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# UNIVERSITY OF LUND RADIOCARBON DATES III

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## INTRODUCTION

The $C^{14}$ measurements reported here were made in this laboratory between October 1968 and October 1969.

The measuring technique and equipment, and the treatment of samples are the same as reported previously (Radiocarbon, 1968, v. 10, p. 36-37). Shell samples are treated in the following way: after removal of foreign matter by mechanical cleaning, outermost parts of shells, 10% or more depending on sample size, are removed by washing in dilute HCl. $CO_2$ is normally liberated from remaining shells in 2 stages with predetermined amounts of HCl. $CO_2$ from the first stage is called outer fraction (o) and the rest inner fraction (i). Subsequent treatment is same as for other samples. Amount of $CO_2$ in each fraction is given in sample descriptions as per cent of $CO_2$ from total shell sample. Bone samples are treated as follows: mechanical cleaning of bone surface, washing, crushing, sizing (0.3 to 2 mm), removal of all bone carbonate with cold 0.7N HCl under reduced pressure, washing, leaching of insoluble residue with cold NaOH (0.1 to 0.5N), repeated washing, acidification, and drying.

The remark, "undersized; diluted", in *Comments* means the sample did not produce enough $CO_2$ to fill the counter to normal pressure and "dead" $CO_2$ from anthracite was introduced to make up the pressure.

Age calculations are based on a contemporary value equal to 0.950 of the activity of the NBS oxalic acid standard and on a half-life for $C^{14}$ of 5568 yr. Results are reported in years before 1950 (years B.P.), and in the A.D./B.C. scale. Errors quoted ($\pm 1\sigma$) include the standard deviations of the count rates for the unknown sample, the contemporary standard, and the background. In view of the increased possibilities to correct for variations in initial $C^{14}$-content in the atmosphere during the last 7000 yr (Suess, 1970; Michael and Ralph, 1970; Willkomm, 1968) we now report $\sigma = 1$ standard deviation also for dates with $\sigma < 100$ yr, starting with this date list. Corrections for deviations from the normal $C^{13}/C^{12}$ ratio for terrestrial plants ($\delta C^{13} = -25.0‰$ in the P.D.B. scale) are applied for all samples. $\delta C^{13}$ values quoted are relative to the P.D.B. standard.

The description of each sample is based on information provided by the person submitting the sample to the laboratory.

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## SAMPLE DESCRIPTIONS

### I. GEOLOGIC SAMPLES

#### *A. Sweden*

**Trummen series**

Sediment samples continued from Lund II (Radiocarbon, 1969, v. 11, p. 434) from Lake Trummen, near city of Växjö, central S Sweden (56° 52′ N Lat, 14° 50′ E Long). Coll. 1967 and subm. by G. Digerfeldt, Dept. Quaternary Geol., Univ. of Lund. Pollen zones according to Nilsson (1935, 1961) and Berglund (1966). Water depth 1.5 m at main profile and 1.0 m at complementary profile. Depths given in sample titles are below lake water level. HCl pretreatment of all samples.

**Trummen, main profile, Late-Glacial part:**

**Lu-210. Trummen, 721 to 726 cm** — **11,730 ± 150**; **9780 B.C.**; $\delta C^{13} = -21.6‰$

Clay gyttja. Increase of *Empetrum* during AL. *Comment*: sample undersized; diluted.

**Lu-209. Trummen, 711 to 716 cm** — **11,060 ± 100**; **9110 B.C.**; $\delta C^{13} = -22.8‰$

Clay gyttja. Decrease of *Empetrum* around AL/DR3.

**Lu-208. Trummen, 696 to 701 cm** — **10,360 ± 105**; **8410 B.C.**; $\delta C^{13} = -22.5‰$

Clay gyttja. Increase of *Empetrum* around DR3/DR3-PB.

**Lu-207. Trummen, 684 to 689 cm** — **10,230 ± 105**; **8280 B.C.**; $\delta C^{13} = -21.3‰$

Clayey gyttja. Culmination of *Empetrum* in DR3-PB.

**Trummen, complementary profile:**

Complementary profile taken in shallower and more sheltered part of lake than main profile. Comprises only uppermost ca. 1.6 m of layer sequence. The limnology and postglacial development of Lake Trummen has been investigated by Björk and Digerfeldt (1965) and Digerfeldt (1969).

**Lu-227. Trummen, 232.5 to 237.5 cm** — **2480 ± 55**; **530 B.C.**; $\delta C^{13} = -29.8‰$

Brown detritus gyttja. Beginning decrease of *Juniperus* in SA2.

**Lu-226. Trummen, 207.5 to 212.5 cm** — **1340 ± 50** / **A.D. 610** / $\delta C^{13} = -29.1‰$

Brown detritus gyttja. Strong increase of *Juniperus* in SA2.

**Lu-225. Trummen, 167.5 to 172.5 cm** — **1010 ± 50** / **A.D. 940** / $\delta C^{13} = -28.8‰$

Brown detritus gyttja. *Picea* limit in SA1.

**Lu-224. Trummen, 127.5 to 132.5 cm** — **1000 ± 50** / **A.D. 950** / $\delta C^{13} = -28.2‰$

Brown detritus gyttja. Increase of *Fagus* just below SB2/SB1.

**Ranviken Bay series**

Sediment samples continued from Lund II (Radiocarbon, 1969, v. 11, p. 431-434) from Ranviken Bay of Lake Immeln, ca. 30 km N of town of Kristianstad, NE Scania (56° 17′ N Lat, 14° 18′ E Long). Coll. 1967 and subm. by G. Digerfeldt. Samples come from main profile taken in central and deepest part of bay, and represent lateglacial part of sediment sequence. Water depth 1.1 m. Depths given in sample titles are below lake water level. HCl pretreatment.

**Lu-223. Ranviken, 809 to 814 cm** — **12,670 ± 130** / **10,720 B.C.** / $\delta C^{13} = -18.2‰$

Clay gyttja. Preliminary in late part of DR2.

**Lu-222. Ranviken, 796 to 799 cm** — **11,430 ± 115** / **9480 B.C.** / $\delta C^{13} = -22.4‰$

Clay gyttja. Preliminary in late part of AL.

**Lu-221. Ranviken, 780 to 785 cm** — **10,370 ± 120** / **8420 B.C.** / $\delta C^{13} = -22.1‰$

Clay gyttja. Culmination of *Empetrum* in DR3-PB. *Comment*: sample undersized; diluted.

**Torreberga series**

Wood and peat samples from ancient lake occupying part of Torreberga valley, 10 km S of Lund, S Sweden (55° 37′ N Lat, 13° 15′ E Long). Dated as part of investigation of postglacial lake development. Owing to influence from local forest vegetation pollen zoning is very complicated. A paleoecologic study of the lateglacial lake has been published (Berglund and Digerfeldt, 1970). Coll. 1965 (Lu-134) and 1967, and subm. by G. Digerfeldt. MBP2 is a profile from deepest part of ancient lake, MBP4 from shallower part, and MBP3 from intermediate position. HCl and NaOH pretreatment.

**Lu-238. Torreberga MBP2** **2600 ± 55**
**650 B.C.**
$\delta C^{13} = -27.7‰$

Wood of *Alnus,* 35 to 40 cm below surface in *Alnus* carr peat.

**Lu-134. Torreberga MBP3** **6070 ± 70**
**4120 B.C.**
$\delta C^{13} = -29.5‰$

Wood of *Alnus,* 120 to 125 cm below ground surface in *Alnus* carr peat.

**Lu-239. Torreberga MBP4, 57.5 to 62.5 cm, peat** **8560 ± 90**
**6610 B.C.**
$\delta C^{13} = -28.0‰$

Magnocaricetum peat.

**Lu-239A. Torreberga MBP4, 57.5 to 62.5 cm, humic acid** **8440 ± 90**
**6490 B.C.**
$\delta C^{13} = -27.4‰$

NaOH-soluble fraction from material used for Lu-239.

**Lu-240. Torreberga MBP4, 35 to 40 cm, peat** **4130 ± 65**
**2180 B.C.**
$\delta C^{13} = -26.9‰$

*Alnus* carr peat.

**Lu-240A. Torreberga MBP4, 35 to 40 cm, humic acid** **3880 ± 65**
**1930 B.C.**
$\delta C^{13} = -26.6‰$

NaOH-soluble fraction from material used for Lu-240.

**Väby series**

Samples from forest soil profile in Väby, Bräkne-Hoby parish, Blekinge (56° 10′ N Lat, 15° 08′ E Long), from which local-influenced pollen diagram has been derived. Forest succession includes 3 phases: *Quercetum Mixtum, Fagus,* and *Picea.* Coll. and subm. by B. E. Berglund and C. E. Nylander, Dept. Quaternary Geol., Univ. of Lund.

**Lu-213. Väby 2** **3360 ± 60**
**1410 B.C.**
$\delta C^{13} = -29.1‰$

Bark of birch, 45 to 50 cm below surface. *Comment*: HCl pretreatment.

**Lu-214. Väby 1a** **2520 ± 55**
**570 B.C.**
$\delta C^{13} = -27.0‰$

**Lu-264. Väby 1b** **2330 ± 55**
**380 B.C.**
$\delta C^{13} = -26.1‰$

Charcoal of birch, 40 to 45 cm below surface, dating regression of *Quercetum Mixtum* forest. *Comment*: HCl and NaOH pretreatment.

**Lu-265. Väby 3** **150 ± 80**
**A.D. 1800**
$\delta C^{13} = -28.3‰$

Wood of willow, 30 to 35 cm below surface. *Comments*: HCl and NaOH pretreatment. Sample undersized; diluted. (B.E.B.): unexpected low value indicates material has been derived from down-growing roots. *General Comment* (B.E.B.): dates for Väby 1 and Väby 2 confirm pollen-analytical dating.

**Torps Mosse series**

Wood samples from peat bog on island of Senoren, Ramdala parish, Blekinge (56° 07′ N Lat, 15° 45′ E Long). Bog dried out in Atlantic time and became wooded with pine and oak, later oak, and birch. During preliminary investigation wood from stump layer ca. 60 cm below surface was coll. for dating. A study of forest succession will be published later. Coll. and subm. 1968 by B. E. Berglund. HCl and NaOH pretreatment.

**Lu-267. Torps Mosse 2, *Pinus*** **6570 ± 75**
**4620 B.C.**
$\delta C^{13} = -25.0‰$

**Lu-266. Torps Mosse 1, *Quercus*** **4800 ± 65**
**2850 B.C.**
$\delta C^{13} = -24.1‰$

**Lu-268. Torps Mosse 3, *Quercus*** **3650 ± 60**
**1700 B.C.**
$\delta C^{13} = -24.3‰$

*General Comment* (B.E.B.): dates show spread of ca. 3000 yr for ages of stumps and indicate very low peat accumulation rate. Oak stumps are of Early Sub-Boreal age and indicate low ground water level.

**Spjutsten series**

Peat samples from heath soil profile on island of Spjutsten, outer archipelago of Stockholm (59° 44′ N Lat, 19° 15′ E Long), belonging to the maritime birch forest area. Peat layer is 43 cm thick, lying directly on rock surface in open dwarf-shrub heath. Lower peat, 36 to 43 cm below surface, seems to derive from birch forest and upper peat from dwarf-shrub heath. Depts given are below surface. Coll. 1963 by M. Fries, Royal Inst. of Forestry, Stockholm, and B. E. Berglund; subm. by B. E. Berglund. HCl and NaOH pretreatment.

**Lu-273. Spjutsten 2, 40 to 43 cm, peat** **1200 ± 50**
**A.D. 750**
$\delta C^{13} = -23.4‰$

**Lu-273A. Spjutsten 2, humic acid** **1090 ± 55**
**A.D. 860**
$\delta C^{13} = -26.4‰$

NaOH-soluble fraction from material used for Lu-273.

**Lu-272. Spjutsten 1, 30 to 35 cm, peat**
**330 ± 50**
**A.D. 1620**
$\delta C^{13} = -26.2‰$

**Lu-272A. Spjutsten 1, humic acid**
**360 ± 50**
**A.D. 1590**
$\delta C^{13} = -25.0‰$

NaOH-soluble fraction from material used for Lu-272.

*General Comment* (B.E.B.): dates indicate that on this site the maritime birch forest is native and climatically conditioned and that the coast heath is a rather modern vegetation type.

**Siretorp series**

Samples from profile on distal side of complex Littorina beach ridge with brackish lagoon sediments at Siretorp, Sölvesborg, Blekinge (56° 01′ N Lat, 14° 37′ E Long). Site is described by Bagge and Kjellman (1939) and discussed by Berglund (1964) and Mörner (1969). Bottom beach sand is covered by brackish gyttja, upper part of which may be subdivided into 3 gyttja lenses separated by sand lenses. Organic layers have been supposed to correspond to transgression phases of the Littorina Sea. Pollen diagram of the profile covers the Late Atlantic and the Early Sub-Boreal zones. Depths given are below surface. Coll. 1968 and subm. by B. E. Berglund. HCl and NaOH pretreatment.

**Lu-269. Siretorp 1**
**6820 ± 75**
**4870 B.C.**
$\delta C^{13} = -24.6‰$

Charcoal of oak from bottom beach sand.

**Lu-302. Siretorp 2**
**6640 ± 70**
**4690 B.C.**
$\delta C^{13} = -26.5‰$

Slightly brackish muddy sand, 133 to 136 cm.

**Lu-302A. Siretorp 2, humic acid**
**6450 ± 75**
**4500 B.C.**
$\delta C^{13} = -24.9‰$

NaOH-soluble fraction from material used for Lu-302.

**Lu-303. Siretorp 3**
**6220 ± 70**
**4270 B.C.**
$\delta C^{13} = -26.5‰$

Slightly brackish gyttja, 126 to 128 cm.

**Lu-304. Siretorp 4**
**6090 ± 70**
**4140 B.C.**
$\delta C^{13} = -21.9‰$

Slightly brackish gyttja, 113 to 115 cm.

**Lu-305. Siretorp 5**
**5930 ± 70**
**3980 B.C.**
$\delta C^{13} = -30.1‰$

Slightly brackish gyttja, 108 to 110 cm.

**6000 ± 70**
**Lu-306. Siretorp 6** **4050 B.C.**
$\delta C^{13} = -23.1‰$

Slightly brackish coarse detritus gyttja, 96 to 100 cm.

**5770 ± 85**
**Lu-306A. Siretorp 6, humic acid** **3820 B.C.**
$\delta C^{13} = -26.7‰$

NaOH-soluble fraction from material used for Lu-306. *Comment*: sample undersized; diluted.

**5700 ± 70**
**Lu-307. Siretorp 7** **3750 B.C.**
$\delta C^{13} = -27.6‰$

Brackish gyttja, 94 to 96 cm.

**5520 ± 90**
**Lu-307A. Siretorp 7, humic acid** **3570 B.C.**
$\delta C^{13} = -22.4‰$

NaOH-soluble fraction from material used for Lu-307. *Comment*: sample undersized; diluted.

**5030 ± 80**
**Lu-308. Siretorp 8** **3080 B.C.**
$\delta C^{13} = -21.8‰$

Brackish gyttja, 83 to 85 cm. Slightly below the *Ulmus*-decrease. *Comment*: sample slightly undersized; diluted.

**5040 ± 65**
**Lu-309. Siretorp 9** **3090 B.C.**
$\delta C^{13} = -21.0‰$

Brackish gyttja, 74 to 76 cm. At the *Ulmus*-decrease. *Comment*: sample slightly undersized; diluted. Date based on 3 1-day counts.

**4640 ± 85**
**Lu-309A. Siretorp 9, humic acid** **2690 B.C.**
$\delta C^{13} = -27.0‰$

NaOH-soluble fraction from material used for Lu-309. *Comment*: sample undersized; diluted.

**4470 ± 80**
**Lu-310. Siretorp 10** **2520 B.C.**
$\delta C^{13} = -21.0‰$

Limnic to slightly brackish gyttja in lower lens, 68 to 70 cm. *Comment*: sample undersized; diluted.

**4340 ± 70**
**Lu-310A. Siretorp 10, humic acid** **2390 B.C.**
$\delta C^{13} = -28.2‰$

NaOH-soluble fraction from material used for Lu-310.

**Lu-311. Siretorp 11** **4270 ± 60**
**2320 B.C.**
$\delta C^{13} = -21.8‰$

Limnic to slightly brackish gyttja in middle lens, 56 to 60 cm.

**Lu-311A. Siretorp 11, humic acid** **3930 ± 65**
**1980 B.C.**
$\delta C^{13} = -21.8‰$

NaOH-soluble fraction from material used for Lu-311.

**Lu-312. Siretorp 12** **3950 ± 60**
**2000 B.C.**
$\delta C^{13} = -23.4‰$

Limnic to slightly brackish gyttja in upper lens, 50 to 52 cm.

**Lu-312A. Siretorp 12, humic acid** **3870 ± 65**
**1920 B.C.**
$\delta C^{13} = -22.8‰$

NaOH-soluble fraction from material used for Lu-312.

**Lu-313. Siretorp 13** **3820 ± 65**
**1870 B.C.**
$\delta C^{13} = -27.3‰$

Limnic to slightly brackish sandy gyttja in upper lens, 45 to 47 cm.

**Lu-313A. Siretorp 13, humic acid** **3610 ± 65**
**1660 B.C.**
$\delta C^{13} = -31.0‰$

NaOH-soluble fraction from material used for Lu-313.

*General Comments* (B.E.B.): samples seem to date 2 Atlantic and 3 Sub-Boreal transgressions in accordance with shoreline displacement curve of Berglund (1964). (S.H.): NaOH-soluble fraction was dated for some samples to obtain information about magnitude of contamination with younger material in sediment of this kind.

**Lake Striern series**

Sediment samples from Lake Striern, 900 m NE of Hägerstad new church, Östergötland (58° 05′ N Lat, 15° 47′ E Long). Alt of sediment surface at sampling point ca. 86 m. Coll. 1966 by H. Göransson; subm. by T. Nilsson, Dept. Quaternary Geol., Univ. of Lund. Pollen analyses by H. Göransson. Samples represent characteristic levels in pollen diagram. Depths given in sample titles are below sediment surface. HCl pretreatment of all samples.

**Lu-243. Striern, 490 to 500 cm** **12,090 ± 280**
**10,140 B.C.**
$\delta C^{13} = -24.4‰$

Samples 198+199. Clayey gyttja. Culmination of *Juniperus. Comment*: sample undersized; diluted. Date based on 3 1-day counts.

**Lu-296. Striern, 480 to 490 cm** — **11,750 ± 220** / **9800 B.C.** / $\delta C^{13} = -25.9‰$

Samples 196+197. Slightly calcareous clayey gyttja. Lower part of *Betula* maximum. *Comment*: sample undersized; diluted. Date based on 3 1-day counts. Dated to check reliability of Lu-243.

**Lu-244. Striern, 465 to 475 cm** — **10,220 ± 105** / **8270 B.C.** / $\delta C^{13} = -25.1‰$

Samples 193+194. Gyttja. Somewhat below rational *Corylus* limit. Upper part of Pre-Boreal.

**Lu-245. Striern, 415 to 425 cm** — **8900 ± 95** / **6950 B.C.** / $\delta C^{13} = -26.3‰$

Samples 183+184. Gyttja. Rational *Alnus* limit.

**Lu-246. Striern, 345 to 355 cm** — **7390 ± 80** / **5440 B.C.** / $\delta C^{13} = -27.2‰$

Samples 169+170. Gyttja. Rational *Quercus* limit.

**Lu-247. Striern, 335 to 345 cm** — **6930 ± 65** / **4980 B.C.** / $\delta C^{13} = -28.8‰$

Samples 167+168. Gyttja. Rational *Tilia* limit.

**Lu-248. Striern, 310 to 320 cm** — **5390 ± 55** / **3440 B.C.** / $\delta C^{13} = -22.6‰$

Samples 162+163. Gyttja. Beginning of classical *Ulmus* fall at Atlantic/Sub-Boreal boundary.

**Lu-249. Striern, 240 to 250 cm** — **3740 ± 55** / **1790 B.C.** / $\delta C^{13} = -24.7‰$

Samples 148+149. Gyttja. Final fall of *Ulmus* curve, *Quercus* maximum, *Pinus* minimum, *Betula* maximum.

**Lu-250. Striern, 185 to 195 cm** — **2310 ± 60** / **360 B.C.** / $\delta C^{13} = -23.5‰$

Samples 137+138. Gyttja. Empirical *Picea* limit, distinct increase of *Juniperus*, rather low *Pinus* values. *Comment*: sample undersized; diluted.

**Lu-251. Striern, 140 to 150 cm** — **2040 ± 60** / **90 B.C.** / $\delta C^{13} = -26.0‰$

Samples 128+129. Gyttja. Rational *Picea* limit, *Fraxinus* maximum, increase of *Pinus*. *Comment*: sample undersized; diluted.

**Lu-252. Striern, 80 to 90 cm** **1220 ± 70**
**A.D. 730**
$\delta C^{13} = -27.2‰$

Samples 116+117. Gyttja. Increase of *Picea, Fagus* maximum. *Comment*: sample undersized; diluted.

**Lu-242. Striern, 35 to 45 cm** **740 ± 75**
**A.D. 1210**
$\delta C^{13} = -26.3‰$

Samples 107+108. Gyttja. Distinct increase of *Juniperus*, NAP, and *Gramineae cultae*. *Comment*: sample undersized; diluted.

*General Comments* (T.N.): compared with varve chronology and radiocarbon dates from other parts of S Scandinavia Lu-243 and Lu-296 seem 1000 to 2000 yr too old. Lu-244 is probably too old also. (S.H.): Lu-243 was older than expected and possible contamination with calcareous matter was suspected since only cold HCl had been used for pretreatment (small sample). Material overlying Lu-243 was given normal treatment with hot HCl (2%) and dated as Lu-296. Result agrees well with Lu-243. Unexpected high age for Lu-243 and Lu-296 (and probably also Lu-244) may be due to "hard-water" error.

**Lu-280. Ellesbo, Sample 6** **$30{,}300^{+950}_{-850}$**
**28,350 B.C.**
$\delta C^{13} = -26.6‰$

Sand from gravel pit at Ellesbo, 3 km S of Kungälv, Bohuslän (57° 50′ N Lat, 12° 00′ E Long). Alt 35 m. Coll. 1968 and subm. by Å. Hillefors, Dept. Geog., Univ. of Lund. Area described by submitter (Hillefors, 1969). *Comment*: no pretreatment due to small organic content. Processing of 4.4 kg sample yielded ca. 62% of full requirement. Diluted with $CO_2$ from anthracite; date based on 2 3-day counts. Test on part of sample indicated $< 1\%$ of carbon came from carbonates. NaOH-soluble fraction was extracted from 2.2 kg of HCl-treated material and processed. Yield indicated ca. 19% of carbon in Lu-280 came from NaOH-soluble material. Two 3-day counts on $CO_2$ from NaOH-soluble fraction, much diluted, gave age $>$ 20,000 yr.

**Lu-237. Kristineberg, marine shells** **Apparent Age 420 ± 50**
$\delta C^{13} = +1.1‰$

Marine mollusc shells from shallow water near Kristineberg on island of Skaftölandet, Bohuslän (58° 15′ N Lat, 11° 26′ E Long). Coll. between 1889 and 1904; subm. by Å. Hillefors. *Comment*: outermost 10% of shells removed by acid washing. Date agrees with previous dates on contemporary marine shells (Lu-234, 370 ± 46; Lu-235, 410 ± 46; Lu-236, 430 ± 46, Radiocarbon, 1969, v. 11, p. 441). Correction for deviation from normal $C^{13}/C^{12}$ ratio for terrestrial plants ($\delta C^{13} = -25.0‰$ in P.D.B. scale) is applied.

**Fossil marine shells series**

**Lu-260. Högenorum, *Mya truncata*, i** **11,760 ± 115**
**9810 B.C.**
$\delta C^{13} = +1.3‰$

Thick shells (*Mya truncata*) from Högenorum, Norum, Stenungssund, Bohuslän (58° 04′ N Lat, 11° 53′ E Long). Stratigraphic sequence from bottom to top: glaciofluvial sediments, clay, sand, clay, sand, varved glacial clay, sand, symmict glacial clay with shells, 20 cm washed material. Symmict clay also contained shells of *Saxicava arctica* and fragments of *Pecten islandicus*. Alt ca. 50 m. Coll. 1968 and subm. by Å. Hillefors. *Comments*: inner fraction (30% of shells) was used. (Å.H.): shells probably redeposited to some extent. Sample approx. dates deposition of symmict glacial clay. Deglaciation may have taken place some hundred yr earlier (cf. Björsjö, 1949, p. 133 f., 138).

**Lu-261. Högenorum, *Mya truncata*, o** **11,670 ± 115**
**9720 B.C.**
$\delta C^{13} = +0.9‰$

Outer fraction of shells used for Lu-260. *Comment*: outer fraction corresponds to 32% of shells; outermost 38% removed by acid washing.

**Lu-262. Glimsås, Sample 1** **11,280 ± 130**
**9330 B.C.**
$\delta C^{13} = +1.1‰$

Thick shells (*Saxicava arctica, Mya truncata*) from 100 m SW of road at Glimsås, 1.5 km SE of Ellös on Orust island (58° 10′ N Lat, 11° 29′ E Long). Ref. Björsjö (1949, p. 85). Stratigraphic sequence from bottom to top: basal till, sand, varved clay, clay with shells just above varved clay. Alt ca. 55 m. Coll. 1968 and subm. by Å. Hillefors. *Comments*: outermost 45% of shells removed by acid washing. (Å.H.): shells probably redeposited to some extent. Sample approx. dates deposition of clay with shells.

**Lu-263. Glimsås, Sample 2** **11,090 ± 125**
**9140 B.C.**
$\delta C^{13} = -0.8‰$

Shells (*Saxicava arctica, Mya truncata*) from same stratigraphic position as Lu-262. Coll. 1968 and subm. by Å. Hillefors. *Comment*: outermost 40% of shells removed by acid washing.

**Lu-270. Grimbo, *Balanus hameri*, i** **12,880 ± 125**
**10,930 B.C.**
$\delta C^{13} = -0.1‰$

Shells (*Balanus hameri*) from W of Lillhagen R.R. Sta., Grimbo, Hisingen (57° 45′ N Lat, 11° 57′ E Long). In natural position with plates together in varved clay, 25 to 35 varves above glaciofluvial sand, overlain by coarse glaciofluvial gravel. Alt 23 m. Ref. Hillefors (1966, p. 54; 1969, p. 271, 302-303). Coll. 1969 and subm. by Å. Hillefors. *Comments*: inner fraction (40% of shells) was used. Date based on 3 1-day counts.

(Å.H.): sample probably dates deposition of varved clay and time of deglaciation (after subtraction of ca. 400 yr for apparent age of living marine shells; cf. Lu-237, this date list).

**Lu-271. Grimbo, *Balanus hameri*, o** **12,960 ± 135**
**11,010 B.C.**
$\delta C^{13} = -0.4‰$

Outer fraction of shells used for Lu-270. *Comment*: outer fraction corresponds to 44% of shells; outermost 16% removed by acid washing.

**Lu-281. Bläsebo, *Balanus*** **12,880 ± 145**
**10,930 B.C.**
$\delta C^{13} = -1.9‰$

Shells (*Balanus balanus, Balanus crenatus*) (id. by G. Digerfeldt) from Bläsebo, Lärjedalen, 7 km NNE of Göteborg center (57° 46′ N Lat, 12° 02′ E Long). From varved clay with fragments of *Mytilus edulis* and *Saxicava arctica* underlain by glaciofluvial gravel. Alt ca. 24 m. Coll. 1955 and subm. by Å. Hillefors. *Comments*: outermost 20% of shells removed by acid washing. Sample undersized; diluted. (Å.H.): date earlier than expected (cf. Lu-270, this date list).
*General Comment*: corrections for deviations from normal $C^{13}/C^{12}$ ratio for terrestrial plants ($\delta C^{13} = -25.0‰$ in P.D.B. scale) are applied also for shell samples. No corrections are made for apparent age of shells of living marine molluscs (cf Lu-237, this date list and Lu-234 through Lu-236, Radiocarbon, 1969, v. 11, p. 441).

**Skillinge series**

Wood from Skillinge, E Scania (55° 29′ N Lat, 14° 17′ E Long). Coll. 1969 by W. Vortisch; subm. by T. Nilsson, Dept. Quaternary Geol., Univ. of Lund. Samples are connected with transgression deposits. HCl and NaOH pretreatment. All samples undersized; diluted.

**Lu-299. Skillinge 1** **6840 ± 140**
**4890 B.C.**
$\delta C^{13} = -26.5‰$

Driftwood from boulder stratum 1.2 m below surface, on building site No. 326, ca. 100 m NNE of Skillinge harbour. Alt ca. 3 m. Boulder stratum overlies clayey Baltic basal till; overlain by sand and gravel. *Comment*: date based on 3 1-day counts.

**Lu-300. Skillinge 2** **7080 ± 105**
**5130 B.C.**
$\delta C^{13} = -28.0‰$

Wood from tree roots *in situ* in Baltic basal till ca. 0.3 m below Lu-299.

**Lu-301. Skillinge 3** **3680 ± 80**
**1730 B.C.**
$\delta C^{13} = -30.3‰$

Wood from obliquely stratified sand, 0.6 m below surface on building site No. 258, ca. 400 m NNE of Skillinge harbour. Alt ca. 4.5 m.

*B. Spitsbergen*

**Lu-241. Adventdalen** **2650 ± 55**
**700 B.C.**
$\delta C^{13} = -23.4‰$

Wood from tree trunk (probably driftwood) partly hidden in minerogenic topsoil in summit area of 22 m pingo at Adventdalen, Spitsbergen (73° 13′ N Lat, 15° 52′ E Long). Foot of pingo is at alt ca. 5 m. Coll. 1968 and subm. by H. Svensson, Sci. Res. Council, Stockholm. HCl and NaOH pretreatment.

*C. Norway*

**Porsangerfjord series**

Peat from fossil tundra polygon furrows on raised glaciomarine delta adjacent to Lake Björvatn, 2 km S of Indre Brenna and 2 km from present coast at Porsangerfjord (70° 29′ N Lat, 25° 43′ E Long). Coll. 1968 by R. Langlo; subm. by H. Svensson. Dated as part of study of fossil polygonal ground in N Norway. HCl and NaOH pretreatment.

**Lu-258. Porsangerfjord I, peat** **3100 ± 60**
**1150 B.C.**
$\delta C^{13} = -27.1‰$

Peat from one of deepest furrows delineating polygons; taken just above stratification boundary between inorganic and organic material. Organic layer 29 cm thick in middle of furrow. Alt ca. 54 m.

**Lu-258A. Porsangerfjord I, humic acid** **2980 ± 60**
**1030 B.C.**
$\delta C^{13} = -27.1‰$

NaOH-soluble fraction from material used for Lu-258.

**Lu-259. Porsangerfjord IV, peat** **1590 ± 50**
**A.D. 360**
$\delta C^{13} = -26.9‰$

Peat from middle of polygon furrow, taken just above inorganic material. Peatlike organic layer 16 cm thick. Alt ca. 51 m. Porsangerfjord IV coll. ca. ½ km from Porsangerfjord I.

**Lu-259A. Porsangerfjord IV, humic acid** **1720 ± 55**
**A.D. 230**
$\delta C^{13} = -27.7‰$

NaOH-soluble fraction from material used for Lu-259.

**Altevatn series**

Peat from pals (*i.e.*, permafrost mound) situated 3 km SE of Politiodden, E Altevatn, N Norway (68° 29′ N Lat, 19° 48′ E Long). Alt 496 m. Coll. 1968 and subm. by R. Åhman, Dept. Phys. Geog., Univ. of Lund. Dated as part of study of permafrost forms in N Norway (cf. Radiocarbon, 1968, v. 10, p. 45-46). Depths given in sample descriptions are below upper surface of pals. HCl and NaOH pretreatment.

**Lu-283. Altevatn, Sample 1** — **1140 ± 70** / **A.D. 810**
$\delta C^{13} = -25.5‰$

Moderately humified peat, depth 10 cm. *Comment*: sample undersized; diluted.

**Lu-284. Altevatn, Sample 3** — **2500 ± 60** / **550 B.C.**
$\delta C^{13} = -25.9‰$

Highly humified peat, 70 to 75 cm.

**Lu-285. Altevatn, Sample 5** — **5110 ± 65** / **3160 B.C.**
$\delta C^{13} = -26.2‰$

Highly humified peat, 130 to 135 cm.

**Lu-286. Altevatn, Sample 7** — **6100 ± 110** / **4150 B.C.**
$\delta C^{13} = -25.9‰$

Highly humified peat, 190 to 195 cm. *Comment*: sample undersized; diluted.

**Lu-287. Altevatn, Sample 9, peat** — **7600 ± 155** / **5650 B.C.**
$\delta C^{13} = -26.7‰$

Highly humified peat, 250 to 255 cm; same level as bog surface. *Comment*: sample undersized; diluted.

**Lu-287A. Altevatn, Sample 9, humic acid** — **7090 ± 80** / **5240 B.C.**
$\delta C^{13} = -25.9‰$

NaOH-soluble fraction from material used for Lu-287.

**Lakselv series**

Peat from pals on bog Brennelvmyren, 3.5 km E of Lakselv airport, N Norway (70° 04′ N Lat, 25° 03′ E Long). Alt 24 m. Coll. 1968 and subm. by R. Åhman. HCl and NaOH pretreatment.

**Lu-288. Lakselv, Sample 2, peat** — **2930 ± 60** / **980 B.C.**
$\delta C^{13} = -28.0‰$

Highly humified peat, 0 to 3 cm above mineral substratum.

**Lu-288A. Lakselv, Sample 2, humic acid** — **3300 ± 60** / **1350 B.C.**
$\delta C^{13} = -27.3‰$

NaOH-soluble fraction from material used for Lu-288.

**Lu-289. Lakselv, Sample 4, peat** — **3380 ± 70** / **1430 B.C.**
$\delta C^{13} = -27.3‰$

Highly humified peat, 60 cm above mineral substratum. *Comment*: sample undersized; diluted.

**3270 ± 60**
**Lu-289A. Lakselv, Sample 4, humic acid** **1320 B.C.**
$\delta C^{13} = -27.6‰$

NaOH-soluble fraction from material used for Lu-289.

**2430 ± 60**
**Lu-290. Lakselv, Sample 6** **480 B.C.**
$\delta C^{13} = -26.2‰$

Moderately humified peat, 120 cm above mineral substratum.

**220 ± 50**
**Lu-291. Lakselv, Sample 8, peat** **A.D. 1730**
$\delta C^{13} = -24.6‰$

Slightly humified peat, 170 cm above mineral substratum and 15 cm below upper surface of pals.

**170 ± 50**
**Lu-291A. Lakselv, Sample 8, humic acid** **A.D. 1780**
$\delta C^{13} = -29.3‰$

NaOH-soluble fraction from material used for Lu-291.

**Varangerbotn series**

Peat samples from pals situated 1 km NW of road parting at Varangerbotn, N Norway (70° 11′ N Lat, 28° 32′ E Long). Ref. Åhman (1967). Coll. 1968 and subm. by R. Åhman. HCl and NaOH pretreatment.

**4900 ± 95**
**Lu-292. Varangerbotn, Sample 1, peat** **2950 B.C.**
$\delta C^{13} = -27.9‰$

Moderately humified peat from same level as water surface outside pals. No mineral substratum found at bottom of pals. *Comment*: sample undersized; diluted.

**5010 ± 70**
**Lu-292A. Varangerbotn, Sample 1, humic acid** **3060 B.C.**
$\delta C^{13} = -26.7‰$

NaOH-soluble fraction from material used for Lu-292.

**5110 ± 70**
**Lu-293. Varangerbotn, Sample 2, peat** **3160 B.C.**
$\delta C^{13} = -28.3‰$

Slightly humified peat taken 50 cm above Sample 1.

**4880 ± 65**
**Lu-293A. Varangerbotn, Sample 2, humic acid** **2930 B.C.**
$\delta C^{13} = -31.2‰$

NaOH-soluble fraction from material used for Lu-293.

**4370 ± 65**
**Lu-294. Varangerbotn, Sample 4** **2420 B.C.**
$\delta C^{13} = -26.5‰$

Slightly humified peat taken 110 cm above Sample 1.

**Lu-295. Varangerbotn, Sample 6** **3130 ± 60**
**1180 B.C.**
$\delta C^{13} = -26.2‰$

Slightly humified peat taken 170 cm above Sample 1 and 10 cm below upper surface of pals.

*D. England*

**Lu-297. Honeygore Track, Somerset Levels** **4760 ± 65**
**2810 B.C.**
$\delta C^{13} = -27.6‰$

Wood (*Betula* sp.) from prehistoric trackway in Somerset, England (51° 09′ N Lat, 2° 49′ W Long), built on Fen wood peat and later overwhelmed by development of ombrogenous peat (*Sphagnum* and *Eriophorum* peat). See Coles and Hibbert (1968). Coll. 1969 and subm. by F. A. Hibbert, Sub-Dept. Quaternary Research, Univ. of Cambridge. *Comment* (S.H.): dated to check operating condition of rebuilt dating equipment in Cambridge. Same wood dated in Cambridge as Q-909 (see index, this volume) gave 4773 ± 75 B.P. in good agreement with Lu-297. HCl and NaOH pretreatment.

**Lu-298. Abbot's Track, Somerset Levels** **3940 ± 65**
**1990 B.C.**
$\delta C^{13} = -25.3‰$

Wood from prehistoric trackway in Somerset, England (51° 09′ N Lat, 2° 49′ W Long), built on a surface of *Sphagnum-Calluna-Eriophorum* peat and embedded in peat of similar kind. See Dewar and Godwin (1963), Coles and Hibbert (1968). Coll. 1969 and subm. by F. A. Hibbert. *Comment* (S.H.): same wood dated in Cambridge as Q-926 (see index, this volume) gave 4018 ± 80 B.P. in good agreement with Lu-298.

## II. ARCHAEOLOGIC SAMPLES

*Sweden*

**Bare Mosse series**

Charcoal from Maglemose settlement at Bare Mosse, Halmstad parish, Scania (55° 57′ N Lat, 13° 05′ E Long). Stratigraphic sequence from bottom to top: washed till, 15 cm gyttja, 20 cm *Cladium* peat, ca. 2 cm thick culture stratum, 215 cm carr peat. Coll. 1968 and subm. by S. Welinder, Dept. Quaternary Geol., Univ. of Lund. HCl and NaOH pretreatment.

**Lu-230. Bare Mosse II** **8800 ± 100**
**6850 B.C.**
$\delta C^{13} = -23.2‰$

Charcoal from culture stratum 215 to 217 cm below present surface.

**Lu-231. Bare Mosse IV** **8970 ± 100**
**7020 B.C.**
$\delta C^{13} = -26.5‰$

Charcoal from gyttja layer 237 to 252 cm below present surface.

*General Comment* (S.W.): pollen-analytical age of settlement Bare Mosse IV is PB/BO1-BO1e(b) and Bare Mosse II BO1/BO2-BO2c. Compared to chronology of Nilsson (1964) greater age difference between the 2 samples was expected.

**530 ± 100**
**Lu-232. Smedjeryd 1[2], charcoal** **A.D. 1420**
$\delta C^{13} = -25.4‰$

Slag with charcoal from primitive iron melting furnace at Smedjeryd 1[2], Våxtorp parish, Halland (56° 21′ N Lat, 13° 14′ E Long). Coll. 1967 and subm. by S. Nöjd, Örkelljunga. *Comment*: HCl and NaOH pretreatment. For additional dates on similar samples from S Sweden, see: St-1696, 650 ± 65; St-1697, 740 ± 65 (Radiocarbon, 1967, v. 9, p. 427).

**130 ± 100**
**Lu-233. Smedjeryd 1[2], wood** **A.D. 1820**
$\delta C^{13} = -29.0‰$

Small twigs from air intake for same melting furnace as in Lu-232. Coll. 1967 and subm. by S. Nöjd.

**Hagestad series**

Bone and charcoal samples continued from Lund II (Radiocarbon, 1969, v. 11, p. 447-448) from excavations in Hagestad, Löderup parish, Scania. Coll. 1964 (Lu-274, Lu-275) and 1968; subm. by M. Strömberg, Hist. Mus., Univ. of Lund. HCl and NaOH pretreatment of charcoal samples. Bone samples were given following treatment: mechanical cleaning of bone surface, washing, crushing, sizing (0.3 to 2 mm), removal of all bone carbonate with cold 0.7N HCl under reduced pressure, washing, leaching of insoluble residue with cold 0.5N NaOH, repeated washing, acidification, and drying.

**4230 ± 65**
**Lu-254. Hagestad 14[4], Sample 2, Carlshögen** **2280 B.C.**
$\delta C^{13} = -19.5‰$

Collagen from human femur from pit under floor of passage grave Carlshögen (55° 24′ N Lat, 14° 08′ E Long).

**4230 ± 80**
**Lu-255. Hagestad 14[4], Sample 3, Carlshögen** **2280 B.C.**
$\delta C^{13} = -19.1‰$

Collagen from human femur from lower floor, Sec. D, in passage grave Carlshögen.

**4210 ± 65**
**Lu-277. Hagestad 14[4], Sample 9, Carlshögen** **2260 B.C.**
$\delta C^{13} = -17.6‰$

Collagen from human femur from lower stratum, Sec. B, in passage grave Carlshögen.

**3380 ± 60**

**Lu-282. Hagestad 14[4], Grave 3, Carlshögen** **1430 B.C.**

$\delta C^{13} = -18.8‰$

Collagen from human femur from upper floor, Grave 3, in passage grave Carlshögen. *Comment*: bone was treated with preservatives (zapon lacquer), removed by repeated leaching in acetone. Remaining acetone was removed by washing. To test efficiency of this purification, rest of bone used for Lu-227 (this date list) was given normal preservation treatment with zapon lacquer and 1 month later purified in same manner as Lu-282. Resulting age 4080 ± 80 (Lu-277, 4210 ± 65). Agreement is fairly good.

**4540 ± 90**

**Lu-257. Hagestad 8[2], Sample 5, Ramshög** **2590 B.C.**

$\delta C^{13} = -17.5‰$

Collagen from human femur from lower part of passage grave Ramshög (55° 24′ N Lat, 14° 10′ E Long).

**4330 ± 65**

**Lu-275. Hagestad 8[2], Sample 7, Ramshög** **2380 B.C.**

$\delta C^{13} = -18.2‰$

Collagen from human bones from Flint Deposit 4, S of passage grave Ramshög. *Comment*: bones were treated with zapon lacquer and purified in same manner as Lu-282 (this date list).

**4520 ± 65**

**Lu-276. Hagestad 8[2], Sample 8, Ramshög** **2570 B.C.**

$\delta C^{13} = -17.2‰$

Collagen from human femur from furrow close to wall stones in SE part of passage grave Ramshög.

**4480 ± 65**

**Lu-278. Hagestad 8[2], Sample 10, Ramshög** **2530 B.C.**

$\delta C^{13} = -18.8‰$

Collagen from bone fragments from (offering) pit under floor near entrance in passage grave Ramshög. *Comment*: sample was treated with zapon lacquer and purified in same manner as Lu-282 (this date list).

**2170 ± 55**

**Lu-253. Hagestad 6[2] A, Sample 1** **220 B.C.**

$\delta C^{13} = -20.1‰$

Collagen from bone of cattle from upper culture stratum in Trench 4:1968, on field S of brook at coast rd., Hagestad 6[2] A (55° 23′ N Lat, 14° 09′ E Long).

**2430 ± 55**

**Lu-256. Hagestad 98[1] A, Sample 4** **480 B.C.**

$\delta C^{13} = -21.7‰$

Charcoal from hearth, Trench 1:1968, Hagestad 98[1] A (55° 24′ N Lat, 14° 11′ E Long).

**Lu-274. Hagestad 2² B, Sample 6** **2890 ± 60**
**940 B.C.**
$\delta C^{13} = -24.3‰$

Charcoal from middle of Hearth 4, adjacent to megalithic grave at Hagestad 2² B (55° 25′ N Lat, 14° 08′ E Long). *Comment*: dated to check Lu-77, 2850 ± 100 (Radiocarbon, 1968, v. 10, p. 50) from same site. Date confirms earlier date.

*General Comment* (M.S.): generally, dates seem to agree with archaeologic dates except Lu-256 and Lu-274, which are considerably later than assoc. finds indicate.

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