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UNIVERSITY OF LUND RADIOCARBON DATES VIII

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INTRODUCTION

Most of the ^{14}C measurements reported here were made between October 1973 and October 1974. Equipment, measurement, and treatment of samples are the same as reported previously (R, 1968, v 10, p 36-37; 1970, v 12, p 534).

Age calculations are based on a contemporary value equal to 0.950 of the activity of NBS oxalic acid standard and on the conventional half-life for ^{14}C of 5568 yr. Results are reported in years before 1950 (years BP), and in the AD/BC system. Errors quoted ($\pm 1\sigma$) include standard deviations of count rates for the unknown sample, contemporary standard, and background. When measured activity is less than 2σ above background, minimum age is given. Basis for calculation of age limit is measured net activity plus 3σ. If net activity is negative, only $+3\sigma$ is used for age limit.

Corrections for deviations from $\delta^{13}C = -25.0‰$ in the PDB scale are applied for all samples; also for marine shells, because apparent age of recent marine shells is not always just counterbalanced by the effect of isotopic fractionation (*cf,* Recent marine shells series, R, 1973, v 15, p 506-507). $\delta^{13}C$ values quoted are relative to the PDB standard.

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. "% sample" indicates amount of CO_2 derived from the sample present in the diluted counting gas; the rest is "dead" CO_2. Organic carbon content reported for bone sample is calculated from yield of CO_2 by combustion of pretreated collagen. Organic carbon lost during treatment is not included in calculated percentage.

The description of each sample is based on information provided by the submitter.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Sweden

Tuorkanådas series

Peat from palsa, *ie,* permafrost mound, SE of Tuorkanådas, Torne Lappmark, N Sweden (68° 30′ N, 19° 00′ E). Coll 1972 by N Å Andersson; subm by M Sonesson, Dept Plant Ecol, Univ Lund. Dating

is part of study on peat development in Torneträsk area (Sonesson, 1968, 1974).

Lu-833. Tuorkanådas, 14 to 15cm **9310 ± 180** **7360 BC**
$\delta^{13}C = -24.2‰$

Peat from 0 to 1cm above mineral substratum. *Comment*: mild pretreatment with HCl and NaOH; small sample; diluted; 43% sample.

Lu-832. Tuorkanådas, 13 to 14cm, peat **8960 ± 140** **7010 BC**
$\delta^{13}C = -23.6‰$

Peat from 1 to 2 cm above mineral substratum. *Comment*: normal pretreatment with HCl and NaOH; diluted; 55% sample.

Lu-832A. Tuorkanådas, 13 to 14cm, humic acid **8890 ± 90** **6940 BC**
$\delta^{13}C = -24.8‰$

Acid-precipitated part of NaOH-soluble fraction from Lu-832. *Comment*: diluted; 72% sample (3 1-day counts.) Agreement between fractions indicates contamination is absent or insignificant.

Södra Bergundasjön series

Sediment from Lake Södra Bergundasjön at town of Växjö, Central Småland (56° 51′ N, 13° 47′ E). Coll 1972 and subm by L Bengtsson, Dept Limnol, Univ Lund. Dated to determine rate of sediment deposition. Depths refer to sediment surface. Mild pretreatment with HCl and NaOH.

Lu-860. Södra Bergundasjön, 55 to 60cm **660 ± 55** **AD 1290**
$\delta^{13}C = -25.1‰$

Detritus gyttja. *Comment*: undersized; diluted; 87% sample.

Lu-861. Södra Bergundasjön, 120 to 125cm **620 ± 50** **AD 1330**
$\delta^{13}C = -25.1‰$

Detritus gyttja.

Trummen series

Sediment from Lake Trummen, Central Småland (56° 52′ N, 14° 50′ E). Coll 1974 and subm by G Digerfeldt, Dept Quat Geol, Univ Lund. Dates were part of study of Late glacial development of lake and surrounding landscape. Other dates in series were reported previously (R, 1968, v 10, p 40-43; 1969, v 11, p 434; 1970, v 12, p 535-536). Major results of Postglacial studies are pub by submitter (Digerfeldt, 1972). Depths refer to water surface. Water depth ca 1.7m. Sample Lu-944 consists of clayey gyttja; all other samples are clay gyttja. Pretreated with HCl. All samples except Lu-944 were undersized and therefore diluted. Amount of CO_2 from sample is given in *Comments* below as "% sample".

Lu-936. Trummen, 664 to 666cm — **11,670 ± 130** / **9720 BC** / $\delta^{13}C = -20.5‰$

Comment: 65% sample. (3 1-day counts.)

Lu-937. Trummen, 648 to 652cm — **12,330 ± 165** / **10,380 BC** / $\delta^{13}C = -19.0‰$

Comment: 53% sample. (3 1-day counts.)

Lu-938. Trummen, 636 to 640cm — **12,030 ± 135** / **10,080 BC** / $\delta^{13}C = -19.7‰$

Comment: 64% sample. (4 1-day counts.)

Lu-939. Trummen, 622 to 626cm — **11,820 ± 160** / **9870 BC** / $\delta^{13}C = -18.5‰$

Comment: 63% sample.

Lu-940. Trummen, 608 to 612cm — **11,390 ± 155** / **9440 BC** / $\delta^{13}C = -18.5‰$

Comment: 64% sample.

Lu-941. Trummen, 594 to 598cm — **10,990 ± 145** / **9040 BC** / $\delta^{13}C = -20.0‰$

Comment: 70% sample.

Lu-942. Trummen, 580 to 584cm — **10,670 ± 115** / **8720 BC** / $\delta^{13}C = -22.3‰$

Comment: 91% sample.

Lu-943. Trummen, 566 to 570cm — **10,300 ± 110** / **8350 BC** / $\delta^{13}C = -21.4‰$

Comment: 89% sample.

Lu-944. Trummen, 552 to 556cm — **10,120 ± 100** / **8170 BC** / $\delta^{13}C = -21.5‰$

Lu-989. Trummen, Complementary Sample 1 — **11,180 ± 145** / **9230 BC** / $\delta^{13}C = -21.8‰$

Comment: 55% sample. (3 1-day counts.)

Lu-990. Trummen, Complementary Sample 2 — **12,280 ± 185** / **10,330 BC** / $\delta^{13}C = -21.5‰$

Comment: 42% sample. (3 1-day counts.)

Lu-962. Barsebäcksmossen, 902.5 to 907.5cm — **6700 ± 75** / **4750 BC** / $\delta^{13}C = -22.0‰$

Brackish clayey gyttja from early part of AT 2. Coll 1969 and subm by G Digerfeldt. Main series from this site was pub previously (R, 1973, v 15, p 496-499). *Comment*: pretreated with HCl.

Järlasjön series

Sediment from Lake Järlasjön at Nacka, Stockholm (59° 18° N, 18° 06′ E). Coll 1972 and subm by G Digerfeldt. Dated as part of study on laminated sediments. Samples consist of clay gyttja. Pretreated with HCl.

Lu-905. Järlasjön 1 — **940 ± 65** / **AD 1010** / $\delta^{13}C = -28.0‰$

Comment: undersized; diluted; 56% sample.

Lu-906. Järlasjön 2 — **1360 ± 60** / **AD 590** / $\delta^{13}C = -27.4‰$

Comment: undersized; diluted; 69% sample.

Hinnasjön series

Sediment from Lake Hinnasjön, ca 7km E of town of Växjö, Central S Sweden (56° 53′ N, 14° 56′ E). Coll 1973 by Th Persson; subm by G Digerfeldt. Dated with study of Late Postglacial vegetational history of surrounding landscape. Dates also used to determine rate of sediment deposition to calculate absolute pollen frequency per cm^2 per year. Pollen analyses by Th Persson. Depths refer to sediment surface. Water depth at sampling point, 2.7m. All samples consist of fine detritus gyttja, and were pretreated with HCl and NaOH. Seven samples undersized; diluted. Amount of CO_2 from sample is given in *Comments* below as "% sample".

Lu-960. Hinnasjön, 311 to 316cm — **3590 ± 65** / **1640 BC** / $\delta^{13}C = -29.2‰$

Comment: 80% sample.

Lu-961. Hinnasjön, 241 to 246cm — **2700 ± 55** / **750 BC** / $\delta^{13}C = -29.8‰$

Decrease of *Quercus, Ulmus,* and *Corylus.*

Lu-959. Hinnasjön, 179 to 184cm — **2190 ± 70** / **240 BC** / $\delta^{13}C = -30.1‰$

Distinct increase of *Fagus. Comment*: 68% sample.

Lu-921. Hinnasjön, 144 to 149cm — **1950 ± 50** / **AD/BC 0** / $\delta^{13}C = -29.7‰$

Lu-920. Hinnasjön, 114 to 119cm — **1790 ± 55** / **AD 160** / $\delta^{13}C = -29.3‰$

Beginning of last maximum of *Quercus;* just below maximum of *Carpinus; Fagus* reaches 1%. *Comment*: 87% sample.

Lu-958. Hinnasjön, 90 to 92.5cm — **1400 ± 65** / **AD 550** / $\delta^{13}C = -29.8‰$

Decrease of *Alnus* and *Carpinus. Comment*: 60% sample.

Lu-864. Hinnasjön, 50 to 52.5cm — **1080 ± 60** / **AD 870** / $\delta^{13}C = -30.0‰$

Decrease of *Betula; Juniperus* reaches 1%. *Comment*: 69% sample.

Lu-863. Hinnasjön, 35 to 37.5cm — **930 ± 65** / **AD 1020** / $\delta^{13}C = -30.0‰$

Rational *Picea* limit. *Comment*: 59% sample.

Lu-862. Hinnasjön, 12.5 to 15cm — **600 ± 65** / **AD 1350** / $\delta^{13}C = -28.9‰$

Culmination of *Fagus*; further increase of *Picea* and *Juniperus. Comment*: 61% sample.

Härryda series

Wood from 2 exposures at Härryda, SW Sweden. Coll 1973 and subm by A Hilldén, Dept Quaternary Geol, Univ Lund. Dating is part of study on hydrology in area.

Lu-889. Härryda, Sample 1 — **3920 ± 60** / **1970 BC** / $\delta^{13}C = -27.0‰$

Wood fragments (*Alnus* sp) id by T Bartholin from light clay below 1.5m coarse river gravel at Hwy 40 bridge over Tvärån, Härryda (57° 41′ 33″ N, 12° 19′ 43″ E). *Comment*: pretreated with HCl.

Lu-888. Härryda, Sample 2 — **2260 ± 55** / **310 BC** / $\delta^{13}C = -28.3‰$

Wood from stump (*Alnus* sp) id by T Bartholin from light clay below 1.0m of coarse river gravel in new brook furrow, 350m ESE of Härryda church (57° 41′ 27″ N, 12° 19′ 00″ E). *Comment*: pretreated with HCl and NaOH.

Tomtabacken series

Åkerhultagöl is a mire pool, 1km SW of Tomtabacken, highest hill of South Swedish Upland (57° 29′ N, 14° 28′ E). Alt of pool: +303m; size: ca 300x100m. Samples are from core taken from mire surface in

SW part with Livingstone sampler (100mm diam). This is a Late Weichselian standard profile within a project on S Swedish paleoecology. It is part of study on deglaciation of this upland. Coll 1973 and subm by B E Berglund, Dept Quaternary Geol, Univ Lund. Depths refer to surface of mire. Pollen zones according to Nilsson (1961) and Berglund (1966). Some samples were undersized and therefore diluted. Amount of CO_2 from sample is given in *Comments* below as "% sample". All samples pretreated with HCl.

Lu-893. Tomtabacken 1, 519 to 522cm **12,610 ± 190 / 10,660 BC**

$\delta^{13}C = -21.4‰$

Muddy, silty clay. *Comment*: 0.18% carbonate content in sediment from 530 to 535cm. 47% sample. (3 1-day counts.)

Lu-894. Tomtabacken 2, 517 to 519cm **12,450 ± 130 / 10,500 BC**

$\delta^{13}C = -22.6‰$

Clay gyttja. Sample 1 and 2 should date *Betula* rise in pollen diagram. *Comment*: 74% sample. (3 1-day counts.)

Lu-895. Tomtabacken 3, 509 to 512cm **11,480 ± 115 / 9530 BC**

$\delta^{13}C = -23.2‰$

Clay gyttja. Upper part of *Betula* zone. *Comment*: no detectable carbonate in sample.

Lu-896. Tomtabacken 4, 506 to 509cm **11,150 ± 110 / 9200 BC**

$\delta^{13}C = -24.1‰$

Clay gyttja. Lower part of DR 3.

Lu-897. Tomtabacken 5, 491 to 493cm **10,440 ± 110 / 8490 BC**

$\delta^{13}C = -22.3‰$

Clay gyttja. Upper part of DR 3. *Comment*: 85% sample.

Lu-898. Tomtabacken 6, 489 to 491cm **10,920 ± 150 / 8970 BC**

$\delta^{13}C = -23.8‰$

Clay gyttja. Lower part of DR 3-PB. *Comments*: 52% sample. (3 1-day counts.) (BEB): for some reason this date deviates from the continuous chronologic order.

Lu-899. Tomtabacken 7, 486 to 487cm **10,150 ± 115 / 8200 BC**

$\delta^{13}C = -23.5‰$

Clay gyttja. Uppermost part of DR 3-PB. *Comment*: 82% sample.

Lu-900. Tomtabacken 8, 479 to 480cm — **9860 ± 85**, **7910 BC**, $\delta^{13}C = -27.3‰$

Clayey gyttja. Middle of PB. *Comment*: 92% sample. (3 1-day counts.)

Lu-901. Tomtabacken 9, 474 to 475cm — **9530 ± 95**, **7580 BC**, $\delta^{13}C = -27.7‰$

Clayey gyttja. Uppermost part of PB.

Lu-902. Tomtabacken 10, 468 to 469cm — **9120 ± 95**, **7170 BC**, $\delta^{13}C = -30.6‰$

Clayey gyttja. Middle of BO 1.

Lu-903. Tomtabacken 11, 462 to 463cm — **8470 ± 95**, **6520 BC**, $\delta^{13}C = -31.0‰$

Fine detritus gyttja. Lowermost part of BO 2. *Comment*: 93% sample.

Lu-904. Tomtabacken 12, 440 to 441cm — **7640 ± 80**, **5690 BC**, $\delta^{13}C = -30.3‰$

Fine detritus gyttja. Lower part of AT 1.

Lake Ämmern series

Sediment from Lake Ämmern, 600m NE of Tjärstad church, Östergötland (58° 07′ 30″ N, 15° 43′ 30″ E). Alt of lake: +86.1m. Coll 1972 and subm by H Göransson, Dept Quat Geol, Univ Lund. Lu-924 and -925 taken with 30mm and the rest with 60mm Livingstone core sampler. All samples consist of fine detritus gyttja. Depths are below sediment-water interface. Water depth at sampling point, 423cm. Samples represent characteristic levels in pollen diagram. Pollen analyses by submitter. Dating is part of study on vegetational development and human influence in area. See also Lake Striern and Lake Vån series (R, 1970, v 12, p 541-543; 1974, v 16, p 315-316, and below). All samples pretreated with HCl.

Lu-924. Ämmern, 369 to 379cm — **6140 ± 70**, **4190 BC**, $\delta^{13}C = -28.5‰$

Immediately below *Ulmus* decline and at *Tilia* decline; 1st find of *Triticum*.

Lu-925. Ämmern, 339 to 349cm — **5870 ± 70**, **3920 BC**, $\delta^{13}C = -28.5‰$

Low *Ulmus* and *Tilia* values after decline.

Lu-926. Ämmern, 314 to 318cm — **5760 ± 70**, **3810 BC**, $\delta^{13}C = -27.3‰$

Ulmus and *Tilia* increasing; decline of *Populus* and *Pteridium.*

Lu-927. Ämmern, 256 to 260cm — **5230 ± 70**, **3280 BC**, $\delta^{13}C = -27.9‰$

Second decline of *Ulmus.*

Lu-928. Ämmern, 210 to 214cm — **4840 ± 65**, **2890 BC**, $\delta^{13}C = -28.2‰$

Further decline of *Ulmus;* rising *Pteridium.*

Lu-929. Ämmern, 155 to 160cm — **3980 ± 60**, **2030 BC**, $\delta^{13}C = -28.2‰$

Falling *Quercetum Mixtum.* Increase of apophytes and anthropochors.

Lu-956. Ämmern, 97.5 to 102.5cm — **3140 ± 55**, **1190 BC**, $\delta^{13}C = -27.5‰$

Empiric *Picea* limit. *Juniperus* strongly rising.

Lu-957. Ämmern, 85 to 90cm — **2740 ± 55**, **790 BC**, $\delta^{13}C = -27.3‰$

Picea ca 6%; *Juniperus* 3 to 4%.

General Comment (HG): in Lake Ämmern, *Ulmus* declines at same age as in Lake Vån (*cf* R, 1974, v 16, p 316-317). $CaCO_3$ content in the till is very low around Lake Vån, but distinctly higher near Lake Ämmern (*cf* Gillberg, 1965, p 455). Sedimentation rate is very low in uppermost part of Ämmern profile and there is perhaps some hidden hiatus. Lake Ämmern was lowered ca 3m 100 yr ago.

Lake Striern Series II

Sediment from Lake Striern, ca 850m E of Hägerstad old church, Östergötland (58° 05′ N, 15° 47′ E). Alt of lake: +87.3m. Coll 1972 and subm by H Göransson. Taken with 60mm Livingstone core sampler. All samples consist of fine detritus gyttja. Depths are below sediment-water interface. Water depth at sampling point, 63cm. Dated as complement to Lake Striern and Lake Vån series (R, 1970, v 12, p 541-543; 1974, v 16, p 315-316). All samples pretreated with HCl.

Lu-951. Striern II, 430 to 435cm — **7610 ± 80**, **5660 BC**, $\delta^{13}C = -30.4‰$

Empiric *Quercus* limit.

Lu-952. Striern II, 420 to 425cm — **7090 ± 80** / **5140 BC** / $\delta^{13}C = -30.2‰$

Empiric *Tilia* limit.

Lu-953. Striern II, 415 to 420cm — **6790 ± 75** / **4840 BC** / $\delta^{13}C = -30.1‰$

Rational *Tilia* limit.

Lu-954. Striern II, 380 to 385cm — **6050 ± 70** / **4100 BC** / $\delta^{13}C = -25.2‰$

Optimum of "Older Lime Period" (*sensu* Iversen, 1973, p 62).

Lu-955. Striern II, 340 to 345cm — **5620 ± 70** / **3670 BC** / $\delta^{13}C = -24.9‰$

Immediately below *Ulmus* decline; immediately above *Tilia* decline; strong rise of *Populus.*

Lu-950. Striern II, 320 to 325cm — **5250 ± 65** / **3300 BC** / $\delta^{13}C = -23.0‰$

Low values of *Ulmus* and *Tilia* after decline; high values of *Populus, Pteridium,* and *Rumex acetocella;* continuous curve for *Plantago lanceolata* (since 325cm); find of *Triticum.*

General Comment (HG): real radiocarbon age for *Ulmus* decline in Striern I (R, 1970, v 12, p 542) and Striern II seem exactly the same, considering dated sample in Striern I was from above and in Striern II below decline.

Lu-949. Striern I, 10 to 20cm — **500 ± 80** / **AD 1450** / $\delta^{13}C = -25.3‰$

Fine detritus gyttja, Sample 102+103, with high values of *Myriophyllum spicatum* and *M alterniflorum,* from Lake Striern, 900m NE of Hägerstad new church, Östergötland (58° 05′ N, 15° 47′ E). Coll 1966 and subm by H Göransson. Complement to Lake Striern series (R, 1970, v 12, p 541-543). Pretreated with HCl. Undersized; diluted; 39% sample. *Comment* (HG): because lake was lowered 100 yr ago, ^{14}C ages of uppermost part of Striern I core are wrong. Thus, it is not possible to determine a value for "hard water error" by extending the ^{14}C curve to the sediment surface. Also, ^{14}C values in lowered lakes in Southern Swedish Highlands without $CaCO_3$ in surroundings are too high (see, eg, Lu-862, Hinnasjön series, above).

Lu-945. Bönnarp — **11,490 ± 105** / **9540 BC** / $\delta^{13}C = -19.1‰$

Collagen from metatarsus (*Megaceros giganteus*) from small ancient

lake at Bönnarp, SE of Malmö (55° 32′ N, 13° 07′ E). Coll 1972 by Limhamn Mus; subm by R Liljegren, Dept Quaternary Geol, Univ Lund. *Comments*: collagen extracted as described previously (R, 1970, v 12, p 534). Organic carbon content: 4.2%. (RL): pollen study not possible, but result agrees well with date for antler of *Megaceros giganteus* from Hindby (Lu-824: 11,330 ± 110, R, 1974, v 16, p 317).

Bäckebol series, marine shells

Marine shells from E of pt 82, Bäckebol, Hisingen, SW Sweden (57° 46′ N, 11° 59′ 08″ E). Coll 1961 and subm by Å Hillefors, Dept Phys Geog, Univ Lund. Dated as part of study of chronology for terminal moraine lines at Swedish W coast.

Lu-876:2. Bäckebol, *Mytilus*, inner fraction **12,950 ± 125**
11,000 BC
$\delta^{13}C = -0.8‰$

Shells (*Mytilus edulis*) from sandy shell accumulation enclosed in till (*cf* Hillefors, 1969, p 154, 156: fig 139a). *Comment*: inner fraction (35% of shells) was used.

Lu-876:1. Bäckebol, *Mytilus*, outer fraction **12,780 ± 125**
10,830 BC
$\delta^{13}C = -0.8‰$

Outer fraction of shells used for Lu-876:2. *Comment*: outer fraction was 39% of shells; outermost 26% removed by acid leaching.

Lu-877. Bäckebol, *Hiatella* **12,580 ± 125**
10,630 BC
$\delta^{13}C = +1.2‰$

Shells (*Hiatella* [*Saxicava*] *arctica*) from wave-washed gravel overlying upper till boundary. *Comment*: outer 53% of shells removed by acid leaching.

General Comment: other pertinent dates are Lu-270: 12,880 ± 125; Lu-271: 12,960 ±135; Lu-281: 12,880 ± 145; Lu-507: 12,890 ± 130 (R, 1970, v 12, p 544-545; 1972, v 14, p 386). Corrections for deviations from $\delta^{13}C = -25.0‰$ in PDB scale are applied also for shell samples. No corrections are made for apparent age of shells of living marine mollusks. For apparent age, see Recent marine shells series below, and R, 1969, v 11, p 441; 1970, v 12, p 543.

Recent marine shells series

Lu-593. Slussen, Orust, Sample 1 **Apparent age: 420 ± 45**
$\delta^{13}C = -0.4‰$

Recent shells (*Nassa reticulata*) from seashore at Slussen, Orust, Bohuslän (58° 15′ 07″ N, 11° 45′ 05″ E). Coll 1942 by G Hillefors; subm by Å Hillefors.

Lu-594. Slussen, Orust, Sample 2 Apparent age: 380 ± 48
$\delta^{13}C = +0.8‰$

Recent shells (*Cardium edule, Nassa reticulata, Littorina obtusata,* and *Mytilus edulis*) from same collection as Lu-593.

Lu-878. Skagen, Jutland, Sample 1 Apparent age: 375 ± 44
$\delta^{13}C = +0.2‰$

Recent shells (*Mya arenaria*) from seashore between Skagen and Grenen, Jutland, N Denmark (57° 44′ N, 10° 37′ 40″ E). Coll 1937 by G Hillefors; subm by Å Hillefors. *Comment*: outer 25% removed by acid leaching.

General Comment: corrections are applied for deviations from $\delta^{13}C = -25.0‰$ in PDB scale and activity measurements are age-corrected between collection date and 1950.

Tertiary shell series

Tertiary shell fragments from exposure at mouth of Hallbjarnarstadaá, Tjörnes, Iceland (66° 11′ N, 17° 11′ W). Coll 1971 by I U Olsson, Inst Phys, Univ Uppsala, to test whether fossil shells remain uncontaminated by ^{14}C under favorable environmental conditions.

Lu-591. Hallbjarnarstadaá, inner fraction >43,400
$\delta^{13}C = +0.8‰$

Unid. Tertiary shell fragments. *Comment*: inner fraction (42% of shells) was used. (5 1-day counts.)

Lu-590. Hallbjarnarstadaá, outer fraction >43,600
$\delta^{13}C = +0.5‰$

Outer fraction of shells used for Lu-591. *Comment*: outer fraction was 38% of shells; outermost 20% removed by acid leaching. (5 1-day counts.)

General Comment: shells had no detectable contamination. Measured activity was almost exactly zero for both fractions. Three σ were used for calculation of minimum age.

B. Greenland

East Greenland series (IV)

Marine shells from emerged sediments, and terrestrial peat, from different parts of central E and NE Greenland (mainly from Hudson Land and Hold With Hope). Sample Lu-930 coll 1907 by *Danmark* Expedition; all others coll 1970 to 1973 by C Hjort, Dept Quaternary Geol, Univ Lund, who subm all samples as part of study of glaciation chronology and shoreline displacement in E Greenland. For other dates from area, see R, 1972, v 14, p 388-390; 1973, v 15, p 504-507; 1974, v 16, p 319-322. For apparent age of recent shells in area, see R, 1973, v 15, p 506-507 and Hjort (1973).

Lu-866. Forsblads Fjord, Sample 1 **7140 ± 75**
5190 BC
$\delta^{13}C = +0.7‰$

Shells (*Mya truncata, Hiatella arctica*) from silty sand at +21m, inner Forsblads Fjord (72° 24′ N, 26° 14′ W). Sediment also contained *Mytilus edulis* (Hjort & Funder, 1974). *Comment*: outer 62% of shells removed by acid leaching.

Lu-867. Loch Fyne, Sample 1 **6500 ± 75**
4550 BC
$\delta^{13}C = +0.1‰$

Shells (*Mytilus edulis*) from coastal cliff on W side of Loch Fyne (73° 40′ N, 21° 50′ W). Antedates shoreline at +7m to +8m (*cf* Hjort & Funder, 1974). *Comment*: outer 50% of shells removed by acid leaching.

Lu-868. Ankerbjaergelv **6460 ± 70**
4510 BC
$\delta^{13}C = -0.9‰$

Shells (*Mya truncata, Macoma calcarea, Clinocardium ciliatum*) from fine sand overlain by beach gravel at Ankerbjaergelv delta in Moskusoxefjord (73° 37′ N, 22° 21′ W). Coll at +2m and dates or closely antedates shore level at +6m. Also contained fragments of *Mytilus edulis (cf* Hjort & Funder, 1974). *Comment*: outer 44% of shells removed by acid leaching.

Lu-869. Knudshoved, Sample 1 **42,500 $^{+3600}_{-2500}$**
40,550 BC
$\delta^{13}C = +0.5‰$

Shell fragments (*Mya truncata, Hiatella arctica*) from silt at +50m on basalt hill with glacial striae at Knudshoved, Hold With Hope (73° 44′ N, 20° 32′ W). Probably postdates glaciation reaching outer coast and shelf (Kap Mackenzie Stadial; Funder & Hjort, 1973). *Comment*: outer 25% of shells removed by acid leaching. (4 1-day counts.)

Lu-882. Glommen **10,720 ± 150**
8770 BC
$\delta^{13}C = -4.1‰$

Shells (*Hiatella arctica*) from sandy silt at +45m along R Glommen, Hold With Hope (73° 33′ N, 20° 45′ W). Clearly antedates sea level at +50m. Same sediment reaches ca +60m, with no shells much above sample layer. *Comment*: outer 21% of shells removed by acid leaching. Undersized; diluted; 50% sample. (3 1-day counts.)

Lu-883. Stordalen **9220 ± 90**
7270 BC
$\delta^{13}C = +1.2‰$

Shells (*Mya truncata, Hiatella arctica*) from silt at +35m, at mouth of Stordalen, Hudson Land (73° 40′ N, 22° 00′ W). Age is minimum for

moraine system equivalent to shore level at +70m. Probably dates ice-contact delta rather closely at +60m. *Comment*: outer 16% of shells removed by acid leaching.

Lu-884. Myggbukta **6520 ± 70**
4570 BC
$\delta^{13}C = +0.6‰$

Shells (*Mya truncata, Tridonta* [*Astarte*] *borealis, Nicania* [*Astarte*] *montagui*) from fine sand at ca +6m, overlain by seaweed, organic detritus, and eolian sand at Myggbukta (73° 29′ N, 21° 37′ W). Probably closely dates distinct shore level at +7m. *Comment*: outer 21% of shells removed by acid leaching.

Lu-885. Tobias Dal **9540 ± 90**
7590 BC
$\delta^{13}C = +0.3‰$

Shells (*Mya truncata, Hiatella arctica*) from silty fine sand at +20m in Tobias Dal, Hold With Hope (73° 44′ N, 20° 45′ W). Sediment reaches +30m, the highest for shell-bearing known in this valley. *Comment*: outer 62% of shells removed by acid leaching.

Lu-886. Loch Fyne, Sample 2 **9290 ± 90**
7340 BC
$\delta^{13}C = +0.8‰$

Shells (*Mya truncata*) from fine sand at +35 to 40m on W side of Loch Fyne (73° 41′ N, 21° 50′ W). Equivalent to shore level at or above +52m. *Comment*: outer 63% of shells removed by acid leaching.

Lu-930. Store Koldewey **>40,400**
$\delta^{13}C = -0.7‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea, Clinocardium ciliatum, Serripes groenlandica, Tridonta borealis, Natica* sp, *Nucula* sp, *Portlandia arctica*) from clay on bedrock at +120m on S part of Store Koldewey Ö (76° 10′ N, 18° 35′ W). Coll during *Danmark* Expedition, 1907; described by Jensen (1917). Date is linked with age of glaciation reaching outer coast and shelf (*cf* Kap Mackenzie Stadial; Funder & Hjort, 1973). Alt compares with that of Lu-532 (R, 1973, v 15, p 504). Sample also contained *Cyrtodaria kurriana* (*cf* Símonarson, 1974, p 68). *Comment*: outer 10% of shells removed by acid leaching. Sample undersized; diluted; 78% sample. (3 1-day counts.)

Lu-972. Knudshoved, Sample 2 **2090 ± 60**
140 BC
$\delta^{13}C = -26.5‰$

Terrestrial sandy peat from river cutting at +35m, Knudshoved, Hold With Hope (73° 43′ N, 20° 34′ W). Coll at top of permafrost, into which these sediments continue; overlain by 2m alternating layers of same kind of peat and eolian sand. *Comment*: pretreated with HCl and NaOH. Diluted; 81% sample.

General Comment: corrections for deviations from $\delta^{13}C = -25.0‰$ in

PDB scale are applied also for shell samples. No corrections are made for apparent age of shells of living marine mollusks.

C. Spitsbergen

Nottinghambukta series

Marine shells and plant remains from cliff shore of Kvartsittsletta in Nottinghambukta near Werenskiold Glacier, N of Hornsund, S part of Vest-Spitsbergen (77° 04′ 20″ N, 15° 10′ E). Coll 1972 by J Szupryczyński and A Olszewski; subm by J Szupryczyński, Inst Geog, Polish Acad Sci, Toruń, Poland. Mollusks id by I Dmoch, N Copernicus Univ, Toruń. Depths refer to surface of "5 to 4m marine terrace". Results of studies from Hornsund area pub by Birkenmajer and Olsson (1971).

Lu-847. Nottinghambukta N-1, 0.5 to 1.2m **7290 ± 75 / 5340 BC**

$\delta^{13}C = +1.3‰$

Shells (*Tridonta* [*Astarte*] *borealis*) from gray and brown marine gravel and sand. Fauna in interval 0.5 to 1.2m also contained *Mytilus edulis*. *Comment*: outer 70% of shells removed by acid leaching.

Lu-848. Nottinghambukta N-2, 1.2 to 1.8m **7310 ± 75 / 5360 BC**

$\delta^{13}C = -0.1‰$

Shells (*Mytilus edulis*) from gray marine sand and gravel. Fauna in this interval also contained *Tridonta (Astarte) borealis*. *Comment*: outer 63% of shells removed by acid leaching.

Lu-849. Nottinghambukta N-3:1, 1.7 to 2:2m **7300 ± 75 / 5350 BC**

$\delta^{13}C = +0.4‰$

Shells (*Mytilus edulis*) from gray marine sand. *Comment*: outer 65% of shells removed by acid leaching.

Lu-850. Nottinghambukta N-3:2, 1.7 to 2.2m **7490 ± 75 / 5540 BC**

$\delta^{13}C = +1.6‰$

Shells (*Tridonta* [*Astarte*] *borealis*) from same deposits as Lu-849. *Comment*: outer 65% of shells removed by acid leaching.

Lu-812. Nottinghambukta N-4:1, 2.2 to 3.5m **7580 ± 75 / 5630 BC**

$\delta^{13}C = -1.1‰$

Shells (*Mytilus edulis*) from gray marine very fine sand. Fauna in this interval also included *Hiatella (Saxicava) arctica, Tridonta (Astarte) borealis, Mya truncata, Littorina littorea,* and unid. barnacles. *Comment*: outer 67% of shells removed by acid leaching.

Lu-813. Nottinghambukta N-4:2, 2.2 to 3.5m **7430 ± 75 / 5480 BC**

$\delta^{13}C = +0.1‰$

Barnacle shells from same deposits as Lu-812. *Comment*: outer 60% of shells removed by acid leaching.

Lu-851. Nottinghambukta N-4:3, 2.3 to 2.4m **7400 ± 80**
5450 BC
$\delta^{13}C = -20.0‰$

Remains of unid. littoral plants from top part of interval N-4. *Comment*: pretreated with HCl and NaOH.

General Comment: corrections for deviations from $\delta^{13}C = -25.0‰$ in PDB scale are applied also for shell samples. No corrections are made for apparent age of shells of living marine mollusks.

D. Poland

Lu-852. Grudziadz-Mniszek **>40,200**
$\delta^{13}C = -27.2‰$

Highly humified organic matter from boring at Grudziądz-Mniszek, lower Vistula valley, N Poland (53° 26′ N, 18° 44′ E). Sample from middle part of upper organic layer, ca 10 to 12m below surface of Vistula Terrace II, overlain by sand and alluvium (Drozdowski and Tobolski, 1972, p 77; p 88, fig 3). Coll 1969 and subm by E Drozdowski, Inst Geog, Polish Acad Sci, Toruń, Poland. *Comment*: normal pretreatment with HCl but only short treatment with NaOH at room temperature due to high humification.

Lu-852A. Grudziadz-Mniszek, humic acid **>39,600**
$\delta^{13}C = -25.7‰$

Acid-precipitated part of NaOH-soluble fraction from Lu-852.

E. Scotland

Lu-916. Rannoch Moor **5850 ± 70**
3900 BC
$\delta^{13}C = -24.9‰$

Wood from pine stump 30cm over base of rather humified peat layer (110cm deep) of gently sloping valley bog in W part of Rannoch Moor, 10km N of Loch Tulla, Argyll, Scotland (56° 39′ N, 4° 48′ W). Coll 1973 and subm by N Malmer, Dept Plant Ecol, Univ Lund. Sample was part of distinct stump horizon without contact with underlying mineral substratum of gravel. *Comment* (NM): stump horizon dates last time for formation of peat in this area. *Cf* previous dates for similar samples from Ireland (R, 1974, v 16, p 322-323). Pretreated with HCl and NaOH.

II. ARCHAEOLOGIC SAMPLES

Sweden

Dalkarlstorp series

Charcoal and soot from Stone age settlement at Dalkarlstorp, Kila parish, Västmanland (59° 50′ N, 16° 30′ 30″ E). Coll 1972 and 1973 and subm by S Welinder, Hist Mus, Univ Lund. Preliminary report pub by submitter (Welinder, 1973). All samples pretreated with HCl or H_2SO_4 (Lu-776, -776:S2) and NaOH.

Lu-748. Dalkarlstorp 1 **4080 ± 60**
2130 BC
$\delta^{13}C = -24.8‰$

Charcoal from Hearth-pit 492/9.

Lu-749. Dalkarlstorp 2 **1670 ± 50**
AD 280
$\delta^{13}C = -24.8‰$

Charcoal from Pit 580/40.

Lu-750. Dalkarlstorp 3 **5520 ± 65**
3570 BC
$\delta^{13}C = -23.5‰$

Charcoal from Hearth-pit 496/18.

Lu-776. Dalkarlstorp 4 **5870 ± 75**
3920 BC
$\delta^{13}C = -24.5‰$

Charcoal >1mm from sooty sand from Hearth-pit 275/24. *Comment*: sample undersized; diluted; 88% sample. Charcoal separated from ca 4.5kg sand by screening and subsequent immersion in ca 40% H_2SO_4 (heavy liquid separation).

Lu-776:S1. Dalkarlstorp 4, soot, Sample 1 **4150 ± 60**
2200 BC
$\delta^{13}C = -24.4‰$

Soot and other organic material <1mm, from another 1kg portion Lu-776. *Comment*: organic content enriched to ca 10% by rotation of suitable portions of sooty sand in distilled water, followed by decantation. Normal HCl pretreatment but only very short treatment with NaOH.

Lu-776:S2. Dalkarlstorp 4, soot, Sample 2 **4300 ± 105**
2350 BC
$\delta^{13}C = -23.8‰$

Soot and other organic material <1mm, from another 1kg portion of same sand as Lu-776. *Comment*: organic content enriched to ca 10% by immersion of suitable portions of sooty sand in ca 60% H_2SO_4. Short treatment with NaOH dissolved ca 65% of obtained organic matter. Sample therefore undersized; diluted; 45% sample.

Lu-776:S2A. Dalkarlstorp 4, soot, Sample 2A **4730 ± 70**
2780 BC
$\delta^{13}C = -24.2‰$

Acid-precipitated part of NaOH-soluble fraction from Lu-776:S2. *Comment*: undersized; diluted; 85% sample.

Lu-777. Dalkarlstorp 5 **1550 ± 50**
AD 400
$\delta^{13}C = -24.2‰$

Charcoal from Hearth-pit 275/29.

Lu-778. Dalkarlstorp 6 **5540 ± 65**
3590 BC
$\delta^{13}C = -23.3‰$

Charcoal from Hearth-pit 321/20.

Lu-907. Dalkarlstorp 7 **4010 ± 60**
2060 BC
$\delta^{13}C = -25.0‰$

Charcoal from Hearth-pit 494/7.

Gårdlösa series

Charcoal and bone from Gårdlösa, Smedstorp parish, SE Scania (55° 34′ N, 14° 08′ E). Coll 1973 and subm by B Stjernquist, Hist Mus, Univ Lund. Dated for study of continuity of settlement in Gårdlösa area. For other dates from area and references, see R, 1972, v 14, p 264-266, 392-393; 1973, v 15, p 510-511; 1974, v 16, p 326. Charcoal samples pretreated with HCl and NaOH. Bone collagen extracted by use of modified Longin method (1971) based on the solubility of collagen in slightly acidic hot water.

Lu-835. Gårdlösa 11, Grave 105 **1270 ± 55**
AD 680
$\delta^{13}C = -25.1‰$

Charcoal from hearth near Grave 105. Depth ca 20cm. *Comment*: sample undersized; diluted; 80% sample. (BS): date shows that hearth and grave are of same age.

Lu-834. Gårdlösa 11, Grave 110 **340 ± 50**
AD 1610
$\delta^{13}C = -23.9‰$

Charcoal from pit in Grave 110. Depth ca 30cm. *Comment (BS)*: unexpected young date; charcoal apparently not contemporaneous with grave.

Lu-853. Gårdlösa 11, Grave 111, Sample 1 **1320 ± 50**
AD 630
$\delta^{13}C = -25.4‰$

Charcoal from pit at N side of Grave 111. Depth 15 to 30cm. *Comment* (BS): date shows that pit is younger than grave (see Lu-908 below) and probably connected to adjacent Migration-period features.

Lu-908. Gårdlösa 11, Grave 111, Sample 2 **1930 ± 50**
AD 20
$\delta^{13}C = -20.3‰$

Collagen from human femur from Grave 111. Depth 40 to 45cm below top layer of grave. Assoc with pottery and iron awl. *Comment*: organic carbon content: 2.4%. (BS): date agrees well with time estimate based on assoc archaeol finds.

Lu-978. N Kverrestad 5[50], House 1 **1420 ± 50**
AD 530
$\delta^{13}C = -24.2‰$

Charcoal from hearth in pit-house at N Kverrestad 5[50], SE Scania (55° 32′ N, 14° 03′ 30″ E). Coll 1973 and subm by B Stjernquist. Assoc with stamp ornamented pottery. Pretreated with HCl and NaOH. *Comment* (BS): date of importance for dating of: 1) this type of settlement with pit-houses; 2) a special kind of stamp ornamented pottery.

Hindby Mosse series

Poorly preserved bone fragments of cloven-hoofed animals from Middle Neolithic occupation layer at Hindby Mosse, Fosie, Malmö (55° 34′ N, 13° 03′ E). Coll 1973 and subm by G Burenhult, Hist Mus, Univ Lund. Bone assoc with flint artifacts and pottery. Depth ca 50cm. Collagen extracted as described previously (R, 1970, v 12, p 534).

Lu-844. Hindby Mosse, Sample 1 **3540 ± 60**
1590 BC
$\delta^{13}C = -24.5‰$

Collagen from bone fragments from Sq 14/87. *Comment*: organic carbon content: 1.2%. Sample undersized; diluted; 70% sample. (3 1-day counts.)

Lu-845. Hindby Mosse, Sample 2 **3540 ± 60**
1590 BC
$\delta^{13}C = -22.7‰$

Collagen from rib fragments from Sq 13/87. *Comment*: organic carbon content: 1.7%.

General Comment (GB): date younger than expected since main part of finds from settlement area are Middle Neolithic. There were, however, also some Late Neolithic finds, which may explain the young date.

Lu-971. Tofta Högar **1180 ± 50**
AD 770
$\delta^{13}C = -25.3‰$

Charcoal from fire-layer beneath cairn at Tofta Högar, Hovs parish, Bjäre Peninsula, NW Scania (56° 28′ N, 12° 43′ E). Coll 1974 and subm by G Burenhult. Pretreated with HCl and NaOH. *Comment* (GB): Tofta Högar is primarily a Bronze age cult-place and burial ground. Date indicates secondary use in late Vendel time.

Hagestad series

Charcoal and bone from Hagestad 6[2] A, Löderup parish, Scania (55° 23′ N, 14° 09′ E). Coll 1973 and subm by M Strömberg, Hist Mus, Univ Lund. For other dates from Hagestad, see R, 1972, v 14, p 394-395; 1973, v 15, p 509; 1974, v 16, p 324. Charcoal samples pretreated with HCl and NaOH. Bone collagen extracted using the Longin method (1971) based on solubility of collagen in slightly acidic hot water.

Lu-909. Hagestad 6[2] A, Sample 1:HT73 — **2080 ± 50** / **130 BC** / $\delta^{13}C = -24.4‰$

Charcoal from House 1 on field at coast rd S of Rödkillebäcken.

Lu-917. Hagestad 6[2] A, Sample 3:HT73 — **1230 ± 50** / **AD 720** / $\delta^{13}C = -22.0‰$

Collagen from horse tibia over stone pavement in bog soil near Hagestad Bog; x = +5, y = +0. Assoc with pottery. *Comment*: organic carbon content: 5.0%.

Lu-918. Hagestad 6[2] A, Sample 4:HT73 — **2160 ± 50** / **210 BC** / $\delta^{13}C = -21.9‰$

Collagen from tibia of cattle from pit below stone pavement at same site as Lu-917; x = +7, y = +1. Assoc with pottery. *Comment*: organic carbon content: 4.7%.

Lu-919. Hagestad 6[2] A, Sample 5:HT73 — **2090 ± 55** / **140 BC** / $\delta^{13}C = -22.9‰$

Charcoal from hearth at Oven 3 in house foundation. Assoc with bone, pottery, and daub.

Lu-948. Hagestad 6[2] A, Sample 8:73-74 — **2140 ± 55** / **190 BC** / $\delta^{13}C = -20.3‰$

Collagen from tibia of cattle from lower peat layer in Trench A: Nov 73. Assoc with pottery. *Comment*: organic carbon content: 3.8%. *General Comment* (MS): all dates agree well with results based on archaeol investigation.

Valleberga series

Charcoal from settlement area with grave field at Valleberga, Scania (55° 24′ N, 14° 04′ E). Coll Oct 1973 to May 1974 and subm by M Strömberg. For other dates from Valleberga, see R, 1974, v 16, p 324-325. All samples pretreated with HCl and NaOH.

Lu-910. Valleberga 28[4], Sample 2:HT73 — **2660 ± 55** / **710 BC** / $\delta^{13}C = -25.0‰$

Charcoal from hearth connected with poorly developed occupation layer; Trench 2:Oct 1973. Assoc with pottery and flint objects from transition Middle Neolithic-Late Neolithic and overlain by layer with Bronze age artifacts.

Lu-947. Valleberga 5[2], Sample 6:73-74 — **2330 ± 55** / **380 BC** / $\delta^{13}C = -23.1‰$

Charcoal from hearth connected with occupation layer. Assoc with

flint objects and pottery from early Middle-Neolithic Funnel-Beaker culture. Hearth probably connected with Early Iron age burials on same field.

Lu-965. Valleberga 5[6], Sample 9b:73-74 **3090 ± 55**
1140 BC
$\delta^{13}C = -26.5‰$

Charcoal from oak trunk coffin (Grave I) in burial mound. Assoc with bronze objects from Period III.

Lu-966. Valleberga 5[6], Sample 10:73-74 **3140 ± 55**
1190 BC
$\delta^{13}C = -25.9‰$

Charcoal from oak trunk coffin (Grave II) in burial mound. Assoc with bronze fibula from Period III.

General Comment (MS): dates agree well with archaeol results based on artifact assemblage.

Lu-964. Ingelstorp 19, Sample 7:73-74 **1260 ± 50**
AD 690
$\delta^{13}C = -25.7‰$

Charcoal from hearth on grave field at Ingelstorp 19, Ingelstorp parish, Scania (55° 25′ N, 14° 03′ E). Coll 1974 and subm by M Strömberg. Assoc with millstone. *Comment* (MS): date confirms estimate based on type of millstone.

Stora Råby series

Charcoal from Settlement 2 at Stora Råby, Lund, Scania (55° 42′, N, 13° 14′ E). Coll 1973 and subm by M Wyszomirski, Hist Mus, Univ Lund. Pretreatment with HCl and NaOH.

Lu-911. Stora Råby, Pit 1 **2020 ± 50**
70 BC
$\delta^{13}C = -24.7‰$

Charcoal from big oval pit with Funnel-Beaker culture artifacts. Roman Iron age artifacts were found near pit.

Lu-912. Stora Råby, Pit 11 **1220 ± 50**
AD 730
$\delta^{13}C = -24.1‰$

Charcoal from ca 30cm deep post-hole; probably from part of house construction.

Lu-913. Stora Råby, Object 12 **1320 ± 50**
AD 630
$\delta^{13}C = -23.8‰$

Charcoal from base of hearth with brittle-burnt stones. Assoc with flint objects and potsherds.

Lu-914. Stora Råby, Object 21 **1250 ± 50**
AD 700
$\delta^{13}C = -26.8‰$

Charcoal from walls and bottom of ca 50cm deep stone-filled cylindrical pit.

General Comment (MW): dates younger than expected since settlement occupation layer contained much Early Funnel-Beaker culture material (Period A/B). In part of site, features from Migration period (Vendel time) were dug into this occupation layer. Disturbance caused by burrowing animals was noticed and may account for some mixing of material from different periods.

Lu-970. Fårabacken, Löddesborg **2820 ± 55**
870 BC
$\delta^{13}C = -24.3‰$

Charcoal from hearth in Construction 1974:I at Late Neolithic to Early Bronze age site Fårabacken, Löddesborg, Löddeköpinge parish, Scania (55° 45′ N, 12° 59′ E). For other dates from Löddesborg, see R, 1973, v 15, p 508; 1974, v 16, p 328. Coll 1974 and subm by J Callmer, Hist Mus, Univ Lund. Assoc with pottery, burnt bones, flint implements, and flint waste. Pretreated with HCl and NaOH. *Comment* (JC): from viewpoint of orthodox chronology, date may seem too late. *Cf*, however, Lu-837 from Norrvidinge, 2960 ± 55 (R, 1974, v 16, p 328) and dates from Layer I at Slettabø site, Ogna parish, Rogaland, Norway, 2900 ± 100 to 2840 ± 130 BP (Skjølsvold, 1972, p 68).

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