

TRONDHEIM NATURAL RADIOCARBON MEASUREMENTS VI

REIDAR NYDAL, STEINAR GULLIKSEN, KNUT LÖVSETH

Radiological Dating Laboratory
The Norwegian Institute of Technology, Trondheim, Norway

INTRODUCTION

This date list covers most of the datings made during 1968 to 1970. Each sample is measured in one of the two counters described previously (R., 1970, v. 12, p. 205-237).

Counter 2, with an effective volume of 1.5 L, has a present background and recent standard net count of 0.8 counts/min and 18.8 counts/min, respectively. Counter 3, with an effective volume of 1.1 L has a background of 2.4 counts/min and a recent standard net count of 14.2 counts/min. The counters are operated at a CO₂ pressure of 2 atmospheres.

Increasing demand for higher counting capacity on smaller amounts of sample material led to replacement of Counter 3 in 1971 by 2 new counters with cathode walls made from electrolytic copper plates supplied by AB Svenska Metallverken. They are both operated at 2 atmospheres CO₂ pressure. One of these counters (Counter 5) has an effective volume of 0.9 L, with background of 1.4 counts/min and recent standard net count of 11.7 counts/min. The other counter (Counter 6) has an effective volume of 0.6 L. Background and recent standard net count are 0.6 and 7.6 counts/min, respectively.

Realizing that the maintenance of our vacuum tube electronics would require increasing amounts of work and money, we designed new electronics by using integrated circuits. The prototype was operated in stability tests from the beginning of 1970. All our C¹⁴ units are now equipped with new electronics, and the results from the test period and the first 5 months of operation are very promising. The distribution of 65 individual counts on the background of Counter 6 gives $\sigma = \pm 0.028$ counts/min for each individual background count (20 hr). Approximately the same standard deviation is obtained by assuming Poisson distribution within the individual counting periods.

Samples of wood, charcoal, and peat are generally treated with 1M HCl and 1M NaOH to remove carbonates and humic acid. Treatment of peat with NaOH must be performed with caution, and is stopped before the solution of the peat has reached too far. The sample is placed in a glass filter and 300 ml hot NaOH is added. Sample is then filtered within a few seconds with a pump. Shells are washed, dried, and surface treated with diluted H₃PO₄. Generally the weight of the shells is reduced 10 to 20% by this treatment. In some cases an inner and an outer fraction of the same shells are dated separately to validate the surface treatment. Normally the difference in age for the two fractions is negligible; there are, however, exceptions where age differences are >500 yr for a sample ca. 10,000 yr old.

Most samples were counted for 1200 min, diluted samples 2400 min. Alternating counting sample/background is applied for samples older than 30,000 yr, total counting time 10,000 min. Background is counted weekly for 1200 min, recent standard 2400 min each 2nd week.

All dates are calculated both in years before present (1950) and in the A.D./B.C. scale. The applied C^{14} half-life is 5570 yr; its standard deviation of ± 30 yr is not included in the standard deviation (1σ) of the dating results. We no longer find δC^{13} measurements of every sample very important, as corrections for fractionation error very seldom exceed 30 yr. δC^{13} measurements are performed mainly for scientific interest in studying geophysical problems. δC^{13} correction may be of some interest for very young samples, or for samples of doubtful origin. Relative to the PDB standard applied by Craig (1961), the normal C^{13} value in land vegetation is -25% , and the C^{14} activity in material from the land biosphere is corrected for isotopic fractionation to this value.

Shell samples from the Norwegian coast have δC^{13} values distributed around a mean value close to 0% relative to PDB. In 1957, when dating was started, samples of recent shells with such δC^{13} values from the Trondheimsfjord were found to have C^{14} activity, corrected for age and contaminating effects, very close to 95% of the NBS oxalic standard. This result is now confirmed by the measurements on a series of 10 recent shell samples (T-951 to T-960, this date list) from various parts of the Norwegian coast. Most shell samples are not analyzed for δC^{13} . When it is measured, the samples have been corrected to a δC^{13} value of 0% . According to the observed correlation between recent shell activity and the oxalic acid standard, this method of calculation should give the true age of a shell sample.

Some other laboratories (e.g., Lund and Uppsala) are correcting shell samples to a δC^{13} value of -25% . The age of a shell sample, calculated by this method, is too great by a number of years corresponding to the apparent radiocarbon age of the sea water in which the shell originated. This has to be evaluated and subtracted to obtain the true age of the sample. Our opinion is that this method is of particular interest when recent shell activity is used in the study of geophysical problems. We feel however that submitters generally are more interested in having a probably true age for a sample than facing the circulation problems of the ocean water masses. Consequently we have decided to maintain our method of presenting shell dates.

ACKNOWLEDGMENTS

The authors wish to thank collectors and submitters of the samples for their collaboration in preparing the manuscript. C^{13}/C^{12} ratios are measured by R. Ryhage, Karolinska Inst., Stockholm. Further thanks to Elsa Riiser and Fred Skogseth for treating the samples. Financial support from Norges Almenvitenskapelige Forskningsråd is fully acknowledged.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Norway

1. Interstadial and interglacial samples

- T-922. Skagerak moraine, Jaeren** +6200
41,300
—3500

Marine shells at +160 m from the Skagerak moraine at Opstad, Jaeren (58° 40' N Lat, 5° 42' E Long), Rogaland, Norway. Coll. by K. O. Björlykke; subm. 1970 by B. G. Andersen, Univ. Bergen. *Comment* (B.G.A.): only broken shells were found, and they are younger than the Skagerak moraine. They were deposited during a mid-Weichsel warm phase when Jaeren was deglaciated (Andersen, 1964).

- T-923. Gann clay pit, Jaeren** +4500
41,400
—2900

Marine shells from Gann clay pit, at +30 m at Sandnes, Jaeren (58° 48' N Lat, 5° 45' E Long), Rogaland, Norway. From depth 8 m in glaciofluvial gravel, under- and overlain by clay with *Yoldia*. 1 m thick till covers the surface. Coll. 1968 and subm. 1970 by B. G. Andersen. *Comment* (B.G.A.): shells lived at Jaeren during a mid-Weichsel warm phase, and the upper part of the clay is younger than the shells.

- T-921. Hauer seter m. 1-69** +3900
40,000
—2600

Reindeer antlers from a sand pit with top surface at +210 m in Hauer seter delta, 3.5 km N of Jessheim (60° 10' N Lat, 11° 10' E Long), Akershus, Norway. Material in the 10 m deep sand pit is coarse grained on the top and finer towards bottom. Coll. 1966 by O. Kristiansen; subm. 1970 by S. R. Östmo, Univ. Oslo. *Comment* (S.R.Ö.): sample was under avalanche material at the bottom of the sand pit and was thus supposedly either interglacial (>30,000 yr) or same age as delta.

Karmøy series, Hordaland

Marine shells from Nygaard at +11 m in Karmøy (59° 14' N Lat, 5° 15' E Long), Hordaland, Norway. Shell-bearing gravel (II) on rock surface lies below 5-m-thick marine sand and clay (I), strongly folded and till-like in upper part. Sample II from depth 5 m, from shell-bearing gravel; Sample I from depth 4.5 m, from sandy clay. Coll. by P. A. Öyen, Univ. Oslo; subm. 1969 by B. G. Andersen.

- T-796. Nygaardsprofilet I** 39,000 ± 2000

- T-797. Nygaardsprofilet II** 42,000 ± 2000

Comment (B.G.A.): dates agree well with dates from Jaeren and

a date of shells from till near Nygaard. They indicate SW coast of Norway was deglaciated during mid-Weichsel (Öyen, 1905).

Fjösanger series, Bergen

Shell fragments and wood in para-autochthonous marine sediments from Fjösanger, Fana, Bergen (60° 21' N Lat, 5° 20' E Long), Hordaland, Norway. Sediments had been overridden by ice. Seal bones and a lump of gyttja were in sediments. Coll. and subm. 1968 by Jan Mangerud, Univ. Bergen.

	+ 5000
T-749. Fjösanger shell-fragments	46,000
	— 3000
T-748. Fjösanger wood	>40,000

Comment (J.M.): pollen analyses indicate sediments are interglacial (Mangerud, 1970a). Shell fragments were from different parts of sediment close to present surface. Date (T-749) is considered only minimum.

2. Postglacial samples

	8210 ± 110
T-1100. Ullevål Stadion	6260 B.C.

Wood, part of pine (*Pinus silvestris*) trunk, found below 2 to 2.5 m clay at +98 m (*i.e.*, present surface) near Ullevål Stadion, Oslo (59° 57' N Lat, 10° 44' E Long), Norway. Coll. 1948 and subm. 1971 by Anders Danielsen, Bot. Mus., Univ. Oslo, Norway. *Comment* (A.D.): soil samples from pine forest bottom enclosing trunk, gave almost exclusively pollen of *Pinus*, *Betula*, *Corylus*, *Filices*, strongly indicating Boreal age 8000 to 9000 B.P. (Hafsten, 1956, 1960). A land slide (Holte-dahl, 1953) caused the pine forest to be buried under anaerobic conditions in clay at sea level.

	8240 ± 110
T-852. Vikedal II, Rogaland	6290 B.C.

Gyttja from 2.5 m deep bog at +85 m in Solheim, Vikedal (59° 32' N Lat, 5° 57' E Long), Rogaland, Norway. Coll. at depth 1.75 m in a drainage trench. Coll. and subm. 1969 by Karl Anundsen, Univ. Bergen. *Comment* (K.A.): bog rests on glacio-lacustrine silt and sand; glacial lake dammed by an ice-lake presumably in Younger Dryas time. Sediments are found up to +130 m, indicating that T-852 dates lake surface below +85 m, and not time for maximum extent.

	8330 ± 100
T-853. Vikedal III, Rogaland	6380 B.C.

Gyttja from base of 2.5 m deep bog at +430 m between 2 great moraine ridges in Sötehei, Vikedal (59° 33' N Lat, 6° 03' E Long), Rogaland, Norway. Coll. with a Livingstone sampler. Sample coll. to date moraines, which correspond with Ra-moraines in Ryfylke (Andersen, 1954; 1960). Coll. and subm. by K. Anundsen. *Comment* (K.A.): T-853 seems too young.

Moraine series, Hordaland

Gyttja from a bog, 4 m deep at +56 m at Ryggjaheim Ungdoms-herberge between Sandeid and Ölen (59° 34' N Lat, 5° 49' E Long), Hordaland, Norway. Bog underlain by clay. From base 0.05 m gyttja (Sample I is from the upper 0.03 m of this layer), 0.03 m clay, gyttja until the top. Coll. and subm. 1967 by K. Anundsen.

T-663. Ryggjaheim I

0.02 to 0.05 m above base.

9900 ± 220**7950 B.C.****T-839. Ryggjaheim II**

0.08 to 0.13 m above base.

8770 ± 130**6820 B.C.**

Comment (K.A.): T-663 and T-839 date clay horizon near base of bog. Clay is supposedly result of a climatic deterioration. T-663 and T-839 thus date this deterioration (in Pre-Boreal time). T-839 is presumably too young.

T-585. Busnes, Kinsarvik

Gyttja from base of 3 m deep bog, on a great flat at +110 m in Busnes, Kinsarvik, Hardanger (60° 28' N Lat, 5° 56' E Long), Hordaland, Norway. Coll. and subm. 1966 by K. Anundsen. *Comment* (K.A.): T-585 dates a marine shore level, approx. corresponding with marine limit in a glacial front-delta in Eidfjord, further inland. T-585 thus gives approx. age of front-delta in Eidfjord.

9720 ± 330**7770 B.C.****T-790. Ulvik 6, Hordaland**

Pine wood from lake Instavatnet, Ulvik, Hardanger (60° 36' N Lat, 7° 00' E Long), Hordaland, Norway. From a pine log in bog ca. +700 m, and 150 to 200 m above present pinewood limit. Coll. and subm. 1968 by Asbjörn Simonsen, Stavanger Mus., Stavanger. *Comment* (A.S.): date fully agrees with pollen diagrams from same area which show pinewood reached upper tree line during Atlantic period.

5980 ± 90**4030 B.C.****T-791. Ulvik 7, Hordaland**

Gyttja from bog, 0.86 m below surface, at +950 m at lake Svartavatnet, Ulvik, Hardanger (60° 37' N Lat, 7° 00' E Long), Hordaland, Norway. Coll. and subm. 1968 by A. Simonsen. *Comment* (A.S.): dates upper part of "Eidfjord-Osa" cold spell of Pre-boreal age. This colder phase can be traced both in pollen diagram from lake Svartavatnet, and in glacial deposits (Anundsen and Simonsen, 1968).

9040 ± 140**7090 B.C.****T-792. Ulvik 12, Hordaland**

Peat from 0.84 m below surface in same bog as T-791. Coll. and subm. 1968 by A. Simonsen. *Comment* (A.S.): see T-791.

8720 ± 130**6770 B.C.**

Öyren series, Jaeren

Peat and gyttja from bog dammed up by a beach ridge close to shore at Öyren, Hå, Jaeren (58° 33' N Lat, 5° 41' E Long) Rogaland, Norway. Boat shed sites at +1 m in bog (Simonsen, 1969). Coll. and subm. 1969 by A. Simonsen.

T-866. Öyren 1 **640 ± 60**
 0.80 m below surface. **A.D. 1310**

T-867. Öyren 2 **580 ± 60**
 0.50 m below surface. **A.D. 1370**

T-868. Öyren 3 **670 ± 60**
 0.35 m below surface. **A.D. 1280**

T-869. Öyren 4 **1190 ± 60**
 0.15 m below surface. **A.D. 760**

0.15 m below surface. *Comment* (A.S.): T-866–T-868 date regrowth of former lagoon, once used as harbor. Dates indicate boat sheds must be medieval or older. T-869 supposedly contaminated by inactive carbon.

T-752. Os, Hordaland **10,790 ± 110**
8840 B.C.

Shell (*Mya truncata*, *Saxicava pholas*) from clayey till just above bed-rock surface in center (Osöyri) of Os (60° 11' N Lat, 5° 28' E Long), Hordaland, Norway. Coll. and subm. 1968 by Jan Mangerud, Univ. Bergen. *Comment* (J.M.): fabric of long axes of pebbles parallel to youngest glacial striae on rock surface beneath (Mangerud, 1970b).

T-846. Eikangervåg, Hordaland **11,930 ± 140**
9980 B.C.

Shell (*Chlamys islandicus*, *Saxicava* sp.) from fossil-bearing till, below till layer without fossils, at Eikangervåg, Lindås (60° 36' N Lat, 5° 24' E Long), Hordaland, Norway. Coll. and subm. by J. Mangerud. *Comment* (J.M.): date indicates rapid retreat of ice during Alleröd Interstadial (Mangerud, 1970b).

T-750. Sandviken, Bergen **12,470 ± 150**
10,520 B.C.

Shell (*Chlamys islandicus*) in clay below 2 beds of till in Sandviken, Bergen (60° 25' N Lat, 5° 20' E Long), Hordaland, Norway. Coll. and subm. 1968 by J. Mangerud. *Comment* (J.M.): date indicates Bergen area was ice free during Bölling Interstadial (Mangerud, 1970b).

T-751. Grieghallen, Bergen **11,400 ± 110**
9450 B.C.

Shell (*Chlamys islandicus*) in clay at Grieghallen, Bergen (60° 25' N Lat, 5° 20' E Long), Hordaland, Norway. Coll. and subm. 1968 by

J. Mangerud. *Comment* (J.M.): clay was consolidated by pressure of over-riding glacier. Stratigraphy not clear (Mangerud, 1970b).

Aurlandsdalen series, Sogn og Fjordane

Gyttja coll. with a 54 mm piston borer at various levels in 2.60 m deep bog at +150 m in Loven, Aurlandsdalen (60° 53' N Lat, 3° 28' E Long), Sogn og Fjordane, Norway. Coll. 1969 and subm. 1970 by Björn Bergström, Univ. Bergen.

7180 ± 100
5230 B.C.

T-985. Loven (BB54)
1.25 to 1.28 m below surface. *Comment* (B.B.): dates rise of *Pinus* in pollen diagram.

9590 ± 140
7640 B.C.

T-986. Loven (BB54.9,1 and 9,2)
2.52 to 2.55 m below surface just above silt. *Comment* (B.B.): dates minimum C¹⁴ age of deglaciation in this part of Aurlandsdalen. Corresponds to high *Betula* and low *Pinus* values in pollen diagram (Bergström, 1971; Anundsen and Simonsen, 1968; Klovning and Hafsten, 1965).

Torgarden series, Haramsøy

Peat from Torgarden, Haramsøy (62° 40' N Lat, 6° 13' E Long), Möre og Romsdal, Norway. From 0.95 m thick peat at ca. +8 to 10 m between basal coarse sands and overlying (Tapes?) beach deposit 8 to 10 m high (known locally as "Remen"). Coll. and subm. 1969 by U. Hafsten, Univ. Trondheim. *Comment* (U.H.): microfossil finds in or between dated layers suggest peat was formed near margin of a lagoon lake, which received inwash from adjacent dry land communities. After gradually becoming shallower, water appears to have had final deepening phase, related to rise in relative sea level and increased precipitation, with appearance of *Phragmites* in the swamp. Possible explanation for unrelated dates of T-827 II and T-830, may be penetration by *Phragmites* and *Salix* roots.

9480 ± 150
7530 B.C.

T-827 I. Torgarden A
0 to 0.05 m above basal sand.

9640 ± 120
7690 B.C.

T-827 II. Torgarden I
0.15 to 0.20 m above basal sand. Pollen diagram (Pre-Boreal) shows high (80%) *Betula* and start of *Corylus* curve, just above a *Cyperaceae* pollen maximum (90%).

8920 ± 110
6970 B.C.

T-828. Torgarden II
0.40 to 0.45 m above basal sand. Pollen diagram (Pre-Boreal) shows brief *Betula* minimum and corresponding maxima for *Pinus* and *Salix*, with a marked maximum (80%) of health plants (mainly *Empetrum*).

T-829. Torgarden III **8340 ± 140**
6390 B.C.

0.65 to 0.70 m above basal sand. Pollen diagram (Pre-Boreal/Boreal) shows marked decrease in *Betula* and a corresponding increase in *Pinus*, with the 1st low *Corylus* values, and increase in *Cyperaceae* pollen (70%).

T-830. Torgarden IV **8360 ± 110**
6410 B.C.

0.75 to 0.80 m above basal sand. Pollen diagram (early Atlantic) shows beginning of *Alnus* curve and lies near *Pinus* maximum. Continued high values of *Cyperaceae* and increase in *Salix*.

T-831. Torgarden V **7280 ± 100**
5330 B.C.

0.90 to 0.95 m above basal sand. Pollen diagram (early Atlantic) shows rational *Alnus* limit ($A_o = 10\%$), with continued high *Alnus* values (50%) (Hafsten and Tallantire, ms. in preparation).

Fuglemyra series, Trondheim

Peat from various levels in bog profile at ca. +160 m in Fuglemyra, Steinan, Trondheim (63° 24' N Lat, 10° 43' E Long), Sør-Trøndelag, Norway. Coll. 1967; subm. 1970 by Ulf Hafsten and K. V. Knudsen, Univ. Trondheim.

T-977. Steinan 1 **740 ± 50**
A.D. 1210

From depth 0.45 m. Pollen analysis (K.V.K.): Sub-Atlantic. *Comment* (U.H.): dates rational *Picea* limit (P_o).

T-978. Steinan 2 **1930 ± 80**
A.D. 20

From depth 0.75 m. Pollen analysis (K.V.K.): early Sub-Atlantic. *Comment* (U.H.): dates start of agriculture in area (Cerealia-curve) and empirical *Picea* limit (P_e).

T-979. Steinan 3 **3910 ± 100**
1960 B.C.

From depth 1.25 m. Pollen analysis (K.V.K.): Sub-Boreal. *Comment* (U.H.): dates *Corylus* maximum just after main decline of *Ulmus*.

T-980. Steinan 4 **8270 ± 70**
6320 B.C.

From depth 2.65 m. Pollen analysis (K.V.K.): Boreal. *Comment* (U.H.): dates point at which the curves for *Betula* and *Pinus* intersect (rising *Pinus*).

Koltjänn series, Nord-Trøndelag

Samples coll. with a Hiller borer in lake Lille Koltjänn, at ca. +159 m in Skage, Overhalla (64° 32' N Lat, 11° 45' E Long), Nord-Trøndelag, Norway. Coll. and subm. 1968 by B. Vorren, Univ. Trond-

heim. *Comment* (B.V.): lake L. Koltjönn is just above marine limit, and series gives general vegetational development in bedrock area of middle Namdalen.

8020 ± 150
6070 B.C.

T-726. L. Koltjönn I

Fine detritus-dy, 7.05 to 7.15 m below surface. Pollen analysis (B.V.): beginning of Atlantic period. *Comment* (B.V.): dates beginning of *Alnus* expansion of area. First part of Atlantic period in Namdalen is dominated by *Alnus*.

5610 ± 110
3660 B.C.

T-727. L. Koltjönn II

Fine detritus-dy, 6.05 to 6.15 m below surface. Pollen analysis (B.V.): 2nd part of Atlantic period. *Comment* (B.V.): dates final fall of *Alnus* curve, just below maximum of *Ulmus*. *Ulmus* in bedrock area of Namdalen reaches maximum 7% of total three-pollen. Farther E in *Cambro-Silurian* area, *Ulmus* reaches ca. 20% of total three-pollen sum.

4300 ± 100
2350 B.C.

T-728. L. Koltjönn III

Wood pieces, 3.90 to 4.00 m below surface. Pollen analysis (B.V.): beginning of Sub-Boreal period. *Comment* (B.V.): wood layer was ca. 0.20 m above a preliminary 5% *Picea* phase. This spruce is connected with climatic deterioration ca. 2500 B.C. Preliminary spruce occurrences before expansion are quite common in Namdalen area.

Kirkemyra series, Nord-Trøndelag

Sphagnum peat from peat bog near church of Skage, Overhalla (64° 27' N Lat, 11° 45' E Long), Nord-Trøndelag, Norway. Bog, which is now drained and overgrown with pine, is ca. 3 m deep and at ca. +12 m. Coll. and subm. 1968 by B. Vorren.

1800 ± 80
A.D. 150

T-784. Kirkemyra I

Low humified *Sphagnum* peat 1.85 to 1.90 m below surface. *Comment* (B.V.): dates time of landnam phase in area. Skage/Hunn is one of oldest farm sites in middle Namdalen. Date fits very well with former archaeological date of earliest Iron age settlements in Namdalen (Sandnes, 1965). Birch forest was cleared, and *Graminae* and *Rumex* rise rapidly. Soon after cereal and weed pollen appear. Just after clearing, *Picea* curve rises from 1 to 6 to 7%.

920 ± 80
A.D. 1030

T-785. Kirkemyra II

Sphagnum peat, 0.95 to 1.05 m below surface. *Comment* (B.V.): dates predominating cultivation phase. *Picea* curve reached 15%, but rises rapidly later on.

Åsmyra series, Nord-Trøndelag

Peat from bog Åsmyra at ca. +45 m in Skage, Overhalla (64° 27'

N Lat, 11° 46' E Long), Nord-Trøndelag, Norway. Coll. and subm. 1970 by B. Vorren. *Comment* (B.V.): bog is ca. 2 km N of recent settlement in Skage area, and is now surrounded by spruce forest of high quality. Vegetation of this hill region is one of richest in Overhalla (Vorren, 1970; 1971).

T-937. Åsmyra I **1700 ± 80**
A.D. 250

Brown-moss peat coll. by Hiller borer 1.50 to 1.55 m below surface and close above humus-colored clay, ca. 0.10 m thick. *Comment* (B.V.): dates clearing and settling in area, where no farms are now situated.

T-938. Åsmyra II **1130 ± 80**
A.D. 820

Sphagnum peat coll. by Hiller borer 1.35 to 1.40 m below surface. *Comment* (B.V.): dates time when spruce curve exceeds 10%. *Picea* replaces *Betula* which formerly dominated this hill area. Rise of *Picea* curve is very slow; most diagrams from Namdalen show rapid *Picea* rise.

Lifjellet series, Nord-Trøndelag

Sphagnum-Cyperaceae peat from 2.05 m deep topogenous bog, ca. +400 m on Lifjellet, between Gosen and Sibirien, Nordli (64° 29' N Lat, 13° 08' E Long), Nord-Trøndelag, Norway. Coll. and subm. 1970 by B. Vorren. *Comment* (B.V.): Lifjellet series is part of a pollen-analytic study of *Picea* immigration to Trøndelag and Nordland, middle Norway.

T-973. Lifjellet I **2150 ± 70**
200 B.C.

Sphagnum-Cyperaceae peat from depth 0.53 to 0.56 m with a 4-in. iron tube. Peat consists of *Cyperaceae*-rootlets, treated with 5% KOH for 24 hr, then treated with 5% HNO₃, and sieved through a 1 mm sieve. Fine grained material in filtrate was dated. Pollen analysis (B.V.): early Sub-Atlantic. *Comment* (B.V.): dates expansion of *Picea* in area; *Picea* pollen curve exceeds 10%. Maximum *Picea* in diagram is 30%.

T-974. Lifjellet II **7300 ± 100**
5350 B.C.

Carex-Sphagnum peat coll. with Hiller borer at depth 1.62 to 1.68 m. Pollen analysis (B.V.): early Atlantic. *Comment* (B.V.): dates some preliminary *Picea*, reaching 2%. *Pinus* curve descends from a *Pinus* phase, *Betula* and, soon after, *Alnus* curve ascends.

Brennmoan series, Nord-Trøndelag

Sphagnum-Cyperaceae peat from 0.75 m minerogenous bog, ca. +90 m in Brennmoan, Öysletta, Overhalla, (64° 29' N Lat, 12° 05' E Long), Nord-Trøndelag, Norway. From 0.20 × 0.20 m peat core. Coll. 1969 and subm. 1970 by B. Vorren. Material for C¹⁴ is treated in the same way as Lifjellet I (T-973). *Comment* (B.V.): Brennmoan series is part of pollen-analytic study connected with historian "Ödegård" project of

events about time of the Black Death. Bog is some meters below an ancient farm being excavated by Kr. Möllenus, Videnskapsselskapets Oldsaksamling, Trondheim. Farm is ca. 1 to 2 km SE of recent settlement of Öysletta.

T-975. Brennmoan I

**530 ± 60
A.D. 1420**

From depth 0.34 to 0.36 m below surface. Pollen analysis (B.V.): late Sub-Atlantic. *Comment* (B.V.): dates cessation of descending curves for barley, oats and weeds, just before sharp *Picea* expansion from 10 to 70%. Farm was probably abandoned at time of *Picea* expansion.

T-976. Brennmoan II

**1420 ± 80
A.D. 530**

From depth 0.52 to 0.54 m below surface. Pollen analysis (B.V.): Sub-Atlantic. *Comment* (B.V.): dates settlement of farm.

T-786. Ekle-Tiller I, Trondheim

**10,230 ± 130
8280 B.C.**

Shells (*Barnacles*) from Ekle gravel pit at +150 m, Ekle, Trondheim (63° 22' N Lat, 10° 26' E Long), Sör-Trøndelag, Norway. From layer of sandy clay 25 m below marine limit and above an outwash delta. Coll. 1967 and subm. 1968 by Arne Reite, Norges Geol. Undersøkelse, Trondheim. *Comment* (A.R.): indicates Ekle-Tiller outwash delta was deposited during Younger Dryas sub-stage (Holtedahl, 1928; Undås, 1934; Öyen, 1915).

T-787. Ekle-Tiller II, Trondheim

**11,290 ± 190
9340 B.C.**

A whale vertebra from Tiller gravel pit, at +150 m at Tiller, Trondheim (63° 22' N Lat, 10° 24' E Long), Sör-Trøndelag. From outwash delta at depth 15 m. Age is older than, or simultaneous with outwash sediments (> 9000 yr). Coll. 1962 by Karl Skjetne, Tiller; subm. 1968 by A. Reite. *Comment* (A.R.): indicates Trondheim area was ice free in Alleröd time.

T-854. Ekle-Tiller III, Trondheim

**10,150 ± 100
8200 B.C.**

Shells (*Mya truncata*) from Ekle gravel pit, at +150 m, Ekle, Trondheim (63° 22' N Lat, 10° 26' E Long), Sör-Trøndelag, Norway. From marine clay at 25 m below marine limit and above outwash delta at Ekle-Tiller. Coll. and subm. 1969 by A. Reite. *Comment* (A.R.): indicates Ekle-Tiller outwash delta was deposited during Younger Dryas sub-stage. *Barnacles* from this locality were dated at 10,230 ± 130 yr (T-786).

T-756. Nordsand, Nordland

**5520 ± 110
3570 B.C.**

Peat from base of 1.60 m thick bog profile in Nordsand, Öksnes (68° 55' N Lat, 14° 55' E Long), Nordland, Norway. Coll. and subm.

1968 by Dagfinn Moe, Univ. Bergen. *Comment* (D.M.): dates beginning of ombrosoligenous bogs in Nordsand.

860 ± 70

T-757. Röstlandet, Nordland

A.D. 1090

Sphagnum peat from base of regrown basin at 0.54 to 0.57 m depth on Röstlandet, Röst (67° 32' N Lat, 12° 10' E Long), Nordland, Norway. Coll. and subm. 1968 by D. Moe.

1700 ± 70

T-927. N Helløy, Nordland

A.D. 250

Ericaceous peat coll. with a piston borer from basal layer of 0.90 m deep bog profile in N Helløy, Röst (67° 31' N Lat, 12° 09' E Long), Nordland, Norway. Coll. 1969 and subm. 1970 by D. Moe. *Comment* (D.M.): date 1000 yr younger than expected.

Slettbakkmyr series, Nordland

Peat and wood from bog profile at +29 m in Slettbakkmyr, Ramsvik, Vestvågøy (68° 07' N Lat, 13° 40' E Long), Nordland, Norway. Bog overlies stones and is 2.94 m thick at this section. Coll. and subm. 1968 by D. Moe.

3060 ± 90

T-753. Slettbakk Peat

1110 B.C.

Depth below soil surface 0.66 to 0.68 m.

4740 ± 110

T-754. Slettbakk Birch

2790 B.C.

From strongly humified horizon. Depth below soil surface 1.15 m.

8660 ± 110

T-755. Slettbakk Peat (lowest layer)

6710 B.C.

Depth below soil surface 2.87 to 2.91 m.

9860 ± 120

T-930. Slettbakk Peat (lowest layer)

7910 B.C.

Gyttja coll. with a piston borer at base of bog profile 2.90 m deep. Coll. 1969 and subm. 1970 by D. Moe. *Comment* (D.M.): T-755 and T-930 are from same layer, but T-755 material taken with Hiller sampler. T-930 is probably more reliable and dates oldest organic material from Slettbakk.

12,710 ± 200

T-963. Endletsvann I, Andöya

10,760 B.C.

Gyttja from mire at ca. +33 m, 200 m from small lake Endletsvann (+32 m), Andöya (69° 15' N Lat, 16° 05' E Long), Nordland, Norway. Coll. with Hiller borer at depth 7.42 to 7.52 m, 0.05 m above and below distinct transition from black (below) to brownish (above) gyttja. Coll. and subm. 1970 by K.-D. Vorren, Tromsø Mus., Tromsø. *Comment* (K.-D.V.): sub-fossils reveal arctic vegetation phase with Dryas communities in uppermost layers of black freshwater gyttja.

Deggemyra series, Troms

Sphagnum peat from bog Deggemyra at ca. +8 m near farm Hofsøy, Tranøy (69° 04' N Lat, 17° 05' E Long), Troms, Norway. Coll. with a Hiller borer. Coll. and subm. by K.-D. Vorren. *Comment* (K.-D.V.): series is part of pollen-analytic study of settling and agricultural history in Troms and Vesterålen, N Norway. Deggemyra is close to ancient and abandoned farm (Simonsen, 1970, p. 113, fig.: "gravfelt").

1070 ± 60**T-964. Hofsøy 1****A.D. 880**

From depth 0.42 to 0.50 m. Pollen analysis: late Sub-Atlantic. *Comment* (K.-D.V.): agricultural pollen shows marked final decline, just below dated strata. Because of a contemporary faint RY, this pollen-analytic event was linked with the Black Death (A.D. 1349). Date shows that assumption was incorrect. Decline of agricultural activity presumably originates from abandonment of farm.

1280 ± 80**T-965. Hofsøy 2****A.D. 670**

From depth 0.85 to 0.90 m. Pollen analysis (K.-D.V.): Sub-Atlantic (Viking age). *Comment* (K.-D.V.): date concerns culmination of most intensive cereal (*Hordeum*) cultivation phase at ancient farm.

1600 ± 80**T-966. Hofsøy 3****A.D. 350**

From depth 1.25 to 1.30 m. Pollen analysis (K.-D.V.): early Sub-Atlantic (Roman Iron age). *Comment* (K.-D.V.): date concerns time of settlement and clearing of ancient Norse farm, and fits well with archaeological dates (Simonsen, 1970; Sjøvold, 1962).

Faerdesmyra series, Finnmark

Peat from palsas in bog "Faerdesmyra" at +70 m in Neiden, Sör-Varanger (69° 44' N Lat, 29° 19' E Long), Öst-Finnmark, Norway. Coll. and subm. 1968-1970 by K. D. Vorren, Univ. Trondheim. *Comment* (K.-D.V.): dates from Faerdesmyra concern genetic problems of palsas (Vorren, 1967), hummocks and N type of ombrotrophic bog sites (Ruuhijärvi, 1963).

530 ± 60**T-744. Pals M10, I****A.D. 1420**

Low-humified *Sphagnum fuscum* peat, 0.08 to 0.11 m below surface. *Comment* (K.-D.V.): dates maximum of formation of palsa.

2210 ± 90**T-936. Pals M10, II****260 B.C.**

Sphagnum lindbergii peat 0.21 to 0.23 m below surface from 2.5 m erosion wall. *Comment* (K.-D.V.): date concerns a distinct RY slightly above zone boundary Sub-Boreal/Sub-Atlantic.

T-745. Pals M8, III **3890 ± 80**
1940 B.C.

Low-humified *Sphagnum lindbergii* peat 0.01 to 0.03 m below wind-eroded surface. *Comment* (K.-D.V.): date was intended to give maximum age of formation of palsa in question, but is considered too old. The error is probably due to an unexpected strong peat erosion.

T-746. Hölje, IV **4430 ± 80**
2480 B.C.

Sphagnum lindbergii peat from 1.05 to 1.15 m below surface. *Comment* (K.-D.V.): date concerns an extended RY and transition from minerogenous to ombrogenous peat formation.

T-910. Husfjord, Finnmark **9130 ± 120**
7180 B.C.

Gyttja (fine detritus dy) from a topogenous bog at +95 m in Husfjord, Hasvik, Söröya (70° 35' N Lat, 22° 55' E Long), Finnmark, Norway. Bog situated at edge of small lake near by distinct bottom-endmoraines in Husfjord. Coll. with Hiller borer 1969 by K.-D. Vorren; subm. 1970 by U. Hafsten and K.-D. Vorren. *Comment* (K.-D.V.): date concerns time of deglaciation in area. Dated material is from lowermost strata.

B. Finland

Peat bog series, N Finland

Peat and gyttja from various bogs in N Finland (Lappalainen, 1970). Coll. 1963 to 1969 and subm. 1969 by E. Lappalainen, The Geological Survey, Otaniemi, Finland.

T-821. Kairanaapa, No. 1 **8410 ± 100**
6460 B.C.

Peat from bog Kairanaapa at +155.1 m in Pelkosenniemi (67° 12' N Lat, 27° 31' E Long), N Finland. From depth 5.22 to 5.30 m. Pollen analysis (E.L.): beginning of Boreal period. Previous date of log at same depth: 8430 ± 160 yr (I-1912).

T-823. Kairanaapa, No. 3 **9170 ± 150**
7220 B.C.

Peat (brown moss, *Drepanocladus*) from depth 6.40 to 6.48 m in same bog as T-821. Pollen analysis (E.L.): *Picea* 5%, *Pinus* 10%, *Betula* 85%, from beginning of Pre-Boreal period.

T-822. Liperi, No. 2 **4340 ± 80**
2390 B.C.

Wood (*Populus*) from bog at +82.5 m in Liperi (62° 32' N Lat, 29° 30' E Long), SE Finland. From depth 1.30 m. Geologic date (E.L.): *Littorina* period, maximum 4000 yr.

T-824. Pahkavuoma, No. 4 **9320 ± 120**
7370 B.C.

Gyttja from bog Pahkavuoma at +181 m in Kittilä (67° 41' N Lat,

25° 00' E Long), Finland. From depth 4.39 to 4.48 m. Geologic dating (E.L.): ca. 6000 yr. Pollen analysis (E.L.): entrance of *Alnus* (ca. 5%), *Betula* sharply decreases and *Pinus* increases. Sample belongs to end of Pre-Boreal period.

11,000 ± 130**T-825. Parvavuoma, No. 5****9050 B.C.**

Peat (brown moss, *Bryales*) from bog Parvavuoma at +179.6 m in Kittilä (67° 37' N Lat, 25° 00' E Long), Finland. From depth 5.87 to 5.90 m at base of bog. Geologic date (E.L.): ca. 10,000 yr B.P. *Comment* (E.L.): previous date of same pollen-analytic horizon, 10,820 ± 270 yr B.P. (I-1666), in excellent agreement with present result. Sample belongs to Younger Dryas period.

8660 ± 130**T-826. Silmäsvuoma No. 6****6710 B.C.**

Gyttja from bog Silmäsvuoma at +200.5 m in Kittilä (67° 33' N Lat, 25° 37' E Long), Finland. From depth 4.68 to 4.72 m. Geologic date (E.L.): ca. 8000 yr. Pollen analysis (E.L.): *Betula/Pinus* shift at end of Pre-Boreal period.

Markkina-aapa series, N Finland

Samples from various levels in bog "Kakkupalsa" profile at +332.7 m in Markkina-aapa palsa area, Enontekiö (68° 30' N Lat, 22° 23' E Long), N Finland. Coll. 1968 and subm. 1969 by Martti Salmi, Inst. Quaternary Geol., Turku Univ.

4150 ± 50**T-801. Markkina-aapa, 1/MS/69****2200 B.C.**

Peat (*Carex-Bryales*) coll. at depth 0 to 0.05 m. Pollen analysis (M.S.): *Pinus* 55%, *Betula* 43%, *Alnus* 2% (2000 yr B.P.).

7200 ± 130**T-802. Markkina-aapa, 2/MS/69****5250 B.C.**

Peat (*Carex-Bryales*) coll. at depth 0.45 to 0.55 m. Pollen analysis (M.S.): *Pinus-maximum* (5400 yr B.P.).

7800 ± 130**T-803. Markkina-aapa, 3/MS/69****5850 B.C.**

Peat (*Carex-Bryales*) coll. at depth 0.95 to 1.05 m. Pollen analysis (M.S.): boundary between *Betula* and *Pinus maximum* (7800 yr B.P.).

8460 ± 140**T-804. Markkina-aapa, 4/MS/69****6510 B.C.**

Gyttja (detritus) coll. at depth 1.60 to 1.70 m above mineral bottom. Pollen analysis (M.S.): *Betula maximum* (8800 yr B.P.).

Kelottijänkä series A, N Finland

Samples from various levels in bog profile at +360.3 m in Kelottijänkä, Enontekiö (68° 34' N Lat, 22° 00' E Long), N Finland. Coll. 1968 and subm. 1969 by M. Salmi.

T-805. Kelottijänkä, 5/MS/69 **1320 ± 70**
A.D. 630
Peat (*Sphagnum*) coll. at depth 0 to 0.05 m. Pollen analysis (M.S.):
Betula 68%, *Pinus* 31%, and *Alnus* 1% (1000 yr B.P.).

T-806. Kelottijänkä, 6/MS/69 **8000 ± 130**
6050 B.C.
Peat (*Carex-Bryales*) coll. at depth 2.35 to 2.45 m. Pollen analysis
(M.S.): boundary between *Betula* and *Pinus* maximum (7700 yr B.P.).

T-807. Kelottijänkä, 7/MS/69 **8690 ± 100**
6740 B.C.
Peat (*Carex-Sphagnum*) coll. at depth 3.20 to 3.25 m. Pollen analysis
(M.S.): *Betula* maximum (8700 yr B.P.).

Kelottijänkä series B, N Finland

Samples from various levels in a bog profile at +359.0 m in
Kelottijänkä. Coll. 1967 and subm. 1969 by M. Salmi.

T-808. Kelottijänkä, 8/MS/69 **3520 ± 80**
1570 B.C.
Peat (*Sphagnum-Bryales*) coll. at depth 0.18 to 0.23 m. Pollen
analysis (M.S.): from upper part of *Pinus* maximum and beginning of
Picea curve (2500 yr B.P.).

T-809. Kelottijänkä, 9/MS/69 **5830 ± 90**
3880 B.C.
Peat (*Sphagnum-Bryales*) coll. at depth 0.57 to 0.63 m at contact
between frozen and not frozen palsa. Pollen analysis (M.S.): upper part
of *Pinus* maximum (5000 yr B.P.).

T-810. Kelottijänkä, 10/MS/69 **6920 ± 110**
4970 B.C.
Peat (*Sphagnum-Bryales*) from frozen palsa at depth 1.75 to 1.85
m. Pollen analysis (M.S.): lower part of *Pinus* maximum (7000 yr B.P.).

T-811. Kelottijänkä, 11/MS/69 **8190 ± 140**
6240 B.C.
Peat (*Bryales-Sphagnum*) from frozen palsa at depth 2.58 to 2.68 m.
Pollen analysis (M.S.): boundary between *Betula* and *Pinus* maximum
(7800 yr B.P.).

Jurmunaapa series, N Finland

Samples from various levels in bog profile at +235.8 m in Jur-
munaapa, Sodankylä (68° 03' N Lat, 26° 46' E Long), N Finland. Coll.
1960 and subm. 1969 by M. Salmi.

T-812. Jurmunaapa, 12/MS/69 **8110 ± 110**
6160 B.C.
Peat (*Bryales-Sphagnum*) coll. at depth 3.05 to 3.15 m. Pollen
analysis (M.S.): boundary between *Betula* and *Pinus* maximum (7500
yr B.P.).

- 8450 ± 110**
6500 B.C.
- T-813. Jurmunaapa, 13/MS/69**
Peat (*Bryales-Sphagnum*) coll. at depth 3.45 to 3.55 m. Pollen analysis (M.S.): from upper part of *Betula maximum* (8500 yr B.P.).

- 9000 ± 140**
7050 B.C.
- T-814. Silmäsvuoma, 14/MS/69**
Bryales mud from bog profile at +200.0 m in Silmäsvuoma, Kittilä (67° 25' N Lat, 25° 30' E Long), N Finland. Coll. at depth 5.20 to 5.25 m, from contact between silt and organogenic material. Coll. 1964 and subm. 1969 by M. Salmi. Pollen analysis (M.S.): upper part of *Betula maximum* (8500 yr B.P.).

- 7790 ± 110**
5840 B.C.
- T-815. Hautavuoma, 15/MS/69**
Peat from bog profile at +192.6 m in Hautavuoma, Kittilä (67° 23' N Lat, 24° 35' E Long), N Finland. Coll. at depth 3.55 to 3.60 m from contact between "siderit" (?) and *Carex* peat. Coll. 1964 and subm. 1969 by M. Salmi. Pollen analysis (M.S.): beginning of *Pinus maximum* (7800 yr B.P.).

C. Canada

L'Anse aux Meadows series, Newfoundland

Additional samples of peat and gyttja from turf walls, bogs, and tarns at or near Norse settlement site, L'Anse aux Meadows (51° 34' N Lat, 55° 35' W Long), Newfoundland (see H. Ingstad, 1964 and 1970; A. S. Ingstad, 1971; Nydal *et al.*, 1970). Coll. 1968 and subm. 1969 to 1970 by Kari Henningsmoen, Univ. Oslo.

- 5680 ± 120**
3730 B.C.
- T-816. "Mosquito bog"**
Gyttja from bog at ca. +20 m, 8 to 10 km from settlement site. Coll. with a Hiller borer at depth 3.40 to 3.50. *Comment* (K.H.): bog is inland. Surroundings are forest covered, uninhabited, and apparently undisturbed by man until quite recently. Pollen diagram from bog and date show a very monotonous vegetation development through last 5680 yr.

- 1300 ± 70**
A.D. 650
- T-817. Turf wall, House D**
Sample from dark layer in ruin wall at depth 0.20 to 0.24 m.

- 1320 ± 80**
A.D. 630
- T-818. Turf wall, House A**
Sample from dark layers in ruin wall at depth 0.28 to 0.42 m below surface. *Comment* (K.H.): walls are built of turf layers, presumably taken from vegetation surface ca. A.D. 1000. Both dates seem reasonable from this point of view, see also Nydal *et al.*, 1970 and A. S. Ingstad, 1971).

T-819. Tarn peat at dig area **1290 ± 80**
A.D. 660
Peat coll. with a Hiller borer at depth 0.60 to 0.70 m.

T-906. Tarn gyttja at dig area **2010 ± 100**
60 B.C.

Gyttja coll. with a Livingstone sampler at depth 1.02 to 1.07 m. *Comment* (K.H.): Samples T-819 and T-906 confirm previous assumptions (Nydal *et al.*, 1970) based on pollen diagram from tarn, that changes in vegetation are older than Norse settlement and must be ascribed to local ecologic development at sampling site.

T-820. Palsa bog, Hiller sample **5320 ± 60**
3370 B.C.

Peat coll. with a Hiller borer from base of bog at depth 1.63 to 1.73 m. *Comment* (K.H.): ruins are situated on an old beach terrace +4 to +6 m. Date of bottom organic layers is minimum for time elapsed since this part of terrace was isolated from sea. Date agrees well with T-500 (Nydal *et al.*, 1970), from basin somewhat lower on same terrace.

T-905. Palsa bog, knife sample **460 ± 80**
A.D. 1490

Peat from a trench wall at depth 0.30 to 0.35 m. *Comment* (K.H.): plant remains from upper, unfrozen peat layers (0 to 0.35 m) of bog were studied by K.-D. Vorren, who concludes that dated sample is older than palsa development in bog. Consequently, permafrost here is rather young and first developed well after Norsemen left site, presumably during cold spell of "Little Ice age".

II. ARCHAEOLOGIC SAMPLES

1. Settlement sites

Laerdal series, Sogn og Fjordane

Comment (A.B.J.): charcoal samples from artifact-bearing layers on some of numerous unstratified Stone-age settlements along Laerdal watercourse in Laerdal, Sogn og Fjordane. Artifacts are abundant on sites, but with strikingly few distinct tools. The traditional typologic method, therefore, is of less use than usual in dating settlements (Johansen, 1969). Results agree with our previous knowledge of early Post-glacial settlement in this area. First occupation took place very rapidly, perhaps not >1000 yr after ice retreat. This appears from several dates (see also R., 1970, v. 12, p. 205-237), especially from Sundet II (T-893), Sulemarki VII (T-671, T-900), Osen III (T-896), Jukleåni (T-667-T-669) and Osen II (T-664-T-666), all falling in the interval ca. 7000 to ca. 8200 yr B.P.

Eldrevatn series, Laerdal

Charcoal from settlement sites at lake Eldrevatn, +1120 m (61° 01' N Lat, 8° 07' E Long).

- 1160 ± 80**
- T-770. 32. Ulvehaugen I (W21 II)** **A.D. 790**
 From top of artifact-bearing layer 0.10 m deep. Coll. 1968 by E. Mikkelsen, Historical Mus., Univ. Bergen.
- 6070 ± 520**
- T-892. 1. Ulvehaugen III (M23 II)** **4120 B.C.**
 From artifact-bearing layer 0.10 to 0.15 m deep. Coll. 1966 by Signe Hvoslef, Historical Mus., Univ. Bergen.
- 7120 ± 140**
- T-766. 35. Ulvehaugen I (V15 III)** **5170 B.C.**
 From fireplace 0.20 to 0.40 m deep. Coll. 1968 by E. Mikkelsen.
- 7460 ± 80**
- T-898. Ulvehaugen I (V16 III)** **5510 B.C.**
 From fireplace 0.30 m deep covered by a large stone. Coll. 1968 by A. Zachariassen, Historical Mus., Univ. Bergen.
- 5780 ± 220**
- T-897. 26. Glitreöyni II (E11)** **3830 B.C.**
 From artifact-bearing layer 0.06 to 0.08 m deep. Coll. 1967 by S. Hvoslef.
- 6490 ± 130**
- T-890. 22. Glitreöyni II (C13)** **4540 B.C.**
 From artifact-bearing layer with burnt flakes of quartzite 0.08 to 0.10 m deep. Coll. 1967 by S. Hvoslef.
- 8510 ± 110**
- T-769. 20. Glitreöyni II (C13)** **6560 B.C.**
 From spot of charcoal under artifact-bearing layer 0.10 m deep. Coll. 1967 by S. Hvoslef.
- 5930 ± 90**
- T-771. 23. Glitreöyni I (H14)** **3980 B.C.**
 From artifact-bearing layer 0.05 to 0.08 m deep. Coll. 1967 by S. Hvoslef.
- 450 ± 100**
- T-765. 29. Osen II (F17)** **A.D. 1500**
 From charcoal layer 0.03 to 0.04 m deep covering interior of small house site close to a Stone age site. Coll. 1968 by A. B. Johansen.
- 7480 ± 120**
- T-896. 31. Osen III (K11 to K12)** **5530 B.C.**
 From artifact-bearing layer 0.04 to 0.08 m deep. Coll. 1968 by A. B. Johansen.

Vassetvatn series, Laerdal

Coll. at lake Vassetvatn at +1100 m (61° 03' N Lat, 7° 53' E Long). Only one site discovered in area surrounding this lake despite extensive search.

- T-894. Bringa I (S13 III)** **2340 ± 120**
390 B.C.
From artifact-bearing layer 0.15 to 0.20 m deep. Coll. 1969 by I. M. Holm-Olsen, Historical Mus., Univ. Bergen.
- T-895. 3. Bringa I (S13 III)** **2520 ± 130**
570 B.C.
From artifact-bearing layer 0.15 to 0.20 m deep. Coll. 1969 by I. M. Holm-Olsen.
- T-891. 36. Bringa I (R10)** **2570 ± 90**
620 B.C.
From artifact-bearing layer 0.30 m deep. Coll. 1968 by I. M. Holm-Olsen. *Comment* (A.B.J.): site perhaps was used for only a restricted period. According to the tools found, this period is in the later part of the stone-using era. Dates, therefore, indicate stone was important as a tool material long after introduction of metals.
- Sulevatn series, Laerdal**
Coll. at lake Sulevatn at +1420 m (61° 05' N Lat, 8° 14' E Long).
- T-772. 38. Kyrkjenesi II (08)** **6020 ± 110**
4070 B.C.
From spot of charcoal in artifact-bearing layer ca. 0.10 m deep. Coll. 1968 by K. Jansen, Historical Mus., Univ. Bergen.
- T-899. 37. Kyrkjenesi II (K9 II)** **6070 ± 130**
4120 B.C.
From artifact-bearing layer ca. 0.10 m deep. Coll. by K. Jansen.
- T-900. 13. Sulemarki VII (K14)** **7630 ± 450**
5680 B.C.
From spot of charcoal 0.10 m deep. A sample from deeper layer 2 to 3 m away is dated to 7920 ± 120 yr (T-671: R., 1970, v. 12, p. 228). Coll. 1967 by S. Indrelid, Historical Mus., Univ. Bergen.
- Store Öljusjö series, Laerdal**
Coll. at lake Store Öljusjö at +1310 m (60° 58' N Lat, 8° 04' E Long).
- T-893. 31. Sundet II (E6)** **7670 ± 150**
5720 B.C.
From bottom of wall mound in house site 0.50 to 0.60 m deep. Coll. by A. B. Johansen. *Comment* (A.B.J.): result agrees with results of statistical analysis of non-tool artifact material (Johansen, 1969).
- T-767. 28. Kjölåni V (08)** **970 ± 70**
A.D. 980
From below wall of house site. Coll. 1967 by O. M. Osaland, Historical Mus., Univ. of Bergen. *Comment* (A.B.J.): result may indicate hunting or fishing in this area in viking period, but no bones were found.

- 1050 ± 70**
- T-768. Kalvsundet, N Hordaland** **A.D. 900**
- Charcoal from depth 0.20 m in a charcoal kiln at Kalvsundet, Lygra, Lindås (60° 40' N Lat, 5° 07' E Long), N Hordaland, Norway. Coll. and subm. 1968 by A. B. Johansen. *Comment* (A.B.J.): kiln is 1 of ca. 40 similar remains in a restricted area.
- 1800 ± 70**
- T-848. Bergsmulvatn II, Ustevassdraget** **A.D. 150**
- Charcoal from 0.05 m thick concentration at +990 m, Ustevassdraget, Hol (60° 30' N Lat, 7° 40' E Long), Buskerud, Norway. Coll. 1960 by Nils Lien; subm. 1969 by Irmelin Martens, De arkeol. mus. registreringstjeneste, Oslo. *Comment* (I.M.): site is middle Neolithic, with stray finds of stone implements of a later date. There were also remains of a stone hut probably 200 to 300 yr old. Sample from opposite part of site, where chances for mixture with late elements should be least.
- 7240 ± 100**
- T-849. Hovatn III, Finndalen** **5290 B.C.**
- Charcoal from peat bog layer at +690 m in site at Hovatn, Valle (59° 10' N Lat, 7° 40' E Long), Aust-Agder, Norway. Coll. 1960 by A. E. Christensen; subm. 1969 by I. Martens. *Comment* (I.M.): sample from periphery of a Stone age site with no clear connection between find layer and charcoal-containing layer in peat bog. Flint material dates from middle Neolithic period, and shows no sign of mixture with Mesolithic elements.
- 4410 ± 140**
- T-850. Kjaerringnes, Ståvatn** **2460 B.C.**
- Charcoal from Stone age site at +970 m at Kjaerringnes, Ståvatn, Vinje (59° 50' N Lat, 7° 10' E Long), Telemark, Norway. From lowest part of 0.10 to 0.15 m thick sand layer below peat. Coll. 1960 by Gro Mandt; subm. 1969 by I. Martens. *Comment* (I.M.): sample derives from a Stone age site where rock crystal is the dominant raw material. Implements from this material cannot be dated exactly. Besides, also present are some clearly Neolithic flint implements, preferably middle Neolithic (ca. 2000 B.C.). Site was probably in use only during a shorter period, but as stratigraphy is lacking, this is uncertain. The use of rock crystal might very well be a Mesolithic tradition. Another site with similar inventory was dated to 4300 B.C. (T-260: R., 1964, v. 6, p. 289).
- 5500 ± 90**
- T-851. Grössae, Bygland** **3550 B.C.**
- Charcoal from a Stone age site, +720 m, at the river Grössae, Bygland (59° 0' N Lat, 7° 50' E Long), Aust-Agder, Norway. From depth 0.05 to 0.15 m. Coll. 1968 by Agnete Rognes; subm. 1969 by I. Martens. *Comment* (I.M.): site has not been properly excavated; sample was coll. during a test dig of 1 m². Main part of material consists of flint and is of middle Neolithic character, with some quartzite which

might derive from a Mesolithic settlement phase, causing the early dating.

Bone series, Vestfold

Animal bones from cultural layer at depth 0.25 to 0.35 m in Frebergsvik, Borre (59° 26' N Lat, 10° 24' E Long), Vestfold, Norway. Artifacts were also found. Layer 1 of 5 digging layers down to depth 0.60 m. Coll. 1969 and subm. 1970 by E. Mikkelsen, Univ. Oldsaksamling, Oslo.

T-928. Bone, G18III **2020 ± 140**
70 B.C.

T-929. Bone, H18III **2260 ± 130**
310 B.C.

Comment (E.M.): artifacts belong to settlement traditionally referred to as Nöstvedt culture. Archaeologic date and shoreline date indicate a time ca. 4000 B.C. There seems to be no important qualitative (or time) differences between artifacts in different layers.

T-970. Frebergsvik IV, Vestfold **3850 ± 110**
1900 B.C.

Charcoal from +53 m in Frebergsvik, Borre (59° 26' N Lat, 10° 24' E Long), Vestfold, Norway. From depth 0.23 to 0.25 m. Coll. and subm. 1970 by E. Mikkelsen. Archaeologic date: older Stone age. *Comment* (E.M.): sample comes from same Stone age settlement as T-928 and T-929. It must belong to a later visit in Neolithic period at same place.

Boathouse series II, Rogaland

Charcoal from boathouses at Nord-Kolnes, Sola (58° 55' N Lat, 5° 08' W Oslo), Rogaland, Norway. Coll. 1965 by Perry Rolfsen; subm. 1968 by O. Möllerop, Stavanger Mus., Stavanger. *Comment* (O.M.): this series is a supplement to previous one (R., 1970, v. 12, p. 233). More detailed analysis of material proved there was an older habitation on the spot. (Habitation layers under the walls with pottery of premigration period types). It is probable that the pottery below the E long wall (T-783) belongs to that habitation phase (Rolfsen, 1966).

T-781. Site 1, H 9 **1930 ± 70**
A.D. 20

From charcoal pit in middle of site, probably from wooden wall. Archaeologic date: A.D. 0 to 400.

T-782. Site 1, P 19 **1820 ± 70**
A.D. 130

From middle of site in stratigraphically younger layer than T-783 (S 18). Archaeologic date: A.D. 200 to 400.

T-783. Site 2, S 18 **1830 ± 70**
A.D. 120

From below E long wall in site, and from same place as T-620 (R., 1970, v. 12, p. 233). Archaeologic date: A.D. 200 to 400.

660 ± 60**T-780. Skagen 3 (No. 8), Stavanger****A.D. 1290**

Burnt grain from floor of old house from town of Stavanger (58° 58' N Lat, 4° 59' W Oslo), Rogaland, Norway. Coll. and subm. 1968 by O. Möllerop. *Comment* (O.M.): part of medieval house, wooden floor, and parts of roof and walls preserved, with many finds in and around house (organic material, pottery, runic inscriptions, etc.). Pottery sherds date habitation to 12th to 13th centuries and later (Lillehammer, 1969; Simonsen, 1969; Möllerop, 1969).

House site, Rogaland

Charcoal from house site with area of 42 × 7.5 m in Espeland, Sandnes (58° 41' N Lat, 5° 48' E Long), Rogaland, Norway. Coll. 1966 by O. Espedal; subm. 1968 by O. Möllerop. *Comment* (O.M.): mostly pottery sherds from different parts. According to pottery, site was inhabited 5th and 6th centuries A.D. (Espedal, 1966; 1967).

1540 ± 70**T-778. Espeland (G 17/19)****A.D. 390**

Sample from wood construction.

1690 ± 70**T-779. Espeland (K 16/17 Pit II)****A.D. 540**

Sample from firepit in central part of site.

Stokkaland series, Rogaland

Charcoal from settlement in Slettabö, Stokkaland, Oгна (58° 31' N Lat, 4° 55' E Long), Rogaland, Norway. Coll. and subm. 1966 to 1968 by Arne Skjölsvold, Univ. Oldsaksamling, Oslo. *Comment* (A.S.): 4 cultural layers were found in site; they reflect different settlement phases from Stone and Bronze age. The 3 uppermost layers which are dated here, are separated from each other with sterile sand and are stratigraphically well defined.

2840 ± 130**T-629. Stokkaland VIII (1 i)****890 B.C.**

From 1st (youngest) cultural layer, at depth 0.55 to 0.60 m below soil surface.

2420 ± 90**T-740. Stokkaland III (2—0)****470 B.C.**

From 1st cultural layer at depth 0.57 to 0.59 m.

2900 ± 90**T-626. Stokkaland V (5 1)****950 B.C.**

From 1st cultural layer at depth 0.75 to 0.80 m.

3970 ± 100**T-627. Stokkaland VI (—2 j)****2020 B.C.**

From 2nd cultural layer at depth 1.00 to 1.10 m.

- T-628. Stokkaland VII (3 l)** **3860 ± 100**
1910 B.C.
 From 2nd cultural layer at depth 1.00 to 1.10 m.
- T-739. Stokkaland II (5 n)** **3790 ± 70**
1840 B.C.
 From 2nd cultural layer at depth 1.10 to 1.20 m.
- T-738. Stokkaland I (4 q)** **4730 ± 100**
2780 B.C.
 From 3rd cultural layer at depth 1.50 to 1.60 m.

Rock shelter series, Möre og Romsdal

Charcoal from firepits in rock shelter Dalehelleren, Kristiansund (63° 08' N Lat, 7° 45' E Long), Möre og Romsdal, Norway. Samples from 2 charcoal concentrations in lower part of cultural layer. Coll. 1969 by student Kurt Alterskjaer; subm. 1969 by Kr. R. Möllenus, Videnskapselskapets Oldsaksamling, Trondheim. Flint and bone artifacts were found.

- T-879. Dalehelleren I** **3040 ± 70**
1090 B.C.
- T-880. Dalehelleren II** **2390 ± 70**
440 B.C.

Comment (Kr.R.M.): dates indicate dwelling place was inhabited for a long time, or, at 2 different times. The artifacts found are hardly dateable.

2. Various archaeological samples

Soapstone series, Kvikne

Wood from soapstone quarry W of Bubakk, Kvikne (62° 25' N Lat, 10° 15' E Long), Hedmark, Norway. Samples from depths between 1 and 3 m among ground and soapstone debris. Coll. and subm. 1968 to 1969 by Arne Skjölsvold. Sample from same quarry was dated earlier (2350 ± 90 yrs: R., 1970, v. 12, p. 235).

- T-741. Bubakk I, 1968** **2180 ± 90**
230 B.C.
 Piece of wooden spade from depth 3 m.
- T-742. Bubakk II, 1968** **2440 ± 70**
490 B.C.
 Birch bark from trunk, depth 3 m. *Comment* (A.S.): trunk was possibly used as framework against slides of earth and soapstone debris.
- T-788. Bubakk I, 1969** **2270 ± 70**
320 B.C.
 Birch bark from a worked birch trunk, depth 3 m.
- T-789. Bubakk II, 1969** **2310 ± 70**
360 B.C.
 Piece of wooden spade from depth 2 to 2.5 m.

1470 ± 70**T-758. Wooden trackway, Tiltreidet, Romsdal** **A.D. 480**

Wood from trackway on isthmus Tiltreidet between Eidsöra and Eidsvåg, Toven, Nesset (62° 50' N Lat, 8° 10' E Long), Romsdal, Norway. Trackway consists of 3 m stringers across and resting normally on 3 longitudinal sleepers, discovered in 1932 (Ording, 1935). Pollen-analytic date by Asbjörn Ording: early Middle age.

Arrow shaft series, Oppdal

Wooden arrow shafts lost by hunters through the ages; preserved in glaciers at +1500 to 1800 m in the Oppdal Mts., Sör-Trøndelag. Coll. by different persons at different times; subm. 1968 by O. Farbrege, Videnskapsselskapets Mus., Trondheim.

650 ± 60**T-774. Brattfonna** **A.D. 1300**

Shaft of longbow arrow (Mus. no. T. 16055), (62° 29' N Lat, 9° 45' E Long), Norway. *Comment* (O.F.): typologically of youngest arrow shaft type found in area.

390 ± 50**T-775. Leirtjörnkollen** **A.D. 1560**

Shaft of crossbow arrow, with iron head of triangular type (Mus. no. T. 17697 b), (62° 27' N Lat, 9° 45' E Long), Norway.

1150 ± 80**T-944. Klåstad ship, Tjølling** **A.D. 800**

Piece of wood (Hazel ? twig from brushwood dunnage) from Viking age wreck excavated 1970 at Klåstad, Tjølling (59° 06' N Lat, 10° 10' E Long), Norway. Coll. and subm. 1970 by A. E. Christensen Jr., Univ. Oldsaksamling, Oslo. *Comment* (A.E.C.): fragmentary ship seems to be wreck of a merchant vessel; some 50 unfinished whetstones were found, probably part of cargo. Construction of ship indicates date to 9th or 10th centuries.

Cemetery series, Oppdal

Charcoal from cremation layers and charcoal pits in large cemeteries Vang (62° 36' N Lat, 9° 39' E Long), and Rise (62° 31' N Lat, 9° 37' E Long), Sör-Trøndelag, Norway. Coll. 1966 to 1967 and subm. 1968 to 1969 by O. Farbrege.

1140 ± 70**T-777. Vang, Barrow 560** **A.D. 810**

From charcoal layer ca. 0.15 m below flat surface at edge of barrow. Assoc. artifacts: knife, bridle bit, an iron plate, pieces of whetstone (Mus. no. 18818 f). *Comment* (O.F.): this is probably not a grave. Stratigraphically, this separate deposit seems to be either contemporary with, or younger than central grave, archaeologically dated between A.D. 750 and 850.

T-843. Vang, Barrow 17 **1150 ± 60**
A.D. 800
From charcoal layer below turf at edge of barrow (Mus. no. T.18754 m). *Comment* (O.F.): obviously a secondary deposit, containing 3 bronze weights and some ashes. Probably not a grave.

T-844. Vang, Barrow 17 **1510 ± 70**
A.D. 440
Coll. in a charcoal concentration in subsoil near center of robbed barrow (Mus. no. 18754 m). *Comment* (O.F.): assumed date of destroyed central grave, based on a few simple artifacts left: late Iron age: 7th century?

T-845. Vang, Barrow 211 **1670 ± 70**
A.D. 280
Coll. in a charcoal pit dug 0.2 m down into subsoil below robbed barrow containing traces of burial from A.D. 600 to 900 (Mus. no. T.18756 q). *Comment* (O.F.): dates T-844 and T-845 may indicate cemetery was in use before A.D. 600, but it is not certain. Nature of these pits is not fully understood.

T-776. Rise, Barrow 14 **1230 ± 70**
A.D. 720
From charcoal concentration at base of perimeter trench, contemporary with building of barrow. Artifacts from ca. A.D. 400 to 800 found in partly levelled barrow (Mus. no. T.18822 z).

T-840. Rise, Barrow 14 **1430 ± 70**
A.D. 520
From cremation pit with a few metal fragments and a strike-a-light. Pit was dug ca. 0.3 m down into subsoil below barrow (Mus. no. T.18822 ae). *Comment* (O.F.): dates T-776 and T-840 indicate primary pit grave below flat surface, incidentally covered by a secondary barrow burial.

T-841. Rise, Stone D **1130 ± 60**
A.D. 830
From fire pit grave below flat surface, but covered by a small boulder. Artifacts: some metal fragments and a few glass beads (Mus. no. T.18826 g). *Comment* (O.F.): a grave monument without known local parallels.

T-842. Rise, Barrow 27 **1280 ± 60**
A.D. 670
From cremation layer under a barrow ca. 0.3 m high. Among grave furnishings, a small disc-shaped brooch common in Gotland in 7th century, but rare in Norway (Mus. no. T.18825 e).

Sund skeleton series

A dozen skeletons (of mixed sexes and ages) interred in moraine gravel at Sund, (63° 52' N Lat, 11° 20' E Long), Nord-Trøndelag, Norway, (Mus. no. T.18863). Some 8 skeletons in disorderly heap, others a

few m apart. Surrounding them all a circular trench, indicating perimeter of a removed cairn of barrow, some 12 m wide. Inside trench was also a charcoal pit, presumably part of burial complex. A single artifact found with skeletons: a simple bone pin. Excavated 1968 by O. Farbregd; subm. 1968 and 1969 by K. R. Möllenus and O. Farbregd.

3300 ± 100

T-747. Sund I

1350 B.C.

Sample from a cranium in main concentration of skeletons.

2900 ± 90

T-881. Sund II

950 B.C.

Sample from a femur of skeleton placed apart from others.

2950 ± 90

T-925. Sund III

1000 B.C.

Charcoal from charcoal pit.

Cemetery series, Etne, Hordaland

Wood and charcoal from burial field at edge of river terrace at +50 m in Sørheim, Etne (59° 35' N Lat, 6° 0' E Long), Hordaland, Norway. Coll. and subm. 1969 by Björn Myhre, Historical Mus., Univ. Bergen. *Comment* (B.M.): 10 barrows were lying in a row with flat graves between some of them. Biggest one must be dated to older Bronze age (1500 to 900 B.C.) and had also been used as burial place in migration period (A.D. 400 to 600). Rest of the cemetery consisted of small cairns difficult to see above ground, containing poor burnt graves with few objects, which must be dated to younger Iron age, probably Viking period (A.D. 800 to 1000). These poor graves seem to be usual burial costume in SW Norway in Viking period.

3330 ± 80

T-858. Garahaugen I, Sørheim, Etne

1380 B.C.

From burial chamber in large mound Garahaugen. *Comment* (B.M.): burial chamber was robbed in 1904 and dagger of bronze (Stavanger Mus. S 2849) seems to have belonged to this chamber. Dagger archaeologically dated to older Bronze age—Period III (1100 to 900 B.C.). Body had been cremated; this is one of oldest cremation graves from Norway.

3030 ± 70

T-859. Garahaugen II, Sørheim, Etne

1080 B.C.

Iron grave at edge of Garahaugen, untouched since burial. *Comment* (B.M.): grave was only a layer of charcoal with some burnt bones. Poor cremation graves like this could archaeologically be dated to younger Bronze age (A.D. 900 to 500).

3080 ± 80

T-860. Garahaugen III, Sørheim, Etne

1130 B.C.

Coll. from pit in ground below Garahaugen. *Comment* (B.M.): pit

was dug into original ground and must be older than grave. Pit contained charcoal and burnt stones; it was probably cooking pit.

T-861. Burial mound, Sørheim, Etne **1570 ± 90**
A.D. 380

Fragments from wooden pole in ground below burial mound. *Comment* (B.M.): a small cairn ca. 10 m diam. and 0.75 m high contained a robbed grave with an axe, a bead, and some iron fragments. Grave can be dated to Viking period. Underneath barrow were found 6 post holes which could be assoc. with barrow. Date means perhaps that post holes are older than grave.

T-962. Stone ring, Etne **2270 ± 50**
320 B.C.

Charcoal from earlier untouched fire grave in a stone ring. In the middle of a ring of 7 stones was a grave pit containing charcoal and burnt bones. This is the only grave of this type excavated in W Norway. Dates of similar graves in E Norway and Sweden are from 100 B.C. to A.D. 400, but some Swedish ones are as old as this ring.

T-972. Spranget (No. II), Rondane **2290 ± 140**
340 B.C.

Charcoal from ash and charcoal layer at base of burial mound at +1000 m at "Spranget", Mysusetter, Rondane (61° 50' N Lat, 9° 45' E Long), Hedmark, Norway. Coll. and subm. 1970 by A. Skjölsvold, Archaeologic date: Iron age. *Comment* (A.S.): only specimen found was iron knife of a type which does not permit a closer date within Iron age.

Burial mound series, Östfold

Charcoal from great mound Jellhaug in Jellestad, Berg, (59° 09' N Lat, 11° 15' E Long), Östfold, Norway. Sample I was between fragments of burnt bones in trench dug through mound. Sample II from well-defined layer, possibly original surface of mound where vegetation was burnt before robbery of mound. Coll. and subm. 1969 by Erling Johansen, Univ. Oldsaksamling, Oslo.

T-887. Jellhaug I **1540 ± 90**
A.D. 410

T-888. Jellhaug II **1200 ± 80**
A.D. 750

Comment (E.J.): dates are not contradicted by observations during excavations. Mound seems to have a complicated history of construction, with different phases in period between dates. Latter date represents the great mound after completion and before it was broken and robbed.

Structures connected with reindeer trapping in the Rondane area

Einsethø series

A hunting construction for trapping wild reindeer was discovered at +1100 to 1200 m at Einsethø, Dovre (62° 01' to 62° 02' N Lat, 9° 27'

to 9° 28' E Long), Oppland, Norway, by E. K. Barth, Zool. Mus., Univ. Oslo. Small assemblages of stones id. as supporting stones for post holes in V-shaped fence system over 2900 m distance. Some remnants of wooden poles (all pine) were found from fence line, crossing brooks and peat bogs. Remnants of several house foundations were found ca. 100 m from tapering end of construction. Subm. 1969 to 1970 by E. K. Barth.

T-1046. Einsethø, wood **910 ± 90**
A.D. 1040

Remnants of pole below one of stones on top of a post hole (ca. No. 800). Coll. 1969 by E. K. Barth. *Comment* (E.K.B.): though pole was lying partly exposed (dry), a large part was preserved.

T-795. Einsethø, wood **840 ± 50**
A.D. 1110

Remnant from lower part of pole from peat bog (ca. No. 627). Coll. 1968 by E. K. Barth. *Comment* (E.K.B.): a depression at every 3rd m in bog indicated a pole.

T-883. Einsethø, wood **1000 ± 60**
A.D. 950

Remnants of pole from a brook (ca. No. 96). Coll. 1969 by E. K. Barth. *Comment* (E.K.B.): pole was very well preserved and had almost the consistency of fresh wood.

T-882. Einsethø, wood **760 ± 60**
A.D. 1190

Remnant of pole in peat bog along same brook as for T-883 (ca. No. 90). Coll. 1969 by E. K. Barth. *Comment* (E.K.B.): pole was 0.92 m long, and largest of "ordinary poles."

T-1045. Einsethø, wood **930 ± 90**
A.D. 1020

Part of very large pole, 17 kg, dry, from base of another brook. Coll. 1970 by E. K. Barth. *Comment* (E.K.B.): pole also belonged to fence system.

T-884. Einsethø, charcoal **1380 ± 80**
A.D. 570

From cultural layer inside a house construction, at depth 0.28 m. Coll. 1968 by E. K. Barth.

T-1007. Einsethø, charcoal **950 ± 60**
A.D. 1000

From cultural layer inside another house construction, at depth 0.05 to 0.12 m. Coll. 1970 by A. Skjølsvold.

T-915A. Einsethø, wood **1250 ± 120**
A.D. 700

Small pieces of wood from depth 0.45 m in refuse heap outside house. Coll. 1968 by E. K. Barth.

T-915B. Einsethø, bone **800 ± 80**
A.D. 1150

Protein fraction of reindeer bones found in above mentioned refuse heap close to T-915A. *Lab. Comment*: protein fraction separated by dissolving sample (50% HCl) and evaporating to dryness.

T-715. Svartdalen, Lesja **1230 ± 80**
A.D. 720

Wood from wall in pit fall at +1000 m in Svartdalen, Lesja (62° 15' N Lat, 8° 50' E Long), Oppland, Norway. In a series of 25 pits with stone walls, one had walls of split pine logs. Coll. 1967 by Ö Mölmen, Lesja; subm. 1968 by Tore Fossum, Norwegian Mus. Forestry, Elverum.

T-885. Bråkdalshø, Sel **670 ± 60**
A.D. 1280

Wood from vertical pole in center of pit fall at +1440 m at Indre Bråkdalshø, Sel (61° 54' N Lat, 9° 38' E Long), Oppland, Norway. Coll. and subm. 1969 by E. K. Barth. *Comment* (E.K.B.): hypothesis: pole used for spitting the animal.

Spranget series

A system of 42 pit falls at +1050 m at Spranget, Sel (61° 50' N Lat, 9° 43' to 9° 44' E Long), Oppland, Norway. Samples coll. and subm. 1969 to 1970 by E. K. Barth.

T-916. Spranget I, wood **2050 ± 70**
130 B.C.

From depth 0.4 m below basal surface of 1 m deep pit, No. 33. *Comment* (E.K.B.): possibly remnants from a covering frame work on top of pit.

T-1028. Spranget II, charcoal **380 ± 90**
A.D. 1570

From a layer 0.3 m below basal surface of a 1 m deep pit, No. 4.

Dovre series

Wood remnants, from covering frame work in pit falls at +1250 m on Gravhø (ca. 62° 03' N Lat, 9° 38' E Long), and at +1300 m, 600 m SW of Hornsjö (62° 02' N Lat, 9° 34' E Long), respectively, Oppland, Norway. Subm. 1970 by E. K. Barth.

T-1006. Dovre I, Gravhø **480 ± 80**
A.D. 1470

Wood from depth 0.2 m below basal surface of 1.9 m deep pit. Coll. 1970 by E. K. Barth.

T-1008. Dovre II, Gravhø **640 ± 60**
A.D. 1310

Wooden sticks from depth 0.10 to 0.15 m below basal surface of 2 m deep pit. Coll. 1970 by A. Engen.

T-1010. Dovre III, Hornsjö **650 ± 80**
A.D. 1300

Wooden sticks from depth 0.55 m below basal surface of pit. Coll. 1970 by A. Engen. *Comment* (E.K.B.): in the 2 latter pit falls many sticks were found, the longest, 0.40 m.

T-1009. Gunstadseter **220 ± 120**
A.D. 1730

Small piece of wood from depth 0.10 to 0.15 m below basal surface of 2 m deep pit fall at +980 m at Gunstadseter, Stor-Elvdal (61° 00' N Lat, 10° 11' E Long), Hedmark, Norway. It belongs to system of 10 pits. Coll. 1970 by E. K. Barth. *Comment* (E.K.B.): may be last remnants of covering frame work.

III. GEOCHEMICAL MEASUREMENTS

Modern shell series

To evaluate recent C^{14} activity in marine shells formed on Norwegian coast line, 10 samples were measured. Samples were selected from colln. of Zool Mus., Bergen, by Johanne Kjennerud. Collection dates are precise and shells were alive at collection. Subm. 1970 by Jan Mangerud, Inst. Geology, Univ. Bergen.

General Comment: δC^{13} values quoted are relative to the PDB standard. Sample activities are corrected for age to the collection year and to $\delta C^{13} = 0\%$. Values corresponding to $\delta C^{13} = -25\%$ are also given. The mean Δ value for samples is $-4 \pm 3\%$. There is no significant deviation between the C^{14} activity in the 10 recent shells and 95% of the activity in NBS oxalic acid. According to these measurements, variations in the apparent age of Norwegian coastal water is small, ranging from 340 ± 75 yr to 550 ± 85 yr, with a mean value of 450 yr; this should not be a source of serious error in dates from Norwegian coastal shells. But 10 samples are a rather scanty number for such a long coast, and further investigation is desirable for verification.

T-951. Sognefjord, *Buccinum undatum* $\Delta = +1 \pm 9\%$
 $\delta C^{13} = +0.8\%$
 Δ (corrected to $\delta C^{13} = -25\%$) = $-49 \pm 9\%$
Apparent age of water: 400 ± 75 yr

From depth 20 to 40 m in Sognefjord at Leikanger (61° 11' N Lat, 6° 48' E Long), Sogn og Fjordane. Coll. 1912.

T-952. Sognefjord, *Linia excavata* $\Delta = -8 \pm 9\%$
 $\delta C^{13} = +2.1\%$
 Δ (-25%) = $-57 \pm 9\%$
App. age of water: 470 ± 75 yr

From depth 300 m in Sognefjord at Vangsnes (61° 10' N Lat, 6° 39' E Long), Sogn og Fjordane. Coll. 1920.

T-953. Fjaerlandsfjord, *Chlamys septemradiatus* $\Delta = -10 \pm 10\text{‰}$
 $\delta C^{13} = +2.7\text{‰}$

$$\Delta (-25\text{‰}) = -60 \pm 10\text{‰}$$

App. age of water: 500 ± 80 yr

From depth 180 to 200 m in Fjaerlandsfjord ($61^{\circ} 13' \text{ N Lat}$, $6^{\circ} 34' \text{ E Long}$ to $61^{\circ} 22' \text{ N Lat}$, $6^{\circ} 85' \text{ E Long}$), Sogn og Fjordane. Coll. 1909. Sample diluted, 67% sample.

T-954A. Herdla, *Cyprina islandica* $\Delta = +1 \pm 9\text{‰}$
 (outer fraction, 50%) $\delta C^{13} = +1.9\text{‰}$

$$\Delta (-25\text{‰}) = -49 \pm 9\text{‰}$$

App. age of water: 400 ± 75 yr

From depth 10 m in Ideosen, Herdla ($60^{\circ} 34' \text{ N Lat}$, $5^{\circ} 0' \text{ E Long}$), Hordaland. Coll. 1923.

T-954B. Herdla, *Cyprina islandica* $\Delta = -4 \pm 9\text{‰}$
 (inner fraction, 50%) $\delta C^{13} = +2.2\text{‰}$

$$\Delta (-25\text{‰}) = -54 \pm 9\text{‰}$$

App. age of water: 450 ± 75 yr

T-955. Hardangerfjord, *Cyprina islandica* $\Delta = -10 \pm 9\text{‰}$
 $\delta C^{13} = +2.6\text{‰}$

$$\Delta (-25\text{‰}) = -59 \pm 9\text{‰}$$

App. age of water: 490 ± 75 yr

From depth 20 to 50 m in Hardangerfjord at Solesnes, Jondal ($60^{\circ} 18' \text{ N Lat}$, $6^{\circ} 17' \text{ E Long}$), Hordaland. Coll. 1908.

T-956. Mosterhavn, *Tapes pullastra* $\Delta = +5 \pm 11\text{‰}$
 $\delta C^{13} = -0.2\text{‰}$

$$\Delta (-25\text{‰}) = -45 \pm 11\text{‰}$$

App. age of water: 370 ± 90 yr

From depth 15 m in Mosterhavn ($59^{\circ} 42' \text{ N Lat}$, $5^{\circ} 24' \text{ E Long}$), Hordaland. Coll. 1918. Sample diluted, 46% sample.

T-957. North Sea, *Modiolus modiolus* $\Delta = -4 \pm 9\text{‰}$
 $\delta C^{13} = +1.9\text{‰}$

$$\Delta (-25\text{‰}) = -54 \pm 9\text{‰}$$

App. age of water: 450 ± 75 yr

From depth 110 to 115 m in North Sea ($60^{\circ} 38' \text{ N Lat}$, $2^{\circ} 35' \text{ E Long}$), approx. half way between Bergen in Norway and Shetland. Coll. 1906. Sample diluted, 88% sample.

T-958. Komagfjord, *Mytilus edulis* $\Delta = -14 \pm 9\text{‰}$
 $\delta C^{13} = 0.0\text{‰}$

$$\Delta (-25\text{‰}) = -63 \pm 9\text{‰}$$

App. age of water: 520 ± 75 yr

From depth 0 to 10 m in Komagfjord ($70^{\circ} 16' \text{ N Lat}$, $23^{\circ} 24' \text{ E Long}$), Finnmark. Coll. 1922.

T-959. Brevikfjord, *Chlamys septemradiatus*

$$\Delta = -16 \pm 10\%$$

$$\delta C^{13} = +0.8\%$$

$$\Delta (-25\%) = -66 \pm 10\%$$

App. age of water: 550 ± 80 yr

From depth 100 to 120 m in Brevikfjord (59° 03' N Lat, 9° 42' E Long), Telemark. Coll. 1898. Sample diluted, 55% sample.

T-960. Risör, *Modiolus modiolus*

$$\Delta = +9 \pm 9\%$$

$$\delta C^{13} = +1.4\%$$

$$\Delta (-25\%) = -42 \pm 9\%$$

App. age of water: 340 ± 75 yr

From depth 10 m in Grønholmsund, Risör (58° 44' N Lat, 9° 18' E Long), Aust-Agder. Coll. 1905.

REFERENCES

- Andersen, B. G., 1954, Front and lateral moraines in southwestern Norway: Norsk geog. tidsskr. Bd. 14, p. 274-342.
- 1960, The late and postglacial history of southern Norway between Fevik and Ana-Sira: Norges geol. unders., no. 210, 142 p.
- 1964, Har Jaeren vaert dekket av en Skagerak-bre?: Norges geol. unders., no. 228, p. 5-11.
- Anundsen, K., 1968, Comments on stages of glacial retreat in southwestern Norway: Geol. Fören. Förh., v. 90, no. 543, p. 453.
- Anundsen, K. and Simonsen, A., 1968, Et Pre-borealt brefframstöt på Hardangervidda og i området mellom Bergensbanen og Jotunheimen: Univ. Bergen Årb., Mat.-Naturvit. ser. 1967, no. 7, 42 p.
- Barth, Edvard K., 1958, Reinsdyrgraver i Rondane: Den norske Turistforen. årb., p. 120-124.
- 1970, Gamle fangstanlegg for rein i Rondane: Den norske Turistforen. årb., p. 158-167.
- Bergström, B., 1971, Deglasiasjonsforløpet i Aurlandsdalen og områdene omkring: Doctoral thesis, Univ. Bergen (unpub.).
- Danielsen, Anders, 1972, A pine forest of Boreal age in a clay slide at Ullevål Stadion, Oslo, Norway: Norwegian Jour. Botany, v. 19 (in prep.).
- Espedal, Odd, 1966, Espeland: Frå haug og heidni, v. 6, no. 3, p. 237-241.
- 1967, Ei folkevandringstids grav fra Espeland i Høyland: Frå haug og heidni, v. 7, no. 3, p. 59-61.
- Hafsten, Ulf, 1956, Pollen-analytic investigations on the late Quaternary development in the inner Oslofjord area: Univ. Bergen årb. 1956, Nat. r. 8.
- 1960, Pollen-analytic investigations in South Norway, in: O. Holtedahl, Geology of Norway: Norges geol. unders., no. 208, pp. 434-462.
- Holtedahl, Olaf, 1928-29, Om landisens bortsmelting fra strøkene ved Trondheimsfjorden: Norsk geog. tidsskr., v. 2, p. 95-118.
- 1953, Norges geologi v. 2: Norges geol. unders., no. 164, p. 734.
- Ingstad, A. S., 1971, The Norse Settlement at L'Anse aux Meadows, Newfoundland. A preliminary report from the excavations 1961-68: Acta Archaeologica, v. 41, 1970, in press.
- Ingstad, Helge, 1964, Vinland ruins prove Vikings found the New World: Natl. Geographis, p. 708-734.
- 1970, Westward to Vinland: Cape, London and St. Martin, New York.
- Johansen, A. B., 1969, Høyfjellsfunn ved Laerdalsvassdraget I: Oslo/Bergen: Universitetsforlaget 1969. Bergen: Arbok for Univ. Bergen 1969, Hum. serie.
- Klovning, I. and Hafsten, U., 1965, An early post-glacial pollen profile from Flåmsdalen, a tributary valley to the Sognefjord, western Norway: Norsk geol. tidsskr. no. 45, p. 333-338.
- Lappalainen, Eino, 1970, Über die spätquartäre Entwicklung der Flussufermoore Mittel-Lapplands: Bulletin de la Commission Géologique de Finlande, no. 244, p. 1-79.

- Lillehammer, A., 1969, Skagen 3 og Stavanger i mellomalderen: Frå haug og heidni, v. 9, no. 2, p. 229-239.
- Mangerud, Jan, 1970a, Interglacial sediments at Fjøsanger, near Bergen, with the first Eemian pollenspectra from Norway: Norsk geol. tidsskr., v. 50, p. 167-181.
- 1970b, Late Weichselian vegetation and Ice-Front oscillations in the Bergen District, western Norway: Norsk geog. tidsskr., v. 24, p. 121-148.
- Martens, Irmelin, and Hagen, Anders, 1961, Arkeologiske undersøkelser langs elv og vann: Norske oldfunn, ser. 10, Oslo, 95 p.
- Möllerop, Odmund, 1969, Bygravninger i Stavanger: Frå haug og heidni, v. 9, no. 2, p. 141-144.
- Nydal, Reidar *et al.*, 1964, Trondheim natural radiocarbon measurements IV: Radiocarbon, v. 6, p. 280-290.
- 1970, Trondheim natural radiocarbon measurements V: Radiocarbon, v. 12, p. 205-237.
- Odner, Knut, 1965, Vivik ved Holmevatn på Haukelifjell: Viking XXIX, Oslo, p. 201-243.
- Ording, A., 1933-35, Myrens nytte for vernskogens bevarelse og for våre saeterbruk: Medd. fra Det norske myrselskap, p. 96-101.
- Øyen, P. A., 1905, Nygårdsprofilen på Karmöen: Christiania Vidensk. Selsk. forh. 8, 15 p.
- 1915, Kvartaerstudier i Trondheimsfeltet III: Kgl. N. Vid. Selsk. Skr. Bd. 2, no. 6, p. 1-506.
- Rolfen, Perry, 1966, Naust med keramikk som handelsvare fra eldre-jernalder: Frå haug og heidni, v. 6, no. 2, p. 207-214.
- Ruuhijärvi, R., 1963, Zur Entwicklungsgeschichte der nordfinnischen Hochmoore: Bot. Fennicae Annales, v. 34, no. 2, 40 p.
- Sandnes, J., 1965, Namdalens historie til år 1600: Namsos.
- Simonsen, A., 1969, Palynologiske undersøkelser ved nausttuftene på "Öyren", Hå: Stavanger Mus. Årb. 1969, p. 39-49.
- Simonsen, P., 1970, Fortidsminner nord for Polarsirkelen: Univ. forlaget, Oslo.
- Sjövold, T., 1962, The Iron age settlement of Arctic Norway: Tromsø Mus. Skr. X, no. 1, 253 p., Tromsø/Oslo. Norw. Univ. Press.
- Undås, I., 1934, Fra istiden i Trøndelag: Kgl. N. Vid. Selsk. Skr., no. 7, p. 1-64.
- Vorren, B., 1970, Jordbrukshistorie, vegetasjons- og klima- utvikling i Skage i Overhalla, Namdalen: Thesis Univ. Trondheim, unpub.
- 1971, Pollenanalysen, - en kilde til bosetningshistorien. Litt om jordbruksutviklingen i Overhalla: Årb. for Namdal, 1971.
- Vorren, K. D., 1967, Evig tele i Norge: Ottar, no. 51, 24 p.
- 1971, Faerdesmyra, en palsamy i Öst-Finnmark. Stratigrafi: Astarte, 1971, ms. in preparation.