

**GEOLOGICAL SURVEY OF FINLAND  
RADIOCARBON MEASUREMENTS V**

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The C<sup>14</sup> measurements reported here were made in this laboratory between July 1969 and September 1970. The dating system consists of a 0.55 L copper-walled proportional counter (adapted from Östlund and Engstrand, 1963, constructed by Outokumpu Oy, Research Lab., Tapiola, Finland) surrounded by a lead cylinder, 1.5 cm thick, placed within an anticoincidence meson detector. The system is encased in selected lead 1.5 cm thick, 7 cm of paraffin wax with ca. 10% boric acid and ca. 20 cm iron. Counter gas is CO<sub>2</sub> with which the counter is filled to 228.6 mm Hg at a detector temperature of 20°C. Background is 1.50 cpm and net contemporary value is ca. 10.0 cpm.

The radiocarbon dates in this list are based on 95% activity of NBS oxalic acid as modern standard and they were calculated using Libby half-life of C<sup>14</sup>. The results are reported in years before 1950 and in the A.D./B.C. scale. Age errors include counting errors of samples, background, and standard, and error in the half-life of C<sup>14</sup>. Errors smaller than 100 yr have been rounded off to an even 100 years. Mass-spectrometric analyses for fractionation correction were performed by Karolinska Inst., Stockholm. δC<sup>13</sup> values quoted are relative to the NBS oxalic acid standard.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

*A. Finland*

**Su-68. Inari, N Finland** **4920 ± 120**  
**2970 B.C.**

Wood from base of Morgam bog, surface alt 325 m, in Lemmenjoki (68° 40' N Lat, 25° 48' E Long). Coll. 1951 by E. Hyyppä.

**Su-69. Hattula, S Finland** **5880 ± 200**  
**3930 B.C.**

*Pinus* wood from *Sphagnum-Eriophorum*-deciduous peat taken with piston drill, depth 3.10 to 3.20 m, surface alt 110 m, Saunasuo bog (60° 45' N Lat, 24° 13' E Long). Coll. 1961 by E. Hyyppä. *Comment*: according to pollen analysis, horizon represents rise in *Picea* pollen.

- Su-70. Hattula, S Finland** **8150 ± 150**  
**6200 B.C.**  
Same bog as Su-69, detritus-diatom gyttja, depth 4.85 to 4.90 m. Coll. 1961 by E. Hyypä. *Comment:* horizon belongs to beginning Atlantic stage (Hyypä, 1966).
- Su-73. Porvoo, S Finland** **4670 ± 100**  
**2720 B.C.**  
 $\delta C^{13} = -6.26\text{‰}$   
Birch bark, depth 0.65 m, surface alt 28.5 m, Bastuberg (60° 21' N Lat, 25° 47' E Long). Coll. 1967 by E. Hyypä. *Comment:* according to pollen analysis, horizon represents rise in *Picea* pollen (Hyypä *et al.* 1969).
- Su-80. Multia, central Finland** **8510 ± 130**  
**6560 B.C.**  
Fine detritus gyttja taken with piston drill, depth 5.70 to 5.80 m, surface alt 156.7 m, Kuusilampi bog (62° 27' N Lat, 24° 49' E Long). Coll. 1968 by E. Hyypä. *Comment:* according to pollen analysis, horizon represents last stage of Pre-Boreal period.
- Su-81. Multia, central Finland** **9560 ± 280**  
**7610 B.C.**  
Same sec. as Su-80, fine detritus gyttja, depth 5.80 to 5.95 m. Coll. 1968 by E. Hyypä. *Comment:* same as Su-80.
- Su-82. Pylkönmäki, central Finland** **8470 ± 100**  
**6520 B.C.**  
*Betula* wood taken with piston drill, depth 2.60 m, surface alt 149 m, Uodinjärvensuo bog (62° 43' N Lat, 24° 49' E Long). Coll. 1968 by E. Hyypä. *Comment:* according to pollen and diatom analyses, horizon represents Boreal period and lies above Ancyclus Lake I level.
- Su-83. Aura, SW Finland** **3150 ± 100**  
**1200 B.C.**  
 $\delta C^{13} = +0.62\text{‰}$   
Deciduous-*Carex* peat from hand-dug sec., depth 3.00 to 3.04 m, surface alt 52 m, Ukuransuo bog (60° 36' N Lat, 22° 29' E Long). Coll. 1968 by E. Hyypä.
- Su-84. Aura, SW Finland** **3980 ± 160**  
**2030 B.C.**  
 $\delta C^{13} = -4.07\text{‰}$   
Same bog as Su-83, deciduous *Carex*-peat, depth 3.04 to 3.07 m. Coll. 1968 by E. Hyypä. *Comment:* according to pollen analysis, horizon represents Sub-Boreal period.

- Su-85. Aura, SW Finland** **3500 ± 120**  
**1550 B.C.**  
 $\delta C^{13} = -5.63\%$   
Same bog as Su-83 and Su-84, detritus gyttja, depth 3.07 to 3.10 m. Coll. 1968 by E. Hyyppä. *Comment:* according to pollen analysis, horizon represents Sub-Boreal period.
- Su-86. Aura, SW Finland** **4210 ± 110**  
**2260 B.C.**  
 $\delta C^{13} = -8.76\%$   
Same bog as Su-83-85, detritus gyttja, depth 3.10 to 3.13 m. Coll. 1968 by E. Hyyppä. *Comment:* according to pollen analysis, horizon represents Sub-Boreal period.
- Su-100. Aura, SW Finland** **4070 ± 100**  
**2120 B.C.**  
 $\delta C^{13} = -5.87\%$   
Same bog as Su-83-86, peat, depth 2.45 m. Coll. 1968 by E. Hyyppä.
- Su-101. Aura, SW Finland** **4360 ± 100**  
**2410 B.C.**  
 $\delta C^{13} = -8.03\%$   
Same bog as Su-83-86, and Su-100, peat with clay, depth 2.55 m. Coll. 1968 by E. Hyyppä.
- Su-87. Uurainen, central Finland** **7380 ± 120**  
**5430 B.C.**  
Fine detritus gyttja taken with piston drill, depth 2.10 to 2.20 m, surface alt 229.2 m, Kotanen bog (62° 27' N Lat, 25° 10' E Long). Coll. 1968 by E. Hyyppä.
- Su-88. Haapajärvi, N Finland** **6490 ± 125**  
**4540 B.C.**  
Detritus gyttja from hand-dug sec., depth 1.20 to 1.24 m, surface alt 94.2 m, Päivärinta bog (63° 48' N Lat, 25° 10' E Long). Coll. 1968 by E. Hyyppä.
- Su-109. Kytäjä, S Finland** **9820 ± 150**  
**7870 B.C.**  
Peat and detritus gyttja taken with piston drill, depth 1.40 to 1.50 m, surface alt 121 m, Jukolansuo bog (60° 35' N Lat, 24° 36' E Long). Coll. 1969 by E. Hyyppä.
- Su-110. Ruovesi, S Finland** **7620 ± 150**  
**5670 B.C.**  
Peat taken with piston drill, depth 0.05 to 0.15 m, surface alt 134.5 m, Niemisen sorakuoppa (61° 56' N Lat, 23° 51' E Long). Coll. 1969 by E. Hyyppä.
- Su-111. Joensuu, E Finland** **850 ± 150**  
**A.D. 1100**  
Peat, depth 1.60 m, surface alt 78.59 m, Vaneritehdas (62° 36' N Lat, 29° 47' E Long). Coll. 1969 by E. Hyyppä.

- Su-112. Joensuu, E Finland** **6700 ± 100**  
**4750 B.C.**  
Same sec. as Su-111, wood, depth 3.75 m. Coll. 1969 by E. Hyyppä.
- Su-74. Kittilä, N Finland** **8280 ± 130**  
**6330 B.C.**  
*Bryales* peat taken with piston sampler, depth 1.75 to 1.85 m, surface alt 205 m, small bog ca. 5 km S of Sirkka (67° 46' N Lat, 24° 51' E Long). Coll. 1967 by Raimo Kujansuu. *Comment:* peat underlain by till-like landslide material; according to pollen analysis, peat is Pre-Boreal in age (*Betula maximum*).
- Su-75. Kittilä, N Finland** **7840 ± 175**  
**5890 B.C.**  
*Sphagnum-Carex* peat taken with piston sampler, depth 1.25 to 1.35 m, surface alt 205 m, same bog as Su-74. Coll. 1967 by Raimo Kujansuu. *Comment:* pollen analysis shows end of *Betula maximum*.
- Su-76. Kittilä, N Finland** **2130 ± 110**  
**180 B.C.**  
Humified hardwood peat taken with piston sampler, depth 0.55 to 0.65 m, surface alt 205 m, same bog as Su-74. Coll. 1967 by R. Kujansuu. *Comment:* pollen analysis shows rise in *Picea* pollen.
- Su-77. Kolari, N Finland** **7390 ± 195**  
**5540 B.C.**  
*Bryales-Sphagnum* peat taken with piston sampler, depth 2.05 to 2.15 m, surface alt ca. 180 m, small bog on W flank of Taapaselkä hill (67° 08' N Lat, 24° 44' E Long). Coll. 1967 by R. Kujansuu. *Comment:* peat underlain by till-like landslide material; according to pollen analysis sample represents later part of *Betula maximum*.
- Su-78. Kittilä, N Finland** **6610 ± 175**  
**4660 B.C.**  
Sandy accumulation peat taken with piston sampler, depth 1.90 to 2.00 m, surface alt ca. 320 m, Aakkenustunturi (67° 40' N Lat, 24° 31' E Long). Coll. 1967 by Raimo Kujansuu. *Comment:* peat underlain by till-like landslide materials; according to pollen analysis sample represents later part of *Betula maximum*. Discrepancy between pollen dating and C<sup>14</sup> date.
- Su-79. Kittilä, N Finland** **2610 ± 100**  
**660 B.C.**  
*Bryales* peat taken with piston sampler, depth 0.65 to 0.75 m, surface alt ca. 320 m, same bog as Su-78. Coll. 1967 by Raimo Kujansuu. *Comment:* pollen analysis shows rise in *Picea* pollen.

- 3750 ± 110**  
**1800 B.C.**
- Su-71. Lavia, W Finland**  
Coarse detritus gyttja with *Trapa* fruits from hand-dug section, depth 0.50 to 0.56 m, surface alt 5.80 m, Huidanlahti tilled peat bog (61° 37' N Lat, 22° 30' E Long). Coll. 1967 by V. E. Valovirta. *Comment:* pollen analysis shows middle part of Sub-Boreal period.
- 4430 ± 100**  
**2480 B.C.**
- Su-72. Lavia, W Finland**  
Same place as Su-71. Coarse detritus gyttja with *Trapa* fruits from hand-dug section, depth 0.85 to 0.92 m. Coll. 1967 by V. E. Valovirta. *Comment:* pollen analysis shows beginning of Sub-Boreal period.
- 5220 ± 100**  
**3270 B.C.**  
 $\delta C^{13} = -2.16\text{‰}$
- Su-107. Keuruu, central Finland**  
*Trapa* fruits from hand-dug section, depth 0.6 to 0.7 m, surface alt 113 m, Koskela tilled peat bog (62° 19' N Lat, 24° 42' E Long). Coll. 1968 by V. E. Valovirta. *Comment:* pollen analysis shows end of Atlantic period.
- 5090 ± 100**  
**3140 B.C.**  
 $\delta C^{13} = -6.80\text{‰}$
- Su-108. Petäjavesi, central Finland**  
*Trapa* fruits taken with piston sampler, depth 1.8 to 1.9 m, surface alt 112 m, Kuristainen bog (62° 13' N Lat, 25° 14' E Long). Coll. 1968 by V. E. Valovirta. *Comment:* pollen analysis shows end of Atlantic period.
- 5010 ± 100**  
**3060 B.C.**
- Su-114. Loppi, S Finland**  
*Pinus* wood taken with piston sampler, depth 1.25 to 1.30 m, surface alt 123.5 m, Pitkäjärvi bog (60° 41' N Lat, 24° 33' E Long). Coll. 1969 by V. E. Valovirta. *Comment:* pollen analysis shows transition from Atlantic to Sub-Boreal period.
- 5610 ± 100**  
**3660 B.C.**
- Su-115. Loppi, S Finland**  
Same bog as Su-114, peat taken with piston sampler, depth 1.35 to 1.40 m. Coll. 1969 by V. E. Valovirta. *Comment:* pollen analysis shows Atlantic period.
- 7030 ± 100**  
**5080 B.C.**
- Su-116. Tuusula, S Finland**  
Limnic peat and pieces of wood taken with piston sampler, depth 3.20 to 3.25 m, surface alt 48 m, Vuohikka bog (60° 27' N Lat, 25° 00' E Long). Coll. 1969 by V. E. Valovirta. *Comment:* pollen analysis shows transition from Boreal to Atlantic period.
- 9430 ± 130**  
**7480 B.C.**
- Su-123. Renko, S Finland**  
Detritus gyttja taken with piston sampler, depth 5.80 to 5.84 m,

surface alt 118.3 m, Pukkinummenlampi (60° 47' N Lat, 24° 24' E Long). Coll. 1969 by V. E. Valovirta. *Comment*: pollen analysis shows transition from Pre-Boreal to Boreal period.

**9670 ± 130**  
**7720 B.C.**

**Su-124. Renko, S Finland**

Detritus gyttja taken with piston sampler, depth 3.85 to 3.90 m, surface alt 132.5 m, Pormestarinsuo bog (60° 58' N Lat, 24° 18' E Long). Coll. 1969 by V. E. Valovirta. *Comment*: pollen analysis shows Pre-Boreal period.

**6030 ± 110**  
**4080 B.C.**

**Su-125. Taipalsaari, SE Finland**

Conifer wood taken from submerged stump by sawing, depth of water 1.5 m, level of Lake Saimaa alt 76 m, Kirkkosaari (61° 14.5' N Lat, 28° 17.2' E Long). Coll. 1969 by T. Liukkonen. Subm. by K. Virkkala. *Comment*: sample older than transgression of Lake Saimaa.

**5210 ± 140**  
**3260 B.C.**

**Su-133. Siilinjärvi, central Finland**

$\delta C^{13} = -4.94\%$

*Trapa* fruits from hand-dug section, depth 1.15 to 1.20 m surface alt 103 m, Mikansuo bog (63° 10' N Lat, 27° 33' E Long). Coll. 1969 by V. E. Valovirta. *Comment*: pollen analysis shows latter half of Atlantic period.

**2440 ± 100**  
**490 B.C.**

**Su-98. Enontekiö, N Finland**

$\delta C^{13} = -1.54\%$

Pine stem (*Pinus sylvestris*) from bottom of Lake Ropinjärvi (68° 41' N Lat, 21° 36' E Long). Coll. 1968 by Eino Lappalainen. *Comment*: organic bottom sediment was insufficient for pollen dating. Sample was ca. 30 km N of present pine forest limit (ref: E. Lappalainen, 1970b).

**4850 ± 160**  
**2900 B.C.**

**Su-99. Enontekiö, N Finland**

$\delta C^{13} = -0.31\%$

Pine stem (*Pinus sylvestris*) from bottom Lake Peerajärvi (68° 53' N Lat, 21° 06' E Long). Coll. 1968 by Eino Lappalainen. *Comment*: organic bottom sediment was insufficient for pollen dating. Sample, diam. 30 cm, was ca. 60 km N of present pine forest limit. In zone of pollen diagrams used in Finnish Lapland (e.g., Salmi, 1968), this date coincides with Zone Limit VII/VIII, *i.e.*, beginning of Sub-Boreal period (ref: E. Lappalainen, 1970b, p. 150).

**3610 ± 120**  
**1660 B.C.**

**Su-102. Pelkosenniemi, N Finland**

*Bryales-Carex* peat taken with piston sampler 1.35 to 1.45 m below bog surface, 163 m, at Sudenvaaraanaapa (67° 13' N Lat, 27° 37' E Long). Coll. 1965 by Eino Lappalainen. *Comment*: pollen analysis shows rise in

*Picea* pollen; horizon represents Sub-Boreal period (compare Su-103; ref: E. Lappalainen, 1970a, p. 62).

**Su-103. Sodankylä, N Finland** **3280 ± 120**  
**1330 B.C.**

*Carex-Bryales-Sphagnum* peat taken with piston sampler 1.39 to 1.44 m below bog surface at Virttiövuoma, alt 199 m (67° 30' N Lat, 25° 50' E Long). Coll. 1965 by Eino Lappalainen. *Comment*: pollen analysis shows rise in *Picea* pollen. Su-102 is 80 km E of Virttiövuoma (ref: E. Lappalainen, 1970a, p. 57).

**Su-104. Pelkosenniemi, N Finland** **8450 ± 150**  
**6500 B.C.**

*Carex-Sphagnum* peat taken with piston sampler 4.95 to 5.01 m below bog surface at bog Kairanaapa, alt 151 m (67° 12' N Lat, 27° 31' E Long). Coll. 1965 by Eino Lappalainen. *Comment*: pollen analysis shows transition from *Betula* to *Pinus* maximum (ref: E. Lappalainen, 1970a, p. 59).

**Su-105. Sodankylä, N Finland** **7870 ± 110**  
**5920 B.C.**

*Sphagnum-Carex* peat taken with piston sampler 3.73 to 3.78 m below the bog surface at Lehonjätkä, alt 182 m (67° 24' N Lat, 27° 40' E Long). Coll. by Eino Lappalainen. *Comment*: pollen analysis shows increase in *Alnus* pollen, Zone Boundary V/VI (ref: E. Lappalainen, 1970a, p. 58).

**Su-106. Pelkosenniemi, N Finland** **9030 ± 120**  
**7080 B.C.**

*Carex-Bryales* peat taken with piston sampler 4.34 to 4.41 m below bog surface. Same bog as in Su-102. Coll. 1965 by Eino Lappalainen. *Comment*: pollen analysis shows middle Pre-Boreal period, Zone IV (ref: E. Lappalainen, 1970a, p. 61).

#### Tohmajärvi series

Wood and peat taken with piston sampler from peat bog near Kangasvaara in Tohmajärvi, E Finland (62° 16' N Lat, 30° 22' E Long), surface alt 90 m. Coll. 1968 by A. Leino and P. Lindroos.

**Su-117. Tohmajärvi** **5270 ± 100**  
**3320 B.C.**

Wood from peat bog, depth 160 m. *Comment*: pollen analysis indicates Postglacial climatic optimum.

**Su-118. Tohmajärvi** **8800 ± 200**  
**6850 B.C.**

*Sphagnum-Phragmites* peat, depth 2.80 to 2.90 m. *Comment*: pollen analysis shows beginning of Boreal *Pinus* maximum.

**Su-120. Tohmajärvi** **9200 ± 100**  
**7250 B.C.**

*Bryales* peat, depth 3.30 to 3.40 m. *Comment*: pollen analysis shows Pre-Boreal *Betula* maximum.

**4180 ± 100**  
**2230 B.C.**

**Su-119. Tohmajärvi, Vatala**  
Surface alt 117 m (62° 19' N Lat, 30° 24' E Long). *Eriophorum-Sphagnum* peat taken with a piston sampler, depth 0.60 to 0.65 m. Coll. 1968 by A. Leino and P. Lindroos. *Comment*: sample represents Sub-Boreal period.

**4480 ± 100**  
**2530 B.C.**

**Su-121. Askola, S Finland**  
*Carex* peat from hand-dug section, depth 0.65 to 0.75 m, surface alt 32.5 m, Porrassuo bog (60° 31' N Lat, 25° 31' E Long). Coll. 1969 by R. Tynni and E. Kukkonen. *Comment*: according to pollen and diatom analyses, sample represents maximum of Littorina III stage, or immediately postdates it, and isolation of bog basin during Sub-Boreal (Tynni, 1966).

**7000 ± 130**  
**5050 B.C.**

**Su-122. Askola, S Finland**  
Detritus gyttja from same bog as Su-121 taken with piston sampler, depth 1.05 to 1.15 m. Coll. 1969 by R. Tynni and E. Kukkonen. *Comment*: sample represents maximum of Littorina I b stage.

**6060 ± 100**  
**4110 B.C.**

**Su-128. Taipalsaari, SE Finland**  
Submerged stump of *Pinus*, Lake Saimaa, Viskarila (61° 9' N Lat, 28° 12' E Long). Sample was taken ca. 0.5 to 1.0 m below lake level, alt +75.8 m. Coll. 1969 by Osmo Hyppönen. *Comments*: sample represents Postglacial transgression of Lake Saimaa (V. Lappalainen, 1962; Saarnisto, 1970).

**2400 ± 100**  
**450 B.C.**

**Su-129. Taipalsaari, SE Finland**  
Submerged stem of *Pinus*, Lake Saimaa, Pieni Jänkäsalo (61° 13' N Lat, 28° 11' E Long). Sample was taken ca. 2 m below lake level, alt +74 m. Coll. 1970 by Osmo Hyppönen. *Comments*: as C<sup>14</sup> age of sample is ca. 3600 yr younger than Su-128, pine stem probably is driftwood and not related to Lake Laimaa transgression.

**Sedimentation rate series, S Finnish lakes**

**690 ± 100**  
**A.D. 1260**  
 $\delta C^{13} = -4.32\%$

**Su-130. Vihti**

Gyttja clay sediment taken with gravity corer from Lake Hiidenvesi, depth 60 to 70 cm below bottom (60° 24.5' N Lat, 24° 19' E Long), lake level alt 31.7 m; water depth at core 4.2 m. Coll. 1969 by H. Harjula. Subm. by Esa Kukkonen. *Comment*: presence of allochthonous humus is possible.



**Su-131. Vihti****770 ± 100****A.D. 1180** $\delta C^{13} = -5.26\%$ 

Gyttja clay sediment taken with piston corer from Lake Hiidenvesi, depth 60 to 70 cm below bottom (60° 23' N Lat, 24° 11' E Long), lake level alt 31.8 m and water depth at core 4.2 m. Coll. 1969 by E. Kukkonen. *Comment*: according to pollen analysis horizon is younger than increase of cereal pollen. Presence of allochthonous humus is possible.

**Su-132. Tuusula****860 ± 110****A.D. 1090** $\delta C^{13} = -8.35\%$ 

Gyttja clay taken with gravity corer from Lake Tuusulanjärvi, depth 60 to 70 cm below bottom (60° 26' N Lat, 25° 03' E Long). Lake level alt 37.8 m; water depth at core 9 m. Coll. 1969 by H. Harjula. Subm. by Esa Kukkonen. *Comment*: presence of allochthonous humus is possible.

*B. North America***Su-89. Portland, Maine****450 ± 100****A.D. 1500**

Peat, depth 0.1 to 0.2 m Scarboro, drowned (43° 34' N Lat, 70° 20' W Long). Coll. 1959 by E. Hyypä.

**Su-90. Portland, Maine****830 ± 100****A.D. 1120**

Same section as Su-89, root, depth 0 to 0.1 m. Coll. 1959 by E. Hyypä.

**Su-91. Eastport, Maine****4770 ± 120****2820 B.C.**

Stump, depth 1.5 m, surface alt 5 to 6 m, Jones Port, Popplestone Beach (44° 34' N Lat, 67° 35' W Long). Coll. 1959 by E. Hyypä.

**Su-92. Kewaunee, Wisconsin****12,200 ± 160****10,250 B.C.**

Wood, depth 4 m, surface alt 195 m, Two Creeks (44° 20' N Lat, 87° 32' W Long). Coll. 1959 by E. Hyypä.

**Su-93. Quebec, Canada****>35,000**

Wood and root, depth 20 m, surface alt 33 m, St. Pierre les Becquets (46° 31' N Lat, 72° 12' W Long). Coll. 1959 by E. Hyypä.

**Su-94. Quebec, Canada****>40,000**

Same section as Su-93, organic remains, depth 20 m. Coll. 1959 by E. Hyypä.

**Su-95. Rye, New Hampshire****4160 ± 125****2210 B.C.**

Wood and stump from lowest tide limit, Odiornes Point (43° 03' N Lat, 70° 44' W Long). Coll. 1959 by E. Hyypä.

- Su-96. Rye, New Hampshire** **3820 ± 135**  
**1870 B.C.**  
Same section as Su-95, wood and stump. Coll. 1959 by E. Hyypä.
- Su-97. Rye, New Hampshire** **4230 ± 125**  
**2280 B.C.**  
Same section as SU-95 and -96, peat. Coll. 1959 by E. Hyypä.
- Su-113. Sagamore, Massachusetts** **3810 ± 110**  
**1860 B.C.**  
Peat, depth 2.10 to 2.30 m, Cape Cod Canal (41° 47' N Lat, 70° 32' W Long). Coll. 1938 by E. Hyypä.

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