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GEOLOGICAL SURVEY OF CANADA RADIOCARBON DATES XV

J.A. LOWDON
W. BLAKE, Jr.

Energy, Mines and Resources Canada
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CONTENTS

The present date list, GSC XV, is the fourth 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 XV

Abstract

This list includes 106 radiocarbon age determinations on 95 geological samples made by the Radiocarbon Dating Laboratory. They are on samples from various areas as follows: Newfoundland (island) (4); Newfoundland (Labrador) (11); Nova Scotia (1): New Brunswick (10); Quebec (11); Ontario (6); Manitoba (4); Saskatchewan (8); Alberta (10); British Columbia (6); Northwest Territories – Arctic Archipelago (32); U.S.A. (2); Norway (1). Details of background and standard for the 2-litre and 5-litre counters during the period from December 19, 1973 to March 30, 1975 are summarized in Tables 1 and 2. Table 3 gives the number of counts used to determine average background and standard counting rates; Table 4 lists the number of different background and standard gas preparations used for counting; and Table 5 provides a comparison of results from all three counters on a single Douglas fir sample of known age.

Résumé

Ce rapport présente les résultats de 106 datations effectuées sur 95 échantillons géologiques par le Laboratoire de datation au radiocarbone. Ces échantillons proviennent des régions suivantes: Ile de Terre-Neuve (4); Labrador (11); Nouvelle-Ecosse (1); Nouveau-Brunswick (10); Québec (11); Ontario (6); Manitoba (4); Saskatchewan (8); Alberta (10); Colombie-Britannique (6); Territoires du Nord-Ouest – archipel Arctique (32); Etats-Unis (2); Norvège (1). Les valeurs du mouvement propre et de l'étalonnage des compteurs 2-litres et 5-litres, pour la période allant du 19 décembre 1973 au 30 mars 1975, sont présentées dans les tableaux 1 et 2. Le tableau 3 donne le nombre de coups utilisés pour déterminer la moyene des taux d'implusions du mouvement propre et l'étalonnage; le tableau 4 donne de nombre de préparations de gaz pour le mouvement propre et pour l'étallonnage utilisées pour le comptage; et, le tableau 5 compare les résultats obtenus par les trois compteurs pour le même échantillon de sapin de Douglas d'âge connu.

Introduction*

During the period covered by this introduction (December 1973 to March 1975), the 1-litre counter (Lowdon *et al.*, 1971) was operated for one month, the 2-litre counter (Dyck and Fyles, 1962) for approximately 5 months, and the 5-litre counter (Dyck *et al.*, 1965) for approximately 15 months. The 1-litre counter was operated at 1 atm, the 2-litre at 2 atm, and the 5-litre at 1 atm, except for the periods December 19, 1973 to February 12, 1974 and December 19, 1974 to March 30, 1975, when it was operated at high pressure (4 atm).

The 2-litre counter was not operated during the period January 5, 1974 to May 15, 1974 because of electronic problems. Before the problems were finally solved, the following changes had been made:

1) The pre-amp boards in the Sharp low-beta counting unit were replaced.
2) The high voltage supply was cleaned and, as this did not improve the situation, a new supply was installed.
3) A new RC network was built.
4) All capacitors were changed.
5) New shielding was constructed around the counter.
6) All high voltage supply and Sharp connectors and all high voltage cables were changed.
7) Finally, the counter was taken apart, cleaned with acetone and distilled water, and reassembled.

After the 2-litre counter had been operating again for 2 months, further problems arose when the new air-conditioning unit (Lowdon *et al.*, 1974) was unable to control the summer humidity, which rose to approximately 70 per cent in the counting room. The 2-litre counter once again had to be taken apart and cleaned. During the period December 20, 1974 to February 14, 1975, the 2-litre counter again became unstable and all counts obtained during this period were discarded. A new 2-litre counter was fabricated, assembled, tested, and finally put into operation in April 1975.

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.

* 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.

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Final version approved for publication: December 30, 1975

TABLE 1

Background (c/m)* for Periods Used for Age Calculations,
December 19, 1973 to March 30, 1975

Period	1-litre Counter (1 atm)	2-litre Counter (2 atm)	5-litre Counter (1 atm)
December 19, 1973 – February 12, 1974	–	–	2.518 ± 0.020**
February 12 – March 21	–	–	1.937 ± 0.021
March 7 – April 10	1.712 ± 0.022	–	–
March 21 – May 16	–	–	1.974 ± 0.025
May 16 – June 24	–	0.994 ± 0.015	–
May 16 – June 6	–	–	2.089 ± 0.032
June 7 – July 31	–	–	2.027 ± 0.019
June 24 – July 4	–	0.953 ± 0.019	–
August	–	–	2.067 ± 0.024
September	–	0.923 ± 0.029	2.123 ± 0.024
October	–	0.903 ± 0.016	2.107 ± 0.021
November 1 – December 18	–	0.967 ± 0.048	2.097 ± 0.025
December 18, 1974 – March 30, 1975	–	–	2.823 ± 0.022**

* c/m = counts per minute
** 5-litre counter operating at 4 atm

TABLE 2

Standard, N_o,* (c/m) for Periods Used for Age Calculations,
December 19, 1973 to March 30, 1975

Period	1-litre Counter (1 atm)	2-litre Counter (2 atm)	5-litre Counter (1 atm)
December 19, 1973 – February 12, 1974	–	–	110.582 ± 0.210**
February 12 – March 21	–	–	28.630 ± 0.139
March 7 – April 10	4.252 ± 0.103	–	–
March 21 – May 16	–	–	28.580 ± 0.102
May 16 – June 24	–	18.429 ± 0.082	–
May 16 – June 6	–	–	28.501 ± 0.123
June 7 – July 31	–	–	28.561 ± 0.146
June 24 – July 4	–	18.529 ± 0.097	–
August	–	–	28.537 ± 0.123
September	–	18.238 ± 0.275	28.417 ± 0.146
October	–	17.828 ± 0.090	28.467 ± 0.120
November 1 – December 18	–	17.704 ± 0.247	28.611 ± 0.165
December 18, 1974 – March 30, 1975	–	–	109.985 ± 0.188**

* N_o = 0.95 x net counting rate of the NBS oxalic acid standard
** 5-litre counter operating at 4 atm

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
December 19, 1973 – February 12, 1974	–	9*	–	5*
February 12 – March 21	–	5	–	3
March 21 – May 16	–	6	–	4
May 16 – June 24	6	–	4	–
May 16 – June 6	–	3	–	3
June 7 – July 31	–	6	–	3
June 24 – July 4	3	–	2	–
August	–	4	–	3
September	5	5	3	3
October	4	5	3	3
November 1 – December 18	4	5	3	3
December 18, 1974 – March 30, 1975	–	15*	–	8*

* 5-litre counter operating at 4 atm

Note: For the 1-litre counter operating between the period March 7 to April 10, 1974 (*see* Tables 1 and 2), 6 backgrounds and 4 standard counts were used.

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

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 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.

Unless otherwise stated in the sample descriptions, all ages are based on two 1-day counts. 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

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
December 19, 1973 – February 12, 1974	–	1*	–	1*
February 12 – March 21	–	1	–	2
March 21 – May 16	–	3	–	2
May 16 – June 24	2	–	1	–
May 16 – June 6	–	1	–	2
June 7 – July 31	–	2	–	1
June 24 – July 4	2	–	1	–
August	–	1	–	1
September	2	2	2	2
October	2	2	2	2
November 1 – December 18	3	3	2	2
December 18, 1974 – March 30, 1975	–	1*	–	1*

* 5-litre counter operating at 4 atm

Note: For the 1-litre counter operating between the period March 7 to April 10, 1974 (*see* Tables 1 and 2), one background gas and two different standard gases were used.

TABLE 5

Comparison of Results from Different Counters on a Sample of Known Age

Sample no.	Counter (litres)	Pressure (atm)	Length of count (days)	Uncorrected age (years B.P.)	$\delta^{13}C$ ‰	Corrected age (years B.P.)
GSC-22(1)-2**	1	1	5	1030 ± 130	-22.2	1080 ± 130
	2	2	3	1040 ± 130		1080 ± 130
	5	1	3	1110 ± 50		1150 ± 50

* $\delta^{13}C$ = -22.2‰ determined by Geochronology Section of the Geological Survey of Canada

** GSC-22(1)-2 was listed incorrectly as GSC-22(1) in GSC XIV (1974, Table 5, p. 4). GSC-22(1) is the original determination carried out by W. Dyck in 1961; GSC-22(1)-2 is a new preparation of gas made in 1973.

0.0‰ for marine shells. Except for those listed below, the $^{13}C/^{12}C$ ratios were determined by the GSC Geochronology Section on aliquots of the same sample gas used for age determination; GSC-964, -1199, and -1246 were done at Isotopes Inc., Westwood, New Jersey; GSC-2082 and -2083 were determined at the Department of Earth Sciences, University of Waterloo, Waterloo, Ontario.

Table 5 presents the results obtained from different counters on a piece of wood of known age. This wood is from a Douglas fir *(Pseudotsuga menziesii)* cut in 1960 on Vancouver Island, British Columbia. Tree ring counting was conducted by the Forest Products Laboratory, Environment Canada, Ottawa. The sample used for dating has a tree ring age of 1126 to 1130 years before 1960, or an average age of 1118 years B.P. (before 1950). The agreement between the results obtained from different counters and the tree ring age is most gratifying.

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 identification of macroscopic organic remains, and the latter for examination of fossil insects; the X-ray Diffraction Laboratory (chiefly A. Roberts) for the identification of mineral constituents in shells; Mrs. G. Mahony and R. Richardson for assistance in compilation. Dr. A.H. Clarke, Jr. and Mrs. M.F.I. Smith, National Museum of Natural Sciences, have identified molluscs in a number of samples, and C.R. Harington of the same organization has identified fossil bones.

GEOLOGICAL SAMPLES

Eastern Canada

Newfoundland (island)

GSC-2085. South Brook, Halls Bay — 11 000 ± 190 / 9050 B.C.

Dated material (sample 72-S2; 21.1 g) includes whole valves and fragments of *Hiatella arctica,* but sample also contained fragments of *Mya truncata* and *Balanus* sp. (identified by W. Blake, Jr.). The shells were collected from a road-cut 4.5 m a.s.l., leading to the present shoreline from a borrow pit 15 m a.s.l. at the northeast corner of the town of South Brook, Newfoundland (49°26'00"N, 56°04'45"W). The enclosing material was a compact dry pelite or clay. Collected 1972 by C.M. Tucker.*

Comment (C.M. Tucker): the date is compatible with GSC-55 (11 520 ± 180 years; 49 m a.s.l.), GSC-75 (11 950 ± 170 years; 12 m a.s.l.), and GSC-87 (11 880 ± 190 years; 12 m a.s.l.; all three dates in GSC II, 1963, p. 41-42), as well as with GSC-1733 (12 000 ± 220 years; 20 m a.s.l.; Tucker, 1974); it is significant in that it fixes the age of the easternmost of a series of glaciomarine deltas in Halls Bay. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

St. George's Bay series

Marine pelecypod shells from two sites on the coast of St. George's Bay, Newfoundland.

GSC-2063. St. George's Bay, east — 13 300 ± 810 / 11 350 B.C.

One incomplete valve (sample (72-6(b); 4.0 g) of *Mya truncata* (identified by W. Blake, Jr.) from a collection of abundant robust, iron-stained pelecypod shells (intact valves and fragments) from a sea cliff 1 km west of the western boundary of Stephenville townsite, Newfoundland (48°32.6'N, 58°36.7'W). The shells occur in a well sorted, plane-bedded, sandy gravel 1 m thick at 5 to 6 m a.s.l. This unit overlies coarser kame gravels and till of the St. George's River Drift and underlies coarser kame gravels of the Robinsons Head Drift. Collected 1965 by I.A. Brookes, York University. Toronto.

Comment (I.A. Brookes): because the marine limit at Stephenville (29 m) is lower than that to the west at Abrahams Cove (42 m; 13 600 ± 110 years; GSC-2015, this list, below) and that to the south at Robinsons Head (44 m; 13 500 ± 210 years; GSC-1200, GSC XI, 1971, p. 261), it was thought that a date on this sample would closely approximate the age of the ice advance responsible for the Robinsons Head Drift. That advance has been postulated to have occurred at 12 750 years B.P. (Brookes, 1974). The large counting error on the present data provides neither support nor refutation of the hypothesis. The Robinsons Head Drift remains undated.

Comment (W. Blake, Jr.): only a single valve was utilized from this sample in order to determine whether or not the shells were 'old' (i.e., beyond the limit of radiocarbon dating). It is now planned to select a larger sample from the same collection for a new determination. Due to small sample size, the HCl leach was omitted. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

GSC-2015 St. George's Bay, west — 13 600 ± 110 / 11 650 B.C.

Complete valves (sample 72-1; 45.5 g) of *Hiatella arctica* (32 left valves and 24 right valves; identified by W. Blake, Jr.) from gravels partially filling solution cracks in limestone 35 to 40 m a.s.l. at Abrahams Cove, south shore of Port au Port Peninsula, western Newfoundland (48°32'N, 56°54'W). New exposure in

* 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.

gravel pit was visited to obtain a larger and more reliable sample than that collected for GSC-1074 (13 700 ± 230 years; GSC XI, 1971, p. 263). Sample site lies 3 to 8 m below marine limit at 45 m a. s. l. Collected 1972 by I. A. Brookes, York University, Toronto.

Comment (I. A. Brookes): this date is considered more reliable than GSC-1074 and supersedes it. It also strengthens the collector's earlier conclusion that shells from fine grained sediments near the base of marine sequences in this area (e. g., those dated at 13 600 ± 180 years B. P. at 6 m a. s. l. at this locality; GSC-968; GSC XI, 1971, p. 262-263) can be used to date the marine limit in the absence of sufficiently reliable shell material at higher elevations.

Comment (W. Blake, Jr.): this age determination adds to the numerous dates in the range of 13 000 to 13 900 which are now available for southwestern Newfoundland (Brookes, 1969; Prest *et al.*, 1972). Although the shells making up this sample no longer had the periostracum attached and were also somewhat chalky, no pitting was observed and some valves retained their internal lustre. Date based on one 3-day count in the 5-litre counter.

GSC-2113. Wreckhouse, Cabot Strait — 13 800 ± 260 / 11 850 B. C.

Broken valves (sample 74-01; 7. 0 g) of *Macoma calcarea* and *Macoma* sp. (identified by W. Blake, Jr.) from pods of gravelly sand and sandy mud enclosed in the lower part of mainly stratified glacigene sediments, exposed at 6 m in 12 to 15 m-high sea cliff 100 m north of Wreckhouse Brook, approximately 20 km northwest of Port aux Basques, Newfoundland (47°42. 5'N, 59°18. 6'W). Collected August 1974 by I. A. Brookes, York University, Toronto.

Comment (I. A. Brookes): enclosing glacigene sediments relate to moraines built by piedmont glaciers issuing westwards from troughs in Long Range Mountains across shelly marine sediment deposited during submergence of Cabot Strait coast after the margin of Newfoundland Ice Cap wasted inland. The determination indicates the age for this submergence and predates the ensuing piedmont glacier readvance.

Comment (W. Blake, Jr.): sample also contains *Hiatella arctica, Mya truncata, Serripes groenlandicus,* and *Balanus* sp. Original sample submitted to laboratory was 10. 5 g of *Hiatella arctica,* but the CO_2 gas was lost due to the wrong valve being opened. Due to small sample size only outer 5 per cent was removed by leaching. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

Newfoundland (Labrador)

Cartwright series

Peat from near Cartwright, Labrador. Collected 1969 by R. J. Fulton with a Davis sampler.

GSC-1311. Cartwright (I) — 6080 ± 150 / 4130 B. C.

Basal peat (sample FI-3-69") from 280 to 285 cm depth in a bog filling the area between two lakes 5 km southeast of Cartwright, Labrador (53°41'04"N, 56°57'40"W), at an altitude of 75 m.

GSC-1346. Cartwright (II) — 5950 ± 150 / 4000 B. C.

Basal peat (sample FI-3-69') from 215 to 225 cm depth in a bog filling the area between two lakes 5 km southeast of Cartwright, Labrador (53°41'04"N, 56°57'40"W), at an altitude of 75 m.

GSC-1435. Cartwright (III) — 1600 ± 130 / 350 A. D.

Peat (sample FI-1-1-69"; 157 g damp) from the basal 10 cm of a 120 cm-deep bog which has developed on a marine terrace 1. 5 km south of Cartwright, Labrador (53°41'26"N, 57°01'10"W), at an altitude of 6 m.

GSC-1398. Cartwright (IV) — 1240 ± 130 / 710 A. D.

Peat (sample FI-1-1-69'; 176 g wet) from the basal 10 cm of a 120 cm-deep bog growing on a marine terrace 1. 5 km south of Cartwright, Labrador (53°41'26"N, 57°01'10"W), at an altitude of 6 m.

GSC-1330. Cartwright (V) — 6720 ± 140 / 4770 B. C.

Peat (sample FI-2-69; ca. 150 g wet) from the basal 10 cm of a 325 cm-deep bog 1. 5 km south-southeast of Cartwright, Labrador (53°41'26"N, 57°00'40"W), at an altitude of 18 m.

Comment (R. J. Fulton): GSC-1311 was collected 25 m farther west of the eastern lake than GSC-1346. Both samples are from a bog located at the assumed limit of marine submergence in the area. As GSC-1330 is older and from about 57 m lower, the two dates from the higher bog must relate to the time of growth and preservation of organic material; they bear no relation to the time of maximum marine submergence. GSC-1398 is 50 m nearer the sea than GSC-1435, but both samples are from the same marine bench. The approximate 400-year time difference between the two ages (a minimum of 100 years and a maximum of 620 years) may represent the time required for the bog to advance this distance.

Comment (W. Blake, Jr.): NaOH leach omitted from the pretreatment of all five samples. For GSC-1311 and GSC-1346 the samples burned weighed 19 g and 20 g, respectively. Dates for GSC-1311 and GSC-1346 each based on one 1-day count, GSC-1330 is based on two 1-day counts, and GSC-1398 and GSC-1435 are each based on one 3-day count, all in the 5-litre counter.

North West River series

Peat from basal organic deposits in bogs near North West River, Labrador. Collected 1970 by R.J. Fulton with a Davis sampler.

GSC-1300. North West River (I) 6580 ± 150
4630 B.C.

Peat (sample FI-41-1-69; 183 g wet) from 135 to 145 cm depth in a bog at the west end of Lake Melville, 12 km southwest of North West River, Labrador (53°28'N, 60°18'W), at an altitude of ca. 165 m.

GSC-1347. North West River (II) 6110 ± 140
4160 B.C.

Typical sedge peat (sample FI-22-1-69; containing *Carex* sp.; identified by M. Kuc) from 150 to 160 cm depth in a bog at the west end of Lake Melville, 21 km north of North West River, Labrador (53°43'N, 67°07'W), at an altitude of ca. 90 m.

Comment (R.J. Fulton): the limit of postglacial marine submergence is probably about 120 m in this area (cf. Fitzhugh, 1972). The dates are at least 1000 years younger than the time of deglaciation and maximum submergence, i.e. GSC-1453 (8640 ± 230 years) is a sample of *Serripes groenlandicus* shells from near the coast of Labrador along 'Michael River' (Hodgson and Fulton, 1972; GSC XIII, 1973, p. 8-9), and GSC-1254 (7490 ± 150 years, this list) is a sample of *Hiatella arctica* shells from near Muskrat Falls on Churchill River, approximately 50 km southwest of North West River.

Comment (W. Blake, Jr.): NaOH leach omitted from the pretreatment of both samples; for GSC-1347, 15 g of sample was burned. Dates for GSC-1300 and GSC-1347 based on one 3-day count and two 1-day counts, respectively, in the 5-litre counter.

GSC-1254. Muskrat Falls 7490 ± 150
5540 B.C.
$\delta^{13}C = +1.7‰$

Marine pelecypod shells and fragments (sample HCA-69-5; 19 g; *Hiatella arctica;* identified by D.A. Hodgson) from silty sand strata 3 m above present river level and below >50 m of fluvial and estuarine sediments on the north bank of the Churchill River, 2.5 km east of Muskrat Falls, and 25 km west-southwest of Goose Bay, Labrador (53°15'30"N, 60°44'45"W). River level at the collection site is not >1 m a.s.l. Collected 1969 by D.A. Hodgson.

Comment (D.A. Hodgson): thin strata and lenses of shell-bearing sand (*Mytilus edulis* also was noted) and gravel are common within laminated silty clay (estuarine?) sediments which are >20 m thick. These sediments are overlain by >30 m of cross-bedded sand. The date is maximum for formation of the extensive terraces at 60 to 80 m elevation, which are underlain by the sand unit, in the lower Churchill Valley. The date is a minimum for deglaciation (although the thickness of clay below the sample is not known), and the incursion of the sea up the lower reaches of Churchill River postdates the development of major end moraines near North West River (Blake, 1956) and on the southeast side of Goose Bay (Grant, 1971). Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

Village Bay series

Peat and wood samples collected in 1971 by B. Matthews, Soil Survey of England and Wales, Calthwaite, Penrith, Cumberland.

GSC-1659. Village Bay, peat 4420 ± 140
2470 B.C.

Frozen peat (sample 31-7-71-4; 200 g wet; identified by M. Kuc as mossy-rhizome sapropel containing *Carex* sp. and mosses: *Drepanocladus exannulatus, Calliergon stramineum,* and several species of *Sphagnum)* from 107 cm depth in a pit excavated 60 cm behind a recently slumped exposure, Village Bay, Labrador (56°58'30"N, 61°24'30"W), at an altitude of 44 m. The peat was frozen below a depth of 68 cm, and the sample was collected at the base of the peat above a layer of ventifacts overlying gravelly sand (marine).

GSC-1930. Village Bay, wood 620 ± 60
1330 A.D.

Wood and bark (sample 30-7-71-1; 6.2 g; identified as decomposed coniferous wood by M. Kuc) in peat at Village Bay, Labrador (56°58'31"N, 61°24'29"W), at an altitude of 40 m. The sample, from a cutbank exposure of peat below 60 cm of eolian sand, was part of a log lying parallel to the surface of the dunes. The bank was excavated to a depth of 60 cm before the sample was collected; the underlying sand is marine. The wood is from a log ca. 200 m east of the site where GSC-1659 was collected.

Comment (B. Matthews): results of dating and stratigraphy of interbedded organic and eolian deposits are similar to those near Sugluk, northern Ungava, Quebec (Bartley and Matthews, 1969); they suggest that peat formation on raised terraces at Village Bay started about 500 years before that at Sugluk.

Comment (W. Blake, Jr.): hearth charcoal from a depth of 7.6 to 22.9 cm in a test pit, altitude 11.3 m, at Thalia Point some 3 km to the northeast, is 3700 ± 140 years old (GSC-1264; GSC XII, 1972, p. 9-10). The site, excavated by W.W. Fitzhugh IV, was believed to represent a late pre-Dorset to early Dorset period of occupation when the shoreline was 9 to 11 m above present sea level. If the beaches at 11 m a.s.l. were exposed 3840 to 3560 years ago, it is obvious that the beaches at 44 m a.s.l. were exposed a long time before the peat of GSC-1659 started to grow. NaOH leach omitted from the pretreatment of GSC-1659; date based on two 1-day counts in the 5-litre counter. GSC-1930 mixed with dead gas for counting; date based on two 1-day counts in the 2-litre counter.

GSC-1560.	Lower Kangalaksiorvik Lake	8240 ± 300 6290 B.C.

Marine pelecypod shells (sample TA-67-C14-1; 10.2 g; *Hiatella arctica;* identified by W. Blake, Jr.) from along the stream at the west end of Lower Kangalaksiorvik Lake, Labrador (59°22.5'N, 64°07.0'W), at an altitude of ca. 18 m. Shells were collected from slumping dry sand where the bank was being undercut. Collected 1967 by F.C. Taylor; submitted 1971 by D.R. Grant.

Comment (W. Blake, Jr.): this site is approximately 50 km south-southeast of a locality at the head of Eclipse Channel where marine pelecypods in silty clay at 15 m a.s.l. were dated at 8190 ± 710 years B.P. (I-1322; Isotopes V, 1966, p. 188). Pelecypod shells near I-1322, in clay at 29 m a.s.l. on the proximal side of an end moraine, were 9000 ± 200 years old (L-642; Løken, 1962). GSC-1560 indicates that the valley occupied by Lower Kangalaksiorvik Lake was an arm of the sea 8540 to 7940 years ago, but the relation of this sample to the readvance phases proposed by Løken (1962) is not clear because the position of sea level when these pelecypods were living is unknown. The sample used for dating consisted of seven whole valves and two fragments. All the intact valves were between 2.4 and 3.4 cm in length, all were somewhat chalky, and all had slight incrustations on the inside. The collection also contained *Balanus* sp. Due to the small sample size, only the outer 10 per cent was removed by leaching. Date based on two 1-day counts in the 1-litre counter.

Nova Scotia

GSC-2062.	Nictaux Falls	11 200 ± 100 9250 B.C.

Black muck (sample E.N. -1972; 42 g) from near the bottom of a 3.1 m-thick sequence of stratified deposits at Nictaux Falls, Annapolis Valley, Nova Scotia (44°54.3'N, 65°01.9'W), at an altitude of ca. 58 to 61 m. The black muck occurs within the upper part of a granitic sand unit ca. 25 cm thick; this sand is overlain, in turn, by ca. 30 cm of a red, clayey, till-like material and 2.7 m of grey silty sand. The collection was made in a fresh cut into the 3.6 to 4.6 m-high bank on the west side of a side road at the junction with Highway 10, on the west side of Nictaux River and southwest of Nictaux Falls. Collected 1972 by E. Nielsen, Dalhousie University, Halifax; submitted by V.K. Prest.

Comment (E. Nielsen): the alluvium containing the black muck overlies red till, and the date gives a minimum age for the deglaciation of South Mountain (cf. Hickox, 1962; Prest and Grant, 1969). The date corroborates a determination of 11 700 ± 160 years (GSC-1486; GSC XIII, 1973, p. 10) on gyttja from 345 to 355 cm depth in Canoran Lake, approximately 52 km to the southeast. Palynological studies on the Nictaux Falls muck by L.D. Farley-Gill (unpublished GSC Palynological Report No. 74-4) indicate that the deposit contains a high percentage of *Salix* pollen; this may correspond to the high percentage of willow reported by Livingstone and Livingstone (1958) in zone L1a (the basal zone) at Gillis Lake, Cape Breton Island, which they state is characteristic of tundra conditions. A study by M. Kuc (unpublished GSC Bryological Report Nos. 196 and 289) indicates that the black muck, in which the only identifiable plant remains were a few fine rhizomes of *Carex* sp., is the product of terrestrial vegetation representing a moist (mesic) or semi-aquatic environment but not bog, aquatic, or xeric conditions. The presence of mica and rounded silt grains in the unsorted organic muck may indicate extensive eolian activity from the nearby Nictaux delta.

Comment (W. Blake, Jr.): only the basal 2 cm of the black mud unit (which is up to 20 cm thick) were used for the sample submitted to the laboratory. A few quartz grains and a few fine rootlets were noted in the organic material. Date based on one 3-day count in the 5-litre counter.

New Brunswick

Little Lake series

Organic lake sediment (sample TB-68-25) from the deeper (5 m) of two basins in a kettle hole lake in the Pennfield Plain, a glacial outwash plain graded to a high sea level (Gadd, 1973), 8.6 km east of St. George, New Brunswick (45°08'35"N, 66°42'50"W), at an altitude of 64 m, water depth 5 m. A total of 594 cm of algal gyttja, which grades into silty gyttja near the base, overlies buff to brown marly gyttja to a depth of 629 cm where a sharp contact occurs with the underlying coarse sand and pebbles. The samples were taken with a Livingstone corer, extruded in the field, covered with Saran wrap and aluminum foil, and preserved in cold storage. Collected 1968 by R.J. Mott.

GSC-1604.	Little Lake, 230-235 cm	6440 ± 300 4490 B.C. $\delta^{13}C = -24.9‰$

Algal gyttja (42 g wet) 230 to 235 cm below the sediment/water interface. 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-1447.	Little Lake, 392-397 cm	9080 ± 200 7130 B.C. $\delta^{13}C = -29.0‰$

Algal gyttja (48 g wet) 392 to 397 cm below the sediment/water interface. Date based on one 4-day count in the 1-litre counter. The $^{13}C/^{12}C$ ratio had not been determined when this date was reported by Mott (1975a, 1975b) as 9140 ± 230 years. The reduction in the error term is due to the revised method of calculation introduced in 1973 (Lowdon and Blake, 1973).

GSC-1272. Little Lake, 588-593 cm — 14 300 ± 270; 12 350 B.C.; $\delta^{13}C = -26.4‰$

Algal gyttja (100 g wet) 588 to 593 cm below the sediment/water interface. 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.

GSC-1063. Little Lake, 627-634 cm — 16 500 ± 370; 14 550 B.C.

Laminated buff marl and brown gyttja (128.4 g wet) 627 to 634 cm below the sediment/water interface. 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.

General comment (R.J. Mott): when the basal date (GSC-1063) appeared anomalously old due to contamination with old carbonates, the other dated samples were taken at pollen zone boundaries, which could be correlated with the Basswood Road Lake pollen profile (this list), situated approximately 52 km to the west-northwest. Thus estimates could be made of the degree of error involved (Mott, 1975a); i.e. GSC-1604 (6440 ± 300 years) corresponds to GSC-1595 (5120 ± 220 years, Basswood Road Lake series, this list), indicating an error of between 800 and 1840 radiocarbon years, and GSC-1447 (9080 ± 200 years) corresponds to GSC-1513 (6530 ± 210 years), indicating an error of between 2140 and 2960 radiocarbon years. The values given previously (Mott, 1975a) were about 1200 years for the 235 cm level (GSC-1604) and 3000 years at the base of the core; but in a discussion of this paper Karrow and Anderson (1975) have suggested that the age deviation at the base of the Little Lake core (627 to 634 cm depth) may be over 4000 years.

Comment (W. Blake, Jr.): in considering the age determination from Little Lake, it sould be remembered that marine pelecypod shells *(Portlandia arctica)* in bottomset beds at the toe of the Pennfield delta, only 7 km southwest of Little Lake, are 13 000 ± 240 years old (GSC-882; GSC IX, 1970, p. 55; Gadd, 1973). A date in the range of 13 000 to 12 000 years for the basal organic sediments in Little Lake would be compatible with GSC-882.

Basswood Road Lake series

Lake sediment (sample TB-68-27) from a small lake in a bedrock basin above the limit of postglacial marine submergence, 7.2 km northwest of St. Stephen, New Brunswick (45°15'15"N, 67°19'50"W), at an altitude of 106 m, water depth 10.6 m. An 80 cm layer of non-calcareous grey and black mottled clay is overlain by 541 cm of algal gyttja. Below the grey and black mottled clay layer are 28 cm of laminated gyttja which overlie coarsely banded, noncalcareous, grey and black mottled clay. Collected 1968 by R.J. Mott. The samples were taken with a Livingstone corer, extruded in the field, covered with Saran wrap, and preserved in cold storage.

GSC-1693. Basswood Road Lake, 160-167 cm — 3020 ± 150; 1070 B.C.

Algal gyttja (65 g wet) from core interval 160 to 167 cm below sediment/water interface. 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-1595. Basswood Road Lake, 260-265 cm — 5120 ± 220; 3170 B.C.; $\delta^{13}C = -28.2‰$

Algal gyttja (42 g wet) from 260 to 265 cm below the sediment/water interface. 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-1513. Basswood Road Lake, 347-352 cm — 6530 ± 210; 4580 B.C.; $\delta^{13}C = -28.5‰$

Algal gyttja (45 g wet) from 347 to 352 cm below the sediment/water interface. NaOH-leach omitted from sample pretreatment. Date based on two 1-day counts in the 1-litre counter. The $^{13}C/^{12}C$ ratio had not been determined when this date was reported by Mott (1975a, 1975b) as 6580 ± 240. The reduction in the error term is due to the revised method of calculation introduced in 1973 (Lowdon and Blake, 1973).

GSC-1643. Basswood Road Lake, 507-512 cm — 9460 ± 220; 7510 B.C.; $\delta^{13}C = -27.5‰$

Algal gyttja (40 g wet) from 507 to 512 cm below the sediment/water interface. 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-1645. Basswood Road Lake, 621-626 cm — 11 300 ± 180; 9350 B.C.; $\delta^{13}C = -27.4‰$

Laminated algal gyttja (54 g wet) from 621 to 626 cm below the sediment/water interface. 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.

GSC-1067. Basswood Road Lake, 639-644 cm — 12 600 ± 270; 10 650 B.C.

Laminated algal gyttja (94.6 g wet) from 639 to 644 cm below the sediment/water interface. 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.

General comment (R.J. Mott): pollen analysis of the Basswood Road Lake core gave a pollen profile in which 9 pollen zones could be outlined (Mott, 1975a, 1975b). GSC-1067 dates the boundary between pollen zones 9 and 8, the basal herb pollen zone and the birch/aspen zone. The maximum of spruce in the spruce pollen zone is dated by GSC-1645. GSC-1643, -1513, -1595, and -1693, respectively, date the boundaries between pollen zones 6 and 5 (the spruce/birch and pine/oak zones), pollen zones 5 and 4 (the pine/oak and hemlock zones), pollen zones 4 and 3 the hemlock and birch/beech zones), and pollen zones 3 and 2 (the birch/beech and hemlock/beech zones). Compare these age determinations with those obtained from nearby Little Lake (this list), where there is good evidence for contamination by "old" carbonate (Mott, 1975a, 1975b). Sparse paleomagnetic data obtained from Basswood Road Lake tend to support the validity of the ^{14}C age determinations (Mott and Foster, 1973; Mott, 1975a).

Quebec

GSC-1911. Sept-Îles — 1520 ± 70; 430 A.D.; $\delta^{13}C = -16.5‰$

Cranial fragment (sample E.S.-1; 630 g) from a whale skeleton found during an excavation for housing on Frontenac Street, Sept-Îles, Quebec (50°13'N, 66°22'W). The skeleton was extracted from horizontally bedded coarse sand associated with a recurved spit which formed when sea level was 17 to 20 m above present level. Collected 1972 by E. Sherrer, Sept-Îles, and submitted by C.R. Harington, National Museum of Natural Sciences, Ottawa.

Comment (L.A. Dredge): the date is much younger than expected if the whale was beached and buried during a stand of the sea at the 17 to 20 m terrace level; therefore, the whole skeleton must have been hauled up to that level from a much lower beach. Because of the size of the skeleton (more than 6 m long and 2.5 to 3 m wide) it probably was transported by man rather than by wild animals.

Comment (W. Blake, Jr.): the bone sample was cut up under the supervision of C.R. Harington, April 1973. All the bone was in good condition although it powdered easily and the exterior was slightly stained. Only a few tiny rootlets were noted and all interstices were clear. The NaOH-leach was omitted from the pretreatment because of the small sample size. After the collagen was burned the sample was mixed with dead gas for counting. Date based on one 2-day count in the 5-litre counter.

GSC-1809. Rivière des Rapides — 7580 ± 70; 5630 B.C.

Whole valves (sample DU-72-50; 49.3 g) of *Serripes groenlandicus* (identified by L.A. Dredge) found at 1 m depth in nearshore sands and silts along the east side of Rivière des Rapides, ca. 700 m from its outlet at Lac des Rapides and 8 km northwest of Sept-Îles, Quebec (50°17'30"N, 66°26'30"W) at an altitude of ca. 72 m. The sample was collected from a section exposed by slumping; the shells were coated with ochre from a deposit 50 cm higher in the section. *Mytilus edulis* shells plus twigs and other organic detritus also were present in the beds exposed by slumping. Collected 1972 by L.A. Dredge, then McGill University, Montreal, now GSC, Ottawa.

Comment (L.A. Dredge): the date approximates the time of postglacial emergence at this level. This date is younger than one on a sample of *Macoma calcarea* shells at a similar altitude (76 m; GSC-1337, 9140 ± 200 years; GSC XI, 1971, p. 268) along the Moisie River, 16.9 km to the east, where the shells were found in sediments (silty clay) characteristic of a deep-water environment.

Comment (W. Blake, Jr.): the sample submitted to the laboratory consisted of three intact valves and one nearly intact valve (all left); the largest was 8.2 by 6.5 cm in size. One large and fragmented valve of *Mya truncata* also was observed in the sample. Date based on one 3-day count in the 5-litre counter.

GSC-1746. Baie Comeau — 8890 ± 150; 6940 B.C.

Well preserved brachiopod shells (sample GB-72-20; 44.1 g; *Hemithyris psittacea;* identified by W. Blake, Jr.) from silt over till and bedrock at Baie Comeau water purification plant, Quebec (49°12'N, 68°10'W), at an altitude of ca. 15 m. Collected 1972 by N.R. Gadd.

Comment (N.R. Gadd): abundant fossils, including *Mya truncata, Mya pseudoarenaria, Mytilus edulis, Macoma calcarea, Clinocardium ciliatum,* and *Balanus* sp. (identified by W. Blake, Jr.), probably represent a relatively warm, high salinity Holocene offlap phase of submergence of the north shore of Gulf of St. Lawrence. A similar date has been obtained on *Balanus* sp. from close to 60 m elevation along Highway 15 at the western entrance to Baie Comeau (GSC-1565, 9280 ± 140 years; GSC XIII, 1973, p. 12). Date based on one 3-day count in the 5-litre counter.

GSC-1526. St. Narcisse moraine — 11 600 ± 630; 9650 B.C.; $\delta^{13}C = +3.7‰$

Sample (GB-70-1; 3.7 g) comprises calcareous foraminifera from till or stony marine clay within the core of the St. Narcisse moraine in its type locality, Barrage St. Narcisse, Quebec (46°34'15"N, 72°25'15"W), at an altitude of ca. 91 m. Sample was collected ca. 15 m above river level in an exposure 32 m high; 0.6 m of slumped material and 0.3 m of loose fractured till were removed to expose moist, compact, unoxidized till. The crest of the moraine above ca. 120 m is wave modified by waters of the Champlain Sea. Collected 1970 by N.R. Gadd.

Comment (N.R. Gadd): the age of foraminifera in stony marine clay or till should date precisely a time when the ice margin and Champlain Sea were in contact

along the position of the St. Narcisse moraine. The foraminifera have been examined by K. Hooper (Carleton University, Ottawa), who states (cf. Gadd *et al.*, 1972):

> The fauna consists overwhelmingly of *Islandiella teretis* (Tappan) (about 95% and mostly broken specimens), *Elphidium bartletti* Cushman, *E. subarcticum* Cushman, *Protelphidium orbiculare* (Brady), *Nonionellina labradorica* (Dawson) *Astacolus hyalacrulus* Loeblich and Tappan, and *Dentalina pauperata* d'Orbigny. All are calcareous, hyaline and benthonic.

The limits of error are large because of the small size of the sample.

Comment (W. Blake, Jr.): the clean sample submitted to the laboratory was separated from the till by wet sieving to the fine sand fraction and then flotation with $ZnBr_2$. The sample next was washed in distilled water; biotite flakes, quartz grains, etc. were removed by hand washing. It was given no further treatment in the laboratory. HCl-leach omitted. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter. The date reported by the submitter in Gadd *et al.* (1972) was given as 11 500 ± 630 years (GSC-1526) because at that time the $^{13}C/^{12}C$ ratio had not be determined.

GSC-1444. Charette — 10 100 ± 150 / 8150 B.C.

Pelecypod shells (sample GB-70-2; 47 g; *Hiatella arctica;* identified by N.R. Gadd) from a freshly exposed working face of a sand and gravel pit in the beach on the crest of a St. Narcisse moraine segment (Gadd, 1971; Gadd *et al.*, 1972), 2.4 km east of Charette, Quebec (46°26'50"N, 72°53'10"W), at an altitude of ca. 137 m. Collected 1970 by N.R. Gadd.

Comment (N.R. Gadd): the presence of paired valves in living position of *Macoma balthica* and *Hiatella arctica* in stratified well sorted sand and gravel (observed during the 1972 IGC field excursion C-44) indicates contemporaneity of shells with depositional environment. The date is one of the youngest based on Champlain Sea shells in the central part of St. Lawrence Lowland. Wave modification of the St. Narcisse moraine took place during offlap of the Champlain Sea and close to the time of transition to freshwater conditions in other parts of the basin.

Comment (W. Blake, Jr.): the wet sample (washed in tap water) was dried in an electric oven at GSC, Ottawa. All valves and fragments of *Hiatella arctica* were <3 cm in length, and most were thin. No incrustations were noted, but some pitting and iron-staining were present. No periostracum was preserved and the exterior of all shells was chalky, although the interior pearly lustre was preserved in many cases. *Macoma balthica* was the most abundant mollusc. Date based on one 3-day count in the 5-litre counter.

GSC-2020. Ste-Rosalie — 0 ± 70 / 1950 A.D.

Soil (sample C-73; 99 g in the form of $BaCO_3$) from lacustrine clay of the Ste-Rosalie soil series, sampled by hand in a field at 90 cm below the surface, 1.6 km northeast of Marieville, Quebec (45°26'N, 73°13'W), at an altitude of 120 m. Collected 1973 by Y. Martel, Agriculture Canada, Ste-Foy.

Comment (Y. Martel): after sampling, the soil was dried at room temperature and stored in plastic bags. Pretreatment was as follows: 1) the few remaining roots were removed with 0.01N HCl flotation; 2) the carbonates were removed by treatment with 1N HCl; 3) the sample was combusted at 950°C and the resulting CO_2 was absorbed in NaOH; and 4) the sodium carbonates were precipitated by adding $BaCl_2$ to obtain $BaCO_3$. The age was expected to be at least 5000 years B.P.; therefore, contamination of the sample by modern carbon is suspected to have occurred.

Comment (W. Blake, Jr.): no further treatment was given to this sample in the laboratory. The $BaCO_3$ was treated (in two batches) with H_3PO_4 in the shell apparatus. Date based on one 1-day count in the 2-litre counter.

GSC-1803. Lac des Bouleaux, 263-267 cm — 12 400 ± 170 / 10 450 B.C. / $\delta^{13}C = -22.7‰$

Greyish brown, silty, organic sediment (sample MS-69-20; 50 g wet) from 263 to 267 cm below the sediment/water interface of a small lake in a bedrock basin on Mont St. Bruno, ca. 2.4 km north of St. Bruno de Montarville, Quebec (45°33'15"N, 73°19'W). Collected 1969 by P. LaSalle, Ministère des richesses naturelles, Quebec, and R.J. Mott. Sample taken with a Livingstone corer, extruded in the laboratory, wrapped, and placed in cold storage.

Comment (R.J. Mott): at an altitude of ca. 125 m, the lake is below the maximum limit of the Champlain Sea on Mont St. Bruno (LaSalle, 1966). A sample of basal organic sediment (267 to 271 cm depth) was submitted previously to provide a minimum date for the isolation of this lake. The result on GSC-1344, 13 000 ± 290 years (GSC XIII, 1973, p. 15), appeared to be anomalous due to contamination by old carbonates. The present sample, from the next core increment, was submitted to check the validity of GSC-1344. Although GSC-1803 is of the proper age in relation to GSC-1344, it is also anomalously old and is probably also contaminated with old carbonates from the glacial deposits surrounding the lake. 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.

Ste-Thérèse series

GSC-1805. St-Thérèse-en-haut (I) 11 300 ± 140
9350 B.C.

Marine shells (sample SV-72-RC3; 27 g; *Balanus hameri;* identified by W. Blake, Jr.) in sand and gravel from fresh exposure in a gravel pit near Ste-Thérèse-en-haut, Quebec (45°37'30"N, 73°51'45"W), at an altitude of 64 m. Collected 1972 by D.A. St-Onge, then GSC, now University of Ottawa, Ottawa.

Comment (D.A. St-Onge): the shells were collected from a beach complex on the side of a major esker and were overlain by 3 m of clay-silt, the lower 30 cm of which has a pronounced reddish colour.

Comment (W. Blake, Jr.): the sample also contained fragments of *Hiatella arctica* and numerous whole limpets, but only calcitic shells of *Balanus hameri* were used for dating. Date based on two 1-day counts in the 2-litre counter.

GSC-1941. Ste-Thérèse-en-haut (II) 9810 ± 110
7860 B.C.

Marine pelecypod shells (sample Ste-Thérèse 1; 25.5 g; *Hiatella arctica;* identified by C. Hillaire-Marcel, Université du Québec à Montréal) from gravel exposed on the south side of an old quarry and on the flank of an esker near Ste-Thérèse-en-haut, Quebec (45°38'45"N, 73°51'55"W), at an altitude of 53 m. The fossiliferous gravel deposit also contains *Mytilus edulis, Balanus crenatus,* and *Balanus hameri.* The gravel is overlain, in turn, by ca. 3 m of Champlain Sea clay (containing *Macoma* sp.) and by 2 to 3 m of sand. Collected 1971 by C. Hillaire-Marcel.

Comment (C. Hillaire-Marcel): the age is much younger than was expected for *Hiatella arctica* shells in glaciomarine sediments of the Champlain Sea episode. Because the shells were in gravel beneath clay they were assumed to relate to the transgressive phase of the sea, rather than to the regression. Another collection was made in the more clayey glaciomarine sediments, and the resulting age was 10 700 ± 210 years (QU-75).

Comment (W. Blake, Jr.): it is difficult to reconcile the date obtained for GSC-1941 (9810 ± 110 years, aragonitic shells at 53 m) with the ages determined for GSC-1805 (11 300 ± 140 years, from sand and gravel at 64 m and under 3 m of clay-silt along the flank of the same esker) and for QU-75 (10 700 ± 210 years, from the same site as GSC-1941 but from the overlying fine sediments). Obviously there remains much to be learned about the sequence of events near Ste-Thérèse-en-haut. Date for GSC-1941 based on two 1-day counts in the 2-litre counter.

GSC-1761. Les Milles Îles, Co. Argenteuil 570 ± 130
1380 A.D.
$\delta^{13}C = -18.5‰$

Whale vertebra (sample GB-72-bone; ca. 617 g) said to have been excavated from beach gravel during the construction of a restaurant "Parc des Cedres", on the property of M. Telesphore Villeneuve, 8 km west of St. Jérôme, Quebec (45°47'20"N, 74°07'25"W), at an altitude of between 213 and 229 m. Collected 1972 by G.A. Meilleur and J.A. Lowdon for N.R. Gadd.

Comment (N.R. Gadd): the bone appears to have been moved recently to the site where it was found. It does not bear on the age of the Champlain Sea beaches.

Comment (W. Blake, Jr.): the specimen was well preserved, although it had been varnished by M. Villeneuve for display purposes. The bone was cored and ten 3.5 cm-diameter cores (each ca. 15 cm long) were recovered to use for dating. The outer, varnished end of each core was cut off and discarded. The sample was wet on receipt due to the use of distilled water in the coring operation, but the cores were dried in an electric oven at GSC, Ottawa. Sample treated with 3N HCl and 0.1N NaOH (plus distilled water rinses) in order to extract the collagen fraction. Date based on one 3-day count in the 5-litre counter.

GSC-1612. Lascelles, Quebec 11 500 ± 150
9550 B.C.

Pelecypod shells (GB-71-26; 45.9 g) of *Macoma* sp. (mainly *Macoma balthica;* identified by W. Blake, Jr.) from raised beach with top altitude of ca. 185 m a.s.l., 2.4 km north-northeast of Lascelles, Quebec (45°43'45"N, 75°57'15"W). Sample altitude is 166 m; the shells were collected from one bed over a distance of ca. 2.4 m. Most shells were articulated. Collected 1971 by N.R. Gadd on the farm of L.G. Spallin.

Comment (N.R. Gadd): the shells were collected from the highest known clearly marked gravel beach in an area where the marine limit is estimated to be 211 m a.s.l. A nearby beach locality at Meach Lake contains *Hiatella arctica* and *Macoma balthica* dated at 11 600 ± 150 years (GSC-842; GSC IX, 1970, p. 59) at an altitude of 170 m. Compare also GSC-1646, 12 200 ± 160 years (*Macoma balthica;* 194 m; GSC XIII, 1973, p. 16-17), GSC-982, 11 300 ± 180 years (*Macoma* sp.; 155 to 160 m; GSC IX, 1970, p. 59-60), and other ^{14}C age determinations from the Ottawa area as listed by Gadd (1964), Mott (1968), and Richard (1974).

Comment (W. Blake Jr.): the entire sample was dried in an electric oven, most of the adhering sand was removed by brush, and then the shells were washed in distilled water and dried again. Shells showed some iron-stain but no pitting or incrustations. The exteriors showed slight chalkiness but the interiors retained their original lustre. Date based on one 3-day count in the 5-litre counter.

Ontario

GSC-1516. Perch Lake — 9830 ± 250 / 7880 B.C.

Gyttja (sample TB-68-24; 47 g dry) from 594 to 600 cm below the gyttja/water interface in 5 m of water at Perch Lake, approximately 2.1 km south of the AECL plant and 6.1 km northeast of Chalk River, Ontario (46°02'N, 77°22'30"W), at an altitude of ca. 165 m. The lake lies within the westernmost limit of the Champlain Sea. Collected 1968 by J. Terasmae, Brock University, St. Catharines, Ontario.

Comment (J. Terasmae): the date provides a minimum age for the end of the Champlain Sea episode in the upper Ottawa Valley and gives the time for the decline of spruce on the pollen percentage diagram from Perch Lake.

Comment (W. Blake, Jr.): this age determination complements one made earlier on basal gyttja and peat in a bog occupying a river channel on the Petawawa Sand Plain (GSC-177, 9540 ± 250 years; GSC IV, 1965, p. 29); the peat, at an altitude of ca. 152 m, started to accumulate when the Ottawa River shifted to its present channel, which is 30 m below the level of the bog. Both GSC-177 and -1516 are in accordance with two age determinations on marine shells at the westernmost limit of the Champlain Sea: GSC-90, 10 870 ± 130 years, marine shells in fine sand and silty clay at 137 m, ca. 6.4 km west of Pembroke, Ontario (GSC II, 1963, p. 44) and GSC-1664, 11 100 ± 160 years, *Macoma balthica* shells (identified by A.H. Clarke, Jr., National Museum of Natural Sciences, Ottawa) from an altitude of 158 m some 8.5 km southeast of Westmeath, Ontario (Allen, 1971; Richard, 1975). NaOH-leach omitted from sample pretreatment. Date based on one 3-day count in the 1-litre counter.

Morel series

Morel, a railway siding 6.4 km west of Mattawa, Ontario, lies in an abandoned glacial channel (Harrison, 1972).

GSC-1162. Morel Pothole — 5250 ± 210 / 3300 B.C.

Wood fragments, some charred (sample 68JH7; 4.9 g), from below 1.5 m of sand and boulders in a 3.6 m-deep pothole with 1.8 m of fill. The pothole is located on a low granite gneiss ridge in the middle of Morel Channel, ca. 90 m south of the east end of the CPR shunting track at Morel (46°16'30"N, 78°47'W), at an altitude of ca. 194 m. Collected 1968 by J.E. Harrison.

Comment (J.E. Harrison): the dated material either was washed into the potholes long after their formation, or it represents fragments of a root system. Sample pretreatment included a cold NaOH-leach. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter at 1 atm.

GSC-1275. Morel Lake — 10 100 ± 240 / 8150 B.C. / $\delta^{13}C = -28.1$ ‰

Basal gyttja (sample MS-69-18; 90 g wet) from 730 to 740 cm interval of a core taken in 6.4 m of water in the middle of a small lake dammed by a granite gneiss ridge with potholes, ca. 8.9 km southwest of Mattawa (46°16'20"N, 78°48'W) at an altitude of 194 m. Collected 1969 by R.J. Mott and J.E. Harrison with a Livingstone sampler.

Comment (J.E. Harrison): date is a minimum for the opening of the North Bay outlet of the Upper Great Lakes (Harrison, 1972). 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.

GSC-1097. Amable du Fond River — 8670 ± 140 / 6720 B.C.

A log (sample JEH-1-68; 16 g; *Picea* or *Larix*, probably *Picea* sp.; identified by R.J. Mott) in a gravel bed ca. 7.5 cm thick at the base of a 2.4 m-high section of well sorted sand containing four other evenly spaced organic-rich horizons. The sand unit, on the west side of the Amable du Fond River 13.3 km upstream from its mouth (46°11'N, 78°57'W) and at an altitude of ca. 290 m, is underlain by an undetermined thickness (>2.1 m) of varved clay. Collected 1968 by J.E. Harrison.

Comment (J.E. Harrison): date is a minimum for initiation of Upper Great Lakes drainage through the Mattawa-Ottawa River system (Harrison, 1972; cf. also GSC-1275, 10 100 ± 240 years, for basal gyttja in Morel Lake near Mattawa, this list).

Comment (W. Blake, Jr.): the log received was ca. 1.25 m long and 6 to 8 cm in diameter. The part used was from the small end which had been buried in the section. Both the bark and outside wood were cut off. Date based on one 3-day count in the 5-litre counter. A portion of this sample was submitted to the ^{14}C dating laboratory at the Department of Geological Sciences, Brock University, St. Catharines, Ontario. Their result is 8475 ± 120 years (BGS-302; H. Melville, pers. comm., September 1975) based on a counting time of approximately two days and utilizing benzene as the counting gas (the liquid scintillation counting system at Brock University is described in Melville, 1972).

GSC-1246. Kilrush Lake — 9860 ± 270 / 7910 B.C. / $\delta^{13}C = -22.0$ ‰

Basal algal gyttja (sample MS-69-17; 106 g very wet) from 825 to 830 cm below the sediment/water interface in 8 m of water from the middle of Kilrush Lake, 24 km east of Powassan and 6.4 km east-northeast of Fossmill, Ontario (46°05'40"N, 79°03'W), at an altitude of ca. 347 m. The algal gyttja is underlain by a 3 to 4 cm-thick layer of grey clay. Collected 1969 by R.J. Mott and J.E. Harrison with a Livingstone sampler.

Comment (J.E. Harrison): Kilrush Lake is situated on the sill of the Fossmill Outlet drainage channel. The date gives a minimum age for the end of Fossmill drainage of the post Main Algonquin Lakes (Harrison, 1972).

Comment (W. Blake, Jr.): the above date, corrected after the $^{13}C/^{12}C$ ratio was determined by Isotopes, Inc. (Westwood, New Jersey), was that used by Harrison (1972). A second determination carried out at GSC gave -23.2 ‰, so that the corrected age would be 9840 ± 270 years. The age of this sample is far older than the 6090 ± 85 year (GRO-1924) value reported by Terasmae and Hughes (1960) for basal peat in a bog in the Fossmill Channel. On the basis of palynological data, however, they suggested that the ice retreat from Fossmill must have occurred much earlier, and their hypothesis was confirmed by two additional dates from near North Bay, north of Fossmill: peat from 180 to 190 cm depth in a bog was 9570 ± 150 years old (S-100; Saskatchewan III, 1962, p. 74) and gyttja from 4.6 to 4.7 m below lake level was 9820 ± 200 years old (GSC-638; GSC VII, 1968, p. 215). NaOH-leach omitted from the pretreatment of GSC-1246. Sample mixed with dead gas for counting. Date based on one 4-day count in the 2-litre counter.

GSC-1263. North Bay — 8060 ± 190
6110 B.C.
$\delta^{13}C = -25.6$ ‰

Discrete pieces of charred wood and charcoal up to 2.5 cm long (sample HEA-69-8; 8.5 g) enclosed in fine iron-cemented gravel and directly overlain by a 7.6 cm-thick band of varved clay. The clay is overlain by 90 cm of stratified sand. The section is exposed in a delta terrace just east of North Bay (3 m north of the guard-rail on the north side of Margaret Road and 6.1 m west of the intersection of this road with Highway 63) and 0.6 km east of Trout Mills, Ontario (46°19'50"N, 79°24'10"W), at an altitude of 212 m.

Comment (J.E. Harrison): the sample was deposited in a nearshore environment and was covered by beach sand. The deposit formed during a low-level phase of the Upper Great Lakes.

Comment (W. Blake, Jr.): modern roots were found growing through some of the larger pieces of wood and charcoal. The bulk sample collected was made into a slurry, swirled, and decanted to remove most of the sand. The decanted material was strained to remove clay, dried, and then hand picked to remove roots. Date GSC-1263 was published in uncorrected form as 8070 ± 190 years by Harrison (1972). Pretreatment of the sample included a cold NaOH-leach. Sample mixed with dead gas for counting. Date based on three 1-day counts in the 2-litre counter.

Western Canada

Manitoba

Northern Manitoba series

Gyttja and organic remains recovered from lakes in northern Manitoba by coring with a Livingstone sampler. Collected 1972 by R.J. Mott.

GSC-1782. Northern Manitoba (I) — 5430 ± 210
3480 B.C.

Fibrous moss remains (sample MS-72-10; 39 g wet) from 423 to 428 cm below the sediment/water interface in a small unnamed kettle lake on a morainic ridge 82 km north of Thompson, Manitoba (56°28.6'N, 97°44'W), at an altitude slightly above 305 m, water depth 6.4 m. The moss sample is from the basal part of a layer of moss and mossy gyttja below 270 cm and is overlain by algal gyttja. *Drepanocladus exannulatus* constitutes ca. 90 per cent of the mosses; the other 10 per cent is *Calliergon trifarium* (identified by M. Kuc).

Comment (R.J. Mott): coring did not extend below the moss layer into the underlying organic sediment, and the date obtained is much too young for the time of deglaciation or emergence from a glacial lake. The date simply gives the age of the sediment (Mott, 1973b). 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.

GSC-1818. Northern Manitoba (II) — 6920 ± 150
4970 B.C.

Basal coarse organic debris (sample MS-72-7; 250 g wet) with wood fragments from 172 to 177 cm below the sediment/water interface in a small unnamed kettle lake on a morainic ridge 64 km north of Thompson, Manitoba (56°21'N, 97°57.5'W), at an altitude slightly below 305 m, water depth 7 m. Coarse organic debris overlies sand and is overlain by algal gyttja. Woody fragments were *Salix* and *Picea* or *Larix* (identified by R.J. Mott).

Comment (R.J. Mott): the sample dates the beginning of organic accumulation in the kettle hole and is a minimum for deglaciation and for the draining of the local phase of glacial Lake Agassiz which washed the morainic ridge (Mott, 1973b). 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-1825. Northern Manitoba (III) — 7970 ± 150
6020 B.C.
$\delta^{13}C = -31.8$ ‰

Basal, clayey, laminated gyttja (sample MS-72-4; 123 g wet) from 371 to 376 cm below the sediment/water interface of a small unnamed lake in a bedrock basin beside Highway 10, 11.2 km east-southeast of Flin

Flon, Manitoba (54°44'30"N, 101°40'43"W), at an altitude slightly above 305 m and water depth 8 m.

Comment (R.J. Mott): this lake is probably above the limit of glacial Lake Agassiz in this area, and therefore the date should be minimum for deglaciation of the area. The date is somewhat younger than expected, however, and more detailed work is needed to determine the postglacial history of the area (Mott, 1973b). As the $\delta^{13}C$ determination was not available in time, the date reported by Mott (1973b) as 8080 ± 150 was the uncorrected value. 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-774. Carberry northwest — 1290 ± 130 / 660 A.D.

Humus-rich sandy matter (sample M-2b-66; 28.1 g burnt) from the Ah horizon of the lower of two buried Chernozem soils. The soils are exposed in a road-cut through a stabilized dune in the Brandon Sand Hills along the Trans-Canada Highway (north side), 14.4 km west from the junction with Highway 258 leading south to Carberry, Manitoba (49°54'05.1"N, 99°34'05.2"W). The sample was from 3.96 m depth below the surface. Collected 1966 by P.P. David, Université de Montréal, Montréal.

Comment (P.P. David): the bulk soil sample, which was free of carbonates, was cleaned of plant roots under the binocular microscope. The sample was not chemically pretreated prior to submission to the laboratory. The date represents mean residence time (M.R.T.) of the total soil humus of the sampled soil layer at the time of burial (Campbell *et al.*, 1967). The date should give the age of burial of the paleosol by renewed eolian activity; however, the date may be slightly younger than the age of burial because of possible contamination by younger soil humus from the upper paleosol (undated) lying ca. 20 cm above the dated horizon (*see* Bonn I, 1968, p. 10-11). The date overlaps GSC-990 and -931, 1260 ± 130 and 1200 ± 140 years, respectively (GSC XI, 1971, p. 285) from Carberry NE, which date one period of dune activity, and GSC-953, 1510 ± 150 years (GSC XI, 1971, p. 283) from Brookdale Road, which dates an earlier period of dune activity (cf. David, 1971). GSC-774 probably dates the latter period, assuming that contamination from above has occurred. NaOH-leach omitted from sample pretreatment. Date based on two 1-day counts in the 2-litre counter.

Saskatchewan

GSC-1446. McLennan Lake area — 8590 ± 230 / 6640 B.C. / $\delta^{13}C = -29.1‰$

Basal organic lake sediment (sample MS-70-3; 92 g wet) from a small unnamed lake in a bedrock basin on the northwest side of McLennan Lake, just south of the Cree Lake moraine and about 110 km north-northeast of La Ronge, Saskatchewan (55°53'20"N, 104°24'30"), at an altitude of 485 m. Coarse gravel at 500 cm below the sediment/water interface in 9 m of water is overlain by silty clay and algal gyttja. The sample is from 489 to 494 cm depth. Collected 1970 by R.J. Mott.

Comment (R.J. Mott): the date is a minimum for deglaciation (Mott, 1971). Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

Comment (W. Blake, Jr.): This sample was originally counted for 3 days in the 1-litre counter; the uncorrected age, used by Mott (1971), was 8640 ± 240 years ($\delta^{13}C = -29.1‰$; corrected age 8580 ± 240 years). The same gas was re-counted at a later time in the 2-litre counter, and the corrected result, 8590 ± 230 years, is considered to be a better determination.

GSC-1466. 'Lake 1570' — 8560 ± 250 / 6610 B.C. / $\delta^{13}C = -19.2‰$

Basal organic lake sediment (sample MS-70-6; 78 g wet), from a bay at the east end of an unnamed lake about 142 km north-northeast of La Ronge, Saskatchewan (56°07'30"N, 104°24'30"W), at an altitude of ca. 480 m. The lake occupies a bedrock basin, and the bay is almost isolated from the lake by a bedrock ridge. Water depth at the point of sampling was 8 m, but depths increased through the narrows and into the main part of the lake. The sample, from 562 to 572 cm below the sediment/water interface, was underlain by silty clay and overlain by organic silt and algal gyttja. Collected 1970 by R.J. Mott.

Comment (R.J. Mott): this lake is north of the Cree Lake moraine, and the date is a minimum for the time of formation of the moraine and for deglaciation (Mott, 1971). Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

Comment (W. Blake, Jr.): this sample was originally counted for 3 days in the 1-litre counter; the uncorrected age, used by Mott (1971), was 8230 ± 250 years ($\delta^{13}C = -19.2‰$; corrected age, 8320 ± 250 years). The same gas was re-counted at a later time in the 2-litre counter, and the corrected result, 8560 ± 250 years, is considered to be a better determination. The age of the basal organic material is nearly identical to the value obtained for an unnamed lake near McLennan Lake, south of the Cree Lake moraine (GSC-1446, 8590 ± 230 years, this list), as well as for 'Cycloid Lake' still farther south and only 19 km north of La Ronge (GSC-643, 8520 ± 170 years; GSC VI, 1967, p. 167; Mott, 1973a). The sample from 'Lake 1570' most closely approximates the time of deglaciation.

Clearwater Lake series

Marly gyttja (sample MS-70-15) from a small lake in a closed depression (kettle hole) in a ridged moraine of the Clearwater moraine system about 74 km north of Swift Current, Saskatchewan (50°52'25"N, 107°56'W), at an altitude of 686 m. Maximum water depth is 6 m.

A sediment core totalling 1270 cm was recovered. Basal sample collected 1966, and upper sample collected 1970 by R. J. Mott.

GSC-1563. Clearwater Lake, 60-70 cm (inorganic) 1300 ± 190; 650 A.D.; $\delta^{13}C = +2.9‰$

Inorganic portion (marl; 114 g very wet) from 60 to 70 cm below the sediment/water interface. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 1-litre counter.

GSC-1563-2. Clearwater Lake, 60-70cm (organic) 1170 ± 190; 780 A.D.; $\delta^{13}C = -22.2‰$

Organic portion (12.3 g burned) from 60 to 70 cm below the sediment/water interface, remaining after the sample was dissolved in H_3PO_4. 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-1506. Clearwater Lake, 1250-1260 cm (inorganic) 9310 ± 150; 7360 B.C.

Inorganic portion (marl; ca. 140 g wet) from 1250 to 1260 cm below the sediment/water interface. Date based on one 2-day count in the 5-litre counter.

GSC-1506-2. Clearwater Lake, 1250-1260 cm (organic) 7580 ± 220; 5630 B.C.; $\delta^{13}C = -26.0‰$

Organic portion (6.0 g burned) from 1250 to 1260 cm below the sediment/water interface, remaining after the sample was dissolved in H_3PO_4. NaOH-leach omitted from sample pretreatment. Date based on one 3-day count in the 1-litre counter.

Comment (R. J. Mott): the upper sample is interpreted, on the basis of sediment and pollen spectral changes, as indicating the beginning of the influence of European man on the area some 60 to 70 years ago. This suggests that the date on the organic portion is anomalously old by about 1100 radiocarbon years. An error of the same order of magnitude is indicated for the date on the organic portion of the sample from 1250 to 1260 cm depth; thus these basal sediments are probably no older than 6500 years (Mott, 1973a).

Alberta

Empress series

Bone fragments, probably mostly mammoth, from the Canadian Pacific Railway gravel pit in the north part of Empress, Alberta, in NE ¼, sec. 13, tp. 23, rge. 1, W 4th mer. (50°57'50"N, 110°00'50"W), at an altitude of ca. 590 m. The sample was from a sand and gravel terrace on the south bank of the Red Deer River, 2 to 4 m below the surface, 100 m below the general prairie level, and 15 m above the river at low water. The pit contained abundant bones which were washed into place and thus were rounded, commonly damaged, and widely dispersed in coarse gravel. Taxa (mostly cool weather types) include *Mammuthus primigenius, M. imperator, Equus conversidens, E.* cf. *niobrarensis, Camelops* cf. *hesternus, Rangifer* sp., *Bison* cf. *occidentalis* (identified by C. S. Churcher, University of Toronto).

GSC-1199. Empress, CPR Pit 14 200 ± 1120; 12 250 B.C.; $\delta^{13}C = -19.4‰$

Sample SF-68-35, 380 g; collected 1968 by W. F. Smith, Medicine Hat; C. S. Churcher, University of Toronto; and A. MacS. Stalker. Pretreatment included a 1-hour leach in 0.1N NaOH. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

GSC-1387. Empress, CPR Pit 20 400 ± 320; 18 450 B.C.; $\delta^{13}C = -18.3‰$

Sample SF-69-14, 695 g; collected 1969 by C. S. Churcher, University of Toronto, and A. MacS. Stalker. Pretreatment included a 24-hour leach in 0.1N NaOH. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

Comment (A. MacS. Stalker): the discrepancy between the two age determinations is unexplained, although GSC-1199 may have suffered contamination during collection by three persons; the sample was also soft, damp, and weathered, with modern rootlets that were removed during preparation. GSC-1387 appears more reliable. Both dates however are substantially older than expected, and neither allows sufficient time for post-Classical Wisconsin incision of the large Red Deer Valley. The possibility of the valley having been cut earlier must now be considered. In addition, the presence of a large, well developed fauna so close to the time of Classical Wisconsin Glaciation seems improbably. If the 20 400 ± 320 year date is correct, the fauna may have lived in a prolonged interval between two advances of the Classical Wisconsin glacier.

British Block series

Samples of wood and freshwater shells from along the South Saskatchewan River, Alberta. Collected 1972 by A. MacS. Stalker.

GSC-1734. British Block, wood >43 000

A single piece of wood (sample SF-72-6; 13.0 g) from the southeast part of British Block on the south bank of the South Saskatchewan River, 21 km directly north of Medicine Hat, Alberta and 2 km north of Old Channel Lake, in SE ¼, sec. 8, tp. 15, rge. 5, W 4th mer. (50°14'25"N, 110°39'15"W), about 50 m below the general prairie level, and at an altitude of ca. 635 m.

The wood is from ca. 4.5 m below the top of a strongly contorted, 12 m-thick unit of alluvial sand, silt, clay, with scattered stones. This unit overlies 6 m of sand to river level and itself is overlain by ca. 6 m of till and 8 m of loose sand. The surface is a terrace of the river. Both the dated unit and the surface sand contain vertebrate fossils. Pieces of wood were washed into place, and they are rounded, iron-stained, and weathered on the surface.

Comment (A.MacS. Stalker): it was hoped that the date might give the age of the unit and the vertebrate fauna contained in it, for the bones collected so far are too few and in too poor condition to indicate the age. The result shows the unit is older than Classical Wisconsin, and it probably relates to either the Yarmouth or Sangamon Interglacials. Some 30 m, including at least one till, are missing from the top of the section.

Comment (W. Blake, Jr.): the sample was damp when received in the laboratory. The single largest piece of wood was 12 cm long and 3 cm maximum diameter; it was dried in an electric oven in June 1972. All the outside wood and adhering sand were scraped off or removed by cutting. The piece of wood was reddish in colour and was solid, although the outside was softer and more yellow-brown. No vegetation was adhering to the sample, but both ends were worn and rounded. Examination of the wood by R.J. Mott indicated that it was lignified and very poorly preserved but that it has features most like *Fraxinus* sp. (ash.) Date based on one 4-day count in the 5-litre counter.

GSC-1735.	British Block, shells	5760 ± 170 3810 B.C.

Freshwater gastropod shells (sample SF-72-2; 6.3 g; *Lymnaea elodes* Say; identified by M.F.I. Smith, National Museum of Natural Sciences, Ottawa) on the west bank of the South Saskatchewan River, 20 km north of Medicine Hat, Alberta, and 1.5 km north of Old Channel Lake, in NW ¼, sec. 4, tp. 15, rge. 5, W 4th mer. (50°14'12"N, 110°38'35"W), about 18 m above river level at an altitude of ca. 645 m. The shells were scattered 1 to 3 m below the surface in horizontal beds of alluvial clay and marly muck, on both sides of a small stream tributary to the river. The surface, which is 60 m below the general prairie level, is the floor of an abandoned river meander.

Comment (A.MacS. Stalker): the snails probably were present after the river abandoned the meander but while the channel still contained ponds and was subject to flooding during times of high water. The date represents the time when the river incised below this level, and it indicates an average rate of down-cutting of 1 m per 320 years. The sample also contained a few individuals of *Gyraulus parvus* (identified by M.F.I. Smith), but these were not included in the sample submitted for dating. Due to the small sample size, only the outer 5 per cent was removed with HCl. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

Medicine Hat series (VI)

Bone from 'Reservoir Gully' on the south side of the South Saskatchewan River, directly east of the city reservoir at the western limits of Medicine Hat, Alberta, LSD 16, sec. 27, tp. 12, rge, 6, W 4th mer. (50°01'55"N, 110°44'05"W), at an altitude of ca. 730 m. The sample was taken from sand and gravel beds about 7 m below the youngest till sheet in the region, about 11 m below the present prairie level, and 80 m above the river. The sand and gravel contain an abundant fauna of apparent mid-Wisconsin or younger Wisconsin age. Collected 1969 by A.MacS. Stalker. Two determinations were made:

GSC-1399.	'Reservoir Gully', collagen	15 200 ± 250 13 250 B.C. $\delta^{13}C = -19.5‰$
GSC-1399-2.	'Reservoir Gully', bone apatite	23 500 ± 330 21 550 B.C. $\delta^{13}C = -10.3‰$

General Comment (A.MacS. Stalker): both dates are within the possible time range for the deposit and the fauna. The discrepancy between the dates however is not explained, and although the older date is the more logical, neither should be used until further dates are obtained.

Comment (W. Blake, Jr.): when mentioning these age determinations, Szabo *et al.* (1973) have referred to GSC-1399 as GSC-1399-1; the former notation is the correct one. GSC-1399 (1300 g) was given a 24-hour treatment with 0.1N NaOH, whereas GSC-1399-2 (545 g) was treated with 50 per cent acetic acid until no further effervescence occurred. Both samples were mixed with dead gas for counting. GSC-1399 based on one 1-day count in the 2-litre counter; GSC-1399-2 based on two 1-day counts in the 5-litre counter.

Medicine Hat series (VII)

Wood samples from 'Galt Island Bluff' on the north bank of the South Saskatchewan River, about 1 km west of Redcliff, Alberta, LSD 13, sec. 8, tp. 13, rge. 6, W 4th mer. (50°04'38"N, 110°49'10"W), at an altitude of ca. 683 m. The wood was collected from about 3 m above bedrock in floodplain silt and clay containing much fine organic material and also an abundant vertebrate fauna of mid-Wisconsin age. This fauna, which is found mostly 1 to 2 m below the dated bed, indicates a fairly warm climate. The wood-bearing unit is overlain by about 15 m of stream and lake sand, silt, and clay, which is partly varved towards the top, and 15 m of the youngest till in the region. Elsewhere the floodplain silt and clay unit is overlain by two tills. Collected 1970 by A.MacS. Stalker.

GSC-1442.	'Galt Island', wood (I)	37 900 ± 1100 35 950 B.C.

Small pieces of wood, including much bark, from small shrubs; sample SF-70-2 (20 g).

GSC-1442-2. 'Galt Island', wood (II) — 38 700 ± 1100 / 36 750 B.C.

Similar to GSC-1442, only slightly smaller pieces utilized; sample SF-70-2 (22 g).

General Comment (A. MacS. Stalker): the dates are within the expected range. They confirm that the younger tills are of Classical Wisconsin age and also indicate that the vertebrate fauna is a little more than 38 000 years old.

Comment (W. Blake, Jr.): GSC-1442 was made up of pieces which were all >1 cm long, whereas GSC-1442-2 included some material of this size and some smaller pieces. Most of the pieces appeared to be bark. No rootlets were noticed. The two determinations agree as closely as is possible for material of this age. Unfortunately, it did not prove possible to date the bones from slightly lower in the same floodplain unit by the uranium series method (Szabo *et al.*, 1973). Both GSC-1442 and -1442-2 are based on one 3-day count in the 5-litre counter.

GSC-1501. 'Kipp North Section' — 10 600 ± 280 / 8650 B.C.

Freshwater gastropod shells (sample SF-70-12; 8.5 g; *Lymnaea elodes* Say; identified by A.H. Clarke, Jr., National Museum of National Sciences, Ottawa) from the Kipp North Section, about 12 km northwest of Lethbridge, Alberta on the northeast side of an abandoned meander of the Bow River, SW ¼, sec. 35, tp. 9, rge. 23, W 4th mer. (49°46'30"N, 113°01'30"W), at an altitude of ca. 920 m and about 65 m above the river. The shells were scattered in partly weathered alluvial silt and clay, 5 m below the top of the bluff, 3.5 m below a band of Mazama volcanic ash (age about 6600 years) contained in the alluvium, and 3 m above lake deposits consisting of varved silt and clay (cf. Stalker, 1963). The lake deposits and alluvium apparently were deposited before Oldman River incised its present valley following the last glaciation. GSC-237, >54 500 years (GSC IV, 1965, p. 32), was from about 25 m lower at the same bluff, i.e. beneath the lake deposits and till. Collected 1970 by A. MacS. Stalker.

Comment (A. MacS. Stalker): the date and overlying ash indicate that the Oldman River was flowing near this level and perhaps was still raising its grade 10 000 years ago (and probably for some time after), and that subsequently it incised its present 80 m-deep valley very rapidly. GSC-1332, 10 500 ± 180 years (GSC XI, 1971, p. 286), also on *Lymnaea elodes* from a similar stratigraphic position but much farther downstream and in Saskatchewan, indicates a similar sequence of events, as does GSC-220, 10 000 ± 130 years (GSC IV, 1965, p. 31), from the Blood Indian Reserve, Alberta. Due to the small size of GSC-1501, only the outer 5 per cent was removed by HCl-leach. Date based on one 3-day count in the 1-litre counter.

GSC-612-2. Griffin Gravel Pit, Cochrane — 7220 ± 480 / 5270 B.C.

Bone (529 g) from East Griffin Gravel Pit, ca. 0.5 km east-southeast of Cochrane, Alberta, in NE ¼, sec. 35, tp. 25, rge. 4, W 5th mer (51°10'40"N, 114°27'10"W). The bones are from the middle of three postglacial terraces of Bow River. The surface of the terrace is ca. 23 m above the river and ca. 8 m below the highest terrace. The sample was taken from cross-bedded, sandy alluvium above coarse gravel, ca. 2 m below the terrace surface. Abundant bones indicate a fauna consisting mostly of *Bison bison occidentalis*, *Equus conversidens*, *Ovis canadensis*, and *Cervus canadensis* (identified by C.S. Churcher, University of Toronto, Toronto). The date should indicate the age of the fauna and the time when Bow River was depositing these beds. Collected 1963, 1964 and 1965 by P. Chamney, C.S. Churcher, and A. MacS. Stalker.

Comment (A. MacS. Stalker): the date is markedly younger than other dates from the same terrace: GSC-613, 11 370 ± 170 years (GSC VI, 1967, p. 170) and GSC-989, 11 100 ± 160 years (GSC IX, 1970, p. 68) from the nearby Clarke Gravel Pit and GSC-612 10 760 ± 160 years (GSC VI, 1967, p. 169-170) from the East Griffin Pit (cf. also Stalker, 1968), but is closer to GSC-988, 5670 ± 150 years (GSC IX, 1970, p. 68) also from the East Griffin Pit. Very likely there is a younger fossil bed at the East Griffin Pit that has not been distinguished from the major bone-bearing bed, or possibly during collection over several years by three different collectors some fragments of modern bone were incorporated into the samples. The older dates should be favoured for the age of the chief bone bed in the Cochrane terraces. Pretreatment (to obtain collagen) included a 24-hour leach in 0.1N NaOH. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

British Columbia

GSC-2156. Cathedral Lakes Provincial Park — 820 ± 50 / 1130 A.D.

Wood (sample WHM-74-1; 11.6 g) from a standing hollow stump, 0.6 m in diameter, at the upper limit of small living trees. The site, on the northwest slope of Lakeview Mountain (1.6 km north of the summit) in Cathedral Lakes Provincial Park, British Columbia (49°03.4'N, 120°09.5'W), at an altitude of 2270 m, is 100 m higher than any living tree as large as this stump (ca. 0.6 m in diameter and 2.4 m in circumference). The wood is identified as *Larix* sp. (identified by L.D. Farley-Gill, GSC, and by the Forest Products Laboratory, Environment Canada, Vancouver). Lyalls larch *(L. lyalli)* is common in this vicinity today whereas Western larch *(L. occidentalis)* is not known to be growing within 40 km of this site and is confined to lower altitudes.

Comment (W.H. Mathews): the specimen used for dating contained about 90 annual rings in a 38 mm thickness; the missing core of the trunk, about 270 mm in radius, could have contained as many as 630 rings if growth was uniform. A better estimate, allowing for more rapid growth in the early stages, would be 400 years. It follows therefore that conditions favourable for tree growth well above the Neoglacial tree lines occurred about 1200 years ago. Date based on two 1-day counts in the 5-litre counter.

GSC-1986. Nicola — 140 ± 50
1810 A.D.

Charcoal (sample F.M.S.-W.H.M.; 10.6 g) imbedded in what was originally identified as lava of an outlier of the late Pleistocene 'valley basalt' of the nearby Merritt Basin. The sample was taken on a steep slope above Kirby Creek northeast of Nicola, British Columbia (50°13.2'N, 120°34.7'W), at an altitude of ca. 915 m. Collected by F.M. Smith, Phelps Dodge Corp., Vancouver; submitted by W.H. Mathews, University of British Columbia, Vancouver.

Comment (W.H. Mathews): an examination of the site after the unexpectedly young date was obtained revealed the former activity of a portable sawmill directly upslope from the site. A substantial volume of wood mill-waste had slid downslope and had been incorporated in the upper layers of the sandy soil. Combustion of this wood not only provided the charcoal from which the date was obtained, but also produced sufficient heat to melt the overlying soil. This then flowed over and incorporated the charcoal and then chilled to form a mass of clinkers up to 1 m thick and 3 m long. Date based on one 3-day count in the 5-litre counter.

GSC-1695. Mission — 11 400 ± 170
9450 B.C.

Wood (sample Rouse-1.3.72; 5.9 g) imbedded in a glaciomarine(?) diamicton exposed in a road-cut 4.8 km northeast of Mission, British Columbia (49°09.8'N, 122°15.7'W), at an altitude of ca. 99 m. The site is on Draper Creek near J.E. Armstrong's Monastery site (*see* comment, below). Collected 1972 by G.E. Rouse, R.H. Blunden, and R.W. Mathewes, University of British Columbia, Vancouver; submitted by W.H. Mathews of the same institution.

Comment (W.H. Mathews): this sample is from a site and stratigraphic position very close to L-331C, 10 950 ± 200 years (Lamont IV, 1957, p. 1325; Armstrong *et al.*, 1965a, 1965b; wood under till). GSC-1695 gives a more reasonable date for the proximity of ice during the Sumas Stade than does L-331C (cf. also the new determination for wood chips from the base of Sumas-type till-like material on Mount Lehman Road near Abbotsford; GSC-1675, 11 600 ± 280 years; GSC XIII, 1973, p. 26).

Comment (W. Blake, Jr.): the sample was collected as an intact chunk of wood, truncated at both ends prior to burial. The wood was yellowish in colour and had the consistency of butter. The collector scraped off much of the adhering matrix and wrapped the sample in aluminum foil. It was later dried in an oven at 70°C. On receipt by the laboratory the sample was in pieces, up to 3 cm long, 1.5 cm wide, and 0.5 cm thick. The wood was dense and hard, and according to R.J. Mott it was very poorly preserved and was compressed, and some details were not clear; visible features resembled those of *Salix* sp. (willow). The wood also appeared identical to the above-mentioned sample from Mount Lehman Road (GSC-1675, 11 600 ± 280 years). Some adhering clay was scraped off the wood of GSC-1695. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter. For a general summary of radiocarbon chronology in southern British Columbia *see* Fulton (1971). Also note that in the list of "radiocarbon dates" compiled by Mathews during the preparation of a paper dealing with postglacial crustal movements (Mathews *et al.*, 1970; and Depository of Unpublished Data, National Science Library, National Research Council of Canada), date L-331C (10 950 ± 200 years) was designated mistakenly as L-339C.

GSC-1758. Port Moody — 5380 ± 140
3430 B.C.

Wood (sample WN-W1; 11.5 g; *Thuja plicata* (western red cedar); identified by L.D. Farley-Gill) from a 60 cm-diameter log exposed at 6.4 m depth in a sewer excavation, Cayer Street, Coquitlam District Municipality, 4.5 km south of Port Moody, British Columbia (49°14'10"N, 122°50'45"W), at an altitude of 5.5 m above mean sea level. The log is within a 6.4 m-thick unit of coarse, poorly sorted gravels which are interbedded with lenses of silty clay and peat; one clay lens is immediately beneath the dated log. Collected 1971 by W. Nieuwenhuizen, Simon Fraser University, Burnaby; submitted by E.C. Halstead, Hydrologic Sciences Division, Environment Canada, Vancouver.

Comment (E.C. Halstead): the enclosing gravels with clay and peat lenses are believed to be lowland stream and floodplain deposits of the Fraser River. GSC-1758 is in accordance with GSC-229, 8290 ± 140 years (GSC IV, 1965, p. 35; peaty silt 10.2 to 10.5 m below sea level at Pitt Meadows airport site), and GSC-2, 7600 ± 150 years (GSC I, 1962, p. 15; *see* also S-99, 7300 ± 120 years; Saskatchewan III, 1962, p. 73; both dates are on the same sample of detrital peat 10.0 m below sea level at Port Mann). For a discussion of the post-Sumas emergence *see* Mathews *et al.* (1970).

Comment (W. Blake, Jr.): some mold developed on the log while it was stored in damp conditions in Ottawa. It was dried in an electric oven, 1972. The outermost wood was cut off, then a section comprising approximately 20 annual rings from the outer part of the log was used for dating. Date based on two 1-day counts in the 5-litre counter.

GSC-1993. Sphinx Glacier — 7640 ± 80 / 5690 B.C.

Wood (sample M-Z-1973-1; 11.5 g; *Tsuga heterophylla* (western hemlock); identified by L.D. Farley-Gill) 2 m long and 40 cm wide, part of a much larger trunk, found at an altitude of 1650 m among large boulders and near a meltwater channel of Sphinx Glacier, 80 km north of Vancouver, British Columbia (49°55'N, 122°58'W). Collected 1973 by O. Mokievsky-Zubok, Glaciology Division, Environment Canada, Ottawa.

Comment (O. Mokievsky-Zubok): this hemlock wood, exposed by glacial retreat, was 170 m higher in altitude and 3.5 km east of (inside) the maximum known limit of Sphinx Glacier. Its presence confirms the existence, in this heavily glacierized area, of a forest during the Hypsithermal Interval. For a list of other radiocarbon age determinations from the Mount Garibaldi area see GSC-2027 (5300 ± 70 years; this list). Date based on two 1-day counts in the 5-litre counter.

GSC-2027. Sentinel Glacier (II) — 5300 ± 70 / 3350 B.C.

Wood (sample M-Z-1974-1; 11.6 g; *Tsuga heterophylla* (western hemlock); identified by L.D. Farley-Gill) from the remnant of a stump protruding through gravel and morainic material with large erratics on the surface. The stump was >30 cm in diameter and at least 60 cm high. It was found in the proglacial zone of Sentinel Glacier, 75 km north of Vancouver, British Columbia (49°54'N, 122°59'W), at an altitude of 1510 m. Found by H. Reisenleiter; collected 1973 and submitted by O. Mokievsky-Zubok, Glaciology Division, Environment Canada, Ottawa.

Comment (O. Mokievsky-Zubok): the wood (no bark) was preserved in an area which was deglaciated about 20 years ago, and it was protected during the last ice advance by a small bedrock outcrop. The presence of this stump, 1 km inside the glacier's maximum known extent, confirms the existence of a forest in the area during the Hypsithermal Interval. Other radiocarbon dates in the Mount Garibaldi area are: Y-140 bis, 5260 ± 200 years (Yale V, 1960, p. 58), rooted yellow cedar from Mount Garibaldi; GSC-760, 5950 ± 140 years (GSC VII, 1968, p. 226) root fragments of fir from Mount Breakenridge; GSC-1477, 6170 ± 150 years (GSC XIII, 1973, p. 26), fir wood embedded in till near the snout of Sentinel Glacier (*see* also Mokievsky-Zubok, 1972, 1973); and GSC-1993, 7640 ± 80 years (this list), western hemlock east of Garibaldi Lake and in front of Sphinx Glacier.

Comment (W. Blake, Jr.): the sample, which was collected at ground level, was dry when received by the laboratory. All outside wood and wood along cracks, plus some rotted material, was cut off. Date based on two 1-day counts in the 5-litre counter.

Northern Canada, Arctic Archipelago

Broughton Island

GSC-1969. Broughton Island airstrip — 9100 ± 140 / 7150 B.C.

Marine algae stems (sample B-4 (GRL-122-0); 3.85 g) from a stream cut near the airstrip, Broughton Island, N.W.T. (67°32.8'N, 64°02.5'W). The sample was from 1 m a.s.l. in a silty clay lens with shells and a few pebbles; the marine terrace in which the clay occurs has been overridden by solifluction debris. Collected 1969 by J.H. England, University of Colorado, Boulder, Colorado; now University of Alberta, Edmonton; submitted 1973 by J.T. Andrews, University of Colorado.

Comment (J.T. Andrews): the algae sample was dated to provide a check against a date of 9850 ± 250 years (GaK-2573; Andrews and Miller,) on the marine shells. The two dates are not statistically similar in dating the postglacial marine limit, which, in the vicinity of Broughton Harbour, appears to be ca. 5 m a.s.l. (England and Andrews, 1973). Higher marine features near the site are dated at >40 000 years B.P. (cf. Andrews, 1975).

Comment (W. Blake, Jr.): the most abundant marine algae at a site ca. 100 m to the north was *Sphacelaria plumosa;* fragments of *Desmarestia aculeata* and *Laminaria* sp. occurred in places between the layer of *Sphacelaria* (Illman *et al.*, 1972). If appropriate corrections could be applied (values unknown at present) for the 'apparent age' of these two types of marine materials, perhaps the agreement would be closer. NaOH-leach omitted from the sample pretreatment. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

Baffin Island

GSC-2083. Kingnait Fiord — 8480 ± 270 / 6530 B.C. / $\delta^{13}C = +0.5‰$

Marine shells (sample A-27-73; 8.0 g; *Mya truncata* plus fragments showing little or no truncation, possibly *M. pseudoarenaria;* identified by W. Blake Jr.) collected from a gully incised into raised deltaic sediments on the north side of Kingnait Fiord, Baffin Island, N.W.T. (66°21.5'N, 64°21'W), at an altitude of 4 to 8 m. The shells occurred in silty clay bottomset beds which were overlain by silty sand foreset beds; the shells relate to the delta surface at 16 m a.s.l. The terrace at the head of the fiord is a particularly prominent feature. There was a paucity of deposits between the terrace surface and the lower limit of perched boulders which occurred at 27 to 30 m a.s.l. Farther inland a large valley train graded to 30 m a.s.l. Collected 1973 by J.T. Andrews, University of Colorado, Boulder, Colorado.

Comment (J.T. Andrews): the date is similar in age to GSC-2001, 8690 ± 90 years, from 39 m (marine limit 52 m) above the hamlet of Pangnirtung. Throughout the parts of Kingnait Fiord visited there is a prominent terrace at about 20 m a.s.l. which may date from 8400 years B.P. GSC-2083 is in accordance with a determination of 7990 ± 170 years (GaK-4837; Andrews, 1975) from marine shells in an eroded silt deposit at 13 m in a small cove 2 km to the south.

Comment (W. Blake, Jr.): most whole valves and fragments submitted to the laboratory still had some periostracum attached. All valves were thin and the largest was only 2.6 cm long. One fragment of *Macoma* sp. in the sample was not submitted for dating. Due to small sample size, pretreatment included an HCl-leach of the outer 5 per cent of the shell. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

GSC-1964. Pond Inlet airstrip — 33 300 ± 800 / 31 350 B.C.

Twenty-four fragments (sample HCA-73-22/8-1; 28.5 g) of the marine pelecypod *Mya truncata* (identified by D.A. Hodgson), all with periostracum still attached. The sample was collected from a 30 cm-thick shell-bearing stratum of sandy silt and clay, below 1 to 2 m of well graded gravel and sand, and ca. 1.5 km south-west of the Hudson's Bay Co. Post, Pond Inlet, Baffin Island, N.W.T. (72°41'N, 78°00'W), at an altitude of ca. 65 m. Collected 1973 by D.A. Hodgson in a borrow pit for airstrip construction.

Comment (D.A. Hodgson): whole valves of this and other species in the stratum (including *Hiatella arctica*, *Clinocardium ciliatum*, and *Macoma* sp.) varied from moderate thickness to very thin. Because many shells were fragile, had the periostracum still attached, and did not appear to be worn, it seemed unlikely that they had been glacially transported, although they could have been overridden by ice. The deposits can be interpreted as ice-contact fluvial sediments overlying interglacial marine deposits or, alternatively, as deltas contemporaneous with a sea level higher than the apparent 60 m limit of postglacial marine submergence (Hodgson and Haselton, 1974). GSC-1153 (*Hiatella arctica* and *Mya truncata*) at 49 m, 0.5 km northeast of this site, has been dated at 33 100 ± 900 years, and GSC-1215 (mainly *Mya truncata*) at 30 m, 7 km east of Pond Inlet settlement, is >29 000 years old (GSC XI, 1971, p. 311). Date GSC-1964 based on one 3-day count in the 2-litre counter.

Ellesmere Island

Baad Fiord series

Marine pelecypod shells and a whale rib from localities along Baad Fiord, Ellesmere Island, N.W.T. Collected 1967 by W. Blake, Jr.

GSC-824. Baad Fiord, innermost west side — 8330 ± 160 / 6380 B.C.

Fragments of *Hiatella arctica* and *Mya truncata* (sample BS-32-67; 25.5 g; identified by W. Blake, Jr.) from silt, sand, and beach gravel on the surface of a former delta, 2.4 km west of the head of Baad Fiord (76°38.5'N, 86°42'W), at an altitude of ca. 70 m.

Comment (W. Blake, Jr.): these shells were the highest found in the innermost part of Baad Fiord (Blake, 1975a); no shells were seen in the lateral moraine to the west of, and above, the delta. The glacier, now some 200 m distant from the delta, has not advanced beyond its present position in the last 8000 years. The shells were fragmented, and many pieces were thick, pitted, and chalky, but those with lichen growth or those that were highly discoloured were exluded from the sample submitted for dating. Date based on two 1-day counts in the 2-litre counter.

GSC-881. Baad Fiord, inner east side — 8830 ± 130 / 6880 B.C.

Fragments of *Hiatella* sp. and *Mya* sp. (sample BS-51-67; 15.1 g; identified by W. Blake Jr.) from the ground surface 2.8 km east of Baad Fiord where the major valley joins the fiord (76°41'N, 86°19'W), at an altitude of ca. 105 m.

Comment (W. Blake, Jr.): these shells, the highest found between two branches of the tributary valley, show that marine waters had penetrated approximately 30 km inland from the coast of Jones Sound by about 8500 years ago (*see* discussion of the correction for the apparent age of marine shells in this area; Blake, 1975a, 1975b; Mangerud and Gulliksen, 1975). The shells were fragmented but were fairly well preserved, with little pitting or chalkiness; some thin incrustations were scraped off, but in general shells with incrustations were not submitted. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

GSC-964-2. Baad Fiord, outer west side — 8940 ± 90 / 6990 B.C. / $\delta^{13}C = -16.8$ ‰

Whale rib, probably from the Greenland or bow-head whale, *Balaena mysticetus* (sample BS-102-67; identified by C.R. Harington, National Museum of Natural Sciences, Ottawa), at an elevation of ca. 82 m.

Comment (W. Blake, Jr.): three determinations were made:

GSC-964. Collagen fraction; NaOH-leach omitted from pre-treatment of 500 g of bone. Burnt 18.0 g. Date based on two 1-day counts in the 5-litre counter. — 8690 ± 90 / $\delta^{13}C = -16.9$ ‰

GSC-964-2. Collagen fraction; 525 g of bone treated for 1 hour with 0.1N NaOH. Burnt 30.0 g. Date based on one 2-day count in the 5-litre counter. 8940 ± 90 $\delta^{13}C = -16.8‰$

GSC-964-3. Bone apatite fraction; 410 g of bone treated with 50 per cent acetic acid until no further effervescence. Residue treated with H_3PO_4. Sample mixed with dead gas for counting. Date based on one 3-day count in the 5-litre counter. 8330 ± 120 $\delta^{13}C = -13.2‰$

Of these, the determination utilizing the collagen fraction after base treatment seems most reliable; it is the oldest value, and it best fits the regional chronological picture (Blake, 1975a). However, it is by no means certain that the value for GSC-964-2 (8940 ± 90 years) accurately represents the age of the oldest postglacial raised beaches in outer Baad Fiord, as they presumably attain altitudes of at least 120 m.

Muskox Fiord series (II)

GSC-860. Muskox Fiord, outer east side (I) 10 300 ± 100 8350 B.C.

Fragments of the marine pelecypods *Hiatella arctica* and *Mya truncata* (sample BS-148-67; 32 g; identified by W. Blake, Jr.) from raised beaches on the east side of the outer part of Muskox Fiord, Ellesmere Island, N.W.T. (76°27.5'N, 87°17'W), at an altitude of ca. 107 m. Shell fragments were partly imbedded in fines underlying beaches and partly on the surface. Collected 1967 by W. Blake, Jr.

Comment (W. Blake, Jr.): the shells were damp when collected and were stored damp in a plastic bag. Some shells were encrusted, but only a few of those with thin crusts (scraped off in all cases) were used. Some pieces were quite thick, but there was little pitting, chalkiness, or lichen growth. Date based on one 3-day count in the 2-litre counter (Blake, 1975a).

GSC-2082. Muskox Fiord, outer east side (II) 19 200 ± 790 17 150 B.C. $\delta^{13}C = +1.8‰$

Single valve of *Mya truncata* (sample BS-148-67; 3.4 g; identified by W. Blake, Jr.) from raised beaches on the east side of the outer part of Muskox Fiord, Ellesmere Island, N.W.T. (76°27.5'N, 87°17'W), at an altitude of ca. 107 m. Collected 1967 by W. Blake, Jr.

Comment (W. Blake, Jr.): this aragonitic shell, from the same collection out of which GSC-860 was selected, was dated to check on that determination which seemed about 1000 years too old when viewed in regional context. Only one right valve (3.9 cm long, 2.5 cm high) was used so as to eliminate the problem of mixing shells of different ages. No periostracum remained on the shell, it exhibited some pitting, some spots of lichens were present, and some thin brown encrustations were noted in the interior. As noted already (Blake, 1975a) whether or not a finite age is obtained on such a small sample is largely a function of statistics. It is safest to regard such an age as a minimum value. The two ages show that the collection must be a mixture of "old" shells (predating the last glaciation), which are presumed to derive from the underlying till, and shells of postglacial age. Due to the small size of GSC-2082, the HCl-leach was omitted from the pretreatment. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter. The slight change in age from the 19 100 ± 790 year value reported by Blake (1975a) is because the $^{13}C/^{12}C$ ratio was not available earlier.

GSC-848. Muskox Fiord, inner east side 8640 ± 120 6690 B.C.

Fragments of marine pelecypods (sample BS-199-67; 28.5 g; mainly *Hiatella arctica* and *Mya truncata;* identified by W. Blake, Jr.) from a flat area on the distal side of, and on, a ridge interpreted as being an end moraine, 3.2 km south of the head of Muskox Fiord, Ellesmere Island, N.W.T. (76°36.5'N, 87°33'W) at an altitude of ca. 95 m. Collected 1967 by W. Blake, Jr.

Comment (W. Blake, Jr.): this sample was collected in an attempt to date a stillstand or possible readvance position of the valley glacier which formerly occupied Muskox Fiord. Because older shells have been found 10.5 km to the northwest (north of the present head of the fiord; cf. GSC-1448 and -1518, this series), GSC-848 probably represents an approximate position of sea level well after the ice retreated from the moraine. An alternative explanation is that the pelecypods indicate the true age of the moraine, in which case an advance of one of the lobes of ice entering the head of the fiord would be necessary. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

GSC-1448. Muskox Fiord, north (I) 9020 ± 230 7070 B.C. $\delta^{13}C = 0.0‰$

Marine pelecypod shells (sample BS-70-216; 24.95 g; *Macoma calcarea;* identified by W. Blake, Jr.) from silt 7.5 km north-northwest of the head of Muskox Fiord, Ellesmere Island, N.W.T. (76°41.5'N, 87°41'W), at an altitude of ca. 100 m. Collected 1970 by W. Blake, Jr. and R. Richardson.

Comment (W. Blake, Jr.): the aragonitic shells, mostly whole valves (some paired with periostracum and hinge still intact), were from a band on a sloping surface of silt. No incrustations, pitting, or lichen growth occurred on these thin fragile shells. The adhering silt was washed off in distilled water, and the shells then were dried in an electric oven. These shells were the farthest north found in the area. Date based on one 3-day count in the 1-litre counter.

GSC-1518.	Muskox Fiord, north (II)	8910 ± 110 6960 B.C. $\delta^{13}C = +1.2‰$

Whole valves and large fragments of *Serripes groenlandicus* (sample BS-70-213; 27.7 g; identified by W. Blake, Jr.) from silt and sand 6.5 km north-northwest of the head of Muskox Fiord, Ellesmere Island, N.W.T. (76°40.5'N, 87°41'W), at an altitude of ca. 90 m. Collected 1970 by W. Blake, Jr.

Comment (W. Blake, Jr.): the shells in this collection, made along the banks of the main river leading into the head of Muskox Fiord, probably derive from silt beds at a slightly higher altitude. *Clinocardium ciliatum, Mya truncata,* and *Hiatella arctica* (identified by W. Blake, Jr.) occur with the aragonitic valves of *Serripes groenlandicus.* Ten individual valves, including one pair, were used for the age determination; they ranged in size from 5 by 6 cm to 4 by 4.5 cm. None of the shells utilized had incrustations. This date together with GSC-1448 (9020 ± 230 years), indicate that the sea had penetrated well to the north of the present head of Muskox Fiord by about 9000 years ago (Blake, 1975a). Date based on two 1-day counts in the 2-litre counter.

GSC-822.	Muskox Fiord, north (III)	8290 ± 100 6340 B.C.

Whole pelecypod shells and fragments (sample BS-18-67; 18.8 g; mostly *Hiatella arctica* plus possibly a few bits of *Mya truncata;* identified by W. Blake Jr.) from silt on the north side of the main river leading to the head of Muskox Fiord, Ellesmere Island, N.W.T. (76°39.5'N, 87°45'W), at an altitude of ca. 75 m. Collected 1967 by W. Blake Jr.

Comment (W. Blake, Jr.): at the time this collection was made it was believed to be the farthest north marine mollusc site in the valley leading to the head of Muskox Fiord. Subsequent collections in 1970 (*see* GSC-1448 and -1518, this series) disproved this hypothesis. The pelecypods of GSC-822 lived when sea level had fallen below an altitude of 90 m but was still above 75 m. Many of the shells were somewhat chalky and some had a reddish-brown encrusted layer (the same colour as the enclosing silt); few encrusted shells were in the sample submitted for dating. Sample mixed with dead gas for counting. Date based on one 4-day count in the 2-litre counter.

Cape Storm series (III)

Marine mollusc shells (*Mya truncata;* identified by W. Blake, Jr.) from glaciomarine, till-like sediment 6 km north of Cape Storm, Ellesmere Island, N.W.T. (76°23.5'N, 87°38'W). Collected 1970 by W. Blake, Jr. and R. Richardson.

GSC-1415.	C. Storm, shells, 100.5 m	9330 ± 110 7380 B.C. est. $\delta^{13}C = +2.8‰$

Nearly whole valves and smaller fragments of aragonitic shells, all identifiable as *Mya truncata* (sample BS-70-124; 26.4 g). Most fragments still have some periostracum attached and some incomplete siphon sheaths are also present. This sample is from the dark grey unoxidized part of the exposure.

Comment (W. Blake, Jr.): the $^{13}C/^{12}C$ ratio is an estimate based on the value obtained from the inner portion of GSC-1488, this series. GSC-1415 was given the normal pretreatment; i.e., the outer 20 per cent of shell was removed by leaching in HCl. Date based on one 4-day count in the 2-litre counter.

GSC-1488.	C. Storm, shells, 101.0 m	9370 ± 160 7420 B.C. $\delta^{13}C = +2.8‰$

Nearly whole valves and smaller fragments of aragonitic shells, all identifiable as *Mya truncata* (sample BS-70-126; 87 g). All fragments still had some periostracum and/or partial siphon sheaths attached. Some valves were broken at time of collection from frozen material exposed by stream in spate. This sample, collected just above BS-70-124, is from the oxidized brownish-grey sediment.

Comment (W. Blake, Jr.): two determinations were made, after the outer 10 per cent of the shell was removed by leaching in HCl:

outer fraction (11 to 55 per cent leach), one 3-day count in the 5-litre counter.	9350 ± 80
inner fraction (56 to 100 per cent leach), one 3-day count in the 5-litre counter	9370 ± 110

These determinations on inner and outer fractions are internally consistent and agree as closely as possible with the value obtained for GSC-1415, this series (Blake, 1975a); thus there seems to be no danger that the sample has been contaminated with "old" shells, which also are known to be present in the area. If proper correction is made for the apparent ages of marine shells in the area (cf. discussion in Blake, 1975a, 1975b; Mangerud and Gulliksen, 1975), it is apparent that the incursion of the sea into this area, following withdrawal of glacier ice, had begun by 9000 years ago.

GSC-1490.	C. Storm, periostracum, 101.5 to 101.0 m	7900 ± 710 5950 B.C. $\delta^{13}C = -18.3‰$

Periostracum and siphon sheaths of *Mya truncata;* the sample is composed of 0.9 g removed by hand from samples BS-70-124 and -126, the remainder was retrieved after the outer 10 per cent of BS-70-126 was dissolved in HCl.

Comment (W. Blake, Jr.): no ready explanation has been found for the discrepancy between this age and the three on the shell material itself, although the extremely small sample size may be a factor (Blake, 1975a). Sample mixed with dead gas for counting. Date based on one 3-day count in the 1-litre counter.

GSC-858. Goose Fiord (II) 8720 ± 110
6770 B.C.

Fragments of marine pelecypod shells (sample BS-163-67; 20.1 g; *Hiatella arctica* and *Mya truncata;* identified by W. Blake, Jr.) from the ground surface and in sorted polygons ca. 1.5 km east of the outer part of Goose Fiord, Ellesmere Island, N.W.T. (76°28'N, 88°18'W), at an altitude of ca. 120 m. The shells were on a flat area and gentle slopes near a former lagoon. Collected 1967 by W. Blake, Jr.

Comment (W. Blake, Jr.): the shells were within 7.6 m of the limit of postglacial marine submergence in a tributary valley opening onto Goose Fiord. Although the shells were fragmented, most were thick, clean, and well preserved. Little pitting or lichen growth occurred, and only a few with thin incrustations (scraped off) were utilized. The date gives an approximate age for the highest beaches in outer Goose Fiord; they appear to be somewhat younger than those at Cape Storm, 19.5 km to the east-southeast (*see* Cape Storm series (III), this list). Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

Devon Island

GSC-866. Cape Hawes 9260 ± 100
7310 B.C.

Marine pelecypod shell fragments (sample BS-171-67; 21.1 g; *Hiatella arctica* and *Mya* sp.; identified by W. Blake, Jr.) from beach sand and gravel 3.2 km west of Cape Hawes, Colin Archer Peninsula, Devon Island, N.W.T. (76°17'N, 89°22'W), at an altitude of ca. 114 m. The shells were collected in channels cut through beach material by streams flowing along the edge of an outlet lobe from the easternmost ice cap on Colin Archer Peninsula. Collected 1967 by W. Blake Jr.

Comment (W. Blake, Jr.): the shells were in a zone between ca. 111 and 114 m a.s.l.; they were the highest found in an area where the limit of postglacial marine submergence appears to be 120+ m. The date indicates a marine incursion, following deglaciation, close to 9000 years ago, i.e. similar to the value obtained for Cape Storm, 30 km to the east-northeast (Blake, 1975a). All shell fragments were chalky but clean. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

GSC-874. Berkeley Bay 8950 ± 80
7000 B.C.

Marine pelecypod shell fragments (sample BS-190-67; 33.0 g; *Mya* sp. and *Hiatella arctica;* identified by W. Blake, Jr.) from ground surface and from depths of up to 15 cm in mixed material (fines to gravel), ca. 1.6 km north of Berkeley Bay, Norfolk Inlet, Devon Island, N.W.T. (76°28.5'N, 90°45'W), at an altitude of ca. 114 m. Shells are from an area of sorted polygons beside a pool fed by a perennial snowbank and lying behind a beach ridge. Collected 1967 by W. Blake Jr.

Comment (W. Blake, Jr.): the shells were the highest found in an area where the limit of postglacial marine submergence is not over 125 m. The date indicates the time of marine incursion following deglaciation, and it is in agreement with the regional chronological picture (Blake, 1975a). Some shells were pitted but few had incrustations. Most of the shells collected were from below the ground surface, thus lichen growth was not a problem. The shells were wet when collected and were dried in an electric oven in Ottawa. Date based on one 3-day count in the 2-litre counter.

Bathurst Island

Goodsir Inlet series (II)

Marine pelecypod shells and peat from a creek 7.5 km southwest of Goodsir Inlet, Bathurst Island, N.W.T. (75°43'N, 98°09'W), at an altitude of ca. 67 to 70 m. Collected 1963 by W. Blake, Jr.

GSC-178-2. Goodsir Inlet, peat (II) >51 000

Peat (sample BS-350-63; 100 g) from approximately the top 5 cm of a mass of peat exposed in the 1.5 m-high bank of a creek, at an altitude of ca. 70 m. The sample is overlain by ca. 60 cm of material, including till or colluvium, sand, and sandy silt.

Comment (W. Blake, Jr.): the peat, which was damp when collected, contained an assemblage of mosses typical of moss bog tundra (Brassard and Steere, 1968; M. Kuc. pers. comm., 1969). An earlier determination gave an age of >35 000 years (GSC-178; Blake, 1964; GSC IV, 1965, p. 40) for this material which may have been transported by glacier ice. The presence of both ground and diving beetles in the peat (identified by J.V. Matthews, Jr.) suggests that warmer conditions may have prevailed when the peat was being deposited (Blake, 1974b). Pretreatment included 1 hour in hot 2 per cent NaOH, 1 hour in hot 4N HCl, and distilled water rinses. Date based on one 1-day count and one 3-day count in the 5-litre counter at 4 atm.

GSC-1879. Goodsir Inlet, shells (II) >19 000

Marine shell fragments (sample BS-351-63; 2 large thick pieces and 10 small bits; total weight 2.3 g) from till(?)-colluvium(?) adjacent to peat of GSC-178-2, at an altitude of ca. 70 m. Probably some fragments were *Hiatella arctica,* others may have been *Mya* sp; none were definitely *Astarte* sp. or *Macoma* sp.

Comment (W. Blake, Jr.): the shells probably correspond to undated fragments collected on top of the ridge to the west and to a similar site 5 km to the north where a date of 25 000 ± 500 years was obtained (GSC-166; Blake, 1964; GSC IV, 1965, p. 40). Due to the small sample size, the HCl-leach was omitted. Sample mixed with dead gas for counting. Date based on one 4-day count in the 2-litre counter.

GSC-1873. Goodsir Inlet, shells (III) 8220 ± 90 6270 B.C.

Marine shells (sample BS-353-63; 28.8 g; *Mya truncata;* identified by W. Blake, Jr.) from the creek bed at an altitude of ca. 67 to 69 m. Only thin valves, all with some periostracum intact, were submitted for dating. Most fragments had clean interiors, but a few had thin algal(?) crusts and were discoloured. The sample comprised one whole valve (5.2 cm long), 9 posterior ends, and other bits.

Comment (W. Blake, Jr.): this age determination verifies an earlier date of 8440 ± 150 years (GSC-377; GSC VI, 1967, p. 190; Blake, 1974a) on shells from the ground surface, at an altitude of ca. 73 to 76 m, on the north side of Polar Bear Pass, 9 km northwest of the Goodsir Inlet site. Together the two determinations indicate that glacier ice must have persisted later in Polar Bear Pass than on the outer coasts of Bathurst Island. Date based on two 1-day counts in the 2-litre counter.

Scoresby Hills series (II)

Peat from deposits exposed along streams in the Scoresby Hills. Collected 1963 by W. Blake, Jr.

GSC-1878. Scoresby Hills, 85 m >38 000

Surface peat, typical of wet tundra (sample BS-420-63; 21.4 g), exposed where a stream flows from a pond, 15 km west-southwest of Rapid Point and 8.5 km northwest of the northwest shore of Goodsir Inlet, Bathurst Island, N.W.T. (75°49'N, 98°03'W), at an altitude of ca. 85 m.

Comment (W. Blake, Jr.): the peat was dry when collected, and it occurred in compact masses of pure peat (no inorganic layers included) which were covered in part by till or till-like material. Solifluction was active on the slope above. The dominant moss constituent was *Scorpidium scorpioides,* and *Drepanocladus exannulatus* also was common (identified by M. Kuc). Both mosses are typical of a wet tundra habitat. This deposit is one of several on Bathurst Island which predate the last glaciation (Blake, 1974b). Since the mosses are typical of those growing at the borders of a pond or in permanently flooded depressions, it would appear that a pond such as the one nearby at present has existed in the past also. Date based on one 3-day count in the 5-litre counter.

GSC-1887. Scoresby Hills, 90-120 m 8420 ± 80 6470 B.C.

Peat (sample BS-427-63; 100.0 g) from hummocks 2.4 to 2.7 m high exposed by erosion along a stream 14 km west-southwest of Rapid Point and 10 km northwest of the northwest shore of Goodsir Inlet. Bathurst Island, N.W.T (75°50.5'N, 98°02.5'W), at an altitude of >90 m but <120 m (based on topographic map sheet 68 H, contour interval 100 feet (30 m)).

Comment (W. Blake, Jr.): the peat was dry when collected. Unlike GSC-1878 (this series), the sample used for GSC-1887 contained much interbedded fine sand, and the peat was overlain by brownish sand-silt. The sample was composed almost completely of *Drepanocladus latifolius* (identified by M. Kuc), a moss typical of an aquatic or semi-aquatic habitat. The date shows that there are also extensive peat deposits of postglacial age in the Scoresby Hills, cf. GSC-201, 7100 ± 140 years (GSC IV, 1965, p. 41), surface peat more than 1.5 m thick at ca. 80 m, 13.5 km to the north-northeast along Walker River. Date based on two 1-day counts in the 5-litre counter.

Caledonian River series (II)

Organic detritus in bedded sand and silt below shell-bearing silt, sand, and gravel strata of post-glacial age (Blake, 1970; GSC XI, 1971, p. 317). Site is on the north side of the Caledonian River ca. 1 km east of the head of 'Dartmouth Bight', Bracebridge Inlet, Bathurst Island, N.W.T. (75°43'N, 98°48'W). Collected 1963 by W. Blake, Jr.

GSC-1902. Caledonian River, upper organic horizon >30 000

Organic detritus (sample BS-442-63; 14.0 g) from close to the top of the bedded sand and silt unit, at an altitude of ca. 18 m.

Comment (W. Blake, Jr.): the material contains a moss assemblage typical of both mesic growth and moss bog tundra; individual moss species (identified by M. Kuc) are listed in Blake (1974b). No fragments of wood or coal were noted in this sample (J.V. Matthews, Jr., pers. comm., 1973). NaOH-leach omitted from the pretreatment of this sample. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2-litre counter.

GSC-784. Caledonian River, lower organic horizon >43 000

Carbonized wood and plant fragments (sample BS-443-63; 6.5 g) from ca. 0.9 m below the top of the bedded sand and silt unit, at an altitude of ca. 17 m.

Comment (W. Blake, Jr.): as with GSC-1902, slightly higher in the section, this sample includes a moss assemblage typical of both mesic growth and moss bog tundra; individual moss species (identified by M. Kuc) are listed in Blake (1974b). J.V. Matthews, Jr. (pers. comm., 1973) noted an abundance of small fragments of coal as well as wood fragments that appeared to be of coniferous type in the sample, and this 'old' material may have affected the age value obtained. Both of the organic detritus horizons also contained a single fragment of a ground beetle (identified by J.V. Matthews, Jr.; cf. Blake, 1974b). NaOH-leach omitted from pretreatment of this sample. Date based on one 3-day count in the 2-litre counter.

Stuart River series (II)

Marine pelecypod shells, driftwood, and peat from a terrace on the south side of the Stuart River valley, ca. 9 km east-northeast from the head of Stuart Bay and 1 km west-southwest of the mouth of Cut Through Creek, Bathurst Island, N.W.T. (76°11.2'N, 99°07'W). Collected 1963 by W. Blake, Jr.

GSC-1566.	Stuart River, driftwood	8380 ± 110 6430 B.C.

Small piece of driftwood (sample BS-17-63; 14 by 2.5 by 1 cm; 5.2 g; identified as *Picea* sp. by R.J. Mott) from the surface of a terrace (sample not imbedded) at an elevation above 73 m but below 85 m.

Comment (W. Blake, Jr.): this sample is as old as any postglacial driftwood discovered so far in the Queen Elizabeth Islands (Blake, 1972). The date was incorrectly given as 8370 ± 110 in Blake (1974b); the reduced error term reported there and used now is due to recalculation as explained in the introduction to this paper and in Lowdon and Blake (1973). Sample mixed with dead gas for counting. Date based on one 3-day count in the 5-litre counter.

GSC-1854.	Stuart River, shells (II)	8670 ± 100 6720 B.C.

Fragments of marine pelecypod shells (sample BS-13-63; 47.2 g; *Mya truncata;* identified by W. Blake, Jr.), from the surface of, and imbedded in, silt overlying peat deposits interpreted as being of interglacial age (*see* GSC-165-2, this series). Sample collected at an altitude of ca. 73 m (possibly lower as indicated by preliminary calculations from 1975 altimetry).

Comment (W. Blake, Jr.): sample dated to confirm the postglacial age of the silt (sand: silt: clay ratio = 2: 77: 21; Blake, 1974b). The date is in agreement with an earlier determination on *Hiatella arctica* and *Mya truncata* shells from the shaly slope south of the terrace at an altitude of close to 100 m: GSC-164, 9040 ± 170 years old (Blake, 1964; GSC IV, 1965, p. 40). Date based on two 1-day counts in the 5-litre counter.

GSC-165-2.	Stuart River, peat (II)	>50 000

Uppermost 2.5 cm of peat (samples BS-7-63 and BS-368-63; 200 g) from a unit over 1 m thick. Exposed along the east wall of a gully cut through the terrace on which GSC-1566 and -1854 (this series) were collected, at an altitude probably less than 60 m (65 to 70 m given in Blake, 1974b). The upper surface of the peat contained imbedded shale pebbles and was overlain by postglacial marine silt.

Comment (W. Blake, Jr.): an earlier determination of this thin peat horizon gave a value of >36 000 years (GSC-165; Blake, 1964; GSC IV, 1965, p. 40). The peat, which was dry when collected 2.5 to 5 cm behind the naturally exposed face, contained mosses representative of moss bog tundra i.e., *Calliergon giganteum, C. richardsonii, Drepanocladus revolvens, D.* cf. *exannulatus* (identified by M. Kuc; cf. also Brassard and Steere, 1968). Three species of water beetles (identified by J.V. Matthews, Jr.) occurred in this uppermost peat, and other insect remains occurred lower in the section. Because of this, plus the presence of mosses and vascular plants which together suggest an environment more favourable than that existing at present, the organic deposits at this site were assigned to the Stuart River Interglaciation (Blake, 1974b). Sample pretreatment included one hour in hot 2 per cent NaOH, 1 hour in hot 4N HCl, and distilled water rinses. Date based on one 3-day count in the 5-litre counter at 4 atm.

Helena Island

GSC-811.	Helena Island, south coast	>32 000

Organic detritus (sample BS-209-63; 12.0 g) typical of a dry tundra habitat, including *Dryas integrifolia, Salix* sp. *(arctica?)*, and mosses *(Ditrichum flexicaule, Drepanocladus uncinatus, Hypnum* sp. cf. *fastigiatum,* and *Rhacomitrium lanuginosum;* all identifed by M. Kuc) in deltaic sands on the east side of a stream mouth on the south coast of Helena Island, N.W.T. (76°38.5'N, 100°45'W), at an altitude of ca. 8 m. This organic-rich layer is the upper of two; the enclosing sands are overlain in turn by silt and beach shingle. Collected 1963 by W. Blake, Jr.

Comment (W. Blake, Jr.): this collection was expected to be of postglacial age, rather than 'old', but a number of other 'greater than' ages have been obtained from Bathurst Island and from other localities in the Queen Elizabeth Islands (Blake, 1974b). Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2-litre counter.

United States of America

Michigan

GSC-1740. South Haven — 10 900 ± 160; 8950 B.C.; $\delta^{13}C = -24.6‰$

Distorted and highly compressed wood (sample South Haven A; 12.0 g; appears most like *Picea-Larix* type; identified by R.J. Mott) from the base of a 0.6 m-thick peat layer covered by 3 m dune sand. Sample is from the end of 18th Avenue, off 77th Street, off Van Buren County Road A-2; SW ¼ NW ¼, sec. 28, tp. 1S, rge; 17W; in a bluff on the east shore of Lake Michigan at South Haven, Michigan (42°21'13"N, 86°18'04"W), at an altitude of 179 m. The peat and wood layer is underlain by lacustrine(?) sand. Collected 1972 by P.F. Karrow, University of Waterloo, Waterloo, and D.F. Eschman, University of Michigan, Ann Arbor.

Comment (P.F. Karrow): previously published dates on wood and peat from South Haven (Zumberge and Potzger, 1956), which ranged from 6440 ± 230 years (C-848; Chicago V, 1954, p. 735) to 9500 ± 250 years (Y-293A; Yale II, 1955, p. 958), seemed too young by a few thousand years according to modern pollen chronology (Karrow *et al.*, 1975). The new date confirms this suspicion and suggests that peat formation took place during the main Algonquin Lake stage as dated in Ontario.

Comment (W. Blake, Jr.): the wood was very wet on receipt. During drying for three days in June 1972 its weight decreased from 198 g to 50 g. The sample was picked over carefully by hand to avoid obvious rootlets, and all outside wood (some of which had a peculiar black lustre and shard-like fracture) was removed. Date based on one 3-day count in the 5-litre counter.

Washington

GSC-2131. Point Roberts — >47 000

Wood (sample 229-1; 41.5 g) from a coastal bluff on the east side of Point Roberts Peninsula, Washington, about 2 km south of the International Boundary (48°58'47"N, 123°01'25"W), at an altitude of ca. 7 m. The sample was collected from channel fill deposits within a subtill sand section. The channel is cut into horizontally bedded sand (up to 8 m thick), is filled with sand and gravel, and is overlain by cross-bedded and horizontally bedded sand (about 35 m thick). The latter unit is capped by till. Collected 1974 by J.J. Clague.

Comment (J.J. Clague): if the wood is not reworked from older deposits, the date indicates that the subtill sands at Point Roberts are older than the Quadra sediments at Point Grey, British Columbia (49°15'55"N, 123°15'47"W). The Quadra sediments at Point Grey have yielded dates of 24 500 ± 500 years (GSC-108) and 25 100 ± 600 years (GSC-109; both in GSC II, 1963, p. 47-48; see also Armstrong *et al.*, 1965; Fulton, 1971) and 26 100 ± 320 years (GSC-1635; GSC XIII, 1973, p. 27). GSC-2131 is in agreement with I-1385 (>35 000 years; Easterbrook, 1969) from the same site. Date based on two 3-day counts in the 5-litre counter at 4 atm.

Comment (W. Blake, Jr.): according to L.D. Farley-Gill (unpublished GSC Wood Identification Report No. 74-63) the wood was highly compressed and lignified; preservation was too poor to allow identification, but the wood appeared to be coniferous. Two samples of wood were submitted to the laboratory, but only the larger (160.5 g wet) was used for dating. It was 21 cm long, had a maximum width of 8 cm and a maximum thickness of 2 cm. The sample was dried in an electric oven at GSC, Ottawa; then all the outside wood and adhering sand was scraped off. The wood appeared coaly in cross-section and had a conchoidal fracture.

Norway

GSC-2116. Hensmoen 2 — >48 000

Wood (sample TN-1968-wood; 38.0 g), probably *Picea* sp. (identified by R.J. Mott) from a sand pit at Hensmoen, Ringerike, Buskerud, Norway (60°14'N, 10°13'E), at an altitude of 190 m. Collected 1968 by L. Kjemperud (operator of the sand pit); submitted to the Radiological Dating Laboratory, Trondheim, by T. Nygård and K. Henningsmoen, Universitetet, i Oslo, Oslo; then submitted to GSC by R. Nydal, Radiological Dating Laboratory, Trondheim.

Comment (W. Blake, Jr.): this sample was submitted as part of GSC's continuing program of inter-laboratory cross-checking, especially of samples in the 40 000 to 50 000 year range. The dry and well preserved wood, part of the same sample used by Trondheim for T-743/II, was determined to be >47 000 years old by that laboratory (date calculated with a confidence limit of 2σ; Trondheim VII, 1975, p. 365-366). The new determinations from this site are important, for a spruce stump collected earlier from the same sand pit in the ice-marginal delta at Hensmoen-Jytmoen had been dated at $48\,000 \pm {}^{4000}_{2000}$ (T-743; Trondheim V, 1970, p. 215-216; cf. also Sollid, 1969 and Lundqvist, 1974). It would now appear, as stated by the Trondheim laboratory (1975) in their comment on T-743/II, that both pieces of wood are probably of the same age and that the activity found in T-743 might not have been real. Pretreatment of the sample used for GSC-2116 included one hour in hot NaOH and one hour in hot HCl. The date was based on one 1-day, one 2-day, and one 3-day count in the 5-litre counter at 4 atm.

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INDEX

*Two determinations on the same sample.