

UNIVERSITY OF LUND RADIOCARBON DATES XIII

SÖREN HÅKANSSON

Radiocarbon Dating Laboratory, Department of Quaternary Geology
University of Lund, Sweden

INTRODUCTION

Most of the ^{14}C measurements reported here were made between October 1978 and October 1979. Equipment, measurement, and treatment of samples are as reported previously (R, 1968, v 10, p 36-37; 1976, v 18, p 290) except for some minor improvements of the electronic equipment. Sediment samples too small to allow pretreatment, are now burned at $<650^\circ\text{C}$ in order to avoid pyrolysis of carbonates that may be present in the samples. Same max combustion temperature is used for samples with suspected graphite contamination. A movable thermocouple (Philips TERMOCOAX TCI 30/50/3) in the combustion zone is used for checking the temperature.

Age calculations are based on a contemporary value equal to 95% 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). Errors quoted ($\pm 1\sigma$) include standard deviations of count rates for the unknown sample, contemporary standard, and background.

Corrections for deviations from $\delta^{13}\text{C} = -25.0\text{‰}$ in the PDB scale are applied for all samples; also for marine shells. The apparent age for marine material due to the reservoir effect must be subtracted from our dates on such samples.

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 samples is calculated from yield of CO_2 by combustion of gelatine remaining after treatment. Organic carbon lost during treatment is not included in calculated percentage.

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

ACKNOWLEDGMENTS

The author thanks Kerstin Lundahl for sample preparation and routine operation of the dating equipment, and R Ryhage and his staff at the mass-spectrometric laboratory of Karolinska Inst, Stockholm, for the ^{13}C analyses.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Sweden

Abisko series (I)

Sediment from Lake Vuolep Njakajaure ($68^\circ 20' \text{N}$, $18^\circ 45' \text{E}$) and Lake Vuoskojare ($68^\circ 21' \text{N}$, $19^\circ 03' \text{E}$) in Abisko valley, N Sweden. Coll

1977-78 by M Hjelmroos, J Mikaelsson, and G Digerfeldt; subm by M Hjelmroos, Dept Quaternary Geol, Univ Lund. Dating is part of palaeo-ecologic study, belonging to IGCP Subproject 158B (Berglund, 1979), of postglacial vegetational history in area. Depths refer to sediment surface. All samples consisted of fine detritus gyttja or clayey gyttja (Vuoskojaure), and were pretreated with HCl. Six samples undersized; diluted. Amount of CO₂ from sample is given in *Comments* below as “% sample”.

Vuolep Njakajaure, Profile 1

Coll 1977. Water depth at sampling point 13.9m.

Lu-1517. Vuolep Njakajaure 1, 228 to 230cm **7280 ± 75**
 $\delta^{13}C = -30.3\%$

Lu-1518. Vuolep Njakajaure 1, 218 to 220cm **6640 ± 75**
 $\delta^{13}C = -30.1\%$

Lu-1587. Vuolep Njakajaure 1, 208 to 210cm **3810 ± 60**
 $\delta^{13}C = -28.0\%$

Lu-1519. Vuolep Njakajaure 1, 194 to 196cm **3470 ± 60**
 $\delta^{13}C = -28.5\%$

Lu-1520. Vuolep Njakajaure 1, 168 to 170cm **3180 ± 70**
 $\delta^{13}C = -28.4\%$

Comment: 66% sample.

Lu-1521. Vuolep Njakajaure 1, 130 to 134cm **2300 ± 50**
 $\delta^{13}C = -28.0\%$

Lu-1522. Vuolep Njakajaure 1, 122 to 126cm **1850 ± 50**
 $\delta^{13}C = -27.9\%$

Lu-1523. Vuolep Njakajaure 1, 100 to 104cm **1540 ± 55**
 $\delta^{13}C = -27.5\%$

Comment: 91% sample.

Vuolep Njakajaure, Profile 2

Coll 1978. Water depth at sampling point 13.75m.

Lu-1672. Vuolep Njakajaure 2, 100 to 105cm **2570 ± 55**
 $\delta^{13}C = -27.6\%$

Lu-1671. Vuolep Njakajaure 2, 75 to 80cm **2050 ± 50**
 $\delta^{13}C = -28.2\%$

Lu-1670. Vuolep Njakajaure 2, 50 to 55cm **1580 ± 50**
 $\delta^{13}C = -27.7\%$

Lu-1669. Vuolep Njakajaure 2, 32.5 to 37.5cm **900 ± 50**
 $\delta^{13}C = -27.5\%$

Vuoskojaure

Coll 1978. Water depth at sampling point 12.8m.

Lu-1653. Vuoskojaure, 125 to 130cm **6830 ± 90**
 $\delta^{13}C = -26.4\text{‰}$

Comment: 72% sample.

Lu-1654. Vuoskojaure, 94 to 98cm **4490 ± 75**
 $\delta^{13}C = -26.5\text{‰}$

Comment: 73% sample.

Lu-1655. Vuoskojaure, 72 to 76cm **3480 ± 70**
 $\delta^{13}C = -26.3\text{‰}$

Comment: 73% sample.

Lu-1656. Vuoskojaure, 23 to 27cm **1970 ± 70**
 $\delta^{13}C = -26.4\text{‰}$

Comment: 65% sample.**Bjärsjön series**

Sediment from Lake Bjärsjön, Billingen, S Sweden (58° 20' N, 13° 40' E). Alt 255m; area 15ha; max depth 8m. Coll 1976 and subm by G Digerfeldt, Dept Quaternary Geol, Univ Lund. Dating is part of study of Late Weichselian development of lake and surrounding region. Samples come from profile in E part of lake (Livingstone corer, diam 10cm). Water depth 4m at sampling point. Depths given are below sediment surface. All samples pretreated with HCl.

Lu-1589. Bjärsjön, 613 to 615cm **11,260 ± 100**
 $\delta^{13}C = -24.7\text{‰}$

Clay gyttja.

Lu-1590. Bjärsjön, 598 to 600cm **10,890 ± 90**
 $\delta^{13}C = -25.8\text{‰}$

Clay gyttja. *Comment:* sample undersized; diluted; 92% sample. (3 1-day counts.)

Lu-1591. Bjärsjön, 582 to 584cm **10,830 ± 100**
 $\delta^{13}C = -24.1\text{‰}$

Clay gyttja.

Lu-1592. Bjärsjön, 574 to 576cm **10,450 ± 100**
 $\delta^{13}C = -23.9\text{‰}$

Clay gyttja.

Lu-1593. Bjärsjön, 563 to 565cm **10,220 ± 95**
 $\delta^{13}C = -22.5\text{‰}$

Clay gyttja.

Lu-1594. Bjärsjön, 551 to 553cm **9840 ± 95**
 $\delta^{13}C = -23.5\text{‰}$

Clay gyttja.

Lu-1595. Bjärsjön, 537 to 539cm**9560 ± 90**
 $\delta^{13}C = -26.6\text{‰}$

Detritus gyttja.

Lu-1588. Bergsjön, 249 to 253cm**11,970 ± 105**
 $\delta^{13}C = -19.8\text{‰}$

Silty clay gyttja from Lake Bergsjön, Mösseberg, S Sweden (58° 12' N, 13° 30' E). Alt 306m; area 0.9ha; max depth 4.5m. Coll 1976 and subm by G Digerfeldt. Dating is part of same study as Bjärsjön series, above. Sample comes from profile in E part of lake (Livingstone corer, diam 10cm). Water depth 1m at sampling point. Depth given is below sediment surface. *Comment:* no pretreatment because of small organic content. Burned at <650°C to avoid pyrolysis of carbonates that may be present in untreated samples.

Växjösjön series

Sediment from Lake Växjösjön at town of Växjö, S Sweden (56° 52' N, 14° 49' E). Alt 161m; area 87ha; max depth 6.5m. Coll 1972-73 and subm by G Digerfeldt. Dating is part of study of development of lake and surrounding region during last *ca* 2500 yr. For other dates from this lake, see R, 1974, v 16, p 312-314. Samples come from profile in central part of lake (Livingstone corer, diam 6cm). Water depth 5.5m at sampling point. Depths given are below sediment surface. Pretreated with HCl.

Lu-1639. Växjösjön, 415 to 420cm**2500 ± 55**
 $\delta^{13}C = -27.9\text{‰}$

Detritus gyttja.

Lu-1640. Växjösjön, 395 to 400cm**1710 ± 50**
 $\delta^{13}C = -28.1\text{‰}$

Detritus gyttja.

Lu-1638. Växjösjön, 375 to 380cm**1610 ± 65**
 $\delta^{13}C = -27.4\text{‰}$ Detritus gyttja. *Comment:* sample undersized; diluted; 60% sample.**Central Blekinge series (II)**

Sediment from Lake Logylet (56° 18' N, 14° 59' E), alt 61m, and Lake Halsjön (56° 14' N, 15° 19' E), alt 30m, Central Blekinge, S Sweden. Coll 1978 and subm by S Björck, Dept Quaternary Geol, Univ Lund. Dating is part of study of Late Weichselian stratigraphy and shore-line displacement in Blekinge (Björck, 1979). For additional dates in same series, see R, 1979, v 21, p 389-391. Samples are from cores taken with Livingstone sampler, 10cm diam. Depths refer to water surface. No pretreatment because of low organic content. Chronozones below according to Mangerud *et al* (1974).

Logylet

Lu-1597. Logylet 2, 1015 to 1018cm **11,810 ± 190**
 $\delta^{13}C = -23.2\text{‰}$

Clay gyttja. Lower part of Alleröd Chronozone. *Comment:* sample undersized; diluted; 40% sample. (3 1-day counts.)

Lu-1598. Logylet 3, 995 to 998cm **11,040 ± 150**
 $\delta^{13}C = -25.5\text{‰}$

Clayey gyttja. Boundary between Alleröd and Younger Dryas Chronozones. *Comment:* undersized; diluted; 47% sample. (3 1-day counts.)

Halsjön

Lu-1599. Halsjön 1, 532 to 538cm **12,890 ± 190**
 $\delta^{13}C = -23.3\text{‰}$

Clay. Uppermost part of Alleröd Chronozone according to pollen analysis. The reason for difference between radiocarbon age and expected age is discussed by submitter (Björck, 1979, p 119-120). *Comment:* undersized; diluted; 45% sample. (3 1-day counts.)

Lu-1600. Halsjön 2, 525 to 530cm **12,090 ± 145**
 $\delta^{13}C = -25.0\text{‰}$

Clay. Lowermost part of Younger Dryas Chronozone. *Comment:* undersized; diluted; 55% sample. (3 1-day counts.)

Lu-1601. Halsjön 3, 507 to 511cm **10,760 ± 100**
 $\delta^{13}C = -22.8\text{‰}$

Muddy clay. Middle part of Younger Dryas Chronozone.

Lu-1602. Halsjön 4, 502 to 507cm **10,560 ± 100**
 $\delta^{13}C = -24.0\text{‰}$

Muddy clay. Middle part of Younger Dryas Chronozone.

Lu-1603. Halsjön 5, 498 to 502cm **10,740 ± 105**
 $\delta^{13}C = -24.6\text{‰}$

Slightly muddy clay. Upper part of Younger Dryas Chronozone. *Comment:* undersized; diluted; 92% sample.

Lu-1604. Halsjön 6, 491 to 495cm **10,260 ± 95**
 $\delta^{13}C = -24.1\text{‰}$

Clay gyttja. Upper part of Younger Dryas Chronozone.

Lu-1605. Halsjön 7, 482 to 485cm **9760 ± 90**
 $\delta^{13}C = -25.9\text{‰}$

Clayey gyttja. Lowermost part of Pre-Boreal Chronozone.

Håkulls mosse series (II)

Sediment from bog Håkulls mosse on hill ridge Kullaberg, NW Scania (56° 17' N, 12° 31' E). Alt *ca* 125m. Coll 1975 and subm by B E Berglund, Dept Quaternary Geol, Univ Lund. Samples are from core taken with Livingstone sampler, 10cm diam. Depths refer to bog surface.

Dated as complement to Håkulls mosse series (R, 1978, v 20, p 416-417).
Pretreated with HCl.

Lu-1618. Håkulls mosse 11, 838 to 840cm **11,700 ± 105**
 $\delta^{13}C = -23.2\text{‰}$

Clayey gyttja. Rational *Empetrum* curve. Beginning of Alleröd.

Lu-1619. Håkulls mosse 12, 768 to 770cm **10,500 ± 100**
 $\delta^{13}C = -25.8\text{‰}$

Clayey gyttja. Upper *Artemisia*-zone boundary. Middle of DR 3.

Lu-1686. Kroksjön **580 ± 50**
 $\delta^{13}C = -28.6\text{‰}$

Detritus gyttja, 75 to 77.5cm below sediment surface, from Lake Kroksjön, Kristdala parish, S Sweden (57° 24' N, 16° 06' E). Coll 1979 and subm by M Aronsson and Th Persson, Dept Quaternary Geol, Univ Lund. Level with marked increase of *Juniperus* and herbs, indicating human activity. Pollen analysis by M Hjelmroos. Pretreated with HCl.

Svedaskogen series (II)

Barnacle and bivalve shells from gravel pit at Svedaskogen, ca 3km N of Fjärås church, Halland (57° 29' N, 12° 10' 30" E). Coll 1978 and subm by Å Hillefors, Dept Phys Geog, Univ Lund. Dated as complement to Svedaskogen series (R, 1979, v 21, p 393).

Lu-1675. Svedaskogen 1978, *Balanus* **13,110 ± 115**
 $\delta^{13}C = +0.1\text{‰}$

Barnacle shells (*Balanus* sp) from shell bank with eroded upper surface overlain by glaciofluvial sand and wave-washed material. *Comment:* outer 73% removed by acid leaching.

Lu-1676. Svedaskogen 1978, *Mytilus* **13,080 ± 115**
 $\delta^{13}C = -1.0\text{‰}$

Mytilus fragments from same shell bank as Lu-1675, above. *Comment:* outer 30% removed by acid leaching.

General Comment: corrections for deviations from $\delta^{13}C = -25\text{‰}$ PDB are applied also for shell samples. No corrections are made for apparent age of shells of living marine organisms due to the reservoir effect.

B. Norway

Østrevand series

Sediment from Lake Østrevand, Varanger Peninsula, N Norway (70° 09' 15" N, 29° 28' E). Coll 1976 and subm by B Malmström and O Palmér, Dept Phys Geog, Univ Lund. Depths are below sediment surface. Dated as complement to Varanger Peninsula Series II (R, 1978, v 20, p 422-423). No pretreatment; small samples; burned at <650°C to avoid carbonate pyrolysis and graphite oxidation.

Lu-1620. Østrevand 7-lb, 69 to 74cm **7180 ± 75**
 $\delta^{13}C = -24.8\text{‰}$

Clayey gyttja.

Lu-1621. Østrevand 8-lb, 109 to 114cm **9220 ± 100**
 $\delta^{13}C = -26.0\text{‰}$

Clayey gyttja. *Comment:* sample undersized; diluted; 80% sample.

Lerøy series

Sediment samples from small lakes on Lerøy I., Hordaland, W Norway (60° 14' N, 5° 11' E). Coll 1978 and subm by K Krzywinski, Bot Mus, Univ Bergen. Dated as part of study of sea-level changes in area. For other dates from area, see R, 1978, v 20, p 423-424; 1979, v 21, p 394-395. Acid-precipitated part of NaOH-soluble fraction used for dating.

Lu-1580A. Storevatn, Lerøy, No. 10573 **7330 ± 75**
 $\delta^{13}C = -28.1\text{‰}$

Lacustrine gyttja with diatoms indicating brackish water. Absolute max of Tapes transgression.

Lu-1581A. Storevatn, Lerøy, No. 10590 **9420 ± 85**
 $\delta^{13}C = -22.9\text{‰}$

Lacustrine gyttja from level for 1st isolation of lake basin.

Lu-1582A. Austretjønn, Lerøy, No. 10351 **2860 ± 55**
 $\delta^{13}C = -30.5\text{‰}$

Lacustrine gyttja from isolation contact.

Lu-1583A. Vestretjønn, Lerøy, No. 10393 **3600 ± 55**
 $\delta^{13}C = -28.5\text{‰}$

Lacustrine gyttja from isolation contact.

Rondane series

Subfossil wood from 3 small lakes in Rondane mt area, Østlandet, Norway. Samples pretreated with HCl and NaOH.

Lu-995. Kåsi, Mysuseter **4890 ± 65**
 $\delta^{13}C = -25.1\text{‰}$

Wood (*Pinus* sp) id by T Bartholin from bottom of unintentionally drained small lake near Kåsi Mt, ca 1km N of Mysuseter (61° 49' N, 9° 40' E). Alt ca 1000m. Coll 1974 and subm by A Lima-de-Faria, Dept Molecular Cytogenetics, Univ Lund. Sample taken from firmly rooted stump. Site described by submitter (Lima-de-Faria, 1977).

Lu-1692. Haverdalen **8240 ± 80**
 $\delta^{13}C = -23.7\text{‰}$

Wood (*Pinus silvestris*) from ca 50cm thick tree-trunk from small lake 500m SE of Haverdalsseter (62° 02' N, 9° 40' E). Alt 1030m. Treetop visible at lake surface. Coll 1976 by E K Barth, Zool Mus, Oslo; subm by E K Barth and A Lima-de-Faria. Ca 20km to nearest *Pinus* forest today. Sample contained 41 tree rings in ca 20mm and probably came from outer part of tree.

Lu-1693. Illmandalen**8320 ± 80** $\delta^{13}C = -26.5\text{‰}$

Wood (*Betula* sp) id by T Bartholin from peat 7cm above bedrock and 18m from shore of Fremre Illmantjern (61° 52.5' N, 9° 49' E). Alt 1220m. Coll 1972 by P Vassrusten; subm by E K Barth and A Lima-de-Faria. Ca 15km to nearest *Betula* forest today. Sample probably piece of small root with ca 15 indistinct tree rings.

*C. Iceland***Vatnskotsvatn series**

Sediment from 2 profiles in Lake Vatnskotsvatn, Skagafjörður area, N Iceland (65° 42' 05" N, 19° 28' 50" W). Coll 1977 and subm by M Hallsdóttir, Dept Quaternary Geol, Univ Lund. Dated as part of study of Postglacial vegetational history of surrounding region and for correlation of volcanic ash layers in the profiles with similar layers dated in other areas. Samples taken with Livingstone sampler, 6cm diam. Depths refer to water surface. All samples except Lu-1644 and Lu-1648 under-sized; diluted. Amount of CO₂ from sample is given in *Comments* below as “% sample”. No pretreatment. Burned at <650°C to avoid pyrolysis of carbonates.

Lu-1641. Vatnskotsvatn 793:1, 760 to 765cm 2330 ± 55 $\delta^{13}C = -21.2\text{‰}$ Detritus gyttja. *Comment*: 70% sample. (3 1-day counts.)**Lu-1642. Vatnskotsvatn 793:2, 710 to 715cm 1830 ± 55** $\delta^{13}C = -20.9\text{‰}$ Detritus gyttja. *Comment*: 90% sample.**Lu-1643. Vatnskotsvatn 793:3, 660 to 665cm 1850 ± 60** $\delta^{13}C = -20.6\text{‰}$ Detritus gyttja. *Comment*: 75% sample.**Lu-1644. Vatnskotsvatn 793:4, 610 to 615cm 1700 ± 50** $\delta^{13}C = -20.0\text{‰}$

Detritus gyttja.

Lu-1645. Vatnskotsvatn 793:5, 560 to 565cm 1530 ± 50 $\delta^{13}C = -19.2\text{‰}$ Detritus gyttja. *Comment*: 94% sample.**Lu-1646. Vatnskotsvatn 793:6, 510 to 515cm 1320 ± 55** $\delta^{13}C = -19.6\text{‰}$ Detritus gyttja. *Comment*: 80% sample.**Lu-1647. Vatnskotsvatn 793:7, 460 to 465cm 1330 ± 55** $\delta^{13}C = -18.7\text{‰}$ Detritus gyttja. *Comment*: 78% sample.**Lu-1648. Vatnskotsvatn 793:8, 410 to 415cm 1380 ± 50** $\delta^{13}C = -19.3\text{‰}$

Detritus gyttja.

- Lu-1649. Vatnskotsvatn 793:9, 360 to 365cm** **1450 ± 55**
 $\delta^{13}C = -20.9\text{‰}$
 Detritus gyttja. *Comment:* 79% sample.
- Lu-1650. Vatnskotsvatn 793:10, 297 to 302cm** **1590 ± 60**
 $\delta^{13}C = -20.3\text{‰}$
 Detritus gyttja. *Comment:* 67% sample.
- Lu-1651. Vatnskotsvatn 793:11, 247 to 252cm** **1390 ± 60**
 $\delta^{13}C = -21.2\text{‰}$
 Detritus gyttja. *Comment:* 74% sample.
- Lu-1682. Vatnskotsvatn 416:13, 386 to 393cm** **8990 ± 155**
 $\delta^{13}C = -21.3\text{‰}$
 Fine detritus gyttja. No *Betula* pollen. *Comment:* 33% sample (3 1-day counts.)
- Lu-1683. Vatnskotsvatn 416:14, 338 to 343cm** **7660 ± 115**
 $\delta^{13}C = -17.7\text{‰}$
 Coarse detritus gyttja. Ist *Betula* min. *Comment:* 53% sample.
- Lu-1684. Vatnskotsvatn 416:15, 309 to 316cm** **6570 ± 75**
 $\delta^{13}C = -20.3\text{‰}$
 Fine detritus gyttja. A few cm below 2nd *Betula* max. *Comment:* 85% sample.
- Lu-1685. Vatnskotsvatn 416:16, 267 to 272cm** **6040 ± 100**
 $\delta^{13}C = -19.8\text{‰}$
 Coarse detritus gyttja. *Comment:* 56% sample.
- Lu-1724. Vatnskotsvatn 416:17, 228 to 234cm** **4470 ± 95**
 $\delta^{13}C = -20.9\text{‰}$
 Coarse detritus gyttja. *Comment:* 51% sample.
- Lu-1725. Vatnskotsvatn 416:18, 176 to 182cm** **2710 ± 70**
 $\delta^{13}C = -17.5\text{‰}$
 Coarse detritus gyttja. *Comment:* 65% sample.

D. Poland

Wielkie Gacno series

Sediment from Lake Wielkie Gacno, NW Poland (53° 47' 40" N, 17° 33' 45" E). Coll 1977-78 by G Digerfeldt and M Hjelmroos; subm by M Hjelmroos. Dating is part of study of Postglacial vegetational history of surrounding area. Study belongs to IGCP Subproject 158B (Berglund, 1979). Depths refer to sediment surface. All samples pretreated with HCl except Lu-1637, which is wood from dugout canoe from bottom of lake (pretreated with HCl and NaOH).

Profile 1

Coll 1977. Water depth at sampling point *ca* 5m.

Lu-1531. Wielkie Gaćno, 799 to 803cm	9870 ± 90
Silty algal gyttja.	$\delta^{13}C = -25.5\text{‰}$
Lu-1532. Wielkie Gaćno, 775 to 780cm	9280 ± 90
Algal gyttja.	$\delta^{13}C = -19.7\text{‰}$
Lu-1533. Wielkie Gaćno, 750 to 755cm	8830 ± 85
Algal gyttja.	$\delta^{13}C = -21.7\text{‰}$
Lu-1534. Wielkie Gaćno, 725 to 730cm	8350 ± 80
Algal gyttja.	$\delta^{13}C = -23.5\text{‰}$
Lu-1535. Wielkie Gaćno, 675 to 680cm	8120 ± 80
Algal gyttja.	$\delta^{13}C = -22.9\text{‰}$
Lu-1536. Wielkie Gaćno, 625 to 630cm	7160 ± 75
Algal gyttja.	$\delta^{13}C = -22.9\text{‰}$
Lu-1469. Wielkie Gaćno, 575 to 580cm	6590 ± 70
Algal gyttja.	$\delta^{13}C = -17.3\text{‰}$
Lu-1537. Wielkie Gaćno, 525 to 530cm	5950 ± ± 65
Algal gyttja.	$\delta^{13}C = -21.0\text{‰}$
Lu-1538. Wielkie Gaćno, 475 to 480cm	5430 ± 65
Algal gyttja.	$\delta^{13}C = -20.6\text{‰}$
Lu-1539. Wielkie Gaćno, 445 to 450cm	5130 ± 60
Algal gyttja.	$\delta^{13}C = -21.0\text{‰}$
Lu-1470. Wielkie Gaćno, 425 to 430cm	4810 ± 60
Algal gyttja.	$\delta^{13}C = -15.6\text{‰}$
Lu-1540. Wielkie Gaćno, 75 to 80cm	1220 ± 50
Detritus gyttja.	$\delta^{13}C = -23.7\text{‰}$
Lu-1541. Wielkie Gaćno, 25 to 30cm	780 ± 50
Detritus gyttja.	$\delta^{13}C = -26.0\text{‰}$

Profile 2

Coll May 1978. Water depth at sampling point *ca* 5m.

Lu-1608.	Wielkie Gacno, 390 to 395cm	4230 ± 60 $\delta^{13}C = -15.5\text{‰}$
	Algal gyttja.	
Lu-1609.	Wielkie Gacno, 340 to 345cm	3740 ± 55 $\delta^{13}C = -16.5\text{‰}$
	Algal gyttja.	
Lu-1610.	Wielkie Gacno, 290 to 295cm	3320 ± 55 $\delta^{13}C = -18.7\text{‰}$
	Algal gyttja.	
Lu-1611.	Wielkie Gacno, 240 to 245cm	2650 ± 55 $\delta^{13}C = -19.9\text{‰}$
	Algal gyttja.	
Lu-1612.	Wielkie Gacno, 195 to 200cm	2250 ± 50 $\delta^{13}C = -22.8\text{‰}$
	Algal gyttja.	
Lu-1613.	Wielkie Gacno, 140 to 145cm	1790 ± 50 $\delta^{13}C = -22.5\text{‰}$
	Algal gyttja.	

Profile 3

Coll Oct 1978. Water depth at sampling point 1.7m.

Lu-1678.	Wielkie Gacno, 197 to 201cm	11,840 ± 110 $\delta^{13}C = -25.7\text{‰}$
	Algal gyttja.	
Lu-1679.	Wielkie Gacno, 186 to 190cm	11,380 ± 100 $\delta^{13}C = -22.9\text{‰}$
	Clayey and sandy algal gyttja.	
Lu-1680.	Wielkie Gacno, 178 to 182cm	11,100 ± 105 $\delta^{13}C = -22.1\text{‰}$
	Muddy clay.	
Lu-1681.	Wielkie Gacno, 165 to 170cm	11,000 ± 100 $\delta^{13}C = -24.6\text{‰}$
	Muddy clay.	
Lu-1637.	Wielkie Gacno, wood	810 ± 50 $\delta^{13}C = -25.2\text{‰}$
	Wood (<i>Pinus</i> sp) from dugout canoe from bottom of lake.	

Lu-1632.	Weglewiec II	+ 1000 35,100 - 900 $\delta^{13}C = -26.7\text{‰}$
-----------------	---------------------	--

Sample from 25 to 30cm thick continuous layer of organic silt, 520 to 550cm below surface of periglacial terrace of Prosna R, 300m SE of

village Węglewice, Kalisz Voivodship, SW Poland (51° 23' 20" N, 18° 13' 10" E). Layer is overlain and underlain by rhythmically stratified periglacial flood deposits (Rotnicki, 1966). Coll 1976 by K Tobolski and K Rotnicki; subm by K Tobolski, Dept Geog, Adam Mickiewicz Univ, Poznań, Poland. *Comment*: pretreated with HCl and NaOH.

+ 1200

Lu-1632A. Węglewice II, soluble **36,400**

– 1000

$\delta^{13}C = -26.1\%$

Acid-precipitated part of NaOH-soluble fraction from Lu-1632.

E. Switzerland/France

Lu-1606. Messery **3230 ± 85**

$\delta^{13}C = -28.5\%$

Wood from carbonaceous silty lake sediments from Lake Geneva near village Messery, France (46° 22' N, 6° 17' E). Coll 1975 by R Thompson; subm by C Reynaud, Dept Geol, Univ Geneva, Switzerland. Only HCl pretreatment due to small sample size. Diluted; 53% sample.

Corsier series

Organic material from shore deposits overlain by limnic sediments in Lake Geneva near village Corsier, Switzerland (46° 16' N, 6° 12' E). Coll 1979 and subm by C Reynaud. Dated as part of study of lake level changes. No pretreatment; small samples. Burned at <650°C to avoid pyrolysis of carbonates.

Lu-1696. Corsier C1 **5140 ± 120**

$\delta^{13}C = -27.4\%$

Slightly carbonaceous shore-peat. *Comment*: sample undersized; diluted; 31% sample. (3 1-day counts.)

Lu-1697. Corsier C9 **5090 ± 65**

$\delta^{13}C = -27.4\%$

Slightly carbonaceous shore-peat.

II. ARCHAEOLOGIC SAMPLES

A. Sweden

Löddeköpinge No. 10 series (II)

Human bones from grave field at Löddeköpinge No. 10, Löddeköpinge parish, E Scania (55° 45' N, 13° 00' E). Coll 1977 and subm by T Ohlsson, Hist Mus, Univ Lund. All samples are from structures with finds of datable coins; dated to gain information about obvious discrepancy between radiocarbon dates and expected max age of structures, reported in 1st part of series (R, 1979, v 21, p 400-402). Collagen extracted as described previously (R, 1976, v 18, p 290), but only Lu-1543 received NaOH treatment. Vertebrae and other bones with thin outer walls, consisting mainly of spongy bone, were not crushed before extraction.

Lu-1542. Löddeköpinge No. 10, Structure 182 **1010 ± 50**
 $\delta^{13}C = -18.3\text{‰}$

Collagen from 2 heel bones and 2 ankle bones assoc with coin minted for Olof Hunger AD 1085 to 1096. *Comment:* organic carbon content: 6.3‰.

Lu-1543. Löddeköpinge No. 10, Structure 393 **1060 ± 50**
 $\delta^{13}C = -18.2\text{‰}$

Collagen from 2 large heel bones and 1 1/2 ankle bones assoc with coin minted for Sven Estridsen AD 1047 to 1074. *Comment:* organic carbon content: 5.3‰.

Lu-1544. Löddeköpinge No. 10, Structure 398 **1070 ± 50**
 $\delta^{13}C = -18.3\text{‰}$

Collagen from mixture of small bones assoc with coin minted for Sven Estridsen AD 1047 to 1074. *Comment:* organic carbon content: 7.2‰.

Lu-1545. Löddeköpinge No. 10, Structure 406 **1060 ± 50**
 $\delta^{13}C = -17.8\text{‰}$

Collagen from a heel bone and fragments of tubular bones assoc with coin minted for Harald Hein AD 1075 to 1080. *Comment:* organic carbon content: 6.6‰.

Lu-1546. Löddeköpinge No. 10, Structure 416 **1060 ± 50**
 $\delta^{13}C = -18.2\text{‰}$

Collagen from shin bone assoc with coin minted for Sven Estridsen AD 1047 to 1074. *Comment:* organic carbon content: 7.5‰.

Lu-1547. Löddeköpinge No. 10, Structure 464 **960 ± 50**
 $\delta^{13}C = -18.1\text{‰}$

Collagen from fragments of tubular bones and heel bone assoc with coin minted for Sven Estridsen AD 1047 to 1074. *Comment:* organic carbon content: 6.5‰.

Lu-1548. Löddeköpinge No. 10, Structure 471 **1010 ± 50**
 $\delta^{13}C = -17.7\text{‰}$

Collagen from mixture of ill-preserved bone fragments assoc with coin minted for Heinrich II AD 1002 to 1024. *Comment:* organic carbon content: 4.3‰.

Lu-1549. Löddeköpinge No. 10, Structure 488 **1040 ± 50**
 $\delta^{13}C = -17.8\text{‰}$

Collagen from mixture of bone fragments assoc with coin minted for Knut den Store (the Great) AD 1018 to 1035. *Comment:* organic carbon content: 5.8‰.

Lu-1550. Löddeköpinge No. 10, Structure 535 **970 ± 50**
 $\delta^{13}C = -19.0\text{‰}$

Collagen from an ankle bone, some vertebra fragments, and 3 hand or foot bones assoc with German coin, probably minted AD 1036 to 1059. *Comment:* organic carbon content: 6.9‰.

Lu-1551. Löddeköpinge No. 10, Structure 596 **960 ± 50**
 $\delta^{13}C = -18.0\text{‰}$

Collagen from tubular bone assoc with coin minted for Sven Estridsen AD 1047 to 1074. *Comment:* organic carbon content: 5.7%.

General Comment: probable time of deposition for total coin assembly is AD 1050 to 1100 according to numismatologists G Galster and J Steen Jensen, Copenhagen.

Ängdala series

Charcoal from flint mines in Senonian chalk at Ängdala, S Sallerup parish, S Sweden (55° 35' 20" N, 13° 07' 20" E). Coll 1977 by U Säfstestad; subm by B Salomonsson, Malmö Mus. Pretreated with HCl and NaOH.

Lu-1633. Ängdala, 6120:G4 **5010 ± 65**
 $\delta^{13}C = -22.1\text{‰}$

Sample from Mine No. 4.

Lu-1635. Ängdala, 6120:27:8:2 **2760 ± 55**
 $\delta^{13}C = -23.7\text{‰}$

Sample from Level II with Late Bronze age artifacts.

Lu-1636. Ängdala, 6120 **5080 ± 65**
 $\delta^{13}C = -24.9\text{‰}$

Sample from post-hole. *Comment:* sample undersized; diluted; 60% sample. (3 1-day counts.)

S Lappland series

Charcoal from five sites in Vilhelmina parish, S Lappland, N Sweden. Subm by A Huggert, Västerbottens Mus, Umeå. For other dates from same region, see Varris series and Vojmsjöluspen series (R, 1979, v 21, p 396-398). Nine samples were small (Lu-1561, -1562, -1566, -1569 to -1571, -1573, -1576, and -1577) and, therefore, received only mild pretreatment with NaOH and HCl. All other samples received normal pretreatment with HCl and NaOH.

Site Raä 235

(64° 40' N, 16° 20' E). Coll Aug 1978 by L Flodström.

Lu-1558. Raä 235, A5 **7280 ± 75**
 $\delta^{13}C = -25.9\text{‰}$

Charcoal from 180cm below ground level in hunting pit.

Lu-1559. Raä 235, A8 F2/F3 **1100 ± 50**
 $\delta^{13}C = -23.7\text{‰}$

Charcoal from 180cm below ground level in hunting pit.

Lu-1560. Raä 235, A14 K2 **1380 ± 50**
 $\delta^{13}C = -24.4\text{‰}$

Charcoal from 180cm below ground level in hunting pit.

Lu-1561. Raä 235, A17 K2 **1520 ± 50**
 $\delta^{13}C = -25.2\text{‰}$

Charcoal from 200cm below ground level in hunting pit.

Lu-1562. Raä 235, A18 Sample 1 **6160 ± 70**
 $\delta^{13}C = -24.9\text{‰}$

Charcoal from 40cm below surface under mound situated beside hunting pit.

Lu-1563. Raä 235, A18 Sample 2 **4700 ± 60**
 $\delta^{13}C = -23.7\text{‰}$

Charcoal from 180cm below ground level in hunting pit.

Lu-1564. Raä 235, A23 **1370 ± 50**
 $\delta^{13}C = -24.6\text{‰}$

Charcoal from 180cm below ground level in hunting pit.

Site Raä 180

(64° 52' N, 16° 44' E). Coll June 1977 by L G Spång.

Lu-1565. Raä 180, 111/416 K4 **2460 ± 55**
 $\delta^{13}C = -23.4\text{‰}$

Charcoal from *ca* 5cm below recent surface in hearth or cooking pit in eroded area near lake. Assoc with quartz scraper.

Lu-1566. Raä 180, 116/369 K2 **8830 ± 110**
 $\delta^{13}C = -24.9\text{‰}$

Charcoal from 10cm below surface in cooking pit. Assoc with bones. *Comment:* sample undersized; diluted; 67% sample.

Site Raä 553

(64° 52' N, 16° 44' E). Coll July-Sept 1977 by L G Spång, B Syse, and L Kallerskog.

Lu-1567. Raä 553, A2 K21 **8180 ± 80**
 $\delta^{13}C = -24.5\text{‰}$

Charcoal from bottom of earth oven 30cm below surface.

Lu-1568. Raä 553, A4 K14 **2120 ± 50**
 $\delta^{13}C = -24.2\text{‰}$

Charcoal from hearth 30 to 35cm below surface.

Lu-1569. Raä 553, A6 K11 **4440 ± 80**
 $\delta^{13}C = -24.4\text{‰}$

Charcoal from 15 to 20cm below surface. *Comment:* undersized; diluted; 65% sample.

Lu-1570. Raä 553, A7 K15 **5270 ± 90**
 $\delta^{13}C = -24.2\text{‰}$

Charcoal from earth oven (?) 30 to 40cm below surface. *Comment:* undersized; diluted; 56% sample.

Lu-1571. Raä 553, A9 K28 **450 ± 55**
 $\delta^{13}C = -24.4\text{‰}$

Charcoal from hearth 5cm below surface. *Comment:* undersized; diluted; 77% sample.

Lu-1572. Raä 553, K3 **5570 ± 65**
 $\delta^{13}C = -24.5\text{‰}$

Charcoal from cooking pit (?) 20cm below surface. Assoc with bones.

Lu-1573. Raä 553, K23 **7850 ± 115**
 $\delta^{13}C = -24.5\text{‰}$

Charcoal under layer of burned stones 6cm below surface. *Comment:* undersized; diluted; 52% sample.

Lu-1574. Raä 553, K33 **4120 ± 60**
 $\delta^{13}C = -23.4\text{‰}$

Charcoal from hearth 6cm below surface.

Lu-1575. Raä 553, A1 K7:3 **1280 ± 50**
 $\delta^{13}C = -24.4\text{‰}$

Charcoal (*Pinus* sp) id by T Bartholin from bottom of earth oven 25cm below surface.

Site Raä 190

(64° 52' N, 16° 44' E). Coll July-Sept 1977 by K Wijkander and G Rydström.

Lu-1576. Raä 190, A11 **2550 ± 75**
 $\delta^{13}C = -24.5\text{‰}$

Charcoal from hearth 5cm below surface. *Comment:* undersized; diluted; 60% sample.

Lu-1577. Raä 190, A10 **3590 ± 100**
 $\delta^{13}C = -24.5\text{‰}$

Charcoal from hearth 5cm below surface. *Comment:* undersized; diluted; 31% sample. (3 1-day counts.)

Lu-1578. Raä 190, A14 **7070 ± 75**
 $\delta^{13}C = -23.3\text{‰}$

Charcoal from bottom of earth oven 30cm below surface.

Site Raä 921

(64° 52' N, 16° 44' E). Coll June 1977 by L Flodström.

Lu-1579. Raä 921, 110/301 K1 **2310 ± 55**
 $\delta^{13}C = -23.6\text{‰}$

Charcoal from 20cm below surface. Assoc with asbestos ceramics.

Lu-1677. Strimasund **<150**
 $\delta^{14}\text{C} = -1.6 \pm 5.7\text{‰}$
 $\delta^{13}\text{C} = -25.0\text{‰}$

Wood (*Betula* sp) id by T Bartholin from hole for handle in iron object from Feature No. 46, Strimasund, Tärna parish, Västerbotten Co, N Sweden (66° 04' N, 14° 52.5' E). Coll 1974 by S af Ekenstam, Hemanvan; subm by A Huggert. Only mild pretreatment with NaOH and HCl due to small sample size.

Ingelstorp series

Charcoal from settlement area and grave field at Ingelstorp, Scania (55° 25' N, 14° 02' E). Coll 1977 and subm by M Strömberg, Hist Mus, Univ Lund. For other dates from Ingelstorp, see R, 1976, v 18, p 314; 1977, v 19, p 435-436; 1978, v 20, p 430-432. Only mild pretreatment with NaOH and HCl due to small sample size.

Lu-1615. Ingelstorp 41, Sample 1:HT78 **2830 ± 55**
 $\delta^{13}\text{C} = -25.4\text{‰}$

Charcoal from hearth in house foundation at Ingelstorp 41 (Strömberg, 1977, p 62-63). Assoc with pottery and flints.

Lu-1616. Ingelstorp 32:5, Sample 2:HT78 **2660 ± 60**
 $\delta^{13}\text{C} = -23.6\text{‰}$

Charcoal from fire pit (Grave 67, Field 4) at Ingelstorp 32:5 (Strömberg, 1977, p 14-15). Assoc with burned bones. *Comment*: sample undersized; diluted; 86% sample.

Valleberga series

Animal bones from Bronze age settlement area at Valleberga 36, SE Scania (55° 24' N, 14° 03' E). Coll 1975 and subm by M Strömberg. For other dates from Valleberga, see R, 1974, v 16, p 324-325; 1975, v 17, p 192-193; 1976, v 18, p 313-314; 1979, v 21, p 398. Collagen extracted as described previously (R, 1976, v 18, p 290). Lu-1652 and -1674 received NaOH treatment but not Lu-1673.

Lu-1652. Valleberga 36, Sample 3:78-79 **2710 ± 60**
 $\delta^{13}\text{C} = -20.2\text{‰}$

Collagen from ill-preserved lower jaw bone of *Sus* from cultural layer, Trench 1, Sq x = +4, y = +6, lower stratum. Assoc with Late Bronze age pottery. *Comment*: sample undersized; diluted; 80% sample. Organic carbon content: 1.9%.

Lu-1673. Valleberga 36, Sample 4:78-79 **2800 ± 55**
 $\delta^{13}\text{C} = -20.4\text{‰}$

Collagen from well-preserved ulna of *Bos* from cultural layer, Trench 1, Sq x = +0, y = +7, lower stratum. Assoc with Late Bronze age pottery. *Comment*: organic carbon content: 6.0%.

Lu-1674. Valleberga 36, Sample 5:78-79 **2860 ± 55**
 $\delta^{13}C = -20.1\%$

Collagen from an ankle bone and 3 phalanges of *Bos* from cultural layer, Trench 1, Sq x = +2, y = +4. Assoc with Late Bronze age pottery. *Comment*: organic carbon content: 2.4%.

Lu-1614. Gislöv 7 **1100 ± 50**
 $\delta^{13}C = -24.0\%$

Charcoal from House 1:77 at Gislöv 7, Nöbbelöv parish, SE Scania (55° 29' N, 14° 17' E). Coll 1977 by M Strömberg. Assoc with pottery and objects of bronze and iron, indicating Viking age.

General Comment (MS): on Lu-1614 to -1616, -1652, -1673, and -1674 all dates agree well with archaeol estimates based on assoc finds.

Lu-1617. Bulltoftagården **6660 ± 80**
 $\delta^{13}C = -25.6\%$

Hazel-nut shells from Layer 5a at Bulltoftagården, Malmö, S Scania (55° 35' 40" N, 13° 04' 20" E). Coll 1972 and subm by L Larsson, Hist Mus, Univ Lund. Assoc with transverse arrowheads and core axes (Early Ertebølle culture). Pretreated with HCl and NaOH. Sample undersized; diluted; 78% sample.

Ageröd V series

Hazel-nut shells and animal bone from refuse layer of Mesolithic settlement Ageröd V at raised bog Ageröds mosse, Munkarp parish, Scania (55° 56.5' N, 13° 25' E). Coll 1978 and subm by L Larsson. Results of study of settlement area pub by submitter (Larsson, 1978). For other dates from Ageröd V, see R, 1976, v 18, p 307-308. Hazel-nut shells pretreated with HCl and NaOH; bone collagen extracted as described previously (R, 1976, v 18, p 290) without NaOH treatment.

Lu-1622. Ageröd V, No. 016/003 **6680 ± 70**
 $\delta^{13}C = -25.3\%$

Well-preserved hazel-nut shells assoc with transverse and oblique arrowheads and blade tools (Early Ertebølle culture).

Lu-1623. Ageröd V, No. 016/003/0102 **6860 ± 70**
 $\delta^{13}C = -22.0\%$

Collagen from bone (centratarsale navicula cuboide) of *Alces alces* assoc with same artifact assembly as Lu-1622. *Comment*: organic carbon content: 7.3%.

General Comment (LL): on Lu-1617, -1622, and -1623 dates agree well with estimate based on artifact assemblage.

B. Denmark

Lu-1607. Svendborg, Franciscan monastery, IV A-AB 1 **780 ± 50**
 $\delta^{13}C = -24.8\%$

Charcoal (*Fagus* sp) id by T Bartholin from fire-stratum in chancel of monastery church in town of Svendborg, Fyn (55° 03' N, 10° 36' E). Coll 1978 by J Bech; subm by H M Jansen, Svendborg & Omegns Mus, Svendborg. For other dates from Svendborg, see R, 1976, v 18, p 318-319; 1977, v 19, p 437. Pretreated with HCl and NaOH.

C. Egypt

Sakkara series

Three samples assoc with mummy coll Aug 1735 in catacombs of Sakkara (*ca* 29° 51' N, 31° 14' E) by C F von Höpken and E Carlson (Leche, 1739, p 22-26); subm by E Cinthio, Hist Mus, Univ Lund. X-ray examination showed that mummy was embalmed with crossed arms, which places mummy approx between 1500 BC and 1085 BC (Ahlström, Håkansson, and Olin, 1978, p 33).

Lu-1503. Sakkara, Sample 1 **2410 ± 55**
 $\delta^{13}C = -24.5\text{‰}$

Wood from coffin in which mummy was found according to account of journey to Sachara by von Höpken and Carlson (Leche, 1739, p 26). Dated sample consisted of *ca* 20 tree-rings. Pretreated with NaOH.

Lu-1504. Sakkara, Sample 2 **3480 ± 55**
 $\delta^{13}C = -24.0\text{‰}$

Pieces of "pure" resin used for embalming of mummy. No pretreatment.

Lu-1505. Sakkara, Sample 3 **3460 ± 55**
 $\delta^{13}C = -22.9\text{‰}$

Pieces of resin with traces of bandages from mummy wrapping. No pretreatment.

REFERENCES

- Ahlström, C G, Håkansson, Sören, and Olin, Tord, 1978, Den egyptiska mumien på Museum Stobæanum i Lund: Sydsvenska Medicinhist Sällsk Årssk (Lund) 1978, p 17-42.
- Berglund, B E, ed, 1979, Palaeohydrological changes in the temperate zone in the last 15000 years. Subproject B. Lake and mire environments: Project Guide I, Dept Quaternary Geol, Univ Lund, 123 + 21 p.
- Björck, S, 1979, Late Weichselian stratigraphy of Blekinge, SE Sweden, and water level changes in the Baltic Ice Lake: Thesis, Univ Lund, Sweden, 248 p.
- Håkansson, Sören, 1974, University of Lund radiocarbon dates VII: Radiocarbon, v 16, p 307-330.
- 1975, University of Lund radiocarbon dates VIII: Radiocarbon, v 17, p 174-195.
- 1976, University of Lund radiocarbon dates IX: Radiocarbon, v 18, p 290-320.
- 1977, University of Lund radiocarbon dates X: Radiocarbon, v 19, p 424-441.
- 1978, University of Lund radiocarbon dates XI: Radiocarbon, v 20, p 416-435.
- 1979, University of Lund radiocarbon dates XII: Radiocarbon, v 21, p 384-404.
- Larsson, L, 1978, Ageröd I:B—Ageröd I:D. A study of Early Atlantic settlement in Scania: Acta Archaeol Lundensia, ser in 4°, No. 12, 258 p.
- Leche, Johannes, 1739, De Mumia Aegyptiaca, disputatio historico-medica (In latin with account of journey to Sachara by von Höpken and Carlson in Swedish): Thesis, Univ Lund.
- Lima-de-Faria, Antonio, 1977, Femtusenåriga rester av tall vid Rondanes nationalpark: Svensk Bot Tidskr, v 71, p 29-30.
- Mangerud, J, Andersen, S T, Berglund, B E, and Donner, J J, 1974, Quaternary stratigraphy of Norden, a proposal for terminology and classification: Boreas (Oslo), v 3, p 109-126.
- Rotnicki, Karol, 1966, Rzeźba Wzgórz Ostrzeszowskich jako rezultat rozwoju stoku podczas Würmu (English summary: The relief of the Ostrzeszów Hills as result of slope development during the Würm): Prace Komis Geog—Geol, Pozn Tow Przyj Nauk, v 5, no. 2, p 1-260.
- Strömberg, M, 1977, Bondesamhällén under Ingelstorps forntid: Kulturnämnden i Ystad 1977, 84 p.