

## FRANKFURT RADIOCARBON DATES I

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Facilities for radiocarbon dating were established at the University of Frankfurt/Main in the Institute of Anthropology. The Radiocarbon Laboratory provides assistance to the Amino-Acid-Dating Laboratory. This list reports on  $^{14}\text{C}$  dates measured up to September 1983.

The laboratory is installed in the basement of a three-story building and is equipped with a 2L copper proportional counter filled to 1013 mbar with purified  $\text{CO}_2$ . The counter is protected against cosmic and surrounding radiation by a 3.5 ton lead shield and a copper multiwire anti-coincidence ring-counter flushed with purified  $90\text{Ar}/10\text{CH}_4$ . Electronics are of the commercial NIM type. Charcoal and wood samples are treated by standard acid-alkali-acid methods. Bone samples are treated according to the collagen methods described by Berger, Horney, and Libby (1964), Longin (1971), Protsch (1972; 1975), and Protsch and Berger (1973).

Conversion to  $\text{CO}_2$  is by controlled combustion. Initial purification is achieved by passing the  $\text{CO}_2$  over hot ( $600^\circ\text{C}$ )  $\text{CuO}$ , through several  $\text{KMnO}_4$  and  $\text{AgNO}_3$  solutions and dry-ice/acetone water traps. The sample is stored for at least three weeks to ensure  $^{222}\text{Rn}$ -decay. Final purification is by thermal circulation over hot ( $600^\circ\text{C}$ ) copper and silver wool in a 6L sample container with external quartz convection tube. Prior to each counter filling the  $\text{CO}_2$  is routinely passed over hot ( $450^\circ\text{C}$ )  $\text{Cu}/\text{Ag}$  a few times in a separate system and is vacuum-distilled at  $-78^\circ\text{C}$ . Gas quality after this procedure is excellent.

Counter plateaus are 500V long with slopes of  $0.6\%/100\text{V}$  for muons and  $< 1\%/100\text{V}$  for  $^{14}\text{C}$  + background. The standard working point is 4300V. The absence of electronegative impurities is verified before and after each run by measuring the count rate at the steep part of the muon characteristic curve. An experimental linear correlation between guard gross and sample muon count rates, valid within counting statistics, gives a post-measurement check on working point and a long-term check on instrument stability. Background is nominally  $7.9 \pm 0.08\text{cpm}$  with slow seasonal variations in the maximum range  $\pm 0.2\text{cpm}$  (95% confidence level). No dependence on atmospheric pressure was found on the basis of 90 background measurements, each 2000 minutes. Four months of continuous monitoring of the laboratory aerosol radioactivity with a NaI-detector and multichannel-analyzer (Canberra Series 30, 1024 channels) showed unchanged background in the range covering 200-3000keV. Modern standard  $\text{CO}_2$  is prepared by wet oxidation of NBS oxalid acid. The AD 1950  $^{14}\text{C}$  count rate is  $12.10 \pm 0.08\text{cpm}$  at  $20^\circ\text{C}$  with normalization of the  $\delta-^{13}\text{C}$  value of  $-19.75\text{‰}$  to the standard  $-19\text{‰}$ . Counting periods are two days for background, sample, and standard. Samples are measured at least twice. Background is measured at least once a week. Routine  $\chi^2$ -analysis is applied to 100-minute print-outs. Age errors correspond to measured  $\pm 1\sigma$  variations of sample, background, and standard. Calculated errors smaller

than 100 years are increased to this figure as a minimum.  $^{13}\text{C}/^{12}\text{C}$  measurements are not available for samples in the date list below. Thus, 80 years have been added to all bone measurements to give a theoretical correction for  $\delta^{13}\text{C}$  fractionation, with an additional  $\pm 60$  years squared added to the variance (Lerman, 1972). All dates are expressed in  $^{14}\text{C}$  years relative to AD 1950, using the half-life for  $^{14}\text{C}$  of 5568 years. Calendar estimates and archaeologic comments are based on calibrated dates (Pearson, Pilcher, & Baillie, 1983; Pearson & Baillie, 1983).

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In 1982 special emphasis was placed on running a series of cross-checks, the results of which are shown in table 1.

## SAMPLE DESCRIPTIONS

## INTERLABORATORY CHECK SAMPLES

Fra no.	Fra date	Other lab no.	Reported date	Ref
Fra-50	3970 $\pm$ 100	UCLA-928	4120 $\pm$ 120	R, 1966, v 8, p 482
-51	4245 $\pm$ 120	UCLA-739	4280 $\pm$ 80	R, 1965, v 7, p 352
		TB-38	4330 $\pm$ 160	R, 1976, v 18, p 357
		A-569	4290 $\pm$ 90	
		NPL-5	4310 $\pm$ 90	
		LJ-1288	4370 $\pm$ 50	
		BM-248	4160 $\pm$ 110	
		BM-203	4150 $\pm$ 110	
		ANTW-104	4390 $\pm$ 140	
		BIRM-20a	4224 $\pm$ 97	
		BIRM-20b	4206 $\pm$ 68	
-58	6095 $\pm$ 130	Bln-176	5932 $\pm$ 100	R, 1966, v 8, p 31
-61	4370 $\pm$ 100	Bln-782	4310 $\pm$ 100	Quitta, pers commun
-62	3400 $\pm$ 100	Bln-2011	3445 $\pm$ 40	Quitta, pers commun
		LJ-5262	3490 $\pm$ 40	
		GrN-7319	3415 $\pm$ 35	
-66	25,000 $\pm$ 1600	KN-10b	26,560 $\pm$ 1600	Freundlich, pers commun
		KN-10c	26,960 $\pm$ 1200	
		KN-I.010	24,100 $\pm$ 300	
		H-2218/1537	25,480 $\pm$ 880	
-57	5280 $\pm$ 120	KN-21	5370 $\pm$ 160	Freundlich, pers commun
		H-227/277	5150 $\pm$ 100	
		KN-I.021	5080 $\pm$ 70	
-59	3540 $\pm$ 100	BM-341	3500 $\pm$ 70	R, 1971, v 13, p 163
		UCLA-1398	3330 $\pm$ 60	
-79	4070 $\pm$ 100	Bln-1470	4170 $\pm$ 60	Quitta, pers commun

## ARCHAEOLOGIC SAMPLES

## German Federal Republic

**Heldenbergen series**

Charcoal, bone, and mortar samples from medieval site at Heldenbergen (50° 20' N, 8° 55' E) near Frankfurt/M. Excavations by B Pinsker, Inst Prehist, Univ Frankfurt/M revealed oval-shaped pit-house, superimposed by walled framework house. Top layer of pit-house contained burned remains of large loom and ca 30 ceramic weights found *in situ*. Charcoal and overlying stone debris contained pottery of Pingsdorf type. Heldenbergen Pingsdorf pottery is similar to that of Husterknupp site, Period II/III which dates archaeol to AD 1100-1200. Site is near Heldenbergen castle, first mentioned in 12th century AD and is supposed to represent nearby medieval village. Coll 1980 and subm by A Kluge and B Weninger, both of Inst Prehist, Univ Frankfurt/M.

**Fra-54. Heldenbergen loom** **1130 ± 100**

Charcoal from burned loom.

**Fra-64. Heldenbergen pit** **1100 ± 100**

Charcoal from pit of house yard, also containing Pingsdorf pottery. Coll 1981 to cross-check Fra-54.

**Fra-72. Heldenbergen walled framework house** **1180 ± 100**

Large mortar fragments. *Comment:* sample washed and ca 30% of surface removed. Date processed on first HCl-evolved CO<sub>2</sub> fraction.

**Fra-55. Heldenbergen walled framework house** **1450 ± 100**

Faunal bones. *Comment:* sample mixing is not ruled out and date is rejected.

*General Comment:* dates Fra-54 and -64 are ca 250 yr older than expected, probably due to well-known "old wood" reasons (cf Waterbolk, 1971; for medieval sites, Willkomm, 1980; 1983). Fra-54 is one of rare cases that sample can be archaeol judged and <sup>14</sup>C age is not unexpected. Archaeol dating indicates experimental mortar date, Fra-72, is slightly contaminated by older carbon.

**Hausen series**

Charcoal from tumulus at Hausen (50° 5' 34" N, 8° 52' 28" E) near Offenbach/M at depth 60cm, from Urnfield culture (Ha A1) cremation, archaeol represented by bronze ornaments and sherds in tumulus center at same depth. Indeterminable no. of fragments of iron and several Late Iron age sherds suggested disturbance. Coll 1980 by R Plackinger, Mühlheim/M Archaeol Group. Subm 1982 by I Kubach-Richter, Inst Prehist, Univ Frankfurt/M. Bot analysis by K Leistikow, Bot Inst, Univ Frankfurt/M.

**Fra-74. Hausen, Area A** **1720 ± 100**

Charcoal (*Rhamnus cathartica*, *Quercus petraea*, or *Quercus robur*) assoc with iron fragments.

**Fra-78. Hausen, Area C/5** **400 ± 100**

Charcoal (*Acer campestre*). *Comment*: dates confirm suspicion that charcoal does not belong to cremation.

**Schwanheim series**

Wood from Neolithic and Bronze age site in area often flooded by Main R, Schwanheim (50° 5' N, 8° 10' E) near Frankfurt/M. Coll 1978 and subm 1982 by A Jockenhövel, Inst Prehist, Univ Frankfurt/M.

**Fra-67. Schwanheim, Riedwiese** **5340 ± 130**

Wood from Sec II, Sq D8, coordinates x=25-65cm, y=55-95cm, depth z=160cm in peat. Assoc with Middle Neolithic "Michelsberg" pottery. *Comment*: HCl and NaOH treatment. Date agrees well with other Michelsberg dates, ranging from ca 5400-5000 BP (Pape, 1979). However, in view of measurements on sample Fra-69, below, from same site, contamination cannot be excluded and Fra-67 should also be viewed with reservation.

**Fra-69a. Schwanheim, Riedwiese (insoluble fraction)** **5700 ± 130**

Wood (*Alnus*) from Sec II, Sq C8, coordinates x=0-50cm, y=0-50cm, depth z=187cm in peat. *Comment*: HCl treatment only.

**Fra-69b. Schwanheim, Riedwiese (insoluble fraction)** **4560 ± 100**

*Comment*: HCl and NaOH treatment.

**Fra-69c. Schwanheim, Riedwiese (insoluble fraction)** **1970 ± 100**

*Comment*: strong HCl and NaOH treatment and additional acetone treatment in soxhlet extractor.

*General Comment*: contaminated sample Fra-69 is from top filling of pit lined with Middle Bronze age pottery and was expected to date to ca 1400 BC. High level of contamination is not understood, although sample contained many small rootlets, which could not all be removed. Bot analysis by K Leistikow showed sample to be *Alnus glutinosa*, < 40 yr old, at stage of transition between stem base and roots. *Alnus* usually grows in periodically flooded areas where stem base is under water. Possibility of flood redeposition cannot be excluded.

**Fra-75. Manching, Pit 162d** **1970 ± 100**

Human bone from Celtic oppidum of Manching near Ingolstadt (48° 7' N, 11° 5' E), coll 1981 by W Krämer, Römisch-Germanische Komm, Frankfurt/M; subm 1982 by G Lange, Inst Anthropol, Univ Frankfurt/M. Adult femur from burial in settlement Pit 162d dug into sand. *Comment*: collagen with additional NaOH treatment. Since burials in Middle La Tène times (3rd-2nd century BC) were in graves, use of settlement pit for burial of individual in Pit 162d points to latest phase of

Late La Tène (1st century BC). Date supports archaeol expectation. Oppidum was not occupied after 15 BC (Krämer & Schubert, 1970).

**Fra-90. Lorsch, Grave 9 1080 ± 100**

Human femur of male adult, ca 50 yr old, from cemetery in court of Benedictine monastery closely connected to Carolingian King's Hall of Lorsch (49° 38' N, 8° 34' E). Cemetery was archaeol assumed to date either before AD 770 or after AD 1621 because location of Carolingian graves in front of entrance to King's Hall would appear profane. Graves contain no artifacts. Sample coll 1982 by P Schnitzer, Landesamt f Denkmalspflege, Darmstadt; subm 1983 by G Lange. *Comment*: collagen with additional NaOH treatment. Age based on calibrated date: Carolingian.

**Fra-94. Weingarten, Grave 136 1350 ± 100**

Human ribs from Early Medieval cemetery at Weingarten, near Speyer (49° 2' N, 8° 20' E). Osteol analysis by S Stephan, 1983. Coll by F Engels, Mus Speyer. Subm 1983 by R Protsch. *Comment*: date run on total HCl-soluble organic fraction. Archaeol expectation, AD 600-700, is confirmed.

**Fra-86. Burgerroth, Loc 81/III, Level 5 4040 ± 100**

Distal end of femoral diaphysis of *Bos sp* < 2 yr old, from Late Neolithic settlement on hill at Burgerroth (49° 32' 30" N, 10° 2' 5" E) near Würzburg. Archaeol single-component site shows affinities to Bernburg culture of E Germany. Special axe form from site is found also in Switzerland where it is dendrochronol dated to 3100-2900 BC (Spennemann, 1982; 1983). Sample is from refuse pit dug into limestone. Coll 1981 and subm 1983 by D Spennemann, Inst Prehist, Univ Frankfurt/M. Osteol analysis by G Lange. *Comment*: collagen with additional NaOH treatment. Fra-86 is first Bernburg date for S Germany; 13 Bernburg dates presently available (Pape, 1979; Breunig, 1983) all lie within limits 4100-4400 BP, with one exception. Due to extreme distortions of <sup>14</sup>C time scale ca 3000 BC, these 300 <sup>14</sup>C yr correspond to only 150 calendar yr, allowing very confident calibrated reading of 3050-2900 BC for Bernburg culture. In comparison, Fra-86 calibrates to ca 2850 BC and date may thus be 50-100 calendar yr too young. Submitter notes that sample has late Bernburg context.

**Ulvesheim series**

Charcoal from settlement pits of Middle Neolithic Bischheim Group at Ulvesheim, near Worms (49° 40' N, 9° 20' E). Coll 1983 by W Plass, Inst Geol, Univ Frankfurt/M; subm 1983 by J Lüning, Inst Prehist, Univ Frankfurt/M.

**Fra-96. Ulvesheim, Pit D 5640 ± 100**

Charcoal from Pit D at depth 1.5m in loess.

**Fra-97. Ulvesheim, Pit B 5630 ± 100**

Charcoal from Pit B at depth 1.5m in loess. *Comment*: HCl and strong NaOH treatment. Dates are as expected.

+ 2500

**Fra-5a. Kelsterbach, *M primigenius* femur 30,300**

– 1900

Kelsterbach (8° 32' N, 50° 8' E) is adjacent to quarry at ca 14km from Frankfurt/M. From well-stratified deposit remains of *M primigenius* and mollusks, and from lower stratum, calotte of hominid (*H s sapiens*) were excavated. <sup>14</sup>C and amino-acid dates on fauna (bones and teeth) and hominid were measured by different labs from 1975 to 1983. Dates Hv-1297 (unpub), UCLA-2361 and -2359 (unpub) agree well with Frankfurt dates. Coll 1975-1977 and subm 1975 by R Protsch. *Comment*: collagen with additional NaOH treatment.

Sample, femur fragment (*M primigenius*) coll at depth 4.3m just below bones UCLA-2359, 23,675 ± 860 (unpub), and mollusks, Hv-1297, 21,000 ± 1400 (unpub), and Hv-1296, 18,500 ± 950 (unpub). Teeth of *M primigenius* at ca 3.3m to 3.5m were dated to 15,810 ± 410, Hv-1961. Amino-acid date, 30,100, on same piece of bone with amino-acid lab no. Fra-A-10a. UCLA <sup>14</sup>C date on hominid was 29,000 ± 1525, UCLA-2361, and amino-acid date, 32,000 BP, with amino-acid lab no. Fra-A-10 (see Protsch *et al*, in press). Absolute ages of fauna and hominid by <sup>14</sup>C and amino-acid dating agree well with strat-geol estimate of deposit.

#### Belgium

**Fra-98. Martouzin-Neuville 4070 ± 100**

Human bone from lower level of a Megalithic grave at depth 1.4m, dug into limestone on steep slope of hill near Martouzin-Neuville (50° 6' 51" N, 5° 1' 19" E) at alt +235m. Grave contained pottery of Seine-Oise-Marne (SOM) type and three collared flasks of Trichterbecher (TRBC) culture (Huysecon, 1978). Coll 1976 by F Hubert, Service Natle Fouilles, Bruxelles and subm 1983 by E Huysecon, Bruxelles. *Comment*: collagen with additional NaOH treatment. Agrees within limits of error with previous date, 3790 ± 90, Lv-1243, uncorrected for δ<sup>13</sup>C fractionation (E Gilot, pers commun), from higher level of same grave. Martouzin-Neuville provides first TRBC dates for Belgium. Both dates coincide with dates of SOM culture, but appear rather young in comparison with TRBC dates for The Netherlands (Pape, 1979).

#### Switzerland

##### Witterswil series

Mortar samples from Church of St Katharina in Witterswil (47° 15' N, 7° 30' E), Kanton Solothurn. Excavations 1983 by H J Lehner identify several construction phases, ranging from medieval to modern times. Samples were analyzed as experiment to test possibility of mortar dating archaeol unassignable earlier structures. Coll and subm 1983 by H J Lehner, Kantonsarchaeol, Solothurn.

**Fra-106. Witterswil 7890 ± 170**

Mortar from altar historically dated to AD 1641.

**Fra-107. Witterswil 5820 ± 140**

Mortar from wall archaeol dated to AD 1300-1400. *Comment:* dates processed on first HCl-evolved CO<sub>2</sub> fraction. Both samples are evidently contaminated, making value of further dating questionable.

*Ireland***Carrowmore series**

Charcoal from *Ostrea*-shell Kitchen Midden 15A near Carrowmore (54° 14' N, 8° 32' W), Co Sligo. Carrowmore is well known for its large Megalithic cemetery, considered one of the earliest in Europe. Settlement area has been object of large-scale archaeol research between 1977 and 1982 by G Burenhult, Hist Mus, Univ Lund, Sweden (Burenhult, 1980a, b). Depth of shell layers range from +2.5m to +4.5m and are partly eroded by sea. Midden is ca 2500m<sup>2</sup>. Samples coll and subm 1981 by B Weninger. Sample nos. and coordinates from S Österholm in Burenhult (1981).

**Fra-53. Carrowmore, Kitchen Midden 15A 1240 ± 100**

Charcoal no. 21 from coordinates x+15.5m, y-6.60m, z+2.27m. Top layer.

**Fra-63. Carrowmore, Kitchen Midden 15A 2470 ± 100**

Charcoal no. 18 from coordinates x+14.98m, y-18.25m, z+2.01m. Top layer.

**Fra-65. Carrowmore, Kitchen Midden 15A 3000 ± 100**

Charcoal no. 14 from coordinates x+9.80m, y-22.20m, z+2.38m. Middle layer.

**Fra-60. Carrowmore, Kitchen Midden 15A 3090 ± 100**

Charcoal no. 19 from coordinates x+8.65m, y-21.00m, z+2.73m. Middle layer.

*General Comment:* HCl and NaOH treatment. Basal layer of midden was dated to 3780 ± 60, Lu-1759 (R, 1981, v 23, p 401) and 3970 ± 75, Lu-1948 (R, 1982, v 24, p 211). Middle layer samples Fra-65 and -60 derive from hearths at approx same depth and close (ca 1m) horizontal distance, archaeol expected to be of similar age, which is confirmed. Top layer sample Fra-63 was taken exactly 1m above Lu-1948 to study rate of deposit of midden. This is interesting in light of observation that width and thickness of *Ostrea* shells decrease in younger strata, perhaps due to overexploitation (Burenhult, 1980b, p 38; 1981, p 20). Top layer sample Fra-53 proves midden was used up to Viking period. Altogether, four distinct occupation periods over ca 3000 yr are demonstrated.

*Hungary***Gorzsa series**

Charcoal from Late Neolithic tell at Gorzsa near Szeged (46° 16' N, 20° 17' E). Cultural strata 2 to 3m thick, belong to Early and Late Tisza culture, with ceramics of tradition formerly called Gorzsa Group (Gazda-

pusztai, 1957). New excavations from 1978 to 1983 by F Horvarth, Móra Ferenc Múzeum, Szeged, identify four Neolithic phases subdivided into 16 levels, extending from turn of Vinca B2/C1 to end of Vinca C, and perhaps to beginning of Vinca D (Horvarth, 1982). Coll 1978 by F Horvarth and subm by B Weninger and R Protsch.

**Fra-76. Gorzsa, Level 10 5650 ± 110**

Charcoal from Block III, Level 10, depth 200cm, from House 2 destroyed by fire.

**Fra-77. Gorzsa, Level 10 5670 ± 100**

Charcoal from same House as Fra-76, ca 10m away, from depth 2.1m. *Comment:* HCl treatment only. Samples are from two ends of wooden structure of House 2. Archaeol assignment of Level 10 to Late Neolithic Herpály and Vinca C cultures as proposed by F Horvarth on basis of Herpály imported pottery and typol connections to Yugoslavia is confirmed by above dates when compared with dates 5575 ± 100 (Bln-509), 5871 ± 100 (Bln-510), 5775 ± 100 (Bln-512), 5940 ± 100 (Bln-513) (R, 1970, v 12, p 412-413), and 5845 ± 60 (GrN-1993) (R, 1963, v 5, p 184) for Hungarian Herpály-Csöszhalom site. This applies also to Vinca dates of Yugoslavian sites, Gornja Tuzla, 5580 ± 60 (GrN-1974), Banjica, 5710 ± 90 (GrN-1542), and Vinca, 5845 ± 160 (GrN-1537) (R, 1963, v 5, p 183-184).

**Fra-95. Gorzsa, Level 1 5970 ± 100**

Charcoal from Block III/b, Level 1, coordinates 7/a at depth 1.15m with Group 3 of pots. *Comment:* HCl and NaOH treatment. Fra-95 should date youngest Neolithic occupation and is older than expected. Secondary transport coming from lower level cannot be excluded for this sample (F Horvarth, pers commun). Date is within limits of Late Neolithic dates expected at this site.

**Fra-108. Gorzsa, Level 16 5970 ± 100**

Charcoal from Pits 2 and 3 of Level 16. *Comment:* HCl and NaOH treatment. Date is as expected for earliest Neolithic level in Gorzsa.

*Egypt*

**Qubbet el Hawa series**

Human bone from shaft graves cut into limestone at Qubbet el Hawa (Mountain of the Wind) near Assuan (24° 8' N, 32° 53' E). Most graves of this large cemetery were cut in 6th Dynasty for high Egyptian officials. Latest graves were cut in New Kingdom. Cemetery was continually used for secondary burials up to Saitic times and some grave shafts and entrances contain burials of over 100 individuals (Edel, 1973; Rösing, 1982). Coll and subm 1977 by F Rösing, Anthropol Inst, Univ Ulm.

**Fra-70. Qubbet el Hawa, Grave 103 3860 ± 100**

One bone, no. 103/148 (calcaneus) from Grave 103, providing date for four individuals. Expected date: 6th Dynasty.



**Fra-92. Qubbet el Hawa, Grave 207 3730  $\pm$  100**

Two bones, no. 207/183/ISKA (calcaneus) and no. 207/185/ISKC (calcaneus) from Grave 207, providing date for 34 individuals. Expected date: 6th Dynasty or First Intermediate period.

**Fra-71. Qubbet el Hawa, Grave 88 3450  $\pm$  100**

Four bones, no. 88/598/ISF (metacarpal), 88/396/IIISF (fragment of mandible), 88/216/IIISF (fragment of parietal), and 88/306/IVSF (fragment of femur) from Grave 88, providing date for 79 individuals. Expected date: 6th Dynasty.

**Fra-80. Qubbet el Hawa 2430  $\pm$  100**

One bone, no. 0/1145 (calcaneus) providing date for one individual. No expected date.

**Fra-87. Qubbet el Hawa, Grave 89 3550  $\pm$  100**

Four bones, no. 89/24/IISF (metacarpal), 89/24/IIISF (fragment of mandible), 89/192/IIISF (fragment of parietal), and 89/192/IIISF (fragment of femur) from Grave 89, providing date for 76 individuals. Expected date: 6th Dynasty.

**Fra-100. Qubbet el Hawa, Grave 29 3850  $\pm$  100**

Two bones, no. 29b/135 (talus) and 29b/125/ISF (talus) from Grave 29, providing date for 44 individuals. Expected date: 6th Dynasty.

**Fra-104. Qubbet el Hawa, Grave 30 4110  $\pm$  100**

One bone, no. 30b/1/ISF (calcaneus) from Grave 30, providing date for 20 individuals. Expected date: 6th Dynasty. *Comment:* all dates of small (ca 30 to 40g) samples were processed on total HCl-soluble organic fraction without NaOH treatment. Bones are well preserved and show thin, dark surface coloring of remaining skin. Fra-70, -92, and -100 confirm archaeol expectation. Fra-71 and -87 are younger, perhaps 12th Dynasty. Fra-80 is probably 26th Dynasty. Fra-104 is unexpectedly old.

*South Africa***Broederstroom series**

Charcoal from Early Iron age village at Broederstroom (25° 45' S, 27° 50' E), Transvaal. Excavations from 1973 to 1978 by J R Mason, Archaeol Research Unit, Univ Witwatersrand, Johannesburg, exposed remains of many clay-lined huts, furnace areas, as well as stone and iron-ore mounds (Mason, 1973; 1974; 1981). Previous dates are discussed in Mason (1981). Coll 1973 to 1977 by R J Mason and subm 1977 by R Protsch.

**Fra-88. Broederstroom, Hut 24/73 AT 1320  $\pm$  100**

Charcoal at depth 15cm in NE corner of Hut 24/73 AT.

**Fra-82. Broederstroom, Mound 24/73 Azc 1450  $\pm$  100**

Charcoal at depth 65 to 70cm in Sq DF/5, Mound 24/73 Azc. Agrees with previous date, 1600  $\pm$  50 (KN-2643) (Mason, 1981), on same Mound.

**Fra-85. Broederstroom, Hut 24/73 Ar 1360 ± 100**

Charcoal at depth 15cm in SE edge of Ar panel in Hut 24/73 Ar.

**Fra-84. Broederstroom, Hut 24/73 Azz 290 ± 100**

Charcoal at depth 5cm at distance 35cm from N edge of Hut 24/73 Azz in hut plaster. Agrees with previous date on same hut, 330 ± 50 (KN-2642) (Mason, 1981). Both samples date Late Iron age stone wall overlying possible Early Iron age hut floor.

**Fra-83. Fa-Kgale, Site 43/73A 260 ± 100**

Charcoal from Sq C, at depth 75 to 100cm, from thick ash layers in Late Iron age mine at Ga-Kgale (25° 25' S, 24° 30' E). Site 43/73A, W of Gaberone, Botswana. Specularite and copper ore were extracted in this mine by sinking shafts and galleries to ore bodies at depth 5m or more. Stone anvils, hammers, and smelting furnace debris were found near mine (Cohen, 1977). Coll 1973 by R J Mason and subm 1977 by R Protsch. *Comment:* sample from same loc at depth 80 to 100cm dated to 115 ± 115 (Gx-7202, R J Mason, pers commun).

*Sri Lanka*

**Beli Lena series**

Charcoal from Mesolithic levels of Beli Lena cave at Kitulgala (7° 0' N, 80° 25' E). Bot analysis by A Krantz, Bot Inst, Univ Frankfurt/M. Coll 1979 by D Spennemann, and subm 1979 by S Deraniyagala, Archaeol Dept, Sri Lanka.

**Fra-91. Beli Lena 11,780 ± 220**

Sample consisting of 60% charred grain (millet) and 40% wood charcoal with site coordinates 11G/PL9/5 from St 5.

**Fra-93. Beli Lena 8700 ± 220**

Sample consisting of 30% charred grain (millet) and 70% wood charcoal with site coordinates 12G/PL13/7 from St 7. *Comment:* HCl and NaOH treatment. Strata of Beli Lena cave are very thin, with average thickness of a few cm. Both samples were coll by flotation in running water of local stream and contained modern plant remains. Samples were rigorously handpicked, ca 1 hr each, also for hairs of excavation brushes. Fra-91 agrees with previous date 11,550 ± 160 (BS-290, Deraniyagala, pers commun) on St 5 with coordinates 10G/5. Fra-93 is considerably younger than expected when compared to sample from coordinates 10G/7 dated to 11,520 ± 220 (BS-292, Deraniyagala, pers commun) from St 7.

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