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COPENHAGEN RADIOCARBON DATES IV

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The following list includes samples from sites or sections described in archaeologic or geologic publications. Several others, already dated, will be published when the archaeologic and geologic investigations are concluded.

INTRODUCTION

Counting technique.—All dates reported here were made with the proportional gas-counting technique. The counter is made of mild steel and has a sensitive volume of 2 liters. The sample is introduced in the counter as purified CO_2 at a normal pressure of 2 atmospheres, corrected for the standard temperature of 298.2°K. The counter is shielded with 8 inches of iron, a ring of 17 G-M counters arranged in anticoincidence with the proportional counter, and 1 inch of distilled mercury. The mercury is contained in the hollow wall of the counter itself. In this way radioactive dust cannot be deposited between the mercury shield and the proportional counter. All pulses larger than about 8 mV at the central wire are registered.

With this counting equipment the background is 5.2 counts/min at a barometric pressure of 760 mm Hg. The barometric effect on the background is 0.16 counts/min per cm Hg. The activity of contemporary material is 24.60 counts/min.

If necessary, samples are given a pretreatment with 1% phosphoric acid and 2% sodium hydroxide.

Age calculations.—For samples K-501 through K-595, the contemporary standard was tree rings from A.D. 1820-1830 derived from a beech tree which grew 10 km north of Copenhagen. For the rest of the dates the contemporary value was 95% of the activity of the oxalic-acid standard from U. S. National Bureau of Standards. This last value was chosen at the Groningen C^{14} conference in 1959 as a general standard for the calculation of radiocarbon ages. The value of 95% of the activity of the oxalic-acid standard falls close to the average activity of 19th century wood and also close to the average activity of living plant material during the last 1300 years (Willis, Tauber, and Münnich, 1960).

The activity of the Danish local standard, corrected for decay of C^{14}, is $5.3 \pm 0.4\%$ below the activity of the NBS oxalic acid. The difference between the local standard and 95% of the activity of the oxalic acid thus becomes $-0.3 \pm 0.4\%$ ($\Delta C^{14} = -3 \pm 4$ ‰ (Broecker and Olson, 1959)). This means that it has not been possible to measure a definite difference between the two standards on which the age calculations are based, and possible corrections to the dates K-501 to K-595 in order to make them comparable with dates based on the new standard are negligible.

With the corrections given in the Copenhagen III list, all dates from the Copenhagen laboratory thus may be considered as based on a contemporary value (a supposed initial activity of the samples) equal to 95% of the activity of the NBS oxalic-acid standard.

With this new standard the contemporary value in the age calculations is corrected for the effect of the dilution of atmospheric carbon dioxide with inactive carbon (Suess effect), but it is not corrected for the minor periodic variations in the atmospheric C^{14} activity discovered by de Vries (1958). This de Vries effect makes the whole radiocarbon scale uncertain within 100 to 150 years, at least in certain time periods.

The value 5568 $\pm$ 30 years has been used for the half-life of C^{14}.

The results are expressed in years before 1950; the ages in the B.C.-A.D scale, which are the official dates from the laboratory quoted in archaeologic and geologic papers, are given in parentheses in the sample descriptions. The errors given include the standard deviation (σ) of the count rate of the unknown sample, of the modern value, and of the background. Because errors arising from possible isotopic fractionation in the plants and from the de Vries effect have been disregarded, calculated errors smaller than 100 years have been increased by rounding to that figure as a minimum.

The dates have been arranged in the following tables:

Table I. Geologic and pollen-dated samples.

Table II. Archaeologic samples.

ACKNOWLEDGMENTS

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The samples were selected by a committee of archaeologists and geologists consisting of Therkel Mathiassen, Helge Larsen, and J. Troels-Smith, National Museum, Copenhagen, and Sigurd Hansen and Johs. Iversen, Danish Geological Survey.

The sample descriptions have been prepared in collaboration with the collectors and submitters of samples.

C^{13}/C^{12} ratios of the standards were kindly measured by W. Dansgaard, Biophysical Laboratory, University of Copenhagen.

Most samples were combusted by Elisabeth Steffensen.

SAMPLE DESCRIPTIONS

I. GEOLOGIC AND POLLEN-DATED SAMPLES

A. Netherlands

Usselo series

Samples from Allerød and Bølling section at Usselo (52° 10′ N Lat, 6° 50′ E Long), province of Overijsel, Netherlands. The site was excavated in 1955 by C. C. W. J. Hijszeler, Rijksmuseum Twenthe, Enschede. The section corresponds to van der Hammen's profile B (van der Hammen, 1951).

The material consisted of moss peat with dune sand. The samples were collected at three different places, a, b, and c in the same section, B. Depths of the layers are indicated relative to an arbitrary level designated by zero depth. The deposits at the three places could be correlated by means of a number of clearly visible key layers. The samples were taken in the presence of Sigurd Hansen and Harald Krog, Danish Geological Survey; H. T. Waterbolk and A. Bohmers, Biological-Arkaeological Institute, Groningen; and W. A. Zagwijn, Geological Survey, Haarlem. Detailed descriptions and pollen analyses of the sections have been made by Harald Krog (in preparation) who submitted the samples.

K-552. Usselo Bc I **11,300 ± 140**

Moss peat, sample Bc I, depth –14 to –17 cm. Allerød deposit. According to de Vries, Barendsen, and Waterbolk (1958), *Pinus* phase of Allerød. (Age 9350 ± 140 B.C.) *Comment*: material from the same level was dated in Groningen as Gro-925, 11,065 ± 120 (Groningen II; not corrected for Suess effect). Both dates agree with previous Allerød dates (Iversen, 1953; Copenhagen I and III; Godwin and Willis, 1959).

K-553. Usselo Bc III **11,620 ± 140**

Moss peat, sample Bc III, depth –40 to –44 cm. Allerød deposit. According to de Vries, Barendsen, and Waterbolk (1958), *Betula* phase of Allerød. (Age 9670 ± 140 B.C.) *Comment*: material from the same level was dated in Groningen as Gro-933 and Gro-948, average 11,700 ± 90; and Gro-947, 11,470 ± 90 (Groningen II; not corrected for Suess effect). The dates agree with previous Allerød dates (Iversen, 1953; Copenhagen I and III; Godwin and Willis, 1959).

K-547. Usselo Bb I **11,700 ± 140**

Moss peat, sample Bb I, depth 17 to 16 cm (corresponds to level –47 to –48 cm in section Bc). *Betula* phase of Allerød. (Age 9750 ± 140 B.C.)

K-541. Usselo Ba I **11,770 ± 140**

Moss peat, sample Ba I, depth 3 to 0 cm, (corresponds to –32 to –35 cm in section Bb). Top of Older Dryas, pollen zone Ic. (Age 9820 ± 140 B.C.) *Comment*: material from the same level was dated in Groningen as Gro-926, 11,825 ± 120 (Groningen II; not corrected for Suess effect).

K-542. Usselo Ba II **12,070 ± 140**

Moss peat, sample Ba II, depth –8 to –10 cm. Top of Bølling layer. (Age 10,120 ± 140 B.C.) *Comment*: when compared with K-541, the date indicates a very short time interval between the Bølling and the Allerød oscillation. The same was observed in Germany (Firbas, Müller, and Münnich, 1955; Heidelberg I).

K-543. Usselo Ba III **12,200 ± 140**

Moss peat, sample Ba III, depth –11 to –13 cm. Bølling deposit, immediately below Ba II. (Age 10,250 ± 140 B.C.) *Comment*: material from the same level was dated in Groningen as Gro-927, 12,355 ± 170 (Groningen II; not corrected for Suess effect).

K-544. Usselo Ba IV **12,410 ± 140**

Moss peat, sample Ba IV, depth –19 to –22 cm. Oldest Dryas, transition to Bølling. (Age 10,460 ± 140 B.C.)

K-545. Usselo Ba V **12,440 ± 140**

Moss peat, sample Ba V, depth –26 to –30 cm. Oldest Dryas. (Age 10,490 ± 140 B.C.) *Comment*: material from the same level was dated in Groningen as Gro-1104, 12,300 ± 100 (Groningen II; not corrected for Suess effect).

K-546. Usselo Ba VI **12,530 ± 140**

Moss peat, sample Ba VI, depth –36 cm. Oldest Dryas. (Age 10,580 ± 140 B.C.) *Comment*: material from the same level was dated in Groningen as Gro-928, 12,200 ± 100; and Gro-935, 12,380 ± 130 (Groningen II; not corrected for Suess effect).

B. DENMARK (INCLUDING GREENLAND)

Brørup series, Brørup-interstadial

Samples from the post-Eemian deposits at Brørup Hotel Bog (55° 29′ N Lat, 8° 56′ E Long), Brørup, Jutland. The deposits date from the first post-Eemian cold period and from the Brørup interstadial (Andersen, 1957). The interstadial peat and mud layers are protected by a solifluction deposit 2 m thick, of stony sand formed during a later cold period. Lowermost sample is from a mud layer immediately above the Eemian interglacial peat. As the layers are situated below the ground-water level, penetration of modern rootlets into the layers is improbable. Samples are noncalcareous.

The deposits were described and pollen-investigated by Andersen (1957). Samples for dating were exchanged between the dating laboratories in Copenhagen and Groningen and were dated at both stations (Tauber and de Vries, 1958). It was found that the samples were contaminated by younger material (perhaps humic acids), which could be extracted from the samples by a pretreatment with hydrochloric acid and sodium hydroxide. In Groningen all samples were dated as >50,000 (Tauber and de Vries, 1958). Coll. 1954 and subm. by Sv. Th. Andersen, Danish Geological Survey. The Brørup interstadial was dated subsequently by means of isotopically enriched material from the same locality (Andersen, de Vries, and Zagwijn, 1960).

K-512. Brørup interstadial, 2.70 to 2.80 m **>42,000**

Peat from depth 2.70 to 2.80 m, boundary between pollen zones W3 and W4.

K-528. Brørup interstadial, 2.85 to 2.90 m **>42,000**

Mud from depth 2.85 to 2.90 m, pollen zone W3 (subzone e).

K-510. Brørup interstadial, 3.61 to 3.67 m **>42,000**

Peat from depth 3.61 to 3.67 m, pollen zone W3 (subzone c).

K-526. Brørup interstadial, 3.95 to 4.08 m **>42,000**

Mud from depth 3.95 to 4.08 m, pollen zone W3 (subzone b).

K-511. Brørup, post-Eemian, 7.07 to 7.18 m **>42,000**

Mud from depth 7.07 to 7.18 m, pollen zone W1.

Draved series

Section in Draved Forest (55° 0′ N Lat, 8° 59′ E Long) at Løgumkloster, South Jutland. Section with unusually thick mor (terrestrial acid humus, purely organic) deposits from a podsol profile. The section contained two layers of charcoal separated by mor deposits; between the charcoal layers a layer with oak bark was interposed. The samples determine the age and the growth rate for such mor deposits (Iversen, in press). Coll. 1959 and subm. by Johs. Iversen, Danish Geological Survey.

K-596. Draved charcoal **2400 ± 100**

Charcoal (*Quercus* sp. and *Betula* sp.) from the lower layer in the section. Depth 47 to 50 cm below the present surface; 24 cm above sand. Dates a possible human interference in the forest at Draved (perhaps a superficial ground fire). (Age 450 ± 100 B.C.)

K-597. Draved bark **1900 ± 100**

Bark (*Quercus* sp.) from a layer with bark flakes between the two layers of charcoal. Depth 40 cm below the present surface; 32 cm above sand. Pollen-dated to immediately before the rise in the beech curve. From its thickness, the bark is estimated to contain fewer than 100 annual rings. This thickness may produce a date that is a little too old, as only the innermost layer of bark is contemporary with the sediment in which it is found. (Age A.D. 50± 100).

Store Saltsø series

Samples from terraces of lake Store Saltsø (66° 50′ N Lat, 50° 40′ W Long), Søndre Strømfjord, West Greenland. The terraces are designated by letters A-F, the lowermost or modern terrace being called A. The samples, which were taken out of the erosion slopes of terraces A and D, consisted of moss peat. The locality and the deposits are described, and the dates are discussed by Böcher (1959). Coll. 1956 and subm. by T. W. Böcher, University of Copenhagen.

K-562. Store Saltsø, terrace A **1080 ± 120**

Moss peat from a depth of 60 to 70 cm and 110 to 120 cm below the surface of the lowermost terrace A. (Age A.D. 870 ± 120.)

K-551. Store Saltsø, terrace D **2330 ± 140**

Moss peat from terrace D. (Age 380 ± 140 B.C.)

C. Poland

K-529. Krakow 1, Younger Dryas **10,760 ± 200**

Peaty gyttja from Nowy Targ (49° 27′ N Lat, 19° 59′ E Long), "na Gretu", Tatra Mountains, Poland. Supposed Younger Dryas deposit, interposed between an Allerød gyttja and postglacial deposits (Szafer, 1958). Coll. and subm. by Wl. Szafer, University of Krakow. (Age 8810 ± 200 B.C.) *Comment*: age confirms the correlation with Younger Dryas.

D. Colombia

Sabana de Bogotá series, section X

Samples from section X, Sabana de Bogotá (4° 38′ N Lat, 74° 5′ W

Long), Eastern Cordillera, Colombia. Samples taken from a hole, 4 m deep. near the building of the Servicio Geológico Nacional in the "Ciudad Universitaria" in Bogotá. The material was principally clay, locally humic, and locally with charcoal particles; ca. 350 cm thick and deposited (on top of a thick series of lake sediments) by floods. Pollen analyses of this series showed the existence of dry and wet climatic phases, and a cold climate in the lower part. It seems that the dry and wet phases correspond to the European Holocene phases, and the C^{14} dates confirm this view. The samples are listed in stratigraphic order (van der Hammen and Gonzalez, in press). Coll. 1956 and subm. by T. van der Hammen, University of Leiden, Netherlands.

K-576. Sabana de Bogotá, X, 25 **300 ± 180**

Charcoal (sample Col. 25), section X, depth 75 cm. The corresponding pollen zone represents the last and wet climate phase of the Holocene, which may be correlated with the European Sub-Atlantic. Date confirms this interpretation, although it was expected to be a little older. (Age A.D. 1650 ± 180.)

K-560. Sabana de Bogotá, X, 9 **8020 ± 120**

Charcoal (sample Col. 9), section X, depth 170 to 205 cm. This sample corresponds to the younger part of a dry-climate phase, which may be correlated with the European Boreal. The date confirms this interpretation. (Age 6070 ± 120 B.C.)

K-561. Sabana de Bogotá, X, 10 **8960 ± 400**

Charcoal (sample Co. 10), section X, depth 235 to 265 cm. The bulk of the charcoal of this interval comes from a horizon that corresponds in the pollen diagram to a phase of a gradually ameliorating climate, after a cold phase. This warmer phase seems to correspond to the European Pre-Boreal. The date confirms this interpretation. (Age 7010 ± 400 B.C.) *Comment*: sample was too small for a normal filling of the counter; this is reflected in the large error.

K-568. Sabana de Bogotá, X, 11 **23,850 ± 600**

Humic clay (sample Col. 11), section X, depth 320 to 345 cm. This sample corresponds to a cold zone in the pollen diagram, thought to be late (Würm) Pleniglacial or early Late-Glacial. (Age 21,900 ± 600 B.C.) *Comment*: date seems to be several thousand years too old for this interpretation. Possibly the sample contains older reworked interstadial peat, which comes very near to the surface 500 m S of section X. It may have been eroded and redeposited when the Sabana lake dried up.

Sabana de Bogotá series, section CUP

Samples from section CUP, Sabana de Bogotá (4° 38′ N Lat, 74° 5′ W Long), Eastern Cordillera, Colombia. Samples taken with a large Dachnowsky borer in the "Cuidad Universitaria", 500 m S of the building of the Servicio Geológico Nacional, near entrance to the park. The pollen suggests that the samples represent a Würm interstadial, which is present in section X but lies much deeper there. The material is from a peat layer occurring at depth 440 to 460 cm. A few cm above the peat there is an unconformity, the Holocene flood-clay lying immediately above (van der Hammen and Gonzalez, in press).

Coll. 1956 and subm. by T. van der Hammen, University of Leiden, Netherlands.

K-536. Sabana de Bogotá, CUP, 2a **>36,000**

Peat (sample Col. 2a), section CUP, depth 450 to 460 cm. (Age >34,000 B.C.)

K-538. Sabana de Bogotá, CUP, 2b **>36,000**

Peat (sample Col. 2b), section CUP, depth 450 to 460 cm. (Age >34,000 B.C.)

K-577. Páramo de Palacio **8130 ± 120**

Detritus gyttja, section "Laguna de la América", Páramo de Palacio (approx. 4° 46′ N Lat, 73° 51′ W Long), Eastern Cordillera, Colombia. Section taken with the Dachnowsky borer; the pollen represents the Holocene and the Late-Glacial. The detritus gyttja of the sample was taken just below a thin layer of volcanic ash. Pollen diagram suggests an Allerød age for the C^{14} sample (van der Hammen, in press). Coll. 1956 and subm. by T. van der Hammen, University of Leiden, Netherlands. (Age 6180 ± 120 B.C.) *Comment*: age determinations of four peat samples from nearby bogs were made by the U. S. Geological Survey laboratory: W-783, 2960 ± 200; W-781, 4740 ± 160; W-785, 2700 ± 200; W-782, 7210 ± 220 (USGS V) and confirm the interpretation of the upper part of our diagram from "Laguna de la América" as Holocene. In view of these dates, the Allerød pollen date of the present sample also seems to be correct, and the radiocarbon date may therefore be too young. Infiltration of younger material from above might be the cause.

II. ARCHAEOLOGIC SAMPLES

A. Greenland

K-518. Sarqaq Culture, Sarqaq **Average: 2760 ± 100**

Charcoal from Sarqaq (Mosegaard's dwelling place) (70° 0′ N Lat, 52° 0′ W Long), Ritenbenk, West Greenland, the type locality of Sarqaq Culture. Sample came from a hearth belonging to the culture horizon and was found together with chips and implements (*angmaq*) of Sarqaq Culture. Sample was thoroughly investigated by E. Tellerup who picked out remains of driftwood. The remainder originates exclusively from bushes (*Betula nana* L.) that grew in the country itself (Mathiassen, 1958). Coll. 1955 by J. Troels-Smith; subm. by Th. Mathiassen, National Museum, Copenhagen. (Average age 810 ± 100 B.C.) Date is the average of three countings on the same gas sample during 1.5 yr:

K-518 (1). **2610 ± 120**
K-518 (2). **2930 ± 120**
K-518 (3). **2750 ± 120**

Sermermiut series, Main Area B

Peat samples from section I, Main Area B, Sermermiut (69° 12′ N Lat, 51° 11′ W Long), Jacobshavn district, West Greenland. The section contained two separate culture deposits, a lower one (layers 2-3) chiefly with *angmaq*

chips and implements of Sarqaq Culture, and an upper one (layers 10-11) mostly containing chips of chalcedony but also with some *angmaq* and with implements of Dorset Culture. The intermediate layers (5-9) and those overlying (12-14 were sterile (Mathiassen, 1958). Coll. 1955 by J. Troels-Smith; and subm. by Th. Mathiassen, National Museum, Copenhagen.

K-516. Sermermiut B, 19 **Average: 2740 ± 100**

Highly humified peat from layer 3, taken immediately above implements of Sarqaq Culture. (Average age 790 ± 100 B.C.) Date is the average of three measurements:

K-516A.	**2550 ± 120**
K-516B.	**2990 ± 120**
K-516C.	**2670 ± 120**

K-515. Sermermiut B, 24 **Average: 1910 ± 100**

Swamp peat from upper culture deposit, taken immediately below implements of Dorset Culture. (Average age A.D. 40 ± 100.) Date is the average of two measurements:

K-515A.	**1920 ± 120**
K-515B.	**1900 ± 120**

K-517. Sermermiut B, 25 **Average: 1940 ± 100**

Swamp peat from upper culture deposit, taken immediately above implements of Dorset Culture. (Average age A.D. 10 ± 100.) Date is the average of two measurements:

K-517A.	**1850 ± 120**
K-517B.	**2040 ± 120**

Sermermiut series, Inugsuk Culture

Two samples from the Inugsuk Culture deposits in section I, Main Area A, Sermermiut (69° 12′ N Lat, 51° 11′ W Long), Jacobshavn district, West Greenland. In the lowermost part of the Inugsuk deposits was found a large lamp shaped from a slab of gneiss, the ends and the side walls being formed of clay. Peat samples were taken immediately below and above the lamp (Mathiassen, 1958). Coll. by J. Troels-Smith; subm. by Th. Mathiassen, National Museum, Copenhagen.

K-557. Sermermiut A, 17a **Average: 710 ± 100**

Wood (*Betula nana* L.) taken immediately below the lamp from Inugsuk deposit. (Average age A.D. 1240 ± 100.) Date is the average of two measurements:

K-557A.	**740 ± 120**
K-557B.	**670 ± 120**

K-556. Sermermiut A, 18a **940 ± 120**

Peat taken immediately above the lamp from Inugsuk deposit. (Age A.D. 1010 ± 120.)

K-563. Kap Holbaek, group I **3610 ± 120**

Charcoal from Kap Holbaek (80° 39′ N Lat, 23° 26′ W Long), Danmark Fjord, North Greenland. Found in ruin group I on a gravel terrace 12 m

above sealevel and associated with implements of Independence I Culture. Sample originates from driftwood which presumably was collected from the same terrace by the Eskimos (Knuth, 1954, 1956). Coll. 1955 and subm. by Eigil Knuth, National Museum, Copenhagen. (Age 1660 ± 120 B.C.) *Comment*: compare K-564 (this date list), and K-138 (Copenhagen III).

K-565. Kap Holbaek, group II **3000 ± 120**

Charcoal from Kap Holbaek (80° 39′ N Lat, 23° 26′ W Long), Danmark Fjord, North Greenland. Found in ruin group II on a gravel terrace 5 to 6 m above sealevel and associated with implements of Independence II Culture. Sample originates from driftwood which presumably was collected from the same terrace by the Eskimos (Knuth, 1954, 1956). Coll. 1955 and subm. by Eigil Knuth, National Museum, Copenhagen. (Age 1050 ± 120 B.C.) *Comment*: compare K-142 (Copenhagen III).

K-564. Naestved Fjord **3700 ± 120**

Charcoal from Naestved Fjord (80° 39′ N Lat, 23° 56′ W Long), Danmark Fjord, North Greenland. Found at a tent site (Den blå flints boplads) on a gravel terrace 12 m above sealevel and associated with implements of Independence I Culture. Sample originates from driftwood presumably collected at the same terrace by the Eskimos (Knuth, 1956). Coll. 1955 and subm. by Eigil Knuth, National Museum, Copenhagen. (Age 1750 ± 120 B.C.) *Comment*: compare K-563 (this date list) and K-138 (Copenhagen III).

K-566. Kølnaes **460 ± 100**

Baleen from Kølnaes (82° 40′ N Lat, 20° 65′ W Long), Herlufsholm Strand, Pearyland, North Greenland. Lashing-material from an umiaq (whale-hunting boat) associated with implements of the Neo-Eskimo Thule Culture (Knuth, 1951). Coll. 1949 and subm. by Eigil Knuth, National Museum, Copenhagen. (Age A.D. 1490 ± 100.)

K-567. Snenaes, Dove Bugt **410 ± 100**

Baleen from Snenaes (76° 49′ N Lat, 19° 21′ W Long), Dove Bugt, East Greenland. Found in house ruin no. 399 and associated with implements of the Neo-Eskimo Thule Culture. Coll. 1950 and subm. by Eigil Knuth, National Museum, Copenhagen. (Age A.D. 1540 ± 100).

B. Arctic Canada

Igloolik Area series

Two samples from the Igloolik area, NW Territories (69°-70° N Lat, 80°-82° W Long), Canada. Samples taken in cultural deposits on raised gravel beaches. House ruins were found on various sites on terraces up to 54 m above present sealevel, revealing three distinct Eskimo cultures: Thule (5- to 8-m terraces), Dorset (8- to 22-m terraces), and Sarqaq (23- to 54-m terraces) (Meldgaard, 1960). Coll. 1954 and subm. by Jørgen Meldgaard, National Museum, Copenhagen.

K-504. K'aersut Island **600 ± 150**

Antler of caribou from K'aersut Island (69° 29′ N Lat, 80° 19′ W Long),

Igloolik area. From house ruin of latest Dorset stage on 8-m terrace. The culture shows influence from the invading Thule people. Date gives the period of contact between the two cultures and probably the end of Dorset in this area. Sealevel was ca. 6.5 m higher than at present. (Age A.D. 1350 ± 150.) *Comment*: antler is liable to infiltration of foreign material. The surface layers of the sample were removed, therefore, before combustion.

K-505. K'aleruserk **3700 ± 300**

Antler of caribou from K'aleruserk, Igloolik Island (69° 23′ N Lat, 81° 48′ W Long). From house ruin at "Parry Hill site" on terrace 51 m above present sealevel. The culture stage represented is an early form of the Sarqaq Culture as described from West Greenland (Larsen and Meldgaard, 1958). Sealevel was ca. 50 m higher than at present. (Age 1750 ± 300 B.C.) *Comment*: as antler is liable to infiltration of foreign material, the surface layers of the sample were removed before combustion. The sample is identical to P-208, 3560 ± 123 (Rainey and Ralph, 1959); compare also P-209 (Rainey and Ralph, 1959).

C. Denmark

K-503. Grauballe Man **1640 ± 100**

Human flesh from bog corpse found at Grauballe (56° 12′ N Lat, 9° 41′ E Long), Viborg, Jutland. The body was naked and not associated with culture remains. On the front of the neck was a wound stretching from ear to ear. Pollen analyses suggest that the body is from Roman Iron Age (Glob, 1956; Jørgensen, 1956; Tauber, 1956a). Coll. 1952 and subm. by V. P. Glob, Prehistorical Museum, Aarhus, Denmark. (Age A.D. 310 ± 100.)

K-527. Dalshøj, Bornholm **2040 ± 100**

Charcoal from Dalshøj (55° 6′ N Lat, 15° 5′ E Long), Ibsker, Bornholm. At Dalshøj several Iron Age houses (A-G) were found at different superposed levels. In the southern half of the lowermost building (G) was a shallow pit in which the charcoal was found. Building G contained no metal objects but some pottery, suggesting that the house and the pit are pre-Roman (shortly before Christ) (Klindt-Jensen, 1957). Coll. and subm. by Ole Klindt-Jensen, National Museum, Copenhagen. (Age 90 ± 100 B.C.)

Viking ships, Roskilde Fjord series

Two samples from Viking ships found at Skuldelev (55° 48′ N Lat, 12° 4′ E Long), in Roskilde Fjord, Zealand. Several wrecks of old ships, presumably from the Viking Period, were found in a submarine excavation. The ships were sunk deliberately in order to block the narrow natural channel to the town Roskilde, probably for defense. Both samples were from the same wreck (Olsen and Crumlin Pedersen, 1958). Coll. 1958 and subm. by Olaf Olsen, National Museum, Copenhagen.

K-583. Viking ship, Roskilde Fjord, 1 **1010 ± 100**

Wood (*Quercus* sp.) from wreck II, Roskilde Fjord. The wood consisted of twigs and branches placed in the bottom of the ship in order to protect the planks against the load of stones used to sink it. Sample dates the time when the ship was sunk. (Age A.D. 940 ± 100.)

K-584. Viking ship, Roskilde Fjord, 4 **1040 ± 100**

Wool of sheep used as caulking between the planks in wreck II. Sample dates the time of construction of the ship. (Age A.D. 910 ± 100.)

K-585. Nørre Sandegaard, Bornholm **3870 ± 100**

Charred apples from Nørre Sandegaard (55° 11′ N Lat, 14° 59′ E Long), Østerlarsker, Bornholm. Found in a shallow pit no. 399, underneath a stone pavement belonging to a cairn of Early Bronze Age (Montelius III). The pit contained several specimens of cereal grains (einkorn, emmer, naked barley, club or bread wheat, and panicum) (Helbaek, 1952). The find must be older than Early Bronze Age. Traces of several Neolithic cultures were found at the site. Coll. 1951 and subm. by C. J. Becker, University of Copenhagen. (Age 1920 ± 100 B.C.)

K-586. Melsted, Bornholm **8190 ± 130**

Charred nut shells (hazel) from Melsted (55° 12′ N Lat, 14° 59′ E Long), Østerlarsker, Bornholm. Found in the lower part of a culture layer, 40 cm thick, with implements of Maglemose Culture (Melsted Group) (Becker, 1951). Coll. 1951 and subm. by C. J. Becker, University of Copenhagen. (Age 6240 ± 130 B.C.)

D. Iceland

K-589. Bergthorshvoll **1010 ± 100**

Charred wood (*Betula* sp.) from the farm Bergthorshvoll (63° 39′ N Lat, 20° 21′ W Long), Rangarvalla Syssel, Iceland. Bergthorshvoll was the farm of the Icelandic chief Njal, known from the famed medieval saga: The Story of Burnt Njal. The burning of Njal and his farm is supposed to have taken place in August A.D. 1011. The sample originates from an untouched charred layer, belonging to a cowshed, which was the lowermost of the culture layers. The overlying deposits had a thickness of 1.8 m. It is believed that this cowshed was burnt in the same fire in which Njal and his sons were burnt to death, but no final archaeologic proof can be given (Eldjarn and Gestsson, 1952). Coll. 1951 and subm. by K. Eldjarn, National Museum, Reykjavik. (Age A.D. 940 ± 100.) *Comment*: date agrees well with the historical tradition. It should be remembered that the timber of the house must have grown several years before the fire.

E. Germany

K-555. Zwenkau-Harth **5840 ± 120**

Charcoal from burnt post at Zwenkau-Harth (51° 15′ N Lat, 12° 21′ E Long), Kr. Leipzig, Germany. In the Danubian settlement at Zwenkau-Harth five phases of habitation were revealed, covering periods with linear pottery and with stroke-ornamented ware. Sample came from a posthole in a building, 36.5 m long, belonging to an early phase of the stroke-ornamented ware period (ältere Stichbandkeramik), which is the third phase of habitation at the settlement (Quitta, 1958). Coll. 1953 and subm. by H. Quitta, Institut für Vor- und Frühgeschichte der Karl Marx Universität, Leipzig. (Age 3890 ± 120 B.C.)

F. Syria

Hama series

Samples from strata in the citadel mound of Hama (35° 05′ N Lat, 36° 35′ E Long), Syria. The citadel mound of Hama (the old Hamath) was excavated by the Hama Expedition of the Carlsberg Foundation during the years 1931-1938. Excavation revealed habitation layers from the Neolithic and up to Hellenistic time. The present series consists of charcoal from house ruins belonging to Period J (subdivisions 4-6). Layer J5 indicates a large and sudden destruction of the town. Supposed age of the samples 2200-2100 B.C. (Fugmann, 1958). Coll. 1933 and subm. by P. J. Riis, University of Copenhagen.

K-530. Hama 1 **4260 ± 140**

Charcoal (*Alnus* sp.) from layer J6, found in a bowl in house, H 10, room 2, no. 4. (Age 2310 ± 140 B.C.)

K-531. Hama 2 **4180 ± 120**

Charcoal (*Olea europaeus*) from layer J5, found in a vessel in house, I 10/11, room 1, no. 2. (Age 2230 ± 120 B.C.)

K-533. Hama 3 **4160 ± 120**

Charcoal (*Platanus orientalis*) from layer J 4/5, found in a bowl, H 11, no. 4/5. (Age 2210 ± 120 B.C.)

G. United States of America

K-554. Lehner Mammoth Site, Arizona **11,170 ± 140**

Charcoal from the Lehner Mammoth Site (31° 25′ N Lat, 110° 06′ W Long), Cochise County, Arizona. Sample taken from hearth no. 2 on a sand bar in association with a deposit of bones and implements. The hearth was buried under layers of sand, swamp soil, and silt to a depth of ca. 3 m. Fauna included mammoth, horse, bison, and tapir. Implements included Clovis fluted points and cutting and scraping tools (Haury and others, 1959; Antevs, 1959; Lance, 1959). Coll. 1956 by W. W. Wasley; subm. by E. W. Haury, University of Arizona, Tucson. (Age 9220 ± 140 B.C.) *Comment*: charcoal from the same hearth was also dated at the University of Arizona as A-32, 7205 ± 450; A-30, 8330 ± 450; A-40a, 10,900 ± 450; and A-40b, 12,000 ± 450 (Arizona I) and Michigan as M-811, 11,290 ± 500 (Michigan IV). The agreement among the two oldest Arizona dates and the Michigan and Copenhagen dates is satisfactory.

References

Date lists:

Arizona I.	Wise and Shutler, 1958
Copenhagen I.	Anderson, Levi, and Tauber, 1953
Copenhagen II.	Tauber, 1956b
Copenhagen III.	Tauber, 1960
Groningen II.	de Vries, Barendsen, and Waterbolk, 1958
Heidelberg I.	Münnich, 1957
Michigan IV.	Crane and Griffin, 1959
USGS V.	Rubin and Alexander, 1960

Andersen, Sv. Th., 1957, New investigations of interglacial fresh-water deposits in Jutland. A preliminary report: Eiszeit. u. Gegenwart, v. 8, p. 181-185.

Andersen, Sv. Th., de Vries, Hessel, and Zagwijn, W. H., 1960, Climatic change and radiocarbon dating in the Weichselian glacial of Denmark and the Netherlands: Geologie en Mijnbouw, v. 39, p. 38-42.

Anderson, E. C., Levi, Hilde, and Tauber, Henrik, 1953, Copenhagen natural radiocarbon measurements I: Science, v. 118, p. 6-9.

Antevs, Ernst, 1959, Geological age of the Lehner Mammoth Site: Am. Antiquity, v. 25, no. 1, p. 31-34.

Becker, C. J., 1951, Maglemosekultur på Bornholm: Aarbøger for Nord. Oldkyndighed og Historie, p. 96-177. [English summary, p. 171-177.]

Böcher, T. W., 1959, Floristic and ecological studies in Middle West Greenland: Meddelelser om Grønland, v. 156, no. 5, p. 1-68.

Broecker, W. S., and Olson, E. A., 1959, Lamont radiocarbon measurements VI: Am. Jour. Sci. Radioc. Supp., v. 1, p. 111-132.

Crane, H. R., and Griffin, J. B., 1959, University of Michigan radiocarbon dates IV: Am. Jour. Sci. Radioc. Supp., v. 1, p. 173-198.

Eldjarn, K. and Gestsson, G., 1952, Rannsóknir á Bergthórshvoll: Arbók hins íslenzka fornleifafélags 1951-1952, p. 5-75. [English summary, p. 73-75.]

Firbas, F., Müller, H., and Münnich, K. O., 1955, Das wahrscheinliche Alter der späteiszeitlichen "Bölling"-Klimaschwankung: Naturwissenschaften, v. 42, p. 509.

Fugmann, E., 1958, Hama, Fuilles et recherches de la Fondation Carlsberg 1931-1938, L'architecture des périodes pré-Hellenistiques: Nationalmuseets skrifter, Større Beretninger IV, p. 1-283.

Glob, P. V., 1956, Jernaldermanden fra Grauballe: Kuml, p. 99-113. [English summary, p. 111-113.]

Godwin, H., and Willis, E. H., 1959, Radiocarbon dating of the Late-glacial Period in Britain: Royal Soc. [London] Proc., ser. B, v. 150, p. 199-215.

Hammen, T. van der, 1951, Late-glacial flora and periglacial phenomena in the Netherlands: Leidse Geol. Mededel., v. 17, p. 71.

———— in press, Holocene and late-glacial climate and vegetation history of Páramo de Palacio (Eastern Cordillera, Colombia, South America): Geologie en Mijnbouw, v. 22.

Hammen, T. van der, and Gonzalez, E., in press, Upper Pleistocene and Holocene climate and vegetation of the Sabana de Bogotá (Colombia, South America): Leidse Geol. Mededel., v. 25.

Haury, E. W., Sayles, E. B., and Wasley, W. W., 1959, The Lehner mammoth site, southeastern Arizona: Am. Antiquity, v. 25, no. 1, p. 1-30.

Helbaek, H., 1952, Preserved apples and panicum in the prehistoric site at Nørre Sandegaard in Bornholm: Acta Archaeol., v. 23, p. 107-115.

Iversen, Johs., 1953, Radiocarbon dating of the Allerød period: Science, v. 118, p. 9-11.

———— in press, Problems of the early post-glacial development in Denmark: Danmarks geol. Undersøgelse, ser. 4, v. 4, no. 3.

Jørgensen, Svend, 1956, Grauballemandens fundsted: Kuml, p. 114-129. [English summary, p. 128-129.]

Klindt-Jensen, Ole, 1957, Bornholm i folkevandringstiden: Nationalmuseets skrifter, Større Beretninger II, p. 1-320. [English summary, p. 239-259.]

Knuth, Eigil, 1951, Et umiaq-fund i Pearyland: Fra Nationalmuseets Arbejdsmark, p. 77-87.

———— 1954, The Paleo-Eskimo Culture of Northeast Greenland elucidated by three new sites: Am. Antiquity, v. 19, no. 4, p. 367-381.

————, 1956, Archaeology of the farthest North: Internat. Cong. Americanists, 32nd, Copenhagen 1956, Proc., p. 561-573.

Krog, Harald, in preparation.

Lance, J. F., 1959, Faunal remains from the Lehner Mammoth Site: Am. Antiquity, v. 25, no. 1, p. 35-39.

Larsen, Helge, and Meldgaard, Jørgen, 1958, Paleo-Eskimo Cultures in Disko Bugt, West Greenland: Meddelelser om Grønland, v. 161, no. 2, p. 1-75.

Mathiassen, Th., 1958, The Sermermiut excavations 1955: Meddelelser om Grønland, v. 161, no. 3, p. 1-52.

Meldgaard, Jørgen, 1960, Origin and evolution of Eskimo cultures in the eastern Arctic: Canadian Geog. Jour., v. 60, no. 2, p. 64-75.

Münnich, K. O., 1957, Heidelberg natural radiocarbon measurements I: Science, v. 126, p. 194-199.

Olsen, Olaf, and Crumlin Pedersen, O., 1958, The Skuldelev ships: Acta Archaeol., v. 29, p. 161-175.

Quitta, H., 1958, Die Ausgrabungen in der Bandkeramischen Siedlung Zwenkau-Harth, Kr. Leipzig, *in* Neue Ausgrabungen in Deutschland: Berlin, Gebr. Mann., p. 68-74.

Rainey, F. and Ralph, Elizabeth, 1959, Radiocarbon dating in the Arctic: Am. Antiquity, v. 24, no. 4, p. 365-374.

Rubin, Meyer, and Alexander, Corrinne, 1960, U. S. Geological Survey radiocarbon dates V: Am. Jour. Sci. Radioc. Supp., v. 2, p. 129-185.

Szafer, Wl., 1958, Spätglacial am nördlichen Fusse des Tatragebirges: Verhandl. der vierten Intern. Tagung der Quartärbotaniker 1957, Geobot. Inst. Rübel, Zurich, Veröffentl, no. 34.

Tauber, Henrik, 1956a, Tidsfaestelse af Grauballemanden ved kulstof-14 maaling: Kuml, p. 160-163. [English summary, p. 163.]

———— 1956b, Copenhagen natural radiocarbon measurements II: Science, v. 124, p. 879-881.

———— 1960, Copenhagen natural radiocarbon measurements III, corrections to radiocarbon dates made with the solid carbon technique: Am. Jour. Sci. Radioc. Supp., v. 2, p. 5-11.

Tauber, Henrik, and de Vries, Hessel, 1958, Radiocarbon measurements of Würm-interstadial samples from Jutland: Eiszeit. u. Gegenwart, v. 9, p. 69-71.

Vries, Hessel de, 1958, Variation in concentration of radiocarbon with time and location on Earth: Koninkl. Nederlandske Akad. Wetensch. Proc., ser. B, v. 61, no. 2, p. 1-9.

Vries, Hessel de, Barendsen, G. W., and Waterbolk, H. T., 1958, Groningen radiocarbon dates II: Science, v. 127, p. 129-137.

Willis, E. H., Tauber, Henrik, and Münnich, K. O., 1960, Variations in the atmospheric radiocarbon concentration over the past 1300 years: Am. Jour. Sci. Radioc. Supp., v. 2, p. 1-4.

Wise, E. N., and Shutler, Dick, Jr., 1958, University of Arizona radiocarbon dates: Science, v. 127, p. 72-74.