

BERN RADIOCARBON DATES VI

H. OESCHGER and T. RIESEN

Physikalisches Institut, Universität Bern

This date list consists of some of the samples measured since summer 1965. For the routine measurements the same technique and equipment as described earlier was used (Bern IV).

Besides, with two specially designed counters, samples containing as little as 20 to 50 mg carbon were analyzed (Loosli, 1963; Oeschger, 1963). Up to now this technique has been applied only to CO₂ samples extracted from polar ice. These results are listed with numbers above B-1000.

Our laboratory is financed by the Schweizerischer Nationalfonds. The authors wish to thank P. Horisberger and H. H. Loosli for their assistance in the measurement of the samples. They also thank M. Welten and H. G. Bandi for their help in selecting and discussing the samples.

Tuto series, Greenland (Table 1)

During a joint research project with USA CRREL during March-April 1964, CO₂ was extracted from ice of Tuto Tunnel (76° 28' N Lat, 68° 13' W Long), North Greenland, which runs 350 m horizontally into ice sheet. Samples were collected 200 m and 300 m from tunnel portal. Ice was melted in vacuo and two different methods for collecting CO₂ were applied: precipitation in NaOH (method 1) and trapping in molecular sieve 4 A (method 2) (Langway *et al.*, 1965; Oeschger *et al.*, 1966). For measurement CH₄ was prepared (Bern IV). Samples out of ca. one ton of ice yielded 50 to 100 cc of CO₂. Most CO₂ is assumed to be atmospheric. Ages therefore were calculated based on a modern (prebomb) C-activity for atmospheric CO₂ equal to 0.95 NBS oxalic acid x 1.037. Coll. by C. C. Langway, Jr., USA CRREL and H. Oeschger, Univ. of Bern. *Comment* (H.O.): from geometrical array of ice layers and from general rheological knowledge age was expected to increase towards tunnel portal, which is agreement with C¹⁴ results. Series looks consistent with exception of B-1011, which is at 3 σ limit. Mean C¹⁴-age at 300 m is 2420 $\pm$ 185, at 200 m it is 5350 $\pm$ 260. Young age of B-1011 might be due to contamination with recent atmospheric CO₂. In March-April 1966 this project was repeated and samples were collected from each 100 ft. A new *in situ* extraction technique was developed and successfully applied. Results from 1966 project are not yet complete and will be published later.

Motta Naluns series, Switzerland

A profile of 290 cm of well-preserved turf, consisting of sedges, Hypnaceae and wood of Salix, was taken from wall cut in bog on left-

TABLE 1
C¹⁴ ages of ice in Tuto tunnel, N Greenland

Sample No.	Distance from portal m	Method	Age, calculated from modern prebomb atmospheric CO ₂ activity
B-1002	300	2	2850 ± 320
B-1004	300	2	2760 ± 300
B-1011	300	1	1370 ± 360
B-1010	300	1	2700 ± 800
B-1003	200	2	6030 ± 700
B-1005	200	2	5400 ± 400
B-1009	200	1	5040 ± 400

hand slope above Schuls-Tarasp (46° 48' 22" N Lat, 10° 16' 25" E Long, alt 2170 m). Coll. 1962 and subm. by M. Welten. *Comment* (M.W.): pollen diagram is accurately dated by this consistent series of results.

B-532.	Motta Naluns, 50 cm depth	2020 ± 100 70 B.C.
B-533.	Motta Naluns, 81 cm depth	2620 ± 100 670 B.C.
B-534.	Motta Naluns, 120 cm depth	3890 ± 100 1940 B.C.
B-535.	Motta Naluns, 130 cm depth	3890 ± 100 1940 B.C.
B-536.	Motta Naluns, 142 cm depth	4130 ± 100 2180 B.C.
B-537.	Motta Naluns, 160 cm depth	4400 ± 100 2450 B.C.
B-538.	Motta Naluns, 174 cm depth	4580 ± 200 2630 B.C.
B-539.	Motta Naluns, 193 cm depth	4900 ± 120 2950 B.C.
B-541.	Motta Naluns, 230 cm depth	5820 ± 120 3870 B.C.
B-542.	Motta Naluns, 248 cm depth	6170 ± 120 4220 B.C.
B-543.	Motta Naluns, 265 cm depth	7400 ± 120 5450 B.C.
B-544.	Motta Naluns, 276 cm depth	8030 ± 120 6080 B.C.

Auvernier series, Lac de Neuchâtel, Switzerland

Charcoal and wood (piles and boards) from Neolithic settlement at Auvernier, Lake Neuchâtel (46° 58' 16" N Lat, 6° 52' 24" E Long). From cultural layer, 0.8 to 1.0 m thick, ca. 0.1 to 0.15 m below present lake bottom, 10 to 50 m off modern shoreline. Coll. 1964 and 1965 by Ch. Strahm and J. P. Jéquier; subm. by Ch. Strahm, Univ. of Freiburg i.Br. Germany. *Comment* (Ch.St.): site is archaeologically dated by imports from the *Schnurkeramik* Civilization and belongs to the Swiss late Neolithic. Good archaeological proof exists for repeated use of site during longer time range. Oak trunk, sample B-690 (4630 ± 100), is evidently out of place in the settlement series. This is in agreement with stratigraphic position 10 m below oldest part of cultural layer in a distinctively older sediment.

B-685.	Auvernier	4000 ± 120 2050 B.C.
B-686.	Auvernier	4160 ± 100 2210 B.C.
B-687.	Auvernier	3990 ± 100 2040 B.C.
B-688.	Auvernier	4140 ± 140 2190 B.C.
B-689.	Auvernier	4130 ± 100 2180 B.C.
B-690.	Auvernier	4630 ± 100 2680 B.C.
B-643.	Auvernier	4160 ± 120 2210 B.C.
B-644.	Auvernier	4000 ± 150 2050 B.C.
B-645.	Auvernier	4180 ± 120 2230 B.C.
B-646.	Auvernier	3960 ± 120 2012 B.C.

Wachseldorn series, Switzerland

Turf of sedges and Hypnaceae, at base of peat works, at Wachseldorn, E of Thun and the Aaretal (46° 49' 15" N Lat, 7° 44' 5" E Long) at alt 1000 m above sealevel in Tertiary (Molasse) landscape N of Alps, where present climate is harsh. Coll. 1965 by K. Heeb and M. Welten, Univ. of Bern. *Comment* (M.W.): this exceptionally important pollen diagram of late-glacial times has been analyzed by K. Heeb; it demonstrates presence of Bölling and Alleröd as well as Younger Dryas, cool-

climate zones being dominated by grasspollen. The C¹⁴ series is clearly consistent with Heeb's interpretation.

B-700.	Wachseldorn, 416 cm depth	10,550 ± 150 8600 B.C.
B-701.	Wachseldorn, 421 cm depth	10,320 ± 150 8370 B.C.
B-702.	Wachseldorn, 451 cm depth	10,980 ± 200 9030 B.C.
B-703.	Wechseldorn, 466 cm depth	11,660 ± 150 9710 B.C.
B-704.	Wachseldorn, 470 cm depth	11,810 ± 150 9860 B.C.
B-705.	Wachseldorn, 479 cm depth	12,345 ± 150 10,395 B.C.
B-706.	Wachseldorn, 481 cm depth	12,210 ± 150 10,260 B.C.
B-707.	Wachseldorn, 489 cm depth	12,395 ± 130 10,445 B.C.
B-708.	Wachseldorn, 491 cm depth	12,500 ± 150 10,550 B.C.
B-709.	Wachseldorn, 505 cm depth	12,915 ± 130 10,965 B.C.

Sur-Les-Bieds series, Vallée des Ponts, Switzerland

Material from wall of typical peat-bog of Haute Jura Neuchâtelois, close to Sur-les-Bieds (46° 58' 52" N Lat, 6° 44' 25" E Long). Coll. 1964 and subm. by Francois Matthey, Univ. of Neuchâtel. *Comment:* see Sous Martel-Dernier series (B-714 to B-716, this date list).

B-710.	Sur-Les-Bieds, 290-260 cm depth	9360 ± 100 7410 B.C.
	Corylus and Quercetum mixtum phase; Pinus maximum.	
B-711.	Sur-Les-Bieds, 200 cm depth	6930 ± 100 4980 B.C.
	Development of Abies increase of Quercetum mixtum and decrease of Corylus.	
B-712.	Sur-Les-Bieds, 150 cm depth	5730 ± 100 3780 B.C.
	Intensive spread of Abies and decrease of Quercetum mixtum.	
B-713.	Sur-Les-Bieds, 100 cm depth	4430 ± 100 2480 B.C.
	First important appearance of Picea in the Vallée des Ponts.	

Sous Martel-Dernier series, Vallée des Ponts, Switzerland

Material from wall of typical peat-bog of Haute Jura Neuchâtelois close to Sous Martel-Dernier (46° 58' 51" N Lat, 6° 42' 49" E Long). Coll. 1964 and subm. by F. Matthey, Univ. of Neuchâtel. *Comment* (F.M.): the Sur-les-Bieds and Sous Martel-Dernier series date postglacial development of vegetation in Vallée des Ponts. Deposition during Allerød phase is established.

10,950 ± 120**B-714. Sous Martel-Dernier, 300-270 cm depth 9000 B.C.**

Second maximum of *Juniperus*; after a first maximum *Pinus* shows a short decrease followed by a second extension.

8600 ± 100**B-715. Sous Martel-Dernier, 250 cm depth 6650 B.C.**

Corylus and *Quercetum-mixtum* phase; strong decrease of *Pinus*.

4240 ± 100**B-716. Sous Martel-Dernier, 150 cm depth 2290 B.C.**

Decrease of *Corylus* and *Quercetum mixtum*; increase of *Abies*.

Le Grand Cachot series, Vallée de la Brévine, Switzerland

Samples from wall of typical peat-bog of Haute Jura Neuchâtelois close to Le Grand Cachot (47° 0' 24" N Lat, 6° 40' 41" E Long). Coll. 1964 and subm. by F. Matthey. *Comment* (F.M.): B-717 dates beginning of colonization of Vallée de la Brévine by *Abies*; B-718 marks crossing of curves for increasing *Abies* and decreasing *Quercetum-mixtum* pollen.

6220 ± 100**B-717. Le Grand Cachot, 290 cm depth 4270 B.C.**

Extension of *Abies*.

4830 ± 100**B-718. Le Grand Cachot, 250 cm depth 2880 B.C.**

First maximum of *Abies* and appearance of *Picea*.

5820 ± 100**B-917. Noiraigue: "Les Marais," Switzerland 3870 B.C.**

Peat from lowest layer of bog on chalky sediment of ancient lake in Val de Travers (46° 57' 15" N Lat, 6° 42' 56" E Long). Coll. 1965 and subm. by F. Matthey. *Comment* (F.M.): sample dates disappearance of lake from Val de Travers.

2580 ± 100**B-720. Les Saignolis, Switzerland 630 B.C.**

Peat from bog on marl of "Chaîne de Poillerel" (47° 5' 17" N Lat, 6° 45' 56" E Long). Coll. 1965 and subm. by F. Matthey. *Comment* (F.M.): peat of sphagnum lies directly on mineral (calcareous) ground, forming a very special type of bog; strong leaching prior to peat formation is implied.

- B-725. Salchendorf, Germany** **480 ± 100**
A.D. 1470

Charcoal, found during construction of a woodland path at Salchendorf (50° 48' 30" N Lat, 7° 59' 50" E Long). Coll. 1965 by Alfred Henrichs; subm. by W. Kolb, Physikalisch-technische Bundesanstalt, Braunschweig.

- B-730. Aesch, Klushof, Switzerland** **1565 ± 90**
A.D. 385

Wood (*Vitis vinifera*) found during excavation at depth of 4 m in culture layer at Klushof, Aesch (47° 28' N Lat, 7° 36' E Long). Coll. 1965 and subm. by Sandoz AG., Basel. *Comment* (S.): result supports presumption that vine was grown during Roman occupation N of Alps.

Burgmoos series, Seeberg, Canton Bern, Switzerland

Dark humus layer, found by boring at edge of ancient late-glacial lake of Burgmoos near Burgaeschisee (47° 10' 20" N Lat, 7° 40' 28" E Long, alt 465 m). Coll. 1965 by Welten and V. Markgraf; subm. by M. Welten. *Comment* (M.W.): palynological results did not agree with the supposed Alleröd age, inferred from position under less organic sediment. Material proved to be Anmoos (i.e., a humus-rich soil). C¹⁴ dating assigned layer to Younger Dryas, proving an unusual stratigraphy of late-glacial lake-border sediments.

- B-731. Burgmoos I, 235 cm depth** **10,460 ± 140**
8510 B.C.
- B-732. Burgmoos I, 242 cm depth** **10,490 ± 170**
8540 B.C.

- B-736. Zentral-Elburz, Iran** **> 38,500**

Clayey and silty material mixed with plant remains from filling of a Young Pleistocene lake in the Lar-Tal (35° 53' 30" N Lat, 51° 59' 30" E Long), SW of volcano Damavand, Iran. Coll. 1962 and subm. by P. Allenbach, Federal Inst. of Tech. *Comment* (P.A.): date is minimum age for the southernmost lava deposits of volcano Damavand which dammed the Pleistocene lake (Allenbach, 1966).

- B-754. Tabo Temple, Sudan** **1870 ± 80**
A.D. 80

Wood from temple Tabo, Ile d'Argo, Sudan (19° 23' N Lat, 30° 28' E Long) found on floor covered with stone slabs close to central portal. Coll. 1966 and subm. by Charles Bonnet, Univ. of Genève. *Comment* (Ch.B.): date confirms that temple was constructed or reconstructed during the Meroitic epoch.

- B-772. Boltigen, Chutti, Simmental, Switzerland** **10,950 ± 150**
9000 B.C.

Upper 1 cm of a dy-gyttja layer, 5 cm thick, at 555 cm depth below surface, representing beginning of Pinus period from Boltigen, Chutti,

Simmental, Bernese Oberland (46° 38' 10" N Lat, 7° 23' 42" E Long). Coll. 1966 and subm. by M. Welten, *Comment* (M.W.): result supports B-75 (11,230 ± 380, Bern I), obtained for a sample covering the whole 5-cm-thick layer. 7.5 cm above sample is thin layer of volcanic ash, age of which estimated ca. 8800 B.C.

Boltigen, Chutti series, Simmental, Switzerland

Peat of Hypnaceae from Boltigen, Chutti, Simmental, Bernese Oberland (46° 38' 10" N Lat, 7° 23' 42" E Long, alt 925 m). Coll. and subm. 1966 by M. Welten. *Comment* (M.W.): samples represent beginning of development of peat above reddish and gray chalk with increased *Artemisia* content. For beginning of deposition of traces of pollen of xerophytic trees an approximate age of 8200 B.C. is obtained by extrapolation. This is in good agreement with other results.

		9910 ± 150
B-773.	Boltigen, Chutti, 508.5 cm	7960 B.C.
		9100 ± 150
B-774.	Boltigen, Chutti, 500 cm depth	7150 B.C.

REFERENCES

Date lists:

- Bern I Oeschger, Schwarz and Gfeller, 1959
 Bern IV Oeschger and Riesen, 1965

- Allenbach, P., 1966, Geologie und Petrographie des Damavand und seiner Umgebung (Zentral-Elburz), Iran: Mitteilungen aus dem Geologischen Institut der ETH und der Univ. Zürich.
- Langway, C. C., Jun., Oeschger, H., Renaud, A., Alder, B., 1965, Sampling polar ice for radiocarbon dating: *Nature*, v. 206, p. 500.
- Loosli, H. H., 1963, Zählrohr für C¹⁴-Altersbestimmungen an kleinen Proben: Physikalisches Inst. der Univ. Bern, thesis.
- Oeschger, H., Schwarz, U., Gfeller, Chr. 1959, Bern radiocarbon dates I: *Am. Jour. Sci. Radioc. Supp.*, v. 1, p. 133-143.
- Oeschger, H., 1963, Low-level counting methods: *Radioactive Dating*, IAEA, Vienna, p. 13-34.
- Oeschger, H., Riesen, T., 1965, Bern radiocarbon dates IV: *Radiocarbon*, v. 7, p. 1-9.
- Oeschger, H., Alder, B., Loosli, H. H., Langway, C. C., Jun., Renaud, A., 1966, Radiocarbon dating of ice: *Earth and Planetary Science Letters*, v. 1, p. 49-54.