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J.A. LOWDON
W. BLAKE, Jr.

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CONTENTS

The present date list, GSC XVI, is the fifth to be published directly in the Geological Survey's Paper series. Lists prior to GSC XII were published first in the journal **Radiocarbon** and were reprinted as GSC Papers. The lists through 1967 (GSC VI) were given new pagination, whereas lists VII to XI (1968 to 1971) were reprinted with the same pagination.

Tables

GEOLOGICAL SURVEY OF CANADA RADIOCARBON DATES XVI

Abstract

This list includes 83 radiocarbon age determinations on 80 geological samples made by the Radiocarbon Dating Laboratory. They are on samples from various areas as follows: Nova Scotia (8); Quebec (5); Ontario (7); Manitoba(8); Saskatchewan (1); Alberta (1); British Columbia (16); Yukon Territory (22); Northwest Territories, Mainland (5); Northwest Territories, Arctic Archipelago (9); United States of America (1). Details of background and standard for the 2-litre and 5-litre counters during the period from April 1, 1975 to August 4, 1976 are summarized in Tables 1 and 2; Table 3 gives the number of counts used to determine the average background and standard counting rates; and Table 4 lists the number of different background and standard gas preparations used for counting.

Résumé

Ce rapport présente les résultats de 83 datations effectuées sur 80 échantillons géologiques par le Laboratoire de datation au radiocarbone. Ces échantillons proviennent des régions suivantes: Nouvelle-Ecosse (8); Québec (5); Ontario (7); Manitoba (8); Saskatchewan (1); Alberta (1); Colombie-Britannique (16); Yukon (22); Territoires du Nord-Ouest, continent (5); Territoires du Nord-Ouest, archipel Arctique (9); Etats-Unis (1). Les valeurs du mouvement propre et de l'étalonnage des compteurs 2 litres et 5 litres, pour la période allant du 1 avril 1975 au 4 août 1976, sont présentées dans les tableaux 1 et 2; le tableau 3 donne le nombre de coups utilisés pour déterminer la moyenne des taux d'impulsions du mouvement propre et de l'étalonnage; et, le tableau 4 donne le nombre de préparations de gaz pour le mouvement propre et pour l'étalonnage utilisées pour le comptage.

Introduction*

During the period covered by this introduction (April 1975 to August 1976), the 2-litre counter (Dyck and Fyles, 1962) was operated for approximately 14 months, and the 5-litre counter (Dyck **et al.**, 1965) was operated for approximately 15 months. The 1-litre counter was not used during this period. The 2-litre counter was operated at 2 atm and the 5-litre at 1 atm.

A new 2-litre counter (Lowdon and Blake, 1975) was put into operation in April 1975 and was used successfully until September, when electronic problems were incurred. New electronic components were installed with little success. The problems were finally overcome by painting the ends of the counter, resistors, and capacitors with "Glyptol" insulating varnish. Also, the signal wire from the capacitors to the counter terminal was replaced with a shielded and grounded wire. Although the counter was operating in a stable manner, the background was higher than desirable. At the end of February 1976, the counter was washed out with an acetone-distilled water mixture. The much lower background achieved since March shows the results of this treatment.

It will be noted from Table 1 that the backgrounds for both the 2-litre and 5-litre counters were much higher in April 1975 than at other times. The reason for this was the fact that the new capacitors used for the new 2-litre counter were slightly radioactive. These capacitors were replaced at the end of April.

Average background and standard counting rates for the periods used for computerized age calculations are shown in Tables 1 and 2, respectively. On a period basis, counting rates were within statistical limits.

Table 3 lists the number of daily counts used to determine the average background and standard counting rates which were utilized for age calculations during the periods listed. Table 4 lists the number of different background and standard gas preparations used for counting during the same periods.

Since January 1972 age calculations have been carried out by a C.D.C. 6400 computer. Calculations are based on a ^{14}C half-life of 5568 ± 30 years and 0.95 of the activity of the NBS oxalic acid standard. Ages are quoted in radiocarbon years before present (B.P.) where "present" is taken to be 1950.

Since January 1973 the error assigned to each age has been calculated using only the counting errors of sample, background, and standard, and the error in the half-life of ^{14}C (Lowdon **et al.**, 1974; Lowdon and Blake, 1973). Prior to 1973 an error term to account for the average variation of ± 1.5% in the ^{14}C concentration of the atmosphere during the past 1100 years had been incorporated in the age error calculation. This last error term had been used mainly as a result of the work done on Douglas fir (**Pseudotsuga menziesii**) tree rings (Dyck, 1965, 1966, 1967) and sequoia (**Sequoia gigantea**) tree rings (Willis **et al.**, 1960). More recent work on bristlecone pine (**Pinus aristata**), however, mainly by the University of Arizona but also by the University of Pennsylvania and other laboratories, has shown that the concentration of ^{14}C in the atmosphere has varied by as much as 15 per cent over the past few thousand years. Sufficient data are now available to provide a conversion table from radiocarbon years to tree ring (calendar) years for the last 7500 years, if the user so desires (Olsson, 1970; Damon **et al.**, 1972). These data take into account the variations in the ^{14}C concentration in the atmosphere. For this reason it was decided to omit the correction for fluctuations in the concentration of atmospheric ^{14}C from GSC

*Prepared by J.A. Lowdon, who operates the laboratory. The date list has been compiled by W. Blake, Jr. from descriptions of samples and interpretations of age determinations by the collectors and submitters.

Original manuscript submitted: September 28, 1976
Final version approved for publication: December 6, 1976

TABLE 1

Background (c/m)* for Periods Used for Age Calculations,
April 1, 1975 to August 4, 1976

PERIOD	2-LITRE COUNTER (2 atm)	5-LITRE COUNTER (1 atm)
April 1975	2.143 ± 0.024	2.975 ± 0.028
May	1.275 ± 0.018	2.255 ± 0.025
June	1.300 ± 0.019	2.292 ± 0.025
July	1.291 ± 0.019	2.254 ± 0.030
August	1.262 ± 0.018	2.235 ± 0.025
September	1.293 ± 0.027	2.244 ± 0.025
October-November	-	2.171 ± 0.022
December	1.197 ± 0.023	2.221 ± 0.020
January 1976	1.313 ± 0.013	2.242 ± 0.046
February	1.329 ± 0.028	2.208 ± 0.052
March	1.034 ± 0.021	2 121 ± 0.025
April	1.044 ± 0.018	2.145 ± 0.026
May	1.091 ± 0.018	2.141 ± 0.024
June	1.080 ± 0.017	2.152 ± 0.024
July	1.096 ± 0.018	2.166 ± 0.025

*c/m = counts per minute

TABLE 2

Standard, N_o^*, (c/m) for Periods Used for Age Calculations
April 1, 1975 to August 4, 1976

PERIOD	2-LITRE COUNTER (2 atm)	5-LITRE COUNTER (1 atm)
April 1975	19.083 ± 0.100	28.434 ± 0.124
May	20.320 ± 0.123	28.192 ± 0.121
June	20.588 ± 0.116	28.382 ± 0.121
July	20.263 ± 0.097	28.410 ± 0.118
August	20.122 ± 0.133	28.241 ± 0.118
September	20.095 ± 0.109	28.376 ± 0.167
October November	-	28.310 ± 0.122
December	19.970 ± 0.103	27.860 ± 0.155
January 1976	20.323 ± 0.105	28.063 ± 0.131
February	20.465 ± 0.104	28.126 ± 0.130
March	19.187 ± 0.101	28.111 ± 0.190
April	19.469 ± 0.121	28.190 ± 0.120
May	19.360 ± 0.105	28.094 ± 0.128
June	19.220 ± 0.095	28.016 ± 0.117
July	19.343 ± 0.095	28.166 ± 0.229

*N_o = 0.95 x net counting rate of the NBS oxalic acid standard

TABLE 3

Number of Counts Used to Determine Average Background and Standard Counting Rates for Periods Listed

PERIOD	2-LITRE BACKGROUND	5-LITRE BACKGROUND	2-LITRE STANDARD	5-LITRE STANDARD
April 1975	5	6	3	3
May	5	5	3	3
June	4	4	3	3
July	4	4	3	3
August	4	4	3	3
September	4	4	3	3
October-November	-	6	-	4
December	3	6	2	3
January 1976	7	4	3	3
February	5	5	3	3
March	4	4	3	3
April	4	4	3	3
May	4	4	3	3
June	4	4	3	3
July	4	4	3	3

TABLE 4

Number of Different Background and Standard Gas Preparations Used for Counting for Periods Listed

PERIOD	2-LITRE BACKGROUND	5-LITRE BACKGROUND	2-LITRE STANDARD	5-LITRE STANDARD
April 1975	2	3	1	2
May	2	3	2	1
June	2	2	3	2
July	2	2	2	3
August	2	2	2	2
September	2	4	2	2
October-November	-	3	-	2
December	2	3	1	1
January 1976	2	2	1	1
February	3	2	2	2
March	2	2	2	2
April	2	3	2	2
May	2	2	2	2
June	2	3	2	2
July	2	3	2	2

radiocarbon dates, starting in January 1973. The omission of this error term in no way affects the date produced, but it does reduce the error assigned to a date Finite dates are based on the 2σ criterion (95.5% probability) and "infinite" dates on the 4σ criterion (99.9% probability).

No changes have been made in the routine CO_2 pretreatment, preparation, and purification techniques previously described (Lowdon **et al.**, 1969; Lowdon and Blake, 1970). Carbon dioxide gas proportional counting techniques have been discussed by Dyck (1967).

Where $^{13}C/^{12}C$ ratios are available, a correction for isotopic fractionation has been applied to the date and the $\delta^{13}C$ value reported. Related to the PDB standard, the "normal" values used for correction are $\delta^{13}C = -25.0$ for wood, other terrestrial organic materials, and bones (terrestrial and marine), and 0.0 for marine shells. Except for the three samples listed below, all $^{13}C/^{12}C$ ratios were determined by the GSC Geochronology Section on aliquots of the same sample gas used for age determination; GSC 2080, -2081, and -2312 were determined at the Department of Earth Sciences, University of Waterloo, Waterloo, Ontario, under the supervision of Prof. P. Fritz

Acknowledgments

Thanks are extended to the following personnel: I.M Robertson and S.M. Chartrand for assistance in the preparation and measurement of samples in the laboratory; K. Santowski for the GSC $\delta^{13}C$ determinations; R.J. Mott and Mrs. L.D Farley-Gill for wood identifications and palynological determinations; Drs. M. Kuc and J V Matthews, Jr. for the identification of macroscopic organic remains; A. Roberts of the X-ray Diffraction Laboratory for the identification of mineral constituents in shells; Mrs. G. Mahony and R.J. Richardson for assistance in compilation. Dr. A.H. Clarke, Jr. and Mrs M F.I. Smith, National Museum of Natural Sciences, Dr. F.J E. Wagner of Atlantic Geoscience Centre and the Rev H B. Herrington, Westbrook, Ontario, have all assisted in the examination of molluscs.

GEOLOGICAL SAMPLES

Eastern Canada

Nova Scotia

Cape Breton Island series

GSC-1578. East Bay — 10 300 ± 150 / 8350 B.C.

Peat (sample GS/71-18; 38.3 g) lens 5 cm thick under 1.3 m of reddish clay till and overlying 1.5^+ m of greyish till exposed in a road-cut 2.2 km north of the head of East Bay, Cape Breton Island, Nova Scotia (46°02.66'N; 60°22.50'W), at an altitude of 50 m. Collected 1971 by D R. Grant.*

Comment (D.R. Grant): the peat intercalation originally was interpreted as an interstadial organic deposit overridden by a late Wisconsin glacial readvance (Grant, 1972, 1975) because of the compressed nature, the assumption that the covering diamicton was till, and Livingstone's (1968) inference from a series of rhythmites in a nearby lake that there was a late-glacial freshening in the vicinity. However, should the "till" in fact be solifluction debris, as might also be the case for GSC-2146 (11 300 ± 90years, this list) and for the 11 000 ± 170 year-old wood fragments (GSC 540, this list) beneath till on Port Hood Island as suggested by Terasmae (1974), such buried organics in the 10 000 to 11 000 year-range might signify a climatic deterioration equivalent to the Younger Dryas ice advance, not otherwise represented in North America.

Comment (W. Blake, Jr.): a second sample of wood, from slightly lower at the same site on Port Hood Island, gave a value of 11 300 ± 160 years (GSC-541, this list). The peat used for GSC-1578 contained a variety of undeterminable vascular plant fragments as well as several peat forming mosses associated with cold climates, i.e., **Messea triquetra, Catascopium nigritum Scorpidium** sp., **Drepanocladus** sp. (identified by M. Kuc). NaOH leach omitted from sample pretreatment. Date based on one 3-day count in the 5-litre counter.

GSC-2146. Benacadie Point — 11 300 ± 90 / 9350 B.C.

Woody peat (sample GSm/74-25; 25.0 g) 30 cm thick, overlying sand, and covered by 2 m till-like diamicton exposed in shore bluff on Benacadie Point, Bras d'Or Lake, Cape Breton Island, Nova Scotia (45°54.16'N, 60°43.68'W), at an altitude of 1 to 1.5 m. Collected 1974 by D.R. Grant.

Comment (D R Grant): this section appears similar to the stratigraphy of a nearby section described by MacNeill (1969) where peat over bedrock, covered by a thin till, gave an age of 11 670 ± 170 years (I-3234). Here also, as for GSC-1578 (this list) and GSC-2062 (11 200 ± 100 years; GSC XV, 1975, p. 8), unless a glacial readvance is invoked the deposit can be explained as representing early postglacial vegetation which has been buried by solifluction debris which moved down the underlying steep bedrock slopes during the reversion to periglacial conditions of a climatic deterioration perhaps equivalent to the Younger Dryas.

Comment (W Blake, Jr.): the peat was described as a woody (twiggy) moss (**Calliergon-Drepanocladus**) peat by M. Kuc; he considered it to have formed in an extensive moss-**Sphagnum** bog with shrubby growth which resulted in detritus and twigs. NaOH leach omitted from sample treatment. Date based on one 3-day count in the 5-litre counter.

GSC-2058. McAdams Lake — 1560 ± 70 / 390 A.D.

Wood fragment (sample GS/74-8; 11.4 g; **Betula** sp., identified by L.D. Farley-Gill) contained in a 0.5^+ m-thick deposit of pebbly diamicton underlying 0.5 m of pebble gravel exposed in a ditch on the west side of the road ascending a small valley, 1.2 km southeast of McAdams Brook crossing, near the head of East Bay, Cape Breton Island, Nova Scotia (46°01.50'N, 60°24.76'W), at an altitude of 80 m. Collected 1974 by D.R. Grant.

Comment (D R. Grant): because the wood was associated with masses of peat of varying composition in a till-like material, the deposit was thought to represent pre-existing organic sediments incorporated in till deposited during a glacier readvance, then mantled with outwash. The recent age, however, suggests that emplacement probably occurred by a process of slumping,

* All persons referred to as collectors or submitters of samples or otherwise cited as sources of data are with the Geological Survey of Canada unless otherwise specified.

although the overlying gravel is unaccounted for, and the original setting of the peat is problematical considering the present narrow, well drained valley.

Comment (W. Blake, Jr.): this hard, twisted piece of wood was wet and had a considerable amount of adhering inorganic material when received by the laboratory. After drying in an electric oven the wood was 24 cm long and had a maximum diameter of 4 cm. Date based on one 1-day count in the 5-litre counter.

Port Hood Island series

Wood samples from an exposure in a sea cliff at the north end of Port Hood Island, Nova Scotia (46°01'N, 61°34'30"W). Collected 1965 by J. Terasmae, then with the Geological Survey of Canada, now with Brock University, St. Catharines, Ontario, and R.J. Mott.

GSC-484. Port Hood Island (I) 7140 ± 140
5190 B.C.

Wood (sample TB-65-19; 28.0 g burnt) from the basal 15 cm of woody peat, at ca. 2 m depth, in a sinkhole depression underlain by reddish, stony, silty clay till.

Comment (J. Terasmae): date shows that the peat in this sinkhole began to accumulate in early Holocene time, and hence it provides a minimum age for the development of this feature (Terasmae, 1974). NaOH leach omitted from sample pretreatment. Date based on two 1-day counts in the 5-litre counter.

GSC-540. Port Hood Island (II) 11 000 ± 170
9050 B.C.

Twigs and wood fragments (sample TB-65-15A; 6.0 g burnt) in stratified sand and silt, ca. 4 m below the top of a section, and overlying till or soliflucted till.

Comment (J. Terasmae): the date indicates minimum age for the deglaciation of Port Hood Island, about 1.5 km offshore from the west coast of Cape Breton Island. The dated silt and sand unit is overlain by diamicton, interpreted as a solifluction deposit that accumulated in the sinkhole depression during a climatic deterioration in late-glacial time (Terasmae, 1974). Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

GSC-541. Port Hood Island (III) 11 300 ± 160
9350 B.C.

Five pieces of wood (sample TB-65-15B; 5.7 g; the three largest were identified as **Salix** sp. by R.J. Mott) from near the base of the same sand unit from which GSC-540 (this series) was recovered. GSC-541 was collected 49 to 56 cm below the top of the sand unit, a few cm below GSC-540. Submitted 1975 by W. Blake, Jr.

Comment (W. Blake, Jr.): this sample was pretreated with NaOH, HCl, and distilled water rinses in January 1966 (at the same time that GSC-540 was being run), and the laboratory number was assigned, but the sample was never burned. In 1975 further treatment with NaOH was omitted. The date confirms the value obtained for GSC-540 in showing that ice-free conditions existed prior to 11 000 years ago (Terasmae, 1974); see also Y-762, 10 710 ± 240 years, obtained on **Populus** wood from Port Hood Island (Yale VI, 1961, p. 126-127). Sample mixed with dead gas for counting. Date based on two 1-day counts in the 5-litre counter.

Oak Hill Lake series

Algal gyttja from Oak Hill Lake, 3.2 km west of Bridgewater, Lunenburg County, Nova Scotia (44°23'N, 64°34'W), at an altitude of ca. 70 m. This is an elongated lake (0.8 hectares) situated in a drumlin field. This sample was taken in order to date the "G-zone" (Livingstone, 1968). Collected 1970 by J.B. Railton, then with Acadia University, Wolfville, now with Beak Consultants, Ltd., Calgary.

GSC-1540. Oak Hill Lake, 420-425 cm 5600 ± 640
3650 B.C.

Algal gyttja (sample OH 420; upper portion, 11.7 g) from 420 to 425 cm below sediment/water interface. **Pinus-Picea-Tsuga** dominants; AP 92%, shrubs 5%, herbs 3%.

Comment (J.B. Railton): the date is much younger than expected. The "G-zone" must be a feature caused by erosion. The trends in some of the pollen spectra would be distorted, however, if sample OH 420 (upper portion) was placed in its time-stratigraphic position. There, the date is too young if it represents a warm stadial or if it is due to erosion (cf. Railton, 1975).

Comment (W. Blake, Jr.): not only is the date younger than expected, but the same gas was first counted for 3 days in the 1-litre counter and a value of 7620 ± 1070 years was obtained. NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

GSC-2268. Oak Hill Lake, 415-420 cm 6660 ± 220
4710 B.C.

Algal gyttja (sample OH 420; lower portion, 22.4 g).

Comment (W. Blake, Jr.): this portion was dated as a check on the anomalously young age of the increment at 420 to 425 cm depth. The young age is confirmed, and both dates are younger than ages obtained from gyttja higher in the core: OWU-505, 8250 ± 365 years, on increment at 355 to 360 cm depth, and OWU-504, 8675 ± 835 years, on increment at 300 to 305 cm depth (Ohio Wesleyan V, 1973, p. 362-363). NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

Quebec

GSC-1474. Port-Alfred 9530 ± 270
7580 B.C.

Shells (sample Lac St-Jean-1970-1; 8.7 g; **Macoma balthica**; identified by P. LaSalle) from gravelly sand in the Bagotville fluvioglacial delta, located in the northwestern part of the city of Port-Alfred, Quebec (48°19'54"N, 70°54'00"W), at an altitude of approximately 53 m. Collected 1970 by P. LaSalle, Ministère des richesses naturelles, Quebec, and N.R. Gadd.

Comment (P. LaSalle): the age is conformable with other dates obtained in the area, especially I-3489, 9940 ± 230 years (unpublished), obtained on wood collected at the base of a deltaic deposit located across Ha-Ha Bay from the present site; see also GrN-4811, 9380 ± 160 years, on marine shells (LaSalle, 1966). Only outer 10 per cent removed by HCl leach. Date based on one 3-day count in the 1-litre counter.

GSC-1295. Ste-Anne-de-Beaupré 11 200 ± 160
9250 B.C.

Shells (sample Quebec series no. 3; 35 g; **Balanus** sp., probably **Balanus hameri,** identified by P. LaSalle) in compact glaciomarine drift (possibly till), 1.6 km east of Ste-Anne-de-Beaupré, Quebec (47°01'04"N, 70°56'54"W), at an altitude of ca. 67 m. The shell-bearing unit overlies bedrock and is succeeded by 0.9 m of shallow water marine sediments. Collected 1969 by P. LaSalle.

Comment (P. LaSalle): the drift containing the shells seems to have been deposited from floating icebergs, possibly those that became stranded on shoals in the St. Lawrence channel. The time of deposition is just prior to the emplacement of the St. Narcisse moraine which therefore should be slightly younger than GSC-1295 (LaSalle and Elson, 1975); see also GSC-1476 (Gadd **et al.**, 1972) and GSC-1232 (this list).

Comment (W. Blake, Jr.): the shell fragments in this collection were hard and large; many were coloured bluish grey. Date based on one 3-day count in the 2-litre counter.

GSC-1232. Beauport 11 100 ± 160
9150 B.C.

Shell fragments (sample Quebec series no. 1; 30 g; **Balanus** sp., identified by W. Blake, Jr.) from glaciomarine drift (48°53'45"N, 71°12'30"W), at an altitude of ca. 106 m. The shell-bearing till-like unit overlies sand and is overlain by 0.9 m of fossiliferous marine sand. Collected 1969 by P. LaSalle.

Comment (P. LaSalle): the drift containing shells seems to have been deposited from floating icebergs onto shoals in the St. Lawrence channel. The time of deposition is just prior to the emplacement of the St. Narcisse moraine which therefore should be slightly younger than the above result (LaSalle and Elson, 1975); see also GSC-1295 (this list) and GSC-1476 (Gadd **et al.**, 1972).

Comment (W. Blake, Jr.): no pitting, chalkiness or incrustations were noted on these well preserved shell fragments (up to 2 cm in length). Date based on one 2-day count in the 2-litre counter.

GSC-1235. Notre-Dame-des-Laurentides 11 600 ± 160
9650 B.C.

Paired pelecypod valves (sample Quebec series no. 2; 46 g; **Mya truncata**, identified by P. LaSalle) in growth position and shell fragments of the same species from glaciomarine drift near Notre-Dame-des-Laurentides, Quebec (46°54'27"N, 71°17'56"W), at an altitude of ca. 176 m. Casts of other marine shells (**Hiatella arctica**) were also observed, and the glaciomarine unit is overlain by 1 m of marine sand and silt. Collected 1969 by P. LaSalle.

Comment (P. LaSalle): the sample dates the last position of the ice front when it was in contact with the sea north of Quebec City. Ice was in contact with the sea at a later time west of Quebec City, i.e., shortly before the emplacement of the St. Narcisse moraine (LaSalle and Elson, 1975).

Comment (W. Blake, Jr.): the shells, though chalky and with little periostracum, were well preserved and were up to 4 cm in length. Date based on two 1-day counts in the 5-litre counter.

GSC-1555. St-Coeur-de-Marie 9350 ± 280
7400 B.C.

Shells (sample Lac St-Jean-1970-3; 5 g; **Portlandia arctica**, identified by P. LaSalle) from ca. 10 m below the surface in an exposure of marine clays along the shore of Lac St-Jean, approximately 1.2 km southwest of St-Coeur-de-Marie and 11 km north-northwest of Alma, Quebec (48°37'42"N, 71°42'36"W), at an altitude of ca. 100 m. Sample collected 1967 by P. LaSalle and G. Tremblay.

Comment (P. LaSalle): a sample from the same site was submitted first to Isotopes, Inc., and it gave an age of 11 250 ± 300 years B.P. (I-3488, unpublished). This result was judged too old for the area and contamination, probably by calcareous clayey material adhering to the shells, was suspected. A new sample of shells was submitted to the Geological Survey Radiocarbon Dating Laboratory after ultrasonic cleaning. The periostracum was still attached to most shells when collected, and nearly all valves were still articulated at the time of the collection; all are <1 cm in length. The result is in accordance with previous age determinations on similar material from the same area. The maximum age of the marine limit in the area, however, is approximately 10 200 years B.P. (Gif-424, 10 250 ± 350 years; LaSalle, 1966). HCl leach omitted due to small sample size. Date based on one 2-day count in the 1-litre counter.

Ontario

GSC-1968. Bourget 10 200 ± 90
8250 B.C.

Freshwater pelecypods (sample GB-73-6; 46.1 g; **Lampsilis** sp., identified by A.H. Clarke, Jr., National Museum of Natural Sciences, Ottawa) from an abandoned channel across Champlain Sea basin. The collection is from a road-cut for a new bridge over Bear Creek, 1.1 km southeast of Bourget, Ontario (45°25'30"N, 75°09'15"W), at an altitude of ca. 53 m. Collected 1973 by N.R. Gadd.

Comment (N.R. Gadd): post-Champlain Sea channel-bottom sediments at this fossiliferous site, which are possibly equivalent to J.A. Elson's "Lampsilis Lake" (Elson and Elson, 1959), occupy the same channel system as nonfossiliferous but presumed freshwater sediments of the Ottawa area to the west (Gadd, 1963). The shell-bearing sand and gravel layer at ca. 5.4 m depth is underlain by a thick sequence of banded silt containing marine pelecypods (**Portlandia arctica**; identified by N.R. Gadd) near the base. The overlying beds are stratified silty sand and sand (Gadd, 1976).

Comment (W. Blake, Jr.): a sample of marine pelecypods (also containing **Portlandia arctica**) 25 km to the southwest of Bourget and 4.8 km southeast of Russell, Ontario, at an altitude of ca. 70 m, is 10 000 ± 320 years old (GSC-1553; Lowdon and Blake, 1973; Richard, 1975). Date GSC-1968 is based on one 3-day count in the 5-litre counter.

GSC-2312. Kars 10 900 ± 100
8950 B.C.
$\delta^{13}C = +1.7‰$

Champlain Sea molluscan shells (sample 0-5a; 26 g; **Hiatella arctica**, identified by T.M. Cronin) in silty, sandy clay from the freshly exposed face of a gravel pit, on the west side of Hwy. 16, 0.8 km north of Kars, Ontario (45°09'30"N, 75°38'55"W), at an altitude of ca. 98 m.

Collected 1975 by T.M. Cronin, Harvard University, Cambridge, Massachusetts.

Comment (T.M. Cronin): the age generally agrees with other Champlain Sea dates from this region (Richard, 1975). From the same exposure, over 40 species of Foraminifera were found; they comprise a near normal marine, arctic-subarctic assemblage (Cronin, 1976). The ostracode assemblage supports this interpretation. Although relatively late in Champlain Sea history, frigid-subfrigid climates are indicated by the fauna, possibly signifying the cooling influence of the nearby Laurentide ice margin. In contrast to boreal conditions in the southeastern part of the Champlain Sea about 10 800 years B.P. (Elson, 1969), cold water conditions might be expected in Ontario if an ice readvance occurred about 11 200 years B.P. in this region as suggested by Richard (1975).

Comment (W. Blake, Jr.): the whole shells and fragments of aragonitic **Hiatella arctica** in this sample were well preserved; although there were no traces of periostracum and the exteriors were chalky, the interiors of some valves retained a lustre. Valves were from 1 to >2.5 cm in length. Date based on one 3-day count in the 2-litre counter.

Kincardine Bog series

Kincardine Bog, at an altitude of 195 m, is a peat deposit 3.2 km southwest of Kincardine, Ontario (44°09'N, 81°39'W). The peat overlies lagoonal sediments behind a major baymouth bar built by main Lake Algonquin and in front of a minor beach ridge. Samples were taken with a piston corer (30 cm by 5 cm in diameter) during coring of the bog for pollen analysis. Collected 1970 by T.W. Anderson.

GSC-1816. Kincardine Bog, 206.5-208.5 cm — 7620 ± 70; 5670 B.C.; $\delta^{13}C = -26.4‰$

Algal gyttja (sample K-5A; 105 g wet) 206.5 to 208.5 cm below bog surface. NaOH leach omitted from sample pretreatment. Date based on one 3-day count in the 5-litre counter.

GSC-1366. Kincardine Bog, 300-320 cm — 10 600 ± 150; 8650 B.C.

Plant fibres (monocotyledons; sample K-3; 18 g dry) 300 to 320 cm below bog surface. NaOH leach omitted from sample pretreatment. Date based on one 4-day count in the 5-litre counter.

GSC-1644. Kincardine Bog, 300-320 cm — 10 300 ± 200; 8350 B.C.

Shells (sample K-5; 8.7 g dry) 300 to 320 cm below bog surface. NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on one 2-day count in the 2-litre counter.

GSC-1374. Kincardine Bog, 400-417 cm — 11 200 ± 170; 9250 B.C.

Plant detritus (sample K-4; 12.7 g dry) above stiff grey clay 400 to 417 cm below bog surface. NaOH leach omitted from sample pretreatment. Date based on two 1-day counts in the 2-litre counter.

Comment (T.W. Anderson): macrofossil analysis of the 400 to 417 cm interval (GSC-1374) yielded macrofossils of aquatic plants: **Chara, Nitella, Myriophyllum, Potamogeton, Najas, Carex, Juncus** and **Eleocharis**; an aquatic moss (**Scorpidium scorpioides,** identified by M. Kuc); and molluscs **Lymnaea decampi, Amnicola limnosa, Gyraulus deflectus, Valvata tricarinata,** and **V. sincera** (identified by A.H. Clarke, Jr., National Museum of Natural Sciences, Ottawa, and the Rev. H.B. Herrington, Westbrook, Ontario) indicative of quiet bodies of water. Floral and faunal assemblages imply a sheltered lagoonal habitat which is believed to have existed during a low-level stage of Lake Algonquin and which is correlated with the opening of the Trent Valley outlet at Kirkfield, Ontario (Anderson, 1971; Karrow **et al.**, 1975); the date thus provides a minimum age for this event. The date also provides an age for the spruce pollen maximum; a cool (boreal) climate is inferred. Analysis of the increment at 300 to 320 cm depth yielded leaves of **Myriophyllum verticillatum, Picea glauca,** and **Larix laricina**; seeds of **Carex, Juncus,** and **Potamogeton**; and shells of **Pisidium** and **Sphaerium** (identified by Rev. H.B. Herrington). Shallow water conditions prevailed and a boreal climate is inferred. The shallowing event possibly reflects the drop in lake level from Lake Algonquin to the Stanley low-water stage of Lake Huron (Sly and Lewis, 1972). Date GSC-1816 provides an age for the rise in the hemlock pollen curve which is a significant early postglacial marker horizon for pollen zonation in southern Ontario.

GSC-2213. Forest — 13 100 ± 110; 11 150 B.C.

Sample of spruce wood (sample PC 10/75; 11.5 g; **Picea** sp., identified by L.D. Farley-Gill) from an exposure of the St. Joseph Till on the southeast coast of Lake Huron, at Staghorn Valley Camp, 14.4 km southwest of the village of Forest, Ontario (48°03'48"N, 82°09'48"W). The 11 cm-diameter log protruded from the face of a freshly exposed section of till 3 m above the Lake Huron water level. The wood was dry and clean and in good physical condition. Collected 1975 by M. Stupavsky, University of Windsor, Windsor; submitted by C.P. Gravenor, University of Windsor, and V.K. Prest.

Comment (M. Stupavsky): the date is a maximum for the time of deposition of the St. Joseph Till (Cooper and Clue, 1974; also Terasmae **et al.**, 1972) and is in good agreement with the estimated age of 13 000 years B.P. This date also provides a good estimate of the time when the Port Huron moraine was formed in the southern part of the Huron basin (Gravenor and Stupavsky, 1976).

Comment (W. Blake, Jr.): approximately 25 annual rings of this soft and lightweight wood were used for the age determination. Date based on one 2-day count and one 1-day count in the 5-litre counter.

Western Canada

Manitoba

GSC-1909. Sundown — 10 200 ± 80; 8250 B.C.

Organic material (sample FW81-26-27; 94.5 g; undeterminable fragments of mosses and vascular plants; pers. comm. from M. Kuc) recovered from wet unoxidized fine sand and silt at a depth of 7.9 to 8.2 m in a borehole ca. 2.4 km east of Sundown, Manitoba, in LSD 14, sec. 6, tp. 2, rge. 10, E 1st mer. (49°06'20"N, 96°14'15"W), at an altitude of ca. 326 m. Collected 1972 by M.M. Fenton, now with Alberta Research Council, Edmonton, and J.T. Teller, University of Manitoba, Winnipeg.

Comment (M.M. Fenton): provides a date for the fall of glacial Lake Agassiz from the Campbell level (Teller, 1976) at the start of the Moorehead Phase (Ashworth **et al.**, 1972). It agrees with dates from the west side of the basin, e.g. GSC-902, 10 600 ± 150 years B.P. (Klassen and Elson, 1972) and from North Dakota - 10 960 ± 300 years (W-723) to 9900 ± 400 years (W-993; both in Moran **et al.**, 1973). The date also indicates that approximately 8 m of sediment were deposited during the succeeding high stand of the lake, which lasted approximately 500 years. NaOH leach omitted from sample pretreatment. Date based on one 3-day count in the 5-litre counter.

Roseau River series

GSC-1465. Roseau River (I) >38 000

Fine organic material (sample FW-S14-10; 110 g) from a 4 cm-thick discontinuous layer in sand between the Stuartburn and Woodmore tills (Fenton, 1974), exposed by recent slump ca. 0.2 km east of section road, on the south side of Roseau River, Manitoba, NE 1/4 LSD 5, sec. 8, tp. 3, rge. 6, E 1st mer. (49°11'05"N, 96°53'35"W), at an altitude of ca. 262 m. Collected 1970 by M.M. Fenton.

Comment (M.M. Fenton): date provides first proof of mid-Wisconsin or older units in southeastern Manitoba. Date GSC-1663 (>41 000 years, on wood, this list) is from material overlying the Stuartburn till, suggesting that GSC-1465 is either early Wisconsin or pre-Wisconsin in age. NaOH leach omitted from sample pretreatment. Date based on one 3-day count in the 5-litre counter.

GSC-1663. Roseau River (II) >41 000

Wood (sample FWS-21-U6; 12.3 g; **Picea** sp.; identified by R.J. Mott) collected from 60 cm into wet unoxidized silt exposed by recent slump on south side of Roseau River ca. 3.5 km west of Senkiw post office, Manitoba, in SE 1/4, sec. 12, tp. 3, rge. 4, E 1st mer. (49°11'30"N, 96°55'10"W), at an altitude of ca. 262 m. Collected 1971 by M.M. Fenton.

Comment (M.M. Fenton): wood underlies the Roseau till and overlies the Stuartburn till (Fenton, 1974); the age is in agreement with GSC-1801 (>43 000 years, on wood, this list) collected from a similar stratigraphic position ca. 4.5 km east along the river. The wood-bearing unit is believed to be of mid-Wisconsin age. Date is based on one 1-day count plus one 2-day count in the 5-litre counter.

GSC-1801. Roseau River (III) >43 000

Wood (FWS35-U5; 13.2 g; **Picea** sp.; identified by R.J. Mott) exposed in fine sand underlying the Senkiw till and overlying the Stuartburn(?) till (Fenton, 1974), ca. 6 m from the top of a cliff, ca. 2.4 km west of the settlement of Roseau River, Manitoba, centre of LSD 11, sec. 4, tp. 3, rge. 5, E 1st mer. (49°11'12"N, 96°51'45"W) at an altitude of ca. 267 m. Collected 1972 by M.M. Fenton.

Comment (M.M. Fenton): the date is similar to GSC-1663 (>41 000 years, on wood, this list) collected in a similar stratigraphic position ca. 4.5 km to the west along the river. Provides minimum age for the enclosing sediment which is believed to be mid-Wisconsin in age. Date based on one 3-day count in the 5-litre counter.

Thornhill Terrace series

The Thornhill Terrace site is a fluviolacustrine deposit located 2.4 km north of Thornhill and 8 km west of Morden, Manitoba (49°13.7'N, 98°13.6'W); the surface of the terrace is at an altitude of ca. 375 m (calculated from a topographic map). The sediments were deposited in this small tributary channel when Lake Agassiz was first formed adjacent to the Pembina Uplands, and they have been exposed by subsequent downcutting. Samples were obtained from a road cut, ca. 0.9 m behind the natural face. Collected 1969 by L.D. Delorme, then with the Inland Waters Branch, Environment Canada, Calgary, now with Canada Centre for Inland Waters, Burlington.

GSC-1362. Thornhill Terrace (I) 8740 ± 160
6790 B.C.

Organic detritus (sample 19-65-69; 140 g wet) from 198.1 to 200.8 cm below the surface of the terrace.

Comment (L.D. Delorme): no shelled invertebrates were recovered from this uppermost organic-rich layer. NaOH leach omitted from sample pretreatment. Date based on two 1-day counts in the 2-litre counter.

GSC-1349. Thornhill Terrace (II) 9400 ± 150
7450 B.C.

Organic detritus (sample 19-86-69; ca. 360 g wet) from 262.1 to 264.8 cm below the surface of the terrace.

Comment (L.D. Delorme): analysis of shelled invertebrates from the middle organic-rich layer indicates a shallow, intermittent stream draining from the forested uplands into Lake Agassiz. NaOH leach omitted from sample pretreatment. Date based on one 3-day count in the 5-litre counter.

GSC-1369. Thornhill Terrace (III) 14 300 ± 320
12 350 B.C.

Organic detritus (sample 19-106-69; 215 g wet) from 323.0 to 325.8 cm below the surface of the terrace.

Comment (L.D. Delorme): analysis of shelled invertebrates from the lowermost organic-rich layer indicates a shallow water, intermittent stream draining the forested uplands into Lake Agassiz. The elevation corresponds to the earliest Herman beach of Lake Agassiz (**see** Klassen, 1975; Teller, 1976). NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

Comment (W. Blake, Jr.): this date was published with an incorrect error term (± 1970 years) by Klassen (1972; 1975). Teller (1976, p. 39) believed that the lake sediments from which this sample was obtained "may only be related to local ponding between the Manitoba Escarpment and the active ice to the east", and he suggested that "widespread ponding in the Lake Agassiz basin did not occur until after 14 000 years B.P.".

GSC-1333. Somerset Pond 5310 ± 150
3360 B.C.

Organic detritus (sample 16-89-69; 68 g burnt) from 182.8 to 185.6 cm below the surface of Somerset Pond, ca. 6 km southeast of Somerset, Manitoba (49°23'N, 98°37'W), at an altitude of ca. 490 m (calculated from a topographic map). The 0.6 m of gyttja was deposited over 2.8 m of unoxidized lacustrine clay which overlay glacial till. Collected 1969 by L.D. Delorme.

Comment (L.D. Delorme): analysis of shelled invertebrates (ostracodes) from the unit, which includes the sampled interval, indicates a highly eutrophic lake (Delorme, 1971). Paleolimnological and paleoclimatic interpretations derived from the sediments lower in this core are correlated with the fluctuating ice margin within the Agassiz Basin. NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

Saskatchewan

GSC-1356. Yorkton — 10 300 ± 160
8350 B.C.

Wood and organic detritus (sample 29-230-69; 133 g wet) from 6.97 to 7.0 m below the surface in Yorkton channel, located at the eastern outskirts of Yorkton Saskatchewan (51°12.6'N, 102°28'W); the surface altitude is ca. 506 m (calculated from a topographic map). The sediments were deposited as channel fill after the channel ceased to be used for collecting meltwater; they are overlain by clay. Collected 1969 by L.D. Delorme.

Comment (L.D. Delorme): glacial till was encountered at a depth of 9.8 m below the surface. NaOH leach omitted from sample pretreatment. Date based on one 3-day count in the 2-litre counter.

Alberta

GSC-1819. Calgary — 8400 ± 150
6450 B.C.

Carbonized twig fragments (sample HEA-N5b; 6.6 g) from a paleosol 30 to 46 cm thick exposed in the wall of a pit 90 m north of Hwy. No. 1 and 1.6 km west of Calgary, Alberta (51°04'30"N, 114°12'40"W), at an altitude of 1135 m. The exposure shows about 5 m of massive sand and silt containing both a tephra layer and a buried paleosol with bone and carbonized wood fragments. The stratigraphy is described in Harrison (1973). Sample collected in 1972 by B. Gadd for J.E. Harrison.

Comment (J.E. Harrison): although the exposure is in a high terrace of the early Bow River, both paleosol and tephra (Mazama?) are probably much younger than the terrace. The presence of a similar tephra layer 75 m lower, exposed by river erosion in the lowermost terrace, indicates that Bow River had carved much of its valley through glacial and glaciolacustrine deposits by 6600 B.P. when the Mazama ash was deposited. Both the paleosol and the tephra therefore probably are enclosed in colluvium. This demonstrates the considerable depth of remobilized material even on these relatively gentle slopes (3 to 10 degrees). The date also provides a minimum age for the drainage of glacial Lake Calgary. Pretreatment included a cold NaOH leach for 5 minutes. Date based on two 1-day counts in the 2-litre counter.

British Columbia

Upper Elk Valley series

Material from a horizontal organic layer, 1 cm thick, in a 5 m-high silt cutbank, on the east side of Elk River, 14.5 km north of Elkford, B.C. (50°09'30"N, 114°57'20"W), at an altitude of 1355 m. The sampled horizon lies 1 m below a tephra layer (Mazama?). Stratigraphic details and discussion of the dates' significance to deglaciation events are given in Harrison (1976). Collected by J.E. Harrison.

GSC-2142. Upper Elk Valley (I) — 11 900 ± 100
9950 B.C.

Sample HEA-74-41, collected in 1974, was examined for pollen, mosses, and diatoms. Only pollen and strongly decomposed fragments of coniferous woody tissue were observed. The pollen data suggest a recently deglaciated area.

GSC-2275. Upper Elk Valley (II) — 12 200 ± 160
10 250 B.C.

Sample (HEA-74-41/75) was collected in 1975 to confirm date GSC-2142. The site was revisited because the first date was 4000 years older than expected. The pollen data suggest a recently deglaciated area (unpublished GSC Palynological Report No. 76-1 by R.J. Mott).

Comment (J.E. Harrison): deglaciation of the vicinity of the sample site must have occurred sufficiently before 12 000 years B.P. to allow the Elk River to cut a valley into glacial and glaciolacustrine sediments. The sampled horizon is enclosed in alluvium deposited within this valley. In order for this alluvium to be deposited, glacial Lake Elk must have drained already as a result of the wasting of ice in the Rocky Mountain Trench at Elko. Because Elk River and Kananaskis River head in the same ice field, it might be expected that this date is also a minimum for the time of deglaciation of lower Kananaskis Valley.

Comment (W. Blake, Jr.): NaOH leach omitted from the pretreatment of both samples. In order to obtain sufficient gas, 90.0 g of dry sample was burned for GSC-2142 and 100 g was burned for GSC-2275. GSC-2142 based on one 3-day count, and GSC-2275 based on two 1-day counts, both in the 5-litre counter.

Oldman Creek series

Wood and peat from a 235 cm-deep bog deposit exposed in a road-cut along the Trans-Canada Highway on the east side of Oldman Creek, 6.5 km west of Donald, British Columbia (51°28'55"N, 117°13'25"W). Collected 1970 by R.J. Fulton.

GSC-1461. Oldman Creek (I) — 3460 ± 140
1510 B.C.
$\delta^{13}C = -23.3‰$

Wood (sample FI-11-9-70B; 27 g wet; **Picea** or **Larix**, identified by R.J. Mott) at 83 cm depth at the top of a thin volcanic ash bed assumed to be St. Helen's Y and 3 cm below a thin ash bed assumed to be Bridge River.

GSC-1457. Oldman Creek (II) — 10 000 ± 140
8050 B.C.
$\delta^{13}C = -24.4‰$

Peat (sample FI-11-9-70A; 142 g wet) at 232-235 cm depth.

Comment (R.J. Fulton): GSC-1457 is a minimum date for deglaciation of the Rocky Mountain Trench at this latitude, and GSC-1461 is a minimum date for deposition of the St. Helen's Y ash. NaOH leach omitted from the pretreatment of GSC-1457; date based on one 3-day count in the 5-litre counter; GSC-1461 based on two 1-day counts in the same counter.

Fauquier series

Shells, wood, and detritus from a fresh exposure on the east side of Lower Arrow Lake, 0.4 km south of Fauquier, British Columbia (49°52'10"N, 118°05'10"W).

GSC-1212. Fauquier, 435 m — 8910 ± 150
6960 B.C.
$\delta^{13}C = -25.0‰$

Wood and plant detritus (sample FI-1-68D; 10.5 g) from a silty sandy nearshore deposit at an altitude of 435 m, ca. 15 m above present lake level and ca. 2 m below the ground surface. Collected 1968 by R.A. Achard, then with the Geological Survey of Canada, now at Sion, Switzerland.

GSC-1014. Fauquier, 447 m — 9170 ± 150
7220 B.C.

Wood (sample FI-1-68C; 138 g wet, including some silt) from the contact between nearshore sand and overlying offshore silt at an altitude of 447 m. Sample is from 4.5 m below the surface. Collected 1968 by R.J. Fulton.

GSC-1152. Fauquier, 432 m — 9380 ± 140
7430 B.C.
$\delta^{13}C = -25.8‰$

Wood and plant detritus (sample FI-1-68F; 34 g) from nearshore sand and silt at an altitude of 432 m and 2 m below the ground surface. Collected 1968 by R.A. Achard.

GSC-1613. Fauquier, 442 m (I) — 9590 ± 150
7460 B.C.

A single piece of wood (sample FI-18-5-71-III; 5.8 g; **Populus** sp., identified by R.J. Mott) at an altitude of 442 m and 15 cm below the top of a laminated lacustrine silt which overlies massive clayey silt. Collected 1971 by R.J. Fulton.

GSC-1012. Fauquier, 444 m — 10 100 ± 150
8150 B.C.

Wood (sample FI-1-68A; 122 g damp, including adhering silt) from the contact between offshore stratified silt and massive 'glaciolacustrine' silt at an altitude of 444 m and 7 m below the surface. Collected 1968 by R.J. Fulton.

GSC-1596. Fauquier, 442 m (II) — 12 000 ± 200
10 050 B.C.

Freshwater shells (sample FI-18-5-71-IV; 10.5 g; **Anodonta** cf. **nuttalliana** Lea, identified by M.F.I. Smith, National Museum of Natural Sciences, Ottawa) from lacustrine silt at an altitude of ca. 442 m, 5 cm above the contact with the underlying glaciolacustrine silt. Collected 1971 by R.J. Fulton.

GSC-1718. Fauquier, 442 m (III) — 12 800 ± 250
10 850 B.C.

Freshwater shells (sample FI-18-5-71-II; 13.6 g) from lacustrine silt at an altitude of ca. 442 m, 15 cm below the top of a laminated lacustrine silt that overlies massive clayey silt. Collected 1971 by R.J. Fulton.

Comment (R.J. Fulton): the collections are from a series of beach, nearshore, and offshore deposits laid down in a late-glacial lake whose level was from 15 to 45 m above present lake level (Fulton, 1971, p. 17). GSC-1596 and GSC-1718 appear anomalously older than the other dates of this series. The articulated valves of GSC-1596 were collected from about 1 m stratigraphically above GSC-1613, wood, which is only 9590 ± 150 years old.

Comment (W. Blake, Jr.): NaOH leach omitted from the pretreatment of GSC-1212, and GSC-1152 received only a cold NaOH leach. Due to small sample size only the outer 10 per cent of GSC-1596 and the outer 5 per cent of GSC-1718 were removed by HCl; these two samples also were mixed with dead gas for counting. Dates GSC-1012, -1152, and -1212 each based on one 3-day count in the 5-litre counter; GSC-1014 based on two 1-day counts in the 5-litre counter; GSC-1596 and -1613 each based on one 3-day count in the 2-litre counter; and GSC-1718 based on two 1-day counts in the 2-litre counter.

Jordan River to Galena Bay series

GSC-1059. Jordan River — 9990 ± 150
8040 B.C.

Wood (sample FI-A28-69, 54.4 g wet) from 12 m below the contact between a sand-silt succession and the overlying gravel in a fresh exposure on Jordan River, ca. 0.8 km west of Columbia River and 2.6 km north of Revelstoke, British Columbia (51°01'15"N, 118°13'20"W), at an altitude of 450 m. Collected 1968 by R.J. Fulton.

GSC-1065. Shelter Bay — 9160 ± 150
7210 B.C.

Wood (sample FI-A27-68, 53.7 g of damp wood and adhering silt) from the contact between nearshore silt and sand and beach gravel 0.8 km north of Shelter Bay Ferry Dock on Hwy. 23 and 50 km south of Revelstoke, British Columbia (50°38'10"N, 117°55'35"W), at an altitude of 440 m. Collected 1968 by R.J. Fulton.

GSC-1070. Galena Bay — 8390 ± 140
6440 B.C.

Wood (sample FI-A23-68B, 29.3 g dry) from 1 m below the top of clayey silt in a stream cut on Hill Creek, 6.4 km north of Galena Bay ferry landing on Hwy. 23, British Columbia (50°60'05"N, 117°51'00"W), at an altitude of 440 m. Collected 1968 by R.A. Achard.

Comment (R.J. Fulton): the three dates are thought to relate to a late-glacial lake that occupied the Arrow Lakes Basin and the Columbia River valley at least as far north as Revelstoke (**see** Fauquier series, this list). GSC-1306 (9490 ± 160 years; GSC XI, 1971, p. 294) probably dates wood deposited in the same lake. GSC-1059 and -1070 each based on one 3-day count and GSC-1065 based on two 1-day counts, all in the 5-litre counter.

Mica Creek series

Peat from an exposure in a 3 m-thick bog deposit overlying Columbia River overbank deposits on a gravel terrace 3 m above the normal high water level of Mica Creek, British Columbia (52°01'15"N, 118°33'30"W), at an altitude of 1900 m. Collected 1970 by R.J. Fulton.

GSC-1520. Mica Creek (I) 2240 ± 130
290 B.C.
$\delta^{13}C = -27.7‰$

Peat (sample FI-27-9-70C; 231.5 g wet) from a 1 cm interval (149 to 150 cm depth) at the top of the Bridge River ash.

GSC-1532. Mica Creek (II) 2450 ± 130
500 B.C.
$\delta^{13}C = -27.2‰$

Peat (sample FI-27-9-70D; 165 g wet) from a 1 cm interval (151 to 152 cm depth) immediately below the Bridge River Ash.

Comment (R.J. Fulton): dates GSC-1520 and -1532 bracket the time of Bridge River ash eruption and correspond well with other dates on this ash fall (Fulton, 1971, p. 19). Both peat layers contain sedge remains (unpublished GSC Bryological Report Nos. 97 and 100 by M. Kuc). NaOH leach omitted from the pretreatment of both samples. Each date based on one 3-day count in the 5-litre counter.

Northern Canada, Mainland

Yukon Territory

GSC-2202. Donjek River 10 600 ± 90
8650 B.C.

Wood (sample 16ROA-4A; 11 g; **Salix** sp., identified by R.J. Mott) from the west bank of Donjek River, 6.5 km upstream from the Alaska Highway bridge, Yukon Territory (61°38'N, 139°46'W), at an altitude of ca. 760 m. The wood was collected approximately 5 m below the top of an 11 m-thick unit of interbedded fluvial sand and gravel, which is overlain by 1.5 m of lacustrine(?) sands and 3 m of peat; the lower 15 m of the section is covered. Collected 1974 by V.N. Rampton, then with Geological Survey of Canada, now with Terrain Analysis and Mapping Services Ltd., Ottawa.

Comment (V.N. Rampton): the date is a minimum for the deglaciation of the site following the Macauley or Kluane glaciation, and it is in agreement with dates reported for deglaciation by Rampton (1971) and by Lowdon and Blake (1973; cf. GSC-1937, 10 100 ± 430 years). Date based on one 3-day count in the 5-litre counter.

Comment (W. Blake, Jr.): all pieces of wood making up this sample were 0.5 to 1.5 cm in diameter, up to 4 cm long, and the bark was still attached; they showed no signs of wear.

GSC-2214. Count Creek 6230 ± 70
4280 B.C.

Wood (sample 30ROA; 12.3 g; **Picea** sp.; identified by L.D. Farley-Gill) from the south bank of Count Creek, Yukon Territory (61°32'N, 140°31'W), near its confluence with Klutlan Glacier at an altitude of 1220 m and near the present treeline. The wood was collected from foreset beds in an exposed delta face. Collected 1974 by V.N. Rampton.

Comment (V.N. Rampton): the delta from which the wood was derived was constructed by meltwater flowing parallel to the southeast margin of Klutlan Glacier into a lake which formed in Count Creek valley when Klutlan Glacier advanced and dammed it. Because White River ash appeared to compose a large part of the delta, it was believed that the date would postdate 1220 years B.P. (Hughes **et al.**, 1972); however either the stratigraphy is more complex than realized during the 1974 reconnaissance, or the wood has been reworked from an older deposit. Date based on two 1-day counts in the 5-litre counter.

GSC-2227. Generc River 1120 ± 90
830 A.D.

Wood (sample 31ROA-4A; 4.3 g; **Picea** sp.; identified by R.J. Mott) from the west bank of Generc River, 7 km downstream from the mouth of Brooke Creek, Yukon Territory (61°39.5'N, 140°38'W), at an altitude of ca. 915 m. The peat containing the wood was near the base of 12 m of ablation till overlying a complex of Pleistocene tills and glaciofluvial sediments. Collected 1972 by V.N. Rampton.

Comment (V.N. Rampton): the date confirms Rampton's (1970) contention that the Harris Creek moraines, which are the oldest Neoglacial moraines constructed by the Klutlan Glacier, were constructed between 850 and 1100 B.P. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 5-litre counter.

Comment (W. Blake, Jr.): the wood was separated by hand from the mossy peat comprising the bulk of this sample. Only the single largest piece, 13.5 cm long and 0.6 cm in diameter, was used for the age determination.

GSC-1776. Hornet Creek >40 000

Wood (sample 150ROY-A; 12.2 g; **Salix** sp., identified by L.D. Farley-Gill) from peat in the upper part of 1.8 m of weathered gravel underlying approximately 40 m of poorly exposed fluvial and glaciofluvial gravels on the north bank of Hornet Creek, 1.5 km southwest of its confluence with Eagle Creek, Yukon Territory (68°44'N, 136°36'W), at an altitude of ca. 21 m. The base of the weathered gravel is about 15 m above creek level; the exposure was old and partly vegetated, but a fresh section was cleared. Collected 1972 by V.N. Rampton.

Comment (V.N. Rampton): the date indicates that the weathered gravels predate any middle to late Wisconsin interstadial. Associated pollen spectra (counted by J.C. Ritchie, Scarborough College, University of Toronto, West Hill) was dominated by alder, dwarf birch, and sedges; tree pollen were lacking. Date based on one 3-day count in the 5-litre counter.

Purkis Creek series

Peat from under a solifluction lobe at an elevation of about 370 m approximately 2.8 km west of Purkis Creek, Yukon Territory (68°35'N, 137°15.5'W), 20 km from its confluence with Blow River. Collected 1972 by W. Lechow and V.N. Rampton.

GSC-1790. Purkis Creek (I) 350 ± 50
1600 A.D.

Peat (sample C^{14}-B-BL-B2; 88 g), composed mainly of **Sphagnum** sp. cf. **squarrosum** (identified by M. Kuc), from a point 0.6 m from the front of the lobe and 70 cm below its surface. The sample included a few modern rootlets. The age of the sample ranges between 320 and 480 years if fluctuations in atmospheric ^{14}C content are allowed for (Stuiver and Suess, 1966). Date based on two 1-day counts in the 5-litre counter.

GSC-1875. Purkis Creek (II) — 1160 ± 50 / 790 A.D.

Peat (sample C^{14}-B-BL-B4; 75 g) composed mainly of **Sphagnum** sp. and other plant fragments (identified by M. Kuc) from a point 1.2 m from the front of the lobe and 1 m below its surface. The sample included some rootlets. Date based on two 1-day counts in the 5-litre counter.

Comment (V.N. Rampton): the two dates indicate that the solifluction lobe has moved downslope over the last 1200 years at an average rate of the order of 1 mm per year. The average rate seems to have been more rapid over the last 400 years than during the preceding 800 years. These rates concur with those summarized in Benedict (1976). Renewed investigations during the 1973 season (Rampton and Dugal, 1974) indicated that the internal structure of solifluction lobes is complex and suggested complications in their formation and downslope progress (Rampton, unpublished manuscript).

GSC-2022. Sabine Point east — 9940 ± 90 / 7990 B.C.

Wood (sample FG-65-57a; 11.6 g; **Populus** sp., identified by L.D. Farley-Gill) from an altitude of 32 m in a coastal bluff, 5 km southeast of Sabine Point, Yukon Territory (69°02'N, 137°38'W). Wood and peat were found near the base of a 3 m-thick diamicton unit capping the coastal bluff; the diamicton is underlain by approximately 13 m of interglacial sand, and the lower part of the section is covered. Collected 1965 by J.G. Fyles; submitted 1973 by V.N. Rampton.

Comment (V.N. Rampton): the presence of **Populus** wood, some of which appears to be beaver-chewed, at this locality indicates that conditions along the Yukon coastal plain were slightly warmer 9000 to 10 000 years ago than they are at present (Rampton, unpublished manuscript). Date based on one 2-day count in the 5-litre counter.

Comment (W. Blake, Jr.): the wood comprising this sample was dry and well preserved. Only the largest piece, ca. 10 cm long and 6 cm maximum diameter, was used for dating.

GSC-1792. Sabine Point west — 14 400 ± 180 / 12 450 B.C.

Peat (sample 81ROY-3A; 97.6 g) at an altitude of 18 m from a coastal bluff about 4 km west of Sabine Point, Yukon Territory (69°04.5'N, 137°51'W). The peat was collected from pods in the contact zone between a partly oxidized diamicton, 1.5 to 3 m thick, and the overlying unit, 1.2 to 1.8 m of silty clay with pebbles and plant fragments. The silty clay was overlain by 9 m of lacustrine clays and silt with peaty beds. The diamicton is underlain by more than 6 m of till; the base of the section is covered. Collected 1972 by V.N. Rampton.

Comment (V.N. Rampton): the date indicates the time of initiation of a thermokarst lake at this locality, for the material that the peat was collected from is believed to be mudflow debris deposited in an expanding thermokarst basin at the base of a retrogressive thaw flow slide. The mosses, plant remnants, and insects (identified by M. Kuc and J.V. Matthews, Jr., respectively) from the sample indicate a **Dryas** fell-field or steppe-like environment (Rampton, unpublished manuscript). Date based on one 3-day count in the 2-litre counter.

GSC-1798-2. King Point — >51 000 / $\delta^{13}C = -23.0‰$

Wood (sample 57ROY-A; **Picea** sp., identified by L.D. Farley-Gill) from an altitude of 12 m in a sea cliff, 1.6 km west of the western end of King Point lagoon, Yukon Territory (69°07'N, 138°01.5'W). The log comes from a 40 m-high cliff of which the lower part consists of glacially deformed fluvial gravels and sands. Collected 1972 by V.N. Rampton. Two determinations were made:

GSC-1798.	One 3-day count in the 5-litre counter; sample weight 11.6 g.	>38 000 $\delta^{13}C = -23.9‰$
GSC-1798-2.	One 4-day count in the 5-litre counter at 4 atm; sample weight 46.0 g.	>51 000 $\delta^{13}C = -23.0‰$

Comment (V.N. Rampton): the date indicates that the deformed sediments exposed along the coast between King and Kay Points are beyond the range of radiocarbon dating as indicated by their stratigraphic position relative to glacial sediments believed to be early Wisconsin (Mackay **et al.**, 1972) and because of dates on nearby sediments which are believed to be younger than the deformed sediments at King Point (Rampton, unpublished manuscript). GSC-1798-2 also indicates that the ^{14}C date of 37 900 $^{+2800}_{-2100}$ years (Birm-115) reported by Shotton **et al.** (1970) and Naylor **et al.** (1972) on wood from the same unit is in error.

Comment (W. Blake, Jr.): see also GSC-151-2, >51 000 years (GSC V, 1966, p. 116-117), on wood and peaty fragments from 0.6 m above the base of a sea cliff 5.6 km east of the eastern end of King Point spit.

Kay Point series

Peat from ice-wedge casts in outwash near Kay Point.

GSC-480. Kay Point (I) — 9710 ± 140 / 7760 B.C.

Peat (sample FG-65-65a; 20 g burnt) from an altitude of about 1 m in a small scarp to the south of Kay Point, Yukon Territory (69°17.5'N, 138°23.5'W). The peat is from the base of an ice-wedge cast that transects approximately 2 m of sand (glaciofluvial) and 1 m of gravel (also glaciofluvial); the sand is overlain by 0.7 m of peat. Collected 1965 by J.G. Fyles.

GSC-1872. Kay Point (II) — 7170 ± 70 / 5220 B.C.

Peat (sample 50ROY-1A; 61 g) from an altitude of 1.8 m in a coastal scarp about 1.6 km southeast of Kay Point, Yukon Territory (69°17'N, 138°22.5'W). The peat is from the base of an ice-wedge cast developed in 2.2 m of gravel (glaciofluvial) which is overlain by 3 m of sand with peaty lenses (lacustrine) and 2 m of interbedded peat and sand. Collected 1972 by V.N. Rampton.

Comment (V.N. Rampton): these peat-filled casts indicate that local conditions changed about 10 000 to 7000 years ago to allow melting of the ice wedges. GSC-480 may relate directly to the general climatic warming that caused a thickening of the active layer (Rampton, 1973a, b), whereas GSC-1872 probably relates to the early development and expansion of a thermokarst lake at that site. Both dates are based on one 3-day count in the 5-litre counter.

GSC-1262. Stokes Point | 22 400 ± 240
20 450 B.C.

Peat (sample FG-65-19a; 250 g) consisting of fragmented plant remains from 1 m below the upper contact of 1.5 m of fine sand, which underlay 1.5 m of pebbly gravel exposed in a coastal scarp opposite the western end of a large lagoon extending west of Stokes Point, Yukon Territory (66°22'N, 138°48'W). Collected 1965 by J.G. Fyles; submitted 1969 by V.N. Rampton.

Comment (V.N. Rampton): the site was re-examined in 1972; 1 m of poorly exposed silty sand and peat overlies 1 m of pebbly gravel, 30 cm of peat, 1.3 m of fine sand with thin silty gravel and peaty beds, 30 cm of clayey silt with rare pebbles and twigs, and 3 m of cover to sea level. This site exposes material underlying a bench, which is inset into the general upland, and which is underlain by contorted preglacial sediments and till (Mackay **et al.**, 1972). A 1 cm-thick bed of twigs and compressed plant fragments at the midpoint of the fine sand unit (1.3 m thick) appears to match the unit sampled by Fyles, although the section was badly covered at the time that Fyles made the collection. The sediments are believed to have been deposited in a thermokarst lake, a type of lake which is, and has been, common on the Yukon coastal plain (Rampton, unpublished manuscript). GSC-1262 is the oldest date obtained from sediments related to thermokarst and postdating glaciation of the Yukon coastal plain. NaOH leach omitted from sample pretreatment. Date based on one 5-day count in the 5-litre counter.

GSC-1808. Roland Bay | 9610 ± 90
7660 B.C.

Peat (sample 31ROY-3A; 66.3 g dry; no determinable plant fragments found by M. Kuc) from an altitude of 10.2 m in a coastal bluff 2 km east of Roland Bay and 6 km northwest of Stokes Point, Yukon Territory (69°22.5'N, 138°52'W). The peat was in the form of a pod in oxidized bouldery sand, underlying 4 m of lacustrine clay with peaty layers and 30 cm of peat. Till underlies the sandy unit. Collected 1972 by V.N. Rampton.

Comment (V.N. Rampton): the date gives the age of active thermokarst expansion of a lake basin at the site, a process which reached a maximum between 10 000 and 9000 years B.P. (Rampton, 1973a, b). Sample mixed with dead gas for counting. Date based on one 3-day count in the 5-litre counter.

GSC-1881. Roland Creek | 4540 ± 60
2590 B.C.

Wood fragments (sample 70ROY-2A; 9.6 g) from a small bluff along the east bank of Roland Creek, Yukon Territory (69°13'N, 139°19'W), at an altitude of ca. 210 m. The wood is within 60 cm of silty sand with thin peat layers underlying 1 m of sandy gravel and overlying 5 m of gravel. Collected 1972 by V.N. Rampton.

Comment (V.N. Rampton): the date indicates rather recent local incision by Roland Creek. Sample mixed with dead gas for counting. Date based on one 3-day count in the 5-litre counter.

GSC-1900. Malcolm River | 34 600 ± 1480
32 650 B.C.

Plant and moss fragments (sample 73ROY-2A; 14.5 g; **Carex** sp., **Salix** sp., **Saxifraga hirculus, Saxifraga** sp., **Equisetum variegatum, Bryum** sp., and **Barbula** sp., identified by M. Kuc) in a 14 m-high bank on the east side of Malcolm River, Yukon Territory (69°28.7'N, 139°57'W), at an altitude of 130 m. The sample is from a thin silty sandy layer 2.4 m above stream level; the cutbank exposes 11 m of gravel and sand with the upper 1.7 m and lower 1.3 m of bank covered. Collected 1972 by V.N. Rampton.

Comment (V.N. Rampton): this date on material from the base of a terrace sequence near the Yukon coast indicates that Malcolm River was in a phase of aggradation during mid-Wisconsin time when sea level is believed to have stood within a few tens of metres of its present position (Hopkins, 1973). Sample mixed with dead gas for counting. Date based on one 4-day count in the 2-litre counter.

GSC-1838. Komakuk Beach | 10 200 ± 120
8250 B.C.

Wood (sample 22ROY-2B; 5.5 g; **Salix** sp., identified by L.D. Farley-Gill) from an altitude of 5 m in a coastal scarp 7.5 km west of Komakuk Beach, Yukon Territory (69°35.5'N, 140°22'W). The wood was obtained from a peaty layer within 4 m of silty gravel overlain by 2 m of organic silt; the lower 4 m of the scarp is covered by colluvium. Collected 1972 by V.N. Rampton.

Comment (V.N. Rampton): the date indicates that within the last 10 000 years the environment of the Yukon coastal plain in this vicinity has changed, and streams have incised themselves about 8 m. Rampton (unpublished manuscript) has considered a number of reasons for the existence of the earlier higher levels of gravel deposition, notably 1) climatic conditions leading to additional erosion and 2) stream transport of coarse grained fluvial sediments from the British Mountains onto the Yukon coastal plain in combination with streams being graded to a shoreline some miles offshore from its present position (**see** also GSC-1853, this list). Sample mixed with dead gas for counting. Date based on one 3-day count in the 5-litre counter.

Comment (W. Blake, Jr.): the single largest piece of wood (27 g wet before drying in electric oven) used for the age determination was 12 cm long, 1.5 cm maximum diameter. The bark was still intact and the ends were not rounded.

GSC-1853. Backhouse River | 10 900 ± 80
8950 B.C.

Wood (sample 28ROY-A; 8.4 g; **Betula** sp., identified by L.D. Farley-Gill) from an altitude of 2 m in a coastal scarp about 3.2 km west of the mouth of Backhouse River, Yukon Territory (69°36'N, 140°36'W). The wood comes from peaty material in an ice-wedge cast contained within 4 m of gravel that is overlain by 0.5 m of organic silt. Collected 1972 by V.N. Rampton.

Comment (V.N. Rampton): the date indicates that within the last 10 000 years the environment of the Yukon coastal plain in this vicinity has changed and that the surfaces of more recently deposited alluvial fans lie 4 to 8 m below due to stream incision (**see** GSC-1838, this list).

Matthews (1975) studied the pollen and macrofossils from peat associated with the **Betula** wood and concluded that the area was covered by tundra. The submitter believes that the macrofossils and pollen spectra noted by Matthews indicate that the alluvial fan was covered by fell-field over most of its surface. Poorly drained areas, which were covered by tundra dominated by sedges and dwarf birch, were confined to sheltered microenvironments along ice-wedge troughs (Rampton, unpublished manuscript). In any event, the environment probably was similar to that of the present. Date based on one 4-day count in the 5-litre counter.

Comment (W. Blake, Jr.): the sample originally was identified as **Alnus** sp., but re-examination of the sample in consultation with E. Perem, Forest Products Laboratory, Environment Canada, Ottawa, indicated that the samples are probably birch, not alder. The largest piece of wood, used for the ^{14}C determination, was 41 cm long, with a maximum diameter of 1 cm.

GSC-1869. Alaska/Yukon Boundary — 10 400 ± 80, 8450 B.C., $\delta^{13}C = -27.7‰$

Peat (sample 36ROY-A; 252 g dry) from fresh exposure in coastal scarp ca. 400 m east of the Alaska/Yukon boundary, Yukon Territory (69°38'N, 140°59.5'W) where approximately 6 m of lacustrine sediments are exposed. The lower 1.5 m is a sticky clay containing ice-wedge casts(?) and pods of organic material; sample 36ROY-A was collected at the top of this unit by V.N. Rampton in 1972. Two determinations were made:

GSC-1869.	One 4-day count in the 5-litre counter	10 400 ± 80 $\delta^{13}C = -27.7‰$
GSC-1869-2.	Base soluble solution kept and neutralized with HCl. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.	10 600 ± 260 $\delta^{13}C = -27.8‰$

Comment (V.N. Rampton): the dates and the nature of the sediments indicate that a thermokarst lake was present at this site close to 10 400 years ago. Rampton (see date GSC-1808, this list) found that thermokarst expansion was at a maximum between 10 000 and 9000 years B.P.

GSC-1483. Pauline Cove, Herschel Island — 9380 ± 170, 7430 B.C.

Basal peat (sample PA-01 (14 feet); 20 g) from a 4 m-high section of peat exposed in a coastal scarp approximately 1.5 km west of the base of Herschel spit on Herschel Island, Yukon Territory (69°34'N, 138°58'W). The peat, which consisted primarily of **Calix** and **Eriophorum** remains with a few branches (identifications by M. Kuc), was from an altitude of 15 m. Collected 1970 by M. Bouchard; submitted by V.N. Rampton.

Comment (V.N. Rampton): a number of peat-filled thermokarst depressions occur on Herschel Island (Bouchard, 1974). GSC-1483 dates the base of the thickest exposed sequence of peat within a thermokarst depression. A pollen spectra (counted by J.C. Ritchie) indicates that the adjacent upland on Herschel Island was covered partly by a shrubby tundra dominated by dwarf birch and sedges (Rampton, unpublished manuscript). NaOH leach omitted from sample pretreatment. Date based on one 1-day count in the 5-litre counter.

GSC-1670. Lopez Point, Herschel Island — 3940 ± 150, 1990 B.C.

Wood (sample 387ROX-A; 3.7 g; **Salix** sp., identified by R.J. Mott) from a peaty layer near the base of 5 m of silty and sandy alluvium containing abundant twigs, branches, and roots. The sample was collected from an altitude of 3.5 m above sea level in a coastal scarp on the southeast side of Lopez Point, located on the southwestern coast of Herschel Island, Yukon Territory (69°33'N, 139°12'W). Collected 1971 by M. Bouchard and V.N. Rampton.

Comment (V.N. Rampton): the date gives an age for the initiation of alluvial deposition at this site. The date does not correlate with initial thermokarst development throughout the region (Rampton, 1973a, b). Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

Comment (W. Blake, Jr.): these pieces of wood showed no rounding, and most still had the bark attached. Only one large piece, 14.5 cm long and 1.5 cm in diameter, was utilized for dating.

Northwest Territories

GSC-1676. Tuktoyaktuk Harbour — 8160 ± 140, 6210 B.C.

Peat (sample 189BGA-A; 34 g burned; characterized as black muck by M. Kuc) from a small wave-cut bank on the east side of Tuktoyaktuk Harbour, 6.4 km south of the DEW Line station, Northwest Territories (69°23'N, 132°59.5'W), at an altitude of 3 m. The peat overlies more than 0.5 m of beach gravel and underlies 0.7 m of clayey colluvium. Collected 1971 by M. Bouchard; submitted 1971 by V.N. Rampton.

Comment (V.N. Rampton): the date is a minimum for the expansion of a thermokarst lake at this site, and it falls within the period of time when thermokarst development was at a maximum in the region (Rampton and Bouchard, 1975). Date based on one 4-day count in the 5-litre counter.

Comment (W. Blake, Jr.): some modern rootlets were noted in the sample (original weight 300 g) by both Bouchard and Kuc, but it is assumed that these were removed by the NaOH pretreatment.

Zed Lake series

Wood, peat, and marl (sample 131ROW-7A) from a scarp on the east edge of the Eskimo Lakes about 2.5 km south of the inlet into Zed Lake, Northwest Territories (68°57.5'N, 133°13.5'W). The dated material was from the basal 5 cm of a 4.6 m-thick peat layer overlying 70 cm of pond silts and 2^+ m of glaciofluvial sands. Collected 1970 by J.M. Shearer (then with Geological Survey of Canada, now with Ocean and Aquatic Sciences, Environment Canada) and V.N. Rampton; submitted 1970 by V.N. Rampton.

GSC-1469.	Marl. Date based on two 1-day counts in the 5-litre counter.	9140 ± 170 7190 B.C. $\delta^{13}C = -4.4‰$

GSC-1469-2. Peat (less base-soluble fraction). Date based on two 1-day counts in the 5-litre counter. $\delta^{13}C = -27.1‰$ — 9790 ± 180, 7840 B.C.

GSC-1469-3. Wood (1.5 g). Sample mixed with dead gas for counting. Date based on two 1-day counts in the 1-litre counter. $\delta^{13}C = -25.4‰$ — 9640 ± 350, 7690 B.C.

Comment (V.N. Rampton): the dates give a minimum age for the expansion of a thermokarst depression at this site and probably are representative for the time of formation of most thermokarst depressions in the region (Rampton and Bouchard, 1975).

Comment (W. Blake, Jr.): the somewhat splintered wood sample, although too small (7 cm long, 1.5 cm in diameter) for sectioning by microtome, was cut by hand and identified by R.J. Mott as **Salix** sp. M. Kuc described the "peat" as typical sapropel for a still, shallow oligotrophic water body.

GSC-1877. Pullen Island   Dist. Frankl.   >23 000

Marine pelecypod whole shells and fragments (sample Pullen Is. No. 2; 3.1 g; **Macoma inconspicua** (identified by I. Lubinsky, University of Manitoba), and possibly other **Macoma** fragments), from a fresh exposure in sand and gravel of a wave-eroded cliff on the western side of Pullen Island, Northwest Territories (69°46.1'N, 134°23.7'W), at an altitude of ca. 3 m. Collected 1972 by J.M. Shearer.

Comment (J.M. Shearer): a gravel deposit with shell material was observed to be cutting older sands of Pullen Island, and for this reason it was thought that it might have represented a postglacial raised beach. Although no other such beaches have been observed in this area, the rate of shoreline retreat is very high, and this could have caused erosion and disappearance of beaches over a period of years. The date corroborates other age determinations in the area; **cf.** GSC-562, >35 000 years, pelecypod shells from Garry Island, and GSC-690, >37 000 years, **Astarte borealis** from Kendall Island (both in GSC XI, 1971, p. 305). It also confirms the interpretation of offshore work which indicates that submergence in postglacial times has not exceeded the present datum.

Comment (W. Blake, Jr.): in addition to the species listed above the sample contained fragments of **Astarte** sp., **Balanus** sp., **Mytilus** sp., and **Portlandia arctica** (identified by W. Blake, Jr.). All the **Macoma** shells and fragments used for the determination were <1 cm in length. HCl leach omitted due to small sample size. Sample mixed with dead gas for counting. Date based on one 4-day count in the 2-litre counter.

Northern Canada, Arctic Archipelago

Somerset Island   Dist. Franklin.

Cunningham Inlet series

GSC-2080. Cunningham Inlet (I) — 5300 ± 70, 3350 B.C., $\delta^{13}C = -25.1‰$

Driftwood (sample 1; 40 g damp; **Picea** sp., identified by L.D. Farley-Gill) partially buried in frozen raised beach gravel 266 m from the west shore of Cunningham Inlet, Somerset Island, Northwest Territories (74°08'55"N, 93°55'W), at an altitude of ca. 20.8 m. Collected 1974 by R.B. Taylor and R. Wahlgren.

GSC-2081. Cunningham Inlet (II) — 4930 ± 70, 2980 B.C., $\delta^{13}C = -24.9‰$

Driftwood log 4.5 m long (sample 2; 15 g; **Picea** sp., identified by L.D. Farley-Gill) partially exposed in the south-facing bank of a stream valley on the west side of Cunningham Inlet, Somerset Island, Northwest Territories (74°07'55"N, 93°53'50"W), at an altitude of ca. 17.3 m. The stream bank was composed of solifluction debris. Collected 1974 by R.B. Taylor.

Comment (R.B. Taylor): these samples represent the first radiocarbon-dated driftwood samples from Somerset Island (Taylor, 1975), and they aid in defining the position of the shoreline 5000 years ago (Blake, 1975). General agreement of radiocarbon dates suggests little movement of sample II by solifluction. Both dates based on one 2-day count in the 5-litre counter.

Ellesmere Island

GSC-1058. Cape Tennyson — 9040 ± 90, 7090 B.C.

Fragments of marine pelecypod shells (sample BS-122-68, 26 g; mainly **Mya truncata** and **Hiatella arctica**, identified by W. Blake, Jr.), in a sand and silt bed exposed in a stream valley, 11.5 km northeast of Cape Tennyson, Ellesmere Island, Northwest Territories (76°23'N, 79°13'W), at an altitude of ca. 30 m. The shell-bearing unit is underlain by bedded sands and a cobble-boulder bed in which marine shells were not observed, and is overlain by bedded sands (traces of shells) and beach cobbles. Collected 1968 by W. Blake, Jr.

Comment (W. Blake, Jr.): the date indicates that in this valley, by approximately 9000 years ago the glacier, which is now approximately 1 km to the west, had withdrawn sufficiently for the marine incursion to take place. The time of incursion is similar to that at other sites around northern Baffin Bay (Blake, 1976b). Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

Devon Island

Radstock Bay series

Peat samples from an 8 cm-thick in situ layer, intercalated between fine sand loam-textured niveo-alluvial deposits exposed in a 76 cm-high section near the head of an unnamed stream, 2.5 km north-northwest of Cape Liddon on the west side of Radstock Bay, Devon Island, Northwest Territories (74°35'N, 91°23'W), at an altitude of ca. 48.5 m. Collected 1970 by B.T. Bunting, McMaster University, Hamilton.

GSC-1479. Radstock Bay (I) — 8180 ± 160, 6230 B.C., $\delta^{13}C = -29.7‰$

Fibric moss peat (sample 53(SP3); 69 g damp; mainly **Meesea triquetra (trifaria)** identified by M. Kuc).

Comment (B.T. Bunting): the date points to the commencement of a local accumulation of fibric moss peat (with subarctic components) which interrupted mineral sediment deposition by snowmelt streams. The peat layer was at a depth of 25 to 33 cm below the surface; this sample was taken at 29 to 33 cm. Detailed profile descriptions are given in Bunting (1972) and an analysis of the material is in Bunting and Hathout (1971).

GSC-1503. Radstock Bay (II) — 7950 ± 150; 6000 B.C.; $\delta^{13}C$ = -27.6‰

A moss peat (sample 52(SP3); 37 g) of Hemic character with some debris of vascular plants; the sample is from the uppermost part of the moss layer described in GSC-1479, at a depth of 25 to 28 cm below the surface; the peat was overlain by yellowish brown fine sandy loam.

Comment (B.T. Bunting): both dates, and the species identified in the peat, point to a brief period of climatic amelioration and moss peat development over an area of several acres, in a river basin then close to sea level.

Comment (W. Blake, Jr.): in addition to **Meesea triquetra**, M. Kuc (unpublished GSC Bryological Report Nos. 80 and 83), reported **Calliergon** sp. and rare **Drepanocladus revolvens** in the lower sample, and **Calliergon** sp. and **D. revolvens** in the upper sample. The mosses indicate wet tundra conditions. In addition to the information these dated moss peat samples provide as to plant growth and the rate of deposition of alluvium, they also bear on the problem of land emergence, as they are well below the highest postglacial shorelines in the area. NaOH leach omitted from the pretreatment of both samples. Both dates are based on two 1-day counts in the 5-litre counter.

Ellef Ringnes Island

GSC-1846. Cape Nathorst — 8370 ± 200; 6420 B.C.; $\delta^{13}C$ = +1.8‰

Marine pelecypod shells (sample SV-67-A-6; 9.1 g; **Astarte borealis**; identified by W. Blake, Jr.) from ground surface 12 km north-northeast of Cape Nathorst, Ellef Ringnes Island, Northwest Territories (77°53'06"N, 99°38'W). Altitude of sample, as determined in a stereotope plotting instrument by G. Mizerovsky, is 32.5 ± 5 m. The sample was found in an area of frost-heaved shale bedrock, with a few quartzite pebbles scattered about. Collected 1967 by D.A. St-Onge, then Geological Survey of Canada, now University of Ottawa, Ottawa.

Comment (W. Blake, Jr.): dating was carried out on the single largest valve (4.2 cm high, >4 cm long) in the collection. One end was broken off, and the shell was worn and somewhat chalky on the exterior near the hinge. Bits of periostracum remained around the outer margin of the valve, and other shells in the collection had the periostracum nearly intact, implying little transport. **Hiatella arctica** and **Balanus** sp. also are present in the collection. The sample provides an excellent check on L-643, 8500 ± 200 years, shells at 33 m in the same vicinity (St-Onge, 1965; Blake, 1970), and on sample SV-67-A-4, driftwood (probably **Larix** sp.) some 0.4 km to the south, GSC-999, 8320 ± 140 years (Blake, 1972). Due to the small sample size, only the outer 10 per cent was removed with HCl. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

Victoria Island

GSC-1707. Peel Point — 12 600 ± 140; 10 650 B.C.; $\delta^{13}C$ = +2.4‰

Marine pelecypod shells (sample FG-59-87b; 22.3 g; **Portlandia arctica**, identified by F.J.E. Wagner) in clay overlying stratified silt and sand 8 km south of Peel Point, at the northwestern extremity of Victoria Island, Northwest Territories (73°18'N, 114°30'W), at an altitude of 67 to 70 m. Collected 1959 by J.G. Fyles; submitted 1972 by W. Blake, Jr.

Comment (W. Blake, Jr.): this age determination was carried out as a check on I(GSC)-18, 12 400 ± 320 years (Isotopes I, 1961, p. 52; Fyles, 1963), one of the early dates obtained from Isotopes, Inc., Westwood, New Jersey on a portion of the same collection. Agreement between the two determinations is excellent, and it seems clear that the postglacial marine incursion at this site (marine limit is at ca. 82 to 85 m) is the earliest known as yet from the Canadian Arctic Archipelago (Blake, 1976a). The shells were in situ, with many whole valves, a number of which were articulated. Nearly all valves (most are <1 cm long) have intact periostracum and teeth, implying that little or no transport has occurred. Only the outer 10 per cent was removed by HCl leach. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

Banks Island

GSC-2124. Thomsen River — 3460 ± 80; 1510 B.C.

Willow twigs and branches (sample 3; 4.4 g; **Salix** sp., identified by M. Kuc) from the frozen sediments of a terrace on the west bank of Thomsen River, approximately 1 km north of its confluence with Able Creek, Banks Island, Northwest Territories (73°42'N, 119°56'W), at an altitude of more than 100 m. The accumulation of willow underlies 8.0 m of windblown sands. A fresh section was excavated using a Wajax pump. Collected 1974 by H.M. French, University of Ottawa, Ottawa, and A. Pissart, Université de Liège, Liège, Belgium.

Comment (A. Pissart): the samples provide a limiting date for the accumulation of eolian sands in this locality (Pissart and French, 1976).

Comment (W. Blake, Jr.): sample dried in electric oven. Twigs are well preserved and many still have the bark adhering. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

GSC-2117. Able Creek — 4990 ± 90; 3040 B.C.

Willow wood (sample E29; 5.1 g; **Salix** sp., identified by L.D. Farley-Gill) from a section along Able Creek, Banks Island, Northwest Territories (73°43'N, 120°00'W), at an altitude of ca. 100 m. The wood occurred in uptilted fluviatile (sand, silt, and gravel) beds on the flank of a pingo; the exposure was cut in the frozen material with a Wajax pump. Collected 1974 by A. Pissart.

Comment (A. Pissart): the date provides a maximum age for the growth of the pingo (Pissart and French, 1976), which probably occurred following the infilling of a thermokarst lake. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

United States of America

Minnesota

GSC-1666. Red Lake River >39 000

Wood (sample FMH-1; 14.9 g; **Picea** sp.; identified by L.D. Farley-Gill) from unoxidized glacially deformed silt containing many log fragments, approximately 18 m below the cliff top, ca. 0.8 km west of the town of Red Lake Falls, Minnesota, NE 1/4, NE 1/4, NW 1/4, sec. 21, tp. 151, rge. 44 W (47°42'N, 96°20'W), at an altitude of ca. 287 m. Collected 1971 by M.M. Fenton, now with Alberta Research Council, Edmonton.

Comment (M.M. Fenton): sample is from the lower part of Gervais Formation (Harris **et al.**, 1974) and is correlated with stratified sediment underlying the Rosa till in southeastern Manitoba (Fenton, 1974). The date confirms I-5317 (>39 000 years B.P., on wood) from the same section. The Gervais Formation is now believed to be early Wisconsin or pre-Wisconsin in age. Date based on one 3-day count in the 5-litre counter.

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