10° 50′ E Long)	5915 ± 80 3965 B.C.	4240 ± 560 2290 B.C.
BONN-571. Sidi Bennour 10626/4 (35° 31′ N Lat, 10° 54′ E Long)	8480 ± 120 6530 B.C.	6700 ± 590 4750 B.C.

Comment: BONN-529-571 are 2nd series of ground-water studies in Tunisia and are follow-up of BONN-229-521. Coll. 1969 from ground-water deposits in Quaternary, Tertiary, and Cretaceous sediments. After completion of 3rd and last series, coll. in 1970, all samples will be evaluated and isochrones drawn.

II. SOIL SAMPLES

To eliminate recent root and organic cell debris, soil samples were pretreated, as described in R. 1968, v. 10, p. 8-28; 1969, v. 11, p. 3-14; and 1970, v. 12, p. 19-39. Mean residence time of carbon in soil profiles was tested.

A. Hungary

Organic matter of individual genetic horizons from different profiles of major soil groups, mainly chernozem and vertisol, in Hungary was measured by natural radiocarbon, as part of general scrutiny of natural radiocarbon concentration in chernozem and vertisol profiles.

Chernozem with pseudomycelia in loess, Erd, SE Budapest

BONN-611.	Chernozem, 2.0% C, A_{sz}, 10 to 20 cm	860 ± 60 A.D. 1090
BONN-612.	Chernozem, 1.6% C, A, 20 to 30 cm	910 ± 60 A.D. 1040
BONN-613.	Chernozem, 1.2% C, B, 30 to 45 cm	1945 ± 60 A.D. 5

BONN-614.	Chernozem, 0.6% C, BC, 45 to 59 cm	2800 ± 50 850 B.C.
BONN-615.	Chernozem, 0.4% C, C_1, 70 to 87 cm	9680 ± 100 7730 B.C.

Samples belong to Hungarian Chernozem region with loessic parent material (47° 25′ N Lat, 18° 55′ E Long); coll. 1969 and subm. by W. Kerpen and C. Ronzani, Inst. f. Bodenkunde, Bonn, and I. Lamberger, Research Inst. for Soil Sci. and Agric. Chem., Hungarian Acad. Sci. Budapest.

Chernozem with pseudomycelia in sand loess, Balatonföldvár, SE Budapest, S bank of Plattensee

BONN-625.	Chernozem, on Würm sand loess, 0.9% C, A_{hCa1}, 27 to 47 cm	1860 ± 60 A.D. 90
BONN-626.	Chernozem, on Würm sand loess, 0.6% C, CB+BC, 50 to 62 cm	3450 ± 70 1490 B.C.
BONN-627.	Chernozem, on Würm sand loess, 0.6% C, C_1, 80 to 95 cm	4690 ± 60 2740 B.C.

Samples belong to Hungarian Chernozem region (46° 50′ N Lat, 17° 47′ E Long), coll. 1969 and subm. by W. Kerpen, C. Ronzani, and L. Szücz.

Chernozem with pseudomycelia in fine sandy loess Köszàrhegy

BONN-633.	Chernozem on fine sandy loess, A_2, 15 to 39 cm	2940 ± 50 990 B.C.
BONN-634.	Chernozem on fine sandy loess, B, 39 to 54 cm	3640 ± 70 1690 B.C.
BONN-635.	Chernozem on fine sandy loess, CB, 54 to 80 cm	3970 ± 90 2020 B.C.
BONN-636.	Chernozem on fine sandy loess, BC, 80 to 100 cm	4575 ± 60 2625 B.C.

Samples belong to Hungarian Chernozem region (47° 8′ N Lat, 18° 23′ E Long), coll. 1969 and subm. by W. Kerpen, C. Ronzani, and L. Szücs. Profile taken from slope at rim of tilery.

Wiesenboden, formed in loess, transformed by solifluction, Boconad, ENE Budapest

BONN-616.	Wiesenboden solifluction loess, 4.2% C, A_o, 15 to 27 cm	3060 ± 75 1110 B.C.
BONN-617.	Wiesenboden solifluction loess, 2.3% C, B, 28 to 45 cm	3120 ± 70 1170 B.C.
BONN-618.	Wiesenboden solifluction loess, 1.5% C, BC_1, 45 to 59 cm	3730 ± 65 1780 B.C.

BONN-619.	Wiesenboden solifluction loess, 0.35± C, C_1, 69 to 90 cm	3870 ± 100 1920 B.C.
BONN-620.	Wiesenboden solifluction loess, 0.3% C, C_2, 110 to 120 cm	5260 ± 70 3310 B.C.

Wiesenboden is held to be younger than aforementioned chernozems (47° 40′ N Lat, 20° 11′ E Long); coll. 1969 and subm. by W. Kerpen, C. Ronzani, and T. Jankovits.

Brownearth of high base saturation (Eutrochrept) in loess, containing free carbonates, Kapoly, site endangered by erosion

BONN-628.	Brownearth in loess, 0.5% C, B_{v1}, 22 to 30 cm	860 ± 55 1090 B.C.
BONN-629.	Brownearth in loess, 0.5% C, B_{v2}, 31 to 45 cm	2140 ± 60 190 B.C.
BONN-630.	Brownearth in loess, 0.4% C, CB_v, 45 to 67 cm	3370 ± 70 1420 B.C.
BONN-631.	Brownearth in loess, 0.3% C, B_vC, 67 to 89 cm	3650 ± 70 1700 B.C.
BONN-632.	Brownearth in loess, 0.2% C, C, 89 to 120 cm	3990 ± 70 2040 B.C.

Kapoly Brownearth, est. Holocene, younger than following parabrownearth (Hapludalf). Eventually formed from parabrownearth, decapitated by erosion, (46° 43′ N Lat, 17° 55′ E Long), coll. 1969 and subm. by W. Kerpen, C. Ronzani, and L. Szücs.

Parabrownearth (hapludalf) with slight clay migration Nagyrécse, slight slope, SE Budapest, near border of Yugoslavia.

BONN-621.	Parabrownearth in loess, 0.9% C, A_1, 13 to 23 cm	610 ± 50 A.D. 1340
BONN-622.	Parabrownearth in loess, 0.4% C, B_t, 30 to 61 cm	1710 ± 70 A.D. 240
BONN-623.	Parabrownearth in loess, 0.25% C, B_vB_t, 74 to 112 cm	2870 ± 115 920 B.C.
BONN-624.	Parabrownearth in loess, 0.25% C, B_tB_v, 112 to 128 cm	16,750 ± 290 14,800 B.C.

Soil age est. similar to chernozems (46° 28′ N Lat, 17° 8′ E Long). Abrupt age jump in B_tB_v-horizon is unexplainable. There could be some fossil material in this horizon. Sample to be repeated; coll. 1969 and subm. by W. Kerpen, C. Ronzani, and L. Szücs.

Solonetz soil with shallow A-horizon above deep B-horizon, Hortobagy, E of Budapest, SW Debrecen, pusta plain

BONN-648.	Solonetz in pusta plain, 5.5% C, B_2, 15 to 37 cm	3530 ± 70 1580 B.C.
BONN-649.	Solonetz in pusta plain, 3.7% C, B_3, 37 to 51 cm	5110 ± 130 3160 B.C.
BONN-650.	Solonetz in pusta plain, 3.5% C, CB, 51 to 60 cm	4540 ± 100 2590 B.C.
BONN-651.	Solonetz in pusta plain, 2.5% C, C_1, 74 to 108 cm	10,080 ± 160 8130 B.C.

Solonetz shows in C_1-horizon abrupt age increase, indicating importance of taking samples through C-horizon (47° 38′ N Lat, 21° 20′ E Long). Coll. 1969 and subm. by W. Kerpen and I. Boros.

Nethermoor (bog) soil Nadasdladany, SE Budapest, NE Plattensee, surface fresh, peat horizons wet.

BONN-637.	Nethermoor (bog) soil, 12.2% C, A_h, 20 to 29 cm	1070 ± 50 A.D. 880
BONN-638.	Nethermoor (bog) soil, 23.8% C, O_H, 42 to 52 cm	3530 ± 65 1580 B.C.
BONN-639.	Nethermoor (bog) soil, 37.2% C, T_1, 60 to 70 cm	5250 ± 80 3300 B.C.
BONN-641.	Nethermoor (bog) soil, 48.0% C, T_3, 100 to 110 cm	6880 ± 90 4930 B.C.
BONN-642.	Nethermoor (bog) soil, 52.3% C, T_4, 125 to 130 cm	7950 ± 80 6000 B.C.
BONN-643.	Nethermoor (bog) soil, 51.1% C, T_5, 145 to 155 cm	8430 ± 90 6480 B.C.
BONN-644.	Nethermoor (bog) soil, 52.3% C, T_6, 160 to 184 cm	7980 ± 180 6030 B.C.
BONN-645.	Nethermoor (bog) soil, 55.8% C, T_7, 190 to 200 cm	8520 ± 120 6570 B.C.
BONN-646.	Nethermoor (bog) soil, 46.5% C, T_8, 225 to 235 cm	8760 ± 120 6810 B.C.
BONN-647.	Nethermoor (bog) soil, 6.1% C, T_9, 245 to 270 cm	9300 ± 340 7350 B.C.

Nethermoor, according to C^{14} dates, was formed in earliest Holocene (47° 9′ N Lat, 18° 12′ E Long). Samples coll. 1969 and subm. by W. Kerpen, C. Ronzani, and T. Yankovits. *Comment on Hungarian series*: series includes soil profiles of following great soil groups: Chernozem, Wiesenboden, Brownearth with high base saturation, Parabrownearth, Solonetz, and Nethermoor. While maximum mean residence time values

of humus-carbon in deepest profile spots agree with observed radiocarbon ages in profiles of other European sampling spots, profiles BONN-611-615 (Chernozem), BONN 621-624 (Parabrownearth), and BONN-648-651 (Solonetz) show in deepest horizons ages, that may indicate fossil carbon relics, but may also indicate scarcely "rejuvenated" organic material in deepest weathered zone. These examples emphasize need of great care during sampling procedure to assure total collection of carbon in deepest position. All samples were freed of carbonates by HCl pretreatment.

B. Russia

A late sample, belonging to series BONN-455-470 (R. 1970, v. 12, p. 19-39).

BONN-458. Deep chernozem from loess, Orel, 0.4% C, C_{vl}, 240 to 250 cm — **12,470 ± 360 / 10,520 B.C.**

(52.5° N Lat, 36.2° E Long), coll. 1967 and subm. by H. Zakosek. *Comment*: age is several thousand yr beyond mean residence times of humus-C, measured in deepest part of other non-buried chernozem profiles. Although measured age of 12,500 B.P. would fit into theory of chernozem origin of some schools, possibility of fossil C-relics at depth 240 to 250 cm should not be excluded.

C. Podsols

Podsol Hauset, between Hauset and Hergenrath, 1 km S German border. Very strongly developed podsol profile, high residence time of humus-C expected.

BONN-652. Podsol Hauset, raw humus cover, surface, 36% C — 800 ± 60 / A.D. 1150

BONN-653. Podsol Hauset, 2.4% C, A_{eh}, 15 cm — 980 ± 55 / A.D. 970

BONN-654. Podsol Hauset, 0.2% C, A_e, 40 cm — 980 ± 120 / A.D. 970

BONN-655. Podsol Hauset, 3.0% C, B_h, 70 to 80 cm — 1640 ± 50 / A.D. 310

BONN-656. Podsol Hauset, <.7% C, B_s, 90 cm — 2240 ± 50 / 290 B.C.

Coll. 1969 and subm. by H. Butzke, Geol. Landesamt Northrhine-Westfalia, Krefeld (50° 42′ N Lat, 6° 3′ E Long). *Comment*: high mobility of humus in profile causes strong rejuvenation (due to roots, animal transport, and, particularly, percolation) throughout. Mean residence time of max. 2240 yr does not meet expectations and is lower than measurements in less strongly developed podsols (BONN-90, -366; R., 1968, v. 10, p. 8-28; 1969, v. 11, p. 3-14), which approach 3000 B.P.

Bändchenpodsol (string podsol) Schliffkopfhaus, Black Forest (Black Forest "Hochstrasse") very thin, compacted ligands, representing B_{hs}-horizon.

BONN-859. Bändchenpodsol Schliffkopfhaus, 1.4% C, A_h, 38 to 55 cm — 2280 ± 60 / 330 B.C.

BONN-860. Bändchenpodsol upper string, 1.4% C, B_{b1}, 78 to 80 cm — 1780 ± 60 / A.D. 170

BONN-861. Bändchenpodsol lower string, 0.9% C, B_{b2}, 80 to 83 cm — 2160 ± 60 / 210 B.C.

Samples coll. 1969 and subm. by H. W. Scharpenseel and S. Müller, Geol. Landesamt Baden-Württemberg, Stuttgart (48° 32′ N Lat, 5° 53.5′ E Long). *Comment*: "Bändchenpodsols" formation formerly believed a consequence of medieval deforestation. Mean age of >2000 yr requires new explanation of pedogenesis.

D. Plaggen soils

Irish series

Plaggen horizon Donoure, Ardfield, Co. Coak, 0.9% C, A_{p13}, 46 to 56 cm, (51° 36′ N Lat, 8° 57′ W Long).

480 ± 50

BONN-660. Donoure, Ardfield **A.D. 1470**

Plaggen horizon Cahesetrant, Dingle, 1.3% C, A_{p12}, 40 to 48 cm, (52° 6′ N Lat, 10° 23′ W Long).

1265 ± 60

BONN-661. Cahesetrant Dingle **A.D. 685**

Plaggen horizon Castlegregory Co. Kesay, (52° 13′ N Lat, 10° 10′ W Long).

1520 ± 50

BONN-662. 3.0% C, A_{p12}, 50 cm **A.D. 430**

2135 ± 50

BONN-663. 8.8% C, A_{p2b}, 65 to 75 cm **185 B.C.**

Samples coll. 1968 and subm. by M. Conry, The Agricultural Inst., Oak Park, Carlow, Ireland. *Comment*: BONN-660 to 662 agree with ages measured on German plaggen horizons. BONN-663 indicates plaggen economy in N Europe in time B.C. Sample should be checked for possible mixing with underlying fossil material.

E. Australian Krasnozems

Krasnozem of Wollongbar, North S Wales, coll. 1943 before bomb carbon contamination.

BONN-664. Krasnozem Wollongbar, 6.5% C, A_h, 20 cm **1400 ± 60** / **A.D. 550**

Sample coll. 1943 and subm. by Dr. Swaby, C.S.I.R.O., Adelaide. Sample permits comparison with samples of same soil type, coll. after beginning of bomb carbon production.

Krasnozem of S Queensland. Samples from Gabbinbar and Beechmont taken 1968, from Maleny 1964, from Binjour, Gurgeena, Coulston Lakes, and Memerambi, 1959.

BONN-679.	Babbinbar, old plateau, 600 m alt., 890 mm precipitations, 9.2% C, 0 to 7.5 cm (27° 26′ S Lat, 151° 59′ E Long).	101.7 ± 0.8% Modern
BONN-680.	Same location, 1.33% C, 30 to 40 cm	1280 ± 60 A.D. 670
BONN-766.	Same location, 1.2% C, 60 to 65 cm	6010 ± 100 A.D. 4060
BONN-681.	Beechmont, plateau margin, 585 m alt, 1525 mm precipitations, 6.8% C, 0 to 15 cm, (28° 10′ S Lat, 153° 12′ E Long).	600 ± 60 A.D. 1350
BONN-767.	Same location, 1.2% C, 69 to 122 cm	3850 ± 360 1900 B.C.
BONN-682.	Binjour, Old lateritic plateau, 380 m alt, 760 mm precipitations, 5.9% C, 0 to 7.5 cm, (25° 32′ S Lat, 151° 30′ E Long).	200 ± 50 A.D. 1750
BONN-768.	Same location, 1.0% C, 61 to 91 cm	1780 ± 70 A.D. 170
BONN-683.	Gurgeena, Old lateritic plateau, 400 m alt, 760 mm precipitations, 6.1% C, 0 to 15 cm (25° 29′ S Lat, 151° 21′ E Long).	435 ± 50 A.D. 1515
BONN-769.	Same location, 1.1% C, 29 to 66 cm	570 ± 70 A.D. 1380
BONN-684.	Coulston Lakes 1, Valley plain, 250 m alt, 760 mm precipitations, 4.3% C, 0 to 15 cm, (27° 37′ S Lat, 151° 54′ E Long).	105.1 ± 0.7% Modern
BONN-770.	Same location, 0.9% C, 25 to 41 cm	950 ± 50 A.D. 1000
BONN-685.	Coulston Lakes 2, Valley plain, 207 m alt, 760 mm precipitations, 2.2% C, 0 to 15 cm (25° 39′ S Lat, 151° 53′ E Long).	480 ± 50 A.D. 1470
BONN-771.	Same location, 1.4% C, 28 to 56 cm	980 ± 50 A.D. 970

BONN-686.	Maleny, Hilly-dissected plateau, 450 m alt, 1955 mm precipitations, 5.7% C, 0 to 15 cm (26° 46′ S Lat, 152° 49′ E Long).	150 ± 50 A.D. 1800
BONN-687.	Memerambi, Hilly-dissected plateau, 480 m alt, 760 mm precipitations, 4.1% C, 0 to 15 cm (26° 26′ S Lat, 151° 49′ E Long).	170 ± 60 A.D. 1780
BONN-772.	Same location, 1.2% C, 61 to 91 cm	4000 ± 150 2050 B.C.

Samples coll. and subm. by G. D. Hubble, C.S.I.R.O., Div. of Soils, St. Lucia, SW Queensland. *Comment*: mean residence time of humus-C at various levels of profile is rather young, compared with most other profiles of zonal soils. The only exceptions, BONN-767, BONN-772, and BONN-766, represent rather deep layers. As in most red tropical soils, downward organic matter translocation seems to occur quickly, causing low residence times of humus-C.

F. Argentine Vertisols

Vertisol (Grumusol) from Serie Clara, Conception del Uruguay, Entre Rios, Argentina. Pampas soil formed in loessic parent material, below 120 cm light colored and very low in carbon.

BONN-803.	Vertisol Conception del Uruguay, 3.2% C, 0 to 10 cm	101.5 ± 0.5% Modern
BONN-804.	Same location, 2.7% C, 10 to 20 cm	175 ± 50 A.D. 1775
BONN-805.	Same location, 2.0% C, 20 to 30 cm	580 ± 50 A.D. 1370
BONN-806.	Same location, 1.8% C, 30 to 40 cm	980 ± 55 A.D. 970
BONN-807.	Same location, 1.0% C, 40 to 50 cm	1390 ± 60 A.D. 560
BONN-808.	Same location, 0.8% C, 50 to 60 cm	1510 ± 60 A.D. 440
BONN-809.	Same location, 1.3% C, 60 to 70 cm	1560 ± 60 A.D. 390
BONN-810.	Same location, 1.2% C, 70 to 80 cm	1480 ± 70 A.D. 470
BONN-811.	Same location, 0.7% C, 80 to 90 cm	5850 ± 100 3900 B.C.

BONN-812.	Same location, 0.4% C, 90 to 100 cm	7360 ± 100 5410 B.C.
BONN-813.	Same location, 0.4% C, 100 to 120 cm	11,160 ± 150 9210 B.C.

Samples coll. 1968 by M. F. Purnell and N. Hein, Casilla Correo, Conception del Uruguay, and subm. by R. A. Rosell, Inst. de Edafologia, Bahia Blanca, Argentina (30° 30′ S Lat, 58° 20′ W Long). *Comment*: age vs. depth measurements in vertisols reveal interior dynamics of the profile. Down to maximum depth of cracks and self-mulching, mean residence time of humus-C should be about the same. Below the cracks, where the self-mulching (recycling) does not occur, increase of depth should be accompanied by steady increase of mean residence time of humus-C. While many soil profiles held to be vertic have this property less than *a priori* expected, above profile Conception del Uruguay is a typical vertisol with self-mulching down to 80 to 90 cm.

G. Brownearth in volcanic ash

Brownearth in trachyt ash of Alleröd volcanism covering the Neuwied basin. Samples are from profiles in erosion ditches, appearing as darker funnels in street cuts and pits.

Erosion rin profile of brownearth in trachyt ashes, Neuwied basin, 200 m S street Andernach-Kruft (50° 24′ N Lat, 7° 23′ E Long).

BONN-818.	Neuwied basin 1, 0.7% C, B_v, 25 to 40 cm	210 ± 40 A.D. 1740
BONN-819.	Same location, 0.6% C, Colluvium, 1 to 1.5 m	2400 ± 70 450 B.C.
BONN-820.	Same location, 0.3% C, Colluvium, 1.5 to 2 m	3875 ± 60 1925 B.C.
BONN-821.	Same location, 0.2% C, Colluvium, 2 to 2.4 m	3640 ± 75 1690 B.C.
BONN-822.	Same location, Britzbank, 2.4 to 2.8 m	4470 ± 70 2520 B.C.

Erosion rin profile of brownearth in trachyt ashes, Neuwied basin, 300 m S street Andernach-Kruft (50° 23′ N Lat, 7° 23′ E Long).

BONN-823.	Neuwied basin 2, 0.8% C, B_{v1}, 30 to 45 cm	240 ± 40 A.D. 1710
BONN-824.	Same location, 0.4% C, B_{v2}, 80 to 100 cm	1280 ± 60 A.D. 670
BONN-825.	Same location, 0.2% C, Colluvium, 130 to 150 cm	2470 ± 60 520 B.C.

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BONN-826.	Same location, 0.3% C, Colluvium, 180 to 200 cm	3640 ± 60 1690 B.C.
BONN-827.	Same location, 0.2% C, Colluvium, 215 to 230 cm	4210 ± 80 2260 B.C.
BONN-828.	Same location, 0.1% C, Colluvium, 240 to 250 cm	3900 ± 70 1950 B.C.

Deepest point of large erosion rin near Niedermendig (50° 20′ N Lat, 7° 17′ E Long).

BONN-828. Erosion rin Niedermendig, 6 to 8 m **3990 ± 100**
2040 B.C.

Samples coll. 1969 and subm. by E. Mückenhausen and H. W. Scharpenseel. The 2 brownearth profiles are developed in trachyt ash, superimposing fossil horizon in Würm loess, described by BONN-411 to 416. While this horizon, on emerging into rooted zone (BONN-403 to 407) revealed, by rejuvenation, about half its carbon residence time under trachyt ash cover, about the same mean residence time of maximum 4500 B.P. is measured in recent soil profile developed after burial over this fossil horizon in ash blanket. It also appears, that with rejuvenation, mean residence time, measured in humus-C, amounts to about half true age, known approx. due to Alleröd time spread of the ashes (see R., v. 12, 1970, p. 27-28).

H. Fossil chernozems, buried or in root zone of soil

Two sites of chernozems in Czechoslovakia are being measured for radiocarbon in humus-C; samples belong to 4 distinct periods of soil formation in Pleistocene and Holocene.

Chernozem profile Sedlec near Kutna Hora Czechoslovakia (49° 58′ N Lat, 15° 17′ E Long).

BONN-837.	Holocene chernozem buried, 1.5% C, A_{hca}, 100 to 110 cm	3880 ± 80 1930 B.C.
BONN-838.	Same location, 1.4% C, A_{hca}, 160 to 180 cm	4730 ± 90 2780 B.C.
BONN-839.	Same location, 1.4% C, A_{hca}, 105 to 220 cm	8250 ± 80 6300 B.C.
BONN-840.	Same location, 0.5% C, A_h/C_{ca}, 220 to 235 cm	8900 ± 90 6950 B.C.
BONN-841.	Same location, 0.3% C, C_{ca}, 270 to 280 cm	9850 ± 100 7900 B.C.
BONN-842.	Same location, 0.3% C, C_{ca}, 310 to 320 cm	12,480 ± 110 10,530 B.C.
BONN-843.	Holocene chernozem, not buried, emerging to surface 1.5% C, A_{hca}, 40 to 60 cm	4280 ± 60 2330 B.C.

BONN-844.	Same location, 1.3% C, A_{hca}, 70 to 80 cm	5910 ± 60 3960 B.C.
BONN-845.	Same location, 0.8% C, A_h/C_{ca}, 80 to 90 cm	5810 ± 60 3860 B.C.
BONN-846.	Pleistocene chernozem, underlying above Holocene chernozem, 1.5% C, $_fA_h$, 150 to 160 cm	27,990 ± 710 26,040 B.C.
BONN-847.	Same location, 4.3% C, $_fA_h$, 340 to 350 cm	25,730 ± 550 23,780 B.C.

Samples coll. 1969 and subm. by J. Nemecec, Sec. of Soil Sci. Central Research Inst. of Plant Prod., Praha. *Comment*: the same chernozem horizon, buried, shows maximum radiocarbon age of 12,500 yr. Unburied, emerging to surface, and exposed to rejuvenating agents (root growth, animal transport, percolation) age ca. 6000 yr. Thus, extent of rejuvenation is ca. 100% (cf. BONN-407 and BONN-413, R., v. 12, 1970, p. 27). Below is Pleistocene chernozem with humus-C radiocarbon age of 28,000 yr.

Chernozem profile Chabry, Czechoslovakia (50° 08′ N Lat, 14° 16′ E Long).

BONN-848.	Holocene chernozem, buried, 3.1% C, A_{hca}, 250 to 260 cm	5200 ± 130 3250 B.C.
BONN-849.	Same location, 1.8% C, A_h/C_{ca}, 260 to 270 cm	5810 ± 60 3860 B.C.
BONN-850.	Pleistocene chernozem, tilery, dark horizon ascending to present surface, BONN-850 highest, BONN-853 lowest sample, 2.5% C, fA_h	18,050 ± 300 16,100 B.C.
BONN-851.	Same location, 15.9% C, fA_h	30,380 ± 1180 28,430 B.C.
BONN-852.	Same location, 2.3% C, fA_h	18,270 ± 530 16,320 B.C.
BONN-853.	Same location, 2.3% C, fA_h	17,520 ± 540 15,570 B.C.
BONN-854.	Same location, deepest point, perhaps older soil formation, 3.2% C, fA_h	25,630 ± 710 23,680 B.C.

Samples coll. 1969 and subm. by J. Nemecec. *Comment*: 5800 yr for buried chernozem suggests that this organic matter was exposed to rejuvenation (plant roots, animal transport, and percolation) and sediment cover is much younger. In Pleistocene chernozem series ascending dark horizon in tilery wall shows about equal age, except for 2nd highest sam-

ple, BONN-851, which combines exceptionally high C-content with abrupt rise of age. Alien material must be responsible. Dates should help identify 4 assumed fossil soil formations.

I. Charcoal and wood under dune material, Heiligensee near Berlin

Dune cover of region (52° 36′ N Lat, 30° 9′ E Long) was first in studying time; further samples were measured, supplementing information of BONN-609 (R., v. 12, 1970, p. 34).

BONN-855.	Charcoal Heiligensee, under dune sand 30 to 50 cm	1590 ± 60 A.D. 360
BONN-856.	Charcoal Heiligensee, under dune sand 30 to 50 cm	134.1 ± 0.5% Modern
BONN-857.	Charcoal Heiligensee, under dune sand 30 to 50 cm	144.2 ± 0.6% Modern
BONN-858.	Wood sample Heiligensee, under dune sand 30 to 50 cm	102.2 ± 0.6% Modern

Samples coll. 1969 and subm. by U. Schwertmann, Inst. f. Bodenkunde, Tech. Hochschule, München-Weihenstephan. In former study humus-C of same region, BONN-609, deeper dune sand was dated at 760 B.P., suggesting dune cover followed medieval deforestation. Date of charcoal sample, BONN-855, above, increases age of dune cover considerably. Apparently, humus-C of BONN-609 was rejuvenated. Other charcoal and wood samples (BONN-856 -858) are obviously modern. More charcoal lumps should be coll. for final age assessment of dune cover.

J. Buried soil horizon, Scotland

Buried soil horizon, estimated from late Pleistocene, measured for estimate of soil profile development in Scotland. Dark colored horizon, exposed in pit face, from Inchnacardoch Forest, 4 km WSW Ft. Augustus, Inverness-shire (57° 8.5′ N Lat, 4° 45′ W Long).

BONN-863.	**Dark colored horizon, Scotland, 0.3% C, 4.20 m**	**1240 ± 70** **A.D. 710**

Sample coll. 1969 and subm. by R. Glentworth, Macaulay Inst. for Soil Res., Aberdeen. *Comment*: either solifluction material on top of dark horizon is much younger than estimated, or sample is not representative (e.g., taken from outer layer of pit face, open to contamination), since result of 1240 B.P. falls short of estimated > 12,000 yr.

K. Dark layer in rock debris, Vintschgau, Bozen, Italy

Dark layer between loamy rock debris, Vintschgau, prov. Bozen (46° 37′ N Lat, 10° 45′ E Long), probably colluvial material of A-horizon. Sample is pertinent to formation time of dark fossil steppe soils in Vintschgau, est. maximum in old Holocene.

BONN-864. Dark layer of fossil steppe soil in Vintschgau, 2.2% C, 3.00 m — **5270 ± 60 / 3320 B.C.**

Sample coll. 1969 and subm. by J. Breburda, Inst. f. Auswärtige Landwirtschaft, Giessen. *Comment*: mean residence time agrees well with other results on humus-C of European Holocene steppe soils.

L. Peat in Mardelle, Pirmasens

Peat filling a "Mardelle" (round, doline-like depression, filled with water or gravel, soil peat, rubbish), serves age assessment of Mardelle-formation, Lehmgrube Weppler, Pirmasens (49° 11.5′ N Lat, 7° 35.4′ E Long).

BONN-1132. Mardelle 1.5 km SW center Pirmasens — **900 ± 60 / A.D. 1050**

Sample coll. 1964 and subm. 1970 by W. Stöhr, Geol. Landesamt Rheinland-Pfalz, Mainz. *Comment*: result gives residence time of peat-C in Mardelle.

M. Soil organic matter fractions

First series of soil organic matter fractions was pub. in R., v. 12, 1970, p. 35-36 (BONN-6, -138 to -139,, -360 to -370, and -397 to -402). Three more soil profiles have been sampled, and soil organic matter was fractionated into fulvic-, hymatomelanic-, brown humic-, gray humic-acid, humines and humus coal (Scharpenseel, Ronzani, and Pietig, 1968).

BONN-665.	Podsol Haltern-Sinsen, A_h, 8 to 10 cm, (51° 43′ N Lat, 7° 14′ E Long), fulvic acid	140.0 ± 0.2% Modern
BONN-666.	Same location, hymatomelanic acid	114.1 ± 0.7% Modern
BONN-667.	Same location, brown humic acid	925 ± 45 A.D. 1025
BONN-668.	Same location, gray humic acid	1140 ± 70 A.D. 810
BONN-669.	Same location, humine + humus coal	117.2 ± 0.6% Modern
BONN-670.	Chernozem, Söllingen, A_p, 20 cm, (52° 5′ N Lat, 10° 58.5′ E Long), fulvic acid	104.3 ± 0.5% Modern
BONN-671.	Same location, brown and gray humic acid	1560 ± 70 A.D. 390
BONN-672.	Same location, humine + humus coal	2275 ± 60 325 B.C.
BONN-673.	Fossil Chernozem, Michelsberg, scarp, $_tA$, 180 cm, (50° 21′ N Lat, 7° 19′ E Long) fulvic acid	4310 ± 210 2360 B.C.

BONN-674.	Same location, brown and gray humic acid	7600 ± 220 5650 B.C.
BONN-675.	Same location, humines	6930 ± 80 4980 B.C.
BONN-676.	Same location, humus coal	6830 ± 100 4880 B.C.

Samples coll. 1969 and subm. by H. W. Scharpenseel. *Comment*: in all samples, except recent Chernozem A_p-horizon with good aeration and extractibility, humic acid fractions show highest mean residence time. In Chernozem A_p, where most humus is microbial in origin and no hydromorphic conditions can conserve cellulose remnants, humines are highest in mean residence time, as would be expected in all humus fractions. In podsol series, contamination influences modern age in humus coal fraction. The small amount of residual humus coal caught during repeated humic acid extraction, with N/10 NaOH, some modern CO_2 from the air.

N. Soil organic matter, enriched in various gravity fields

Routine sample preparation in our lab. includes carbon-enrichment by a centrifugal process (H. W. Scharpenseel and F. Pietig, 1968/69). Since application of gravity field could exclude certain particle sizes from the carbon-enrichment zone, (that is used for combustion and benzene synthesis), radiocarbon ages from the same material, using different gravity fields for C-enrichment, were compared.

BONN-831.	Chernozem Söllingen, fraction passed in suspension through sieve of 0.5 mm ϕ, 3.5% C, 20 cm (52° 5′ N Lat, 10° 5′ E Long), 500 rpm	2000 ± 50 50 B.C.
BONN-832.	Same location, 3.5% C, 2000 rpm	1870 ± 70 A.D. 80
BONN-833.	Same location, 4.6% C, 3000 rpm	1680 ± 50 A.D. 270
BONN-834.	Same location, 3.1% C, 4000 rpm	1820 ± 100 A.D. 130
BONN-835.	Same location, 3.5% C, 5000 rpm	1770 ± 60 A.D. 180
BONN-836.	Same location, 3.4% C, full speed, ca. 5400 rpm	1780 ± 50 A.D. 170

Comment: except for fractions rpm 500 and rpm 3000, results are identical. In rpm 3000 sample, a higher C-content is parallel, apparently a chance admixture of younger material; Sample 500 rpm is obsolete due to very slow precipitation of the finest clay particles at this low centrifugal speed. 4000 rpm seems to be about the optimal condition.

O. Comparative measurements in texture fractions of same soil

Since our lab. takes only clay-humus from a soil, *i.e.*, the organic fraction, attached to and locked inside the clay minerals, comparative radiocarbon measurements in diverse texture fractions seem essential. The following measurements were made, using a loessic soil, and especially a fossil A horizon, embedded in a recent B_t horizon of a parabrownearth profile. The clay humus of this source is mainly transported and free from contaminating cellulose remnants.

BONN-1133.	Inden Parabrownearth with fossil A-horizon in B_t-horizon (50° 51′ N Lat, 6° 22′ E Long) 0.3% C, $> 60\mu$	3170 ± 80 1220 B.C.
BONN-1134.	Same location, 0.8% C, 60 to 2μ	3450 ± 80 1500 B.C.
BONN-1135.	Same location, 0.5%, 2 to 1μ	3280 ± 80 1330 B.C.
BONN-1136.	Same location, 0.7% C, 1 to 0.5μ	2790 ± 70 840 B.C.
BONN-1137.	Same location, 0.9% C, 0.5 to 0.25μ	2500 ± 70 550 B.C.

Comment: highest carbon residence times are found in fractions 60 to 2μ and 2 to 1μ, with decreasing tendencies towards fine sand as well as medium and fine clay fractions. Coarser fractions can be expected to be younger, since they contain, if available at all, cellular debris. Apparently, the very fine clay particles are the youngest crystallization product, and thus the youngest to form clay-organic complexes with the youngest, then available, humic matter.

P. Subhydric soils, gyttja

Gyttja in Schalkenmeeren-Maar, Eifel, Profile III (50° 11.5′ N Lat, 6° 50′ E Long). Subhydric soil profiles taken with a "case lot" from a volcanic maar ca. 25 m depth (max.), originating about Alleröd time during eruptions, covering area with trachyt ashes. Mean residence time of measured humus carbon should be compared with approx. known true age of oldest sediments.

BONN-781.	Schallenmeeren Maar, III, 6.8% C, 0 to 10 cm	2360 ± 60 410 B.C.
BONN-782.	Same location, 3.5% C, 10 to 20 cm	2180 ± 80 230 B.C.
BONN-783.	Same location, 1.9% C, 20 to 30 cm	950 ± 90 A.D. 1000
BONN-784.	Same location, 2.3% C, 30 to 40 cm	2110 ± 55 160 B.C.

BONN-785.	Same location, 3.5% C, 40 to 50 cm	2200 ± 60 250 B.C.
BONN-786.	Same location, 4.7% C, 50 to 60 cm	2990 ± 70 1040 B.C.
BONN-787.	Same location, 4.9% C, 60 to 70 cm	3300 ± 70 1350 B.C.
BONN-789.	Same location, 3.5% C, 80 to 90 cm	4600 ± 70 2650 B.C.
BONN-790.	Same location, 3.2% C, 90 to 100 cm	2460 ± 60 510 B.C.
BONN-791.	Same location, 1.9% C, 100 to 110 cm	4540 ± 80 2590 B.C.
BONN-792.	Same location, 1.5% C, 110 to 120 cm	1500 ± 50 A.D. 450
BONN-793.	Same location, 2.7% C, 120 to 130 cm	2430 ± 50 480 B.C.
BONN-794.	Same location, 2.6% C, 130 to 140 cm	2435 ± 50 485 B.C.
BONN-795.	Same location, 3.2% C, 140 to 150 cm	2540 ± 60 590 B.C.
BONN-796.	Same location, 4.3% C, 150 to 160 cm	2050 ± 60 100 B.C.
BONN-797.	Same location, 7.8% C, 160 to 170 cm	2120 ± 60 170 B.C.
BONN-798.	Same location, 16.7% C, 170 to 180 cm	2700 ± 60 750 B.C.
BONN-799.	Same location, 13.4% C, 180 to 190 cm	2920 ± 60 970 B.C.
BONN-800.	Same location, 10.9% C, 190 to 200 cm	3240 ± 60 1290 B.C.
BONN-801.	Same location, 16.2% C, 200 to 215 cm	2950 ± 50 1000 B.C.
BONN-802.	Same location, 20.7% C, 215 to 230 cm	3010 ± 60 1060 B.C.

Samples coll. 1969 and subm. by H. W. Scharpenseel, H. Gewehr, and W. Kerpen. *Comment*: discordant tendencies in age vs. depth increase, particularly in 1st m depth, sometimes also seen in marsh and plaggen soils. Here, probably caused by reworking even under submersion, and by

methane bubbles. In lower 130 cm, age vs. depth increase is almost steady. Highest mean residence time of 4600 yr is ca. ½ true age of oldest part of organic sediment.

Gyttja in lake of Selent, E Holsteen, Profile II (54° 41′ N Lat, 10° 35′ E Long). Subhydric soil profiles taken with aid of a "case lot" and with a Livingstone borer from gyttja in lake of Selent, a moraine lake in E Holsteen, 2nd biggest of numerous Holsteen lakes, max. depth ca. 45 m. Long stretches show sediment blanket less than 1 m thickness; basins contain > 5 to 6 m sediment, traced with an echo sounder. E, shallow part of lake believed to cover submerged, prehistoric settlement.

BONN-882.	(Livingstone borer), 20 to 40 cm	110.9 ± 0.8% Modern
BONN-883.	Same location, 40 to 60 cm	109.7 ± 0.8% Modern
BONN-884.	Same location, 60 to 80 cm	710 ± 50 A.D. 1240
BONN-885.	Same location, 80 to 100 cm	104.2 ± 0.8% Modern
BONN-886.	Same location, 100 to 120 cm	101.9 ± 0.8% Modern
BONN-887.	Same location, 120 to 140 cm	1180 ± 50 A.D. 770
BONN-888.	Same location, 140 to 160 cm	1110 ± 80 A.D. 840
BONN-889.	Same location, 160 to 180 cm	1560 ± 80 A.D. 390
BONN-890.	Same location, 180 to 200 cm	940 ± 70 A.D. 1010
BONN-891.	Same location, 200 to 220 cm	1640 ± 80 A.D. 310
BONN-892.	Same location, 220 to 240 cm	2580 ± 50 630 B.C.
BONN-894.	Same location, 260 to 280 cm	2470 ± 50 520 B.C.
BONN-895.	Same location, 280 to 300 cm	2330 ± 60 380 B.C.
BONN-896.	Same location, 300 to 320 cm	2350 ± 50 400 B.C.

BONN-897.	Same location, 320 to 340 cm	3000 ± 60 1050 B.C.
BONN-898.	Same location, 340 to 360 cm	2250 ± 70 300 B.C.
BONN-899.	Same location, 360 to 380 cm	2840 ± 60 890 B.C.
BONN-900.	Same location, 380 to 400 cm	2540 ± 50 590 B.C.
BONN-901.	Same location, 400 to 420 cm	2600 ± 60 650 B.C.
BONN-902.	Same location, 420 to 440 cm	3890 ± 60 1940 B.C.
BONN-903.	Same location, 440 to 460 cm	5060 ± 70 3110 B.C.
BONN-904.	Same location, 460 to 480 cm	5250 ± 70 3300 B.C.
BONN-905.	Same location, 480 to 500 cm	5820 ± 70 3870 B.C.
BONN-906.	Same location, 500 to 520 cm	5210 ± 90 3260 B.C.
BONN-907.	Same location, 520 to 540 cm	6300 ± 90 4350 B.C.
BONN-908.	Same location, 540 to 560 cm	6800 ± 150 4850 B.C.

Samples coll. 1969 and subm. by H. W. Scharpenseel, H. Gewehr, W. Kerpen, and F. R. Averdieck, Inst. f. Ur- und Frühgeschichte, Univ. of Kiel. *Comment*: discordant trends, although available, are less pronounced than in preceding profile, although both should have started to accumulate organic sediment at about Alleröd time. Since gyttja sediments occur in lake basins, strong subsurface currents apparently could not attack and rework them as readily as in Schalkenmeeren Maar. Also, Selent lake is eutrophic, well aerated and probably lacks agitating effect of methane bubbles in most places.

III. ARCHAEOLOGIC SAMPLES

A. Wood samples, Bulgaria

BONN-865.	Wood, mine Dolna Kameniza (42° N Lat, 26° E Long)	1720 ± 50 A.D. 230
BONN-866.	Wood, gold mine Negerstiza (42° N Lat, 25° E Long)	840 ± 70 A.D. 1110

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BONN-867. Wood, lead/zink mine Bzeikowiza (43° N Lat, 23° E Long) — 1310 ± 50 A.D. 640

BONN-868. Wood, gold mine Negerstiza (43° N Lat, 25° E Long) — 1400 ± 60 A.D. 550

Wood samples from old mines in Bulgaria, dated for time of operation, est. ca. A.D. 1500. Samples coll. 1969 and subm. by Mining Mus. Bochum. *Comment*: age of mines much older than expected.

B. Wood sample Ungstein, Pfalz

BONN-862. Wood, "Baugrube Richter" from mud horizon, 2 m — 5430 ± 80 3480 B.C.

Well-preserved wood, probably deposited by water transport in muddy layer, 2 m deep, containing seeds and ceramic fragments (49° 28′ N Lat, 8° 11′ E Long). Helps date possible pre-Roman civilization. Sample coll. 1969 and subm. by F. Schumann, Ungstein, and G. Strunk-Lichtenberg, Inst. *Comment*: age 5400 yr higher than est. age of ca. 2000 B.P.

C. Wood from boat, Ungstein, Pfalz

BONN-764. Wood from buried boat, Ungstein, 220 cm — 25,210 ± 440 23,260 B.C.

Wood from boat, from 220 cm under sandy mud and gravel (49° 28′ N Lat, 8° 11′ E Long). Est. age: 2 to 3000 B.P.? Sample coll. 1969 and subm. by F. Schumann, Ungstein. *Comment*: remnant of wood, possibly part of boat, much older than expected. More samples needed for interpretation. Suspected celtic origin of boat is very unlikely.

D. Bones, Michelsberg

BONN-763. Mole bones, Michelsberg, 5 m — 10,800 ± 100 8850 B.C.

Many mole bones from Würm loess (50° 21 N Lat, 7° 19′ E Long), under fossil chernozem (BONN-413 to 416: R., 1970, v. 12, p. 27-28), covered by trachyt ashes of Alleröd origin. Only organic carbon was used for dating sample. Sample coll. 1969 and subm. by E. Kopp of the Inst. *Comment*: date is younger than expected.

E. Elk horns, Dorsten, Westfalia

BONN-765. Elk horns, Dorsten, 6 to 8 m — 5270 ± 50 3320 B.C.

Elk horns found during excavation of Lippe-Seitenkanal, near Dorsten (51° 40′ N Lat, 6° 59′ E Long). Date important for estimate of time, when elks were also living W of Oder River. Estimated age: 60,000 B.P. Sample coll. 1970 and subm. by Dr. Spiecker, Forschungsstelle f. Jagdkunde, Bonn-Beuel. *Comment*: due to scarcity of material, whole

bone substance was dated. Age falls short of expectations. Contamination by environmental carbonate unlikely, since sample was lying in non-carbonaceous environment of Lippe-terrasse gravel.

F. Defense ditch, Wallertheim

BONN-777. Ditch Wallertheim, 4.8% C, fA_h, 30 to 90 cm — **3750 ± 70 / 1800 B.C.**

BONN-778. Same location, 0.8% C, fA_l+C, 120 to 140 cm — **4750 ± 60 / 2800 B.C.**

A ditch, used for defense of village by Neolithic man was observed in basin of Mainz, near Wallertheim (49° 50′ N Lat, 8° 3′ E Long). Dating of humus-C important for age of Neolithic settlements in area. Samples coll. 1969 and subm. by G. Strunk-Lichtenberg. *Comment*: BONN-777 is younger than expected, probably due to rejuvenation in surface near position by root growth, animal transport, and percolation. BONN-778, far from rooted zone in fairly dry basin of Mainz, is in full accord with expected age and available information.

IV. MODERN SAMPLE

BONN-830. Gras, Röttgen, September 1969 — **151.6 ± 0.5% / Modern**

To continue modern carbon sample measurements, pub. in R., 1968, v. 10, p. 24-27 as BONN-56 to 77, -143 to 155; 1969, v. 11, p. 10-13, as BONN-172 to 200, -301, to 317; and in 1970, v. 12, p. 38, as BONN-385 to 396, a grass sample from Röttgen near Bonn, (50° 41′ N Lat, 7° 5.5′ E Long), coll. 1969 by H. W. Scharpenseel was measured for its bomb-carbon level. *Comment*: sample fits well into trend of 1968 monthly measurements (BONN-385 to 396).

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