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J.A. LOWDON
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Canada

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The present date list, GSC XX, is the ninth 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.

GEOLOGICAL SURVEY OF CANADA RADIOCARBON DATES XX

Abstract

This list includes 121 radiocarbon age determinations on 112 geological samples made by the Radiocarbon Dating Laboratory. They are on samples from various areas as follows: Newfoundland (2); Labrador (1); Nova Scotia (1); New Brunswick (2); Quebec (14); Ontario (6); Saskatchewan (1); Alberta (1); British Columbia (18); Yukon Territory (12); Northwest Territories, Mainland (12); Northwest Territories, Arctic Archipelago (43); Svalbard (8). Age determinations on archeological samples are as follows: Labrador (1); Ontario (1); British Columbia (2). Details of background and standard for the 2 L and 5 L counters during the period from October 3, 1979 to November 4, 1980 are summarized in Tables 1 and 2; Table 3 gives the number of counts used to determine the average background and standard counting rates; and Table 4 lists the number of different background and standard gas preparations used for counting.

Résumé

Ce rapport présente les résultats de 121 datations effectuées sur 112 échantillons géologiques par le Laboratorie de datation au radiocarbone. Ces échantillons proviennent des régions suivantes: Ile de Terre-Neuve (2); Labrador (1); Nouvelle-Ecosse (1); Nouveau-Brunswick (2); Québec (14); Ontario (6); Saskatchewan (1); Alberta (1); Colombie-Britannique (18); Yukon (12); Territoires du Nord-Ouest, continent (12); Territoires du Nord-Ouest, archipel Arctique (43); Svalbard (8). Les datations effectuées sur échantillons archéologiques sont: Labrador (1); Ontario (1); Columbie-Britannique (2). Les valeurs de mouvement propre et de l'étalonnage des compteurs 2 L et 5 L, pour la période allant du 3 octobre 1979 au 4 novembre 1980, sont présentées dans les tableaux 1 et 2; le tableau 3 donne le nombre de coups utilisés pour déterminer la moyenne des taux d'impulsions du mouvement propre et de l'étalonnage; et, le tableau 4 donne le nombre de préparations de gaz pour le mouvement propre et pour l'étalonnage utilisées pour le comptage.

INTRODUCTION[1]

During the period covered by this introduction (October 1979 through October 1980) the 5 L counter (Dyck et al., 1965) was operated for the entire 13 months. In the same period, approximately 6 weeks of counting time was lost for the 2 L counter (Dyck and Fyles, 1962) due to various problems described below.

At the start of October 1979 the 2 L background rose from the September average of 1.27 to approximately 1.67 counts/minute (c/m). Two weeks were spent in testing the electronic equipment (guard tubes, anticoincidence circuit). The problem turned out to be an intermittently noisy pre-amplifier board.

Problems again occurred towards the end of April when the background rose to approximately 2.0 c/m. The counter was removed from the "castle" and washed with an acetone-distilled water mixture. This treatment, although successful in the past (Lowdon and Blake, 1978), did not reduce the background; because the background was steady at about 1.9 c/m, it was decided to continue to date samples. At the beginning of June, however, the background suddenly increased to the unacceptable level of 4.0 c/m, again due to electronic problems which were not solved until the end of the month. At the beginning of October 1980 the background again rose to over 2.0 c/m. The pre-amplifier board was cleaned and several joints were re-soldered. This resulted in the lower background for October.

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, all counting rates were within statistical limits. Table 3 lists the number of daily counts used to determine the average background and standard counting rates that were utilized for age

Table 1. Background (c/m)* for Periods Used for Age Calculations October 3, 1979 to November 4, 1980

PERIOD	2 L COUNTER (2 atm)	5 L COUNTER (1 atm)
October 1979	-	2.213 ± 0.026
October 15-November 9	1.369 ± 0.031	-
November 9-December6	1.399 ± 0.037	-
November	-	2.218 ± 0.046
December	1.433 ± 0.025	2.192 ± 0.032
January 1980	1.359 ± 0.035	2.262 ± 0.025
February	1.391 ± 0.048	2.266 ± 0.025
March	1.398 ± 0.037	2.285 ± 0.043
April	1.433 ± 0.026	2.251 ± 0.026
May	1.925 ± 0.023	2.291 ± 0.026
June	-	2.294 ± 0.030
July	1.214 ± 0.021	2.192 ± 0.037
August	1.230 ± 0.035	2.207 ± 0.037
September	1.258 ± 0.023	2.161 ± 0.032
October	1.110 ± 0.018	2.190 ± 0.033

*c/m = counts per minute

Table 2. Standard, N_o*, (c/m) for Periods Used for Age Calculations October 3, 1979 to November 4, 1980

PERIOD	2 L COUNTER (2 atm)	5 L COUNTER (1 atm)
October 1979	-	28.023 ± 0.140
October 15-November 9	18.252 ± 0.102	-
November 9-December 6	18.142 ± 0.101	-
November	-	27.805 ± 0.130
December	18.267 ± 0.097	27.931 ± 0.121
January 1980	18.152 ± 0.104	28.061 ± 0.126
February	18.173 ± 0.117	27.969 ± 0.118
March	18.167 ± 0.101	27.744 ± 0.124
April	18.135 ± 0.093	27.738 ± 0.140
May	19.186 ± 0.101	17.649 ± 0.116
June	-	27.805 ± 0.121
July	18.396 ± 0.096	27.840 ± 0.193
August	18.377 ± 0.098	28.108 ± 0.147
September	18.386 ± 0.136	28.223 ± 0.116
October	18.586 ± 0.179	28.095 ± 0.099

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

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

Table 3. Number of Counts Used to Determine Average Background and Standard Counting Rates for Periods Listed

PERIOD	2 L BACKGROUND	5 L BACKGROUND	2 L STANDARD	5 L STANDARD
October 1979	-	4	-	3
October 15-November 9	5	-	3	-
November 9-December 6	5	-	3	-
November	-	4	-	3
December	4	4	3	3
January 1980	4	4	3	3
February	5	5	3	3
March	4	4	3	3
April	3	4	2	2
May	4	5	2	3
June	-	4	-	3
July	4	3	3	3
August	3	4	3	3
September	4	4	3	3
October	4	4	3	4

Table 4. Number of Different Background and Standard Gas Preparations Used for Counting for Periods Listed

PERIOD	2 L BACKGROUND	5 L BACKGROUND	2 L STANDARD	5 L STANDARD
October 1979	-	2	-	2
October 15-November 9	2	-	3	-
November 9-December 6	2	-	2	-
November	-	3	-	2
December	2	2	2	2
January 1980	3	3	2	2
February	3	3	2	2
March	3	2	2	2
April	2	3	2	2
May	2	2	2	1
June	-	2	-	2
July	2	2	2	2
August	2	2	2	2
September	2	3	2	2
October	2	2	2	2

calculations during the periods listed. Table 4 lists the number of different background and standard gas preparations used for counting during the same periods.

Sample gas preparation and purification are carried out as described in Lowdon et al. (1977). Carbon dioxide gas proportional counting techniques have been discussed by Dyck (1967).

Age calculations are carried out by a CDC Cyber 70 Series/Model 74 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. 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., 1977). Finite dates are based on the 2σ criterion (95.5% probability) and "infinite" dates on the 4σ criterion (99.9% probability).

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 has been reported. Related to the PDB standard, the "normal" values used for correction are $\delta^{13}C$ = -25.0‰ for wood, other terrestrial organic materials, and bones (terrestrial and marine), and 0.0‰ for marine shells. All determinations were made on aliquots of the same sample gas used for age determinations. Since 1975 most $^{13}C/^{12}C$ ratios have been determined at the Department of Earth Sciences University of Waterloo, Ontario (under a series of contracts supervised by Professor P. Fritz and R.J. Drimmie). Carbon ratio determinations were carried out by the following laboratories:

Teledyne Isotopes, Westwood, New Jersey (under contract) for
GSC-979, -980, -980-2, -1021, -1021-2, -1227;

GSC Geochronology Section (Head, R.K. Wanless) for
GSC-979-3, -1021-3, -1227-2, -1498, -1498-2, -1521, -1556, -1691, -1728, -1786, -1787, -1824, -1871, -1888, -1889, -1951;

Department of Earth Sciences, University of Waterloo, Waterloo, Ontario (under a series of contracts supervised by Professor P. Fritz and R.J. Drimmie) for
GSC-1498-3, -1963, -2099, -2106, -2110, -2122, -2125, -2160, -2246, -2250, -2260, -2413, -2441, -2470, -2545, -2590, -2614, -2633, -2654, -2673, -2763, -2769, -2777, -2797, -2863, -2878, -2886, -2888, -2946; and

Waterloo Isotope Analysts Inc., Kitchener, Ontario (under contract; R.J. Drimmie, chief analyst) for
GSC-2220, -2936, -2942, -2965, -2970, -3076.

Acknowledgments

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GEOLOGICAL SAMPLES

Eastern Canada

Newfoundland

GSC-2936. Trout River — 12 500 ± 120; $\delta^{13}C = +0.5‰$

Marine pelecypod shells (sample 79-1; 24.9 g; **Mya truncata;** identified by I.A. Brookes) from massive, moderately strong glaciomarine mud, sampled in a roadcut 1.05 km southeast of Trout River post office, Newfoundland (49°28.5'N, 58°06.5'W), at an elevation of 60 m. Collected 1979 by I.A. Brookes[1], York University, Toronto.

Comment (I.A. Brookes): The date records late Wisconsin marine submergence of an isostatically depressed coastal zone during wastage of a piedmont glacier tongue fed from Trout River ponds trough to the southeast of the site. Submergence slightly exceeded 70 m, the elevation at which deltaic sediments overlying the shelly mud pass abruptly laterally into lodgment till. The date supersedes GSC-2487 (11 900 ± 160 years, 27 m elevation; GSC XVIII, 1978, p. 3) as a date on marine limit and corroborates the opinion of Brookes (1974) that marine limit here is approximately 70 m.

Comment (W. Blake, Jr.): The well preserved aragonitic shells (two pairs plus four left valves, one intact and three fragments, but all exhibiting the typical truncated posterior end) all retained some periostracum and several had internal lustre. The five small valves were all <4 cm long, the large ones were >5 cm. Because of the small sample size (**Mya arenaria, Macoma calcarea,** and **Hiatella arctica** present were not used for dating), only the outer 10 per cent was removed by HCl leach. Date based on one 3-day count in the 2 L counter.

GSC-2942. Rope Cove Brook — 13 700 ± 340; $\delta^{13}C = +0.8‰$

Marine pelecypod shells (sample 79-2; 7.5 g; **Mya arenaria;** identified by I.A. Brookes) from a grey, massive, moderately stony marine mud, sampled at an elevation of 40 m in the lower part of the eroding right bank of Rope Cove Brook, 35 km at 262° (true) from the western boundary of Corner Brook, Newfoundland (48°55'N, 58°29'W). Collected 1979 by I.A. Brookes.

Comment (I.A. Brookes): The shelly mud is overlain by a sequence of silt, sand, and gravel that coarsens upwards, beneath a gently seaward-sloping outwash delta. This delta was prograded by meltwater streams issuing from a valley glacier in Rope Cove Canyon to the south-southeast. The delta surface abuts an end moraine at the canyon mouth at 70 to 75 m a.s.l. and is cut distally by a prominent abandoned sea cliff, the base of which stands at an elevation of 40 m. The date records initial marine submergence to at least 70 m of an isostatically depressed coastal lowland following glacier retreat inland from an undetermined limit to seaward. Subsequent emergence was interrupted by a major transgression to 40 m which eroded the distal face of the delta. This interpretation supersedes that given in Brookes (1974) in which the surface was identified as an outwash fan.

Comment (W. Blake, Jr.): The aragonitic shells utilized comprised one left and one right valve (perhaps a pair) plus fragments that were probably **Mya arenaria (Hiatella arctica** and **Mya truncata** were present also but were not used for dating). The shells were thin (all <1 mm and most <0.5 mm) and clean; most fragments retained some periostracum. Because of the small sample size, only the outer 10 per cent was removed by HCl leach. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

Labrador

GSC-2970. Northwest River — 7600 ± 100; $\delta^{13}C = +0.8‰$

Barnacle shells (sample 79-RHF#5; 26.7 g; **Balanus hameri;** identified by F.J.E. Wagner) from the south side of the river in a bluff above a bridge construction site, Northwest River, Labrador (53°31.5'N, 60°09.0'W), at an elevation of 27 to 28 m. The enclosing sediment was a compact marine mud. The sample was taken 2.5 m down the face of a borrow pit, immediately below an unconformity which was overlain by deposits containing abundant mussels (**Mytilus edulis**). A bouldery, cobbly layer 1 to 2 m below the dated horizon also contains marine fossils. Collected 1979 by R.H. Fillon.

Comment (R.H. Fillon): The borrow pit was cut into the top part of a moraine ridge (Blake, 1956). The dated shells occur in a unit that gives structural evidence of postdepositional folding and low angle thrusting.

Comment (W. Blake, Jr.): A previous determination on fragments of **Mytilus edulis** from a borrow pit northwest of the school at about 33 m above high-water mark gave a value of 5330 ± 170 years (GSC-1135; GSC XI, 1971, p. 263). **Balanus hameri** lives in deeper water than **Mytilus edulis,** and GSC-2970 may represent the oldest age yet obtained on marine shells from the western end of Lake Melville; cf. GSC-1254 (7490 ± 150 years, GSC XV, 1975, p. 7) on **Hiatella arctica** collected by D.A. Hodgson close to sea level near Muskrat Falls on Churchill River. The material used for dating consisted of eight fragments, the largest being 8.8 cm long and the widest piece, 3.3 cm. The shells are dominantly calcite with traces of rhodochrosite and quartz. Date based on two 1-day counts in the 2 L counter.

Nova Scotia

GSC-2694. Miller Creek — >52 000

Wood (sample Miller Creek 2; 50.2 g; **Pinus banksiana;** identified by R.J. Mott) with peat in a laminated clay (<1 m thick) which underlies 2 m of sand and gravel, 22 to 25 m of greyish red calcareous till (East Milford till), and 2 to 3 m of till grading into a B subzone soil. The wood-bearing clay overlies 1 to 2 m of peat with wood, 2 m of varved clay, and 2 to 4 m of grey-brown gypsiferous till that exhibits a soil horizon at the peat-till contact. The lower till is underlain by gypsum bedrock in the Miller Creek gypsum quarry (Fundy Gypsum Company), 10 km northeast of Windsor, Hants County, Nova Scotia (45°00'50"N, 64°02'40"W), at an

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

elevation of 15 m. Collected 1978 by R. Stea, J. Fowler, and D. Hemsworth, Nova Scotia Department of Mines and Energy, Halifax.

Comment (R. Stea): The section appears similar to the section exposed at East Milford in the National Gypsum Company quarry, described by W. Take (in Prest et al., 1972) and Mörner (1973).

Comment (R.J. Mott): Although the organic beds at Miller Creek and East Milford are correlative based on their stratigraphic position (Stea and Hemsworth, 1979), their contained pollen spectra differ markedly. The Miller Creek organic bed contains a pollen assemblage dominated by pine pollen with only small amounts of pollen from other trees, shrubs, and herbs (R.J. Mott, unpublished GSC Palynological Report, No. 78-10). The spectra at East Milford show successive dominance by beech and other hardwood genera, birch, balsam fir and spruce, and alder pollen with only minor amounts of pine pollen (Mott et al., 1980). The organic beds, therefore, cannot be correlated palynologically. More pollen work is required, especially at the Miller Creek site where only a single sample was analyzed, before the relationship between these two sites can be resolved.

Comment (W. Blake, Jr.): This quarry is the one from which MacNeill (1969) reported a date of 33 200 ± 2000 years (I-3237) on wood from beneath 21 m of till. GSC-2694 does not support the finite date, as was the case at Addington Forks; there **Juniperus** wood in peat beneath 6 m of till was >42 000 years old, whereas MacNeill (1969) reported an age of $33\,700^{+2300}_{-1800}$ (I-3236) from the same site (GSC XIII, 1973, p. 10-11).

New Brunswick

Grand Manan Island Series

GSC-2718. White Head Island 3330 ± 60

Tree root (sample Legget-1977-2a; 11.5 g; **Larix laricina**; identified by R.J. Mott) from a typical submerged forest at Long Point Beach, White Head Island, Grand Manan Island, New Brunswick (44°37.17'N, 66°42.42'W), at an estimated elevation of 4 m below high water on spring tides (HWOST). The dated wood is from one of several stumps rooted in till. Collected 1977 by R.F. Legget, Ottawa.

GSC-2777. Grand Manan Island 13 000 ± 380
$\delta^{13}C = +0.1‰$

Pelecypod shells (sample Legget-1977-9; 13.0 g; **Macoma calcarea**; identified by Mrs. M.F.I. Smith, National Museum of Natural Sciences, Ottawa) from sand 30 cm above the upper surface of red clay till at Red Point Beach, Grand Manan Island, New Brunswick (44°38.9'N, 66°48.9'W), at approximately 4 m above HWOST. Collected 1977 and 1978 by R.F. Legget, but only the 1978 portion was used for dating.

Comment (W. Blake, Jr.): As the collector has stated (Legget, 1980), the dates are in close agreement with the sea level curve for the Maritime Provinces presented by Grant (1975). For GSC-2718 the outside of the firm, dry wood, with borings and some attached algae, was cut away from the sample, which was 69 cm long and in cross-section tapered from 4 by 1.5 cm at one end to 1 by 0.7 cm at the other. The wood had a resinous smell when cut. The shells in GSC-2777 were well preserved, although somewhat abraded. Other species present included **Hiatella arctica** and **Mya truncata.** GSC-2718 based on two 1-day counts in the 5 L counter. Because of the small size of GSC-2777, only the outer 10 per cent was removed by HCl leach; sample mixed with dead gas for counting and date based on two 1-day counts in the 2 L counter.

Quebec

GSC-2703. Calumet 11 100 ± 120

Marine pelecypod shells (sample RAB-77-36; 26.9 g; **Macoma balthica**, identified by S.H. Richard) from a sand pit in a beach deposit of the Champlain Sea located 3 km north of Calumet, Argenteuil County, Quebec (45°40'30"N, 74°37'45"W), at an elevation of 160 m. Collected 1977 and 1978 by S.H. Richard, but only the 1978 collection was used for dating.

Comment (S.H. Richard): GSC-2703 provides a minimum age for deglaciation of the southern part of the Laurentian Highlands in the Grenville region and marine inundation along the northern rim of the western Champlain Sea basin (Richard, 1980). This fossiliferous beach deposit lies fairly close to marine limit. The upper part of the deposit, at about 175 m a.s.l., is the highest marine material found in this area and is believed to represent marine limit in Calumet valley north of Calumet. Some 37 km north of Calumet, however, the northern limit of the area filled with marine sediments in Rouge valley is found at Huberdeau and Arundel, where marine limit, determined from the elevation of the highest deltaic deposits, is believed to be at 210 to 215 m a.s.l. (no shells were found). Northwards, a nonfossiliferous pitted outwash valley train above marine limit fills the Rouge valley floor.

This date (GSC-2703) is the oldest for postglacial marine submergence in the small valleys dissecting the major bedrock escarpment forming the southern margin of the Laurentian Highlands between Grenville and Papineauville. It is the same age as GSC-2590 (11 100 ± 120 years; this list), on **Hiatella arctica** shells collected near Montebello in a small unnamed valley 25 km west of Calumet; those shells were found in a similar beach deposit at ca. 167 m a.s.l., close to marine limit (Richard, 1980). It is also similar in age to GSC-2296 (11 200 ± 90 years; GSC XIX, 1979, p. 10) on **Hiatella arctica** shells from a Champlain Sea beach near marine limit at approximately 160 m elevation on Rigaud Mountain, Quebec; this mountain was an island in the central part of the marine basin after its deglaciation (Richard, 1978).

Comment (W. Blake, Jr.): This determination is on the easternmost of a series of new collections made in 1977 and 1978 by S.H. Richard in the area between Lachute and Gatineau River. The site is south of the position of the St. Narcisse moraine, constructed approximately 11 000 years ago (LaSalle and Elson, 1975). The aragonitic shells comprising the sample were cleaned using distilled water in a sonic bath and then were oven dried. A total of 262 whole and fragmented valves was selected for dating. The largest whole valve measured 2.1 by 1.6 cm, the smallest was 0.9 by 0.8 cm. The shells were thin and fragile, with some pitting, chalkiness, and iron stains. Date based on two 1-day counts in the 2 L counter. The $^{13}C/^{12}C$ sample was lost at the University of Waterloo.

GSC-2590. Montebello 11 100 ± 120
$\delta^{13}C = +2.3‰$

Marine pelecypod shells (sample RAB-77-34; 28.6 g; **Hiatella arctica**, identified by S.H. Richard) from a sand pit in a Champlain Sea beach deposit 5 km north of Montebello, Papineau County, Quebec (45°41'35"N, 74°56'45"W), at an elevation of approximately 167 m. Collected 1977 by S.H. Richard.

Comment (S.H. Richard): GSC-2590 provides a minimum age for deglaciation of the southern part of the Laurentian Highlands in the Montebello region and for marine submergence along this segment of the northern rim of the western Champlain Sea basin (Richard, 1980).

The upper part of the deposit, at about 172 m a.s.l., is the highest marine material found in the area and is believed to represent marine limit in this small unnamed valley north of Montebello. Some 27 km north of Montebello, however, the northern limit of the area filled with marine sediments in Petite rivière Rouge and Petite rivière Rouge Est valleys is found south and east of Namur, where marine limit determined from the elevation of the highest deltaic deposits (marine shells were not found) is believed to be about 205 to 210 m a.s.l. To the north, in the Namur and Sainte-Emile-de-Suffolk area, a nonfossiliferous pitted outwash valley train above marine limit fills the floor of these two valleys.

This date (GSC-2590) is the oldest for postglacial marine submergence in the small valleys dissecting the major bedrock escarpment forming the southern margin of the Laurentian Highlands between Rouge and Petite Nation valleys. It is the same age as GSC-2703 (11 100 ± 120 years, this list) on **Macoma balthica** shells collected near Calumet in Calumet valley, 25 km east of Montebello at about the same latitude and elevation (Richard, 1980). GSC-2590 also overlaps in age with GSC-2296 (11 200 ± 90 years; GSC XIX, 1979, p. 10) for shells from a Champlain Sea beach near the marine limit at ca. 160 m on Rigaud Mountain (Richard, 1978).

Comment (W. Blake, Jr.): The sample was wet sieved to remove adhering silt and clay. Many of these well preserved shells (aragonitic but with a trace (<5%) of calcite) were paired before cleaning. Most were whole valves, the largest being 2.5 by 1.0 cm; some shells retained the periostracum. Date based on two 1-day counts in the 2 L counter.

GSC-2863. Saint-Sixte — 11 500 ± 200; $\delta^{13}C = -4.8‰$

Pelecypod shells (sample RAB-78-8; 9.3 g; **Macoma balthica,** identified by M.F.I. Smith, National Museum of Natural Sciences, Ottawa) from the eastern valley wall of the Saint-Sixte River where it has cut into Champlain Sea clay and silt deposits filling the floor of the valley, 1.5 km northeast of Saint-Sixte, Papineau County, Quebec (45°42'30"N, 75°11'40"W), at an elevation of approximately 145 m. Collected 1978 by S.H. Richard.

Comment (S.H. Richard): GSC-2863 provides a minimum age for deglaciation of Petite Nation valley as far north as Saint-Sixte and an approximate date for marine inundation along part of the northern rim of the western Champlain Sea basin (Richard, 1980). The northern limit of the area filled with marine sediments in this valley is found at Lac-Grosleau, 15 km north of Saint-Sixte, where marine limit is believed to be at 205 to 210 m a.s.l. To the north, in the Lac Viceroi area, a nonfossiliferous pitted outwash valley train fills the floor of Petite Nation valley and lies above marine limit.

This date (GSC-2863) is the oldest for postglacial marine submergence in Petite Nation valley, and the dated marine clay deposit is an offshore deep water sediment overlain by a 3 m-thick unit of shallow water or littoral marine sand deposited during the shoaling phase of the Champlain Sea; therefore, it is likely that GSC-2863 closely dates marine inundation in this valley. It is the same age as a date of 11 500 ± 210 years (GSC-2878, this list) on **Macoma balthica** shells near Mayo in Blanche valley, some 16 km southwest of Saint-Sixte; the collection there was from a similar deep water marine clay deposit at approximately 185 m a.s.l. (Richard, 1980), i.e., much closer to marine limit.

Comment (W. Blake, Jr.): The aragonitic shells were cleaned by hand, washed in a sonic bath using distilled water, and oven dried. A total of 61 valves (including 10 to 12 pairs), plus fragments, remained after cleaning. The well preserved shells were thin and fragile, with minor stains and encrustations; some retained the internal lustre and most had the periostracum intact. The largest valve was 2.2 by 1.8 cm. Only the outer 10 per cent was removed by HCl leach (small sample). Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-2878. Mayo — 11 500 ± 210; $\delta^{13}C = -0.6‰$

Pelecypod shells (sample RAB-78-12; 10.0 g; **Macoma balthica,** identified by S.H. Richard) from a roadside drainage ditch cut into grey marine clay filling the floor of a small rock basin 3 km southwest of Mayo, Papineau County, Quebec (45°38'30"N, 75°22'45"W), at an elevation of approximately 185 m. Collected 1978 by S.H. Richard.

Comment (S.H. Richard): GSC-2878 provides a minimum age for the deglaciation of Blanche valley as far north as Mayo (Richard, 1980). Marine sediments extend upvalley to north of Blanche near Lac du Goéland, 11 km north of Mayo, where marine limit, as determined from the elevation of the highest deltaic sand deposits, is about 205 to 210 m a.s.l. North of the delta and above marine limit, the floor of Blanche valley is filled with nonfossiliferous pitted outwash deposited at the front of the retreating Laurentide Ice Sheet.

GSC-2878 is the oldest date for postglacial marine submergence in Blanche valley. This dated marine clay deposit (**Hiatella arctica** was also present) is an offshore sediment deposited during an early phase of the Champlain Sea in this area, and GSC-2878 closely dates the earliest phase of marine inundation in this valley. This sample is closer to the inferred marine limit than any other in this region north of Buckingham and it is the same age as GSC-2863 (11 500 ± 200 years; this list) on **Macoma balthica** shells near Saint-Sixte in Petite Nation valley, 16 km northeast of Mayo. Preliminary sampling of the marine microfauna at this locality revealed the presence of the following species of foraminifera (identification by C.G. Rodrigues, University of Windsor, Windsor): **Elphidium excavatum** (Terquem), **Protelphidium orbiculare** (Brady), **Elphidium asklundi** (Brotzen), and **Guttulina** sp. The marine faunal assemblage inhabiting this early phase of the Champlain Sea seems to indicate that frigid climatic conditions were present in this part of the sea ca. 11 500 years ago (Richard, 1980).

Comment (W. Blake, Jr.): The shells were first cleaned by hand, then with distilled water in a sonic bath. Numerous valves still had a trace of sediment and/or encrustation adhering. Some valves, many of which were paired before cleaning, were pitted, others retained their internal lustre. Approximately 320 valves were needed to make up the 10.0 g sample. The largest whole valve measured 1.5 by 1.4 cm. Many valves had smaller pairs nestled inside. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-2763. Buckingham — 11 400 ± 140; $\delta^{13}C = +1.9‰$

Pelecypod shells (sample RAB-78-13; 19.5 g; **Hiatella arctica,** identified by S.H. Richard) from a 3 m-thick lens of dark grey stony and gritty fossiliferous marine clay or diamicton; this unit overlies 15 m of fossiliferous ice marginal outwash gravel and sand and is overlain by a 3 m-thick unit of marine sand exposed in an active gravel pit 7 km north-northwest of Buckingham, Papineau County, Quebec (45°38'50"N, 75°26'20"W), at an elevation of approximately 180 m. Collected 1978 by S.H. Richard.

Comment (S.H. Richard): The oldest ^{14}C date obtained so far for postglacial marine submergence in Lièvre valley is GSC-2769 (11 800 ± 100 years; this list); therefore, GSC-2763 does not closely date the beginning of marine inundation in this valley. This sample is approximately the same age as GSC-2878 (11 500 ± 210 years; this list) from close to the same elevation near Mayo in Blanche valley, 5 km east of the collection site for GSC-2763. Preliminary sampling of the marine microfauna at this locality revealed the presence of two species of foraminifera (identification by C.G. Rodrigues, University of Windsor, Windsor): **Elphidium excavatum** (Terquem), and **Protelphidium orbiculare** (Brady). The marine faunal assemblage inhabiting this early phase of the Champlain Sea seems to indicate that frigid climatic conditions were prevalent ca. 11 400 years ago (Richard, 1980).

The fossiliferous marine clay lens dated by GSC-2763 differs from other dated marine clay deposits for this area (GSC-2863, GSC-2878; this list), however, because it contains a large amount of stones, pebbles, and sand grains distributed throughout the silty clay. The geological event responsible for the enrichment in clasts and grit of this particular marine clay lens perched along the eastern wall of lower Lièvre valley has not been determined.

Comment (W. Blake, Jr.): The shells, many of which were whole and paired before cleaning, were separated from the bulk sample by wet sieving, and all **Macoma balthica** valves were excluded. The aragonitic **Hiatella arctica** shells then were cleaned in a sonic bath using distilled water. The shells (the largest measured 2.2 by 1.1 cm) were thin and fragile; many still retained their internal lustre. Some were characterized by iron staining, but none were pitted. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-2769. Val-des-Bois — 11 800 ± 100; $\delta^{13}C = -1.8‰$

Pelecypod shells (sample RAB-78-19-B; 45.7 g; **Macoma balthica**, identified by S.H. Richard) collected along a creek cut into a sandy beach deposit of the Champlain Sea 5 km south of Val-des-Bois, Papineau County, Quebec (45°51'30"N, 75°35'25"W), at an elevation of approximately 182 m. Collected 1978 by S.H. Richard.

Comment (S.H. Richard): GSC-2769 provides a minimum age for deglaciation of Lièvre valley as far north as Lac de l'Argile in the Val-des-Bois area and dates marine submergence along the northern rim of the western Champlain Sea basin (Richard, 1980). This sand deposit is at the northern limit of marine sediments in Lièvre valley, and the upper part of the deposit, at about 200 m a.s.l., represents the limit of postglacial marine submergence in this valley. To the north, above marine limit, nonfossiliferous pitted outwash deposited at the front of the retreating Laurentide Ice Sheet fills the valley floor.

This date is the oldest for postglacial marine submergence in Lièvre valley. It is similar to a date of 11 900 ± 160 years (GSC-1772) obtained near Martindale in Gatineau valley (some 27 km west and slightly south of Val-des-Bois) on **Macoma balthica** shells in a beach deposit at an elevation of about 175 m, near marine limit (GSC XIII, 1973, p. 17; Romanelli, 1975). It is also approximately the same age as a date of 11 800 ± 210 years (GSC-1013) near Maitland, Ontario, in upper St. Lawrence valley (GSC IX, 1970, p. 60-61) and as dates of 11 900 ± 120 years (GSC-2338) and 11 800 ± 150 years (GSC-2366) near Peru and Plattsburg, New York (GSC XIX, 1979, p. 49; Cronin, 1979) for Champlain Sea beaches near marine limit along the southern rim of the basin. **Macoma balthica** was the species utilized for dating at these three sites too.

Comment (W. Blake, Jr.): The sample was wet sieved and then cleaned in a sonic bath with distilled water to remove adhering sand and silt. Many valves were paired; the largest was 1.9 by 1.5 cm although most were in the size range of 1.5 by 1.1 cm. The aragonitic shells, commonly iron-stained and pitted, were characterized by well preserved internal lustre; 687 whole valves plus 109 fragments comprised the dated sample. Date based on one 3-day count in the 5 L counter.

Ramsay Lake Series

Organic lake sediment from a lake basin formed by bedrock and glaciofluvial sediments about 31 km northwest of Ottawa, Ontario in Gatineau Park, Quebec (45°36'00"N, 76°06'00"W). The lake is at an elevation of 200 m and has a maximum depth of 11 m. A total to 850 cm of algal gyttja overlies black, mottled gyttja and black sandy gyttja with calcareous grey sand partings and layers to a depth of 942 cm. The Livingstone sampler could not penetrate the grey sand below this depth. Collected 1972 by R.J. Mott and L.D. Farley-Gill.

GSC-2106. Ramsay Lake, 20-25 cm — 540 ± 90; $\delta^{13}C = -31.9‰$

Black algal gyttja (sample MS-72-1B; 46.8 g wet) from 20 to 25 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 L counter.

GSC-2125. Ramsay Lake, 311-316 cm — 3210 ± 90; $\delta^{13}C = -31.9‰$

Dark brown algal gyttja (sample MS-72-1E; 43.5 g wet) from 311 to 316 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 L counter.

GSC-2110. Ramsay Lake, 542.5-547.5 cm — 6420 ± 140; $\delta^{13}C = -31.1‰$

Black and dark brown algal gyttja (sample MS-72-1C; 44.5 g wet) from 542.5 to 547.5 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 L counter.

GSC-2122. Ramsay Lake, 859.5-864.5 cm — 10 200 ± 410; $\delta^{13}C = -33.6‰$

Black algal gyttja (sample MS-72-1D; 46.5 g wet) from 859.5 to 864.5 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 L counter.

GSC-1963. Ramsay Lake, 930-942 cm — 10 800 ± 180; $\delta^{13}C = -27.6‰$

Basal sandy gyttja and sand (sample MS-72-1; 128 g wet) from 930 to 942 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 L counter.

Comment (R.J. Mott): Even though Ramsay Lake basin was at or above the Champlain Sea limit in the area, the basal date, GSC-1963, postdates the early Champlain Sea (cf. Richard, 1980). It is possible that an ice block associated with the glaciofluvial sediments occupied part of the basin and delayed the beginning of organic accumulation. Pollen analysis revealed nine pollen zones, which from the base

upward are: herb, aspen/poplar, spruce, pine, hemlock, birch/oak, hemlock/beech, pine/hardwoods, and post settlement zones (Mott and Farley-Gill, in press). GSC-2122 dates the aspen/poplar – spruce pollen zone boundary, GSC-2110 the pine – hemlock pollen zone boundary, and GSC-2125 the birch/oak – hemlock/beech pollen zone boundary. GSC-2106 dates the beginning of the ragweed (**Ambrosia**) pollen rise indicative of settlement of the area and may provide a measure of the possible error in the radiocarbon dates due to the hardwater effect.

Poste-de-la-Baleine Palsa Series

Basal peat samples from palsa bogs near Poste-de-la-Baleine, Quebec.

GSC-1543. Post-de-la-Baleine (I) 7310 ± 260

Peat (sample 8.6.70A; 7.0 g (wet)) from 220 cm depth in a half-melted palsa 12 km east of Poste-de-la-Baleine, Quebec (55°18'39"N, 77°33'47"W), at an elevation of 120 m. The sample was collected near the base of a 2.5 m-high natural section, after removal of about 10 cm of peat so as to expose a fresh surface. Collected 1970 by A. Jahn, University of Wroclaw, Wroclaw, Poland, and A. Cailleux, then with Centre d'Etudes Nordiques, Université Laval.

Comment (A. Cailleux): The date of 7310 ± 260 years slightly postdates deglaciation in this area, and it is compatible with other data bearing on postglacial emergence.

Comment (W. Blake, Jr.): The oldest date on marine pelecypods (**Macoma calcarea** in the Poste-de-la-Baleine area is 7625 ± 120 years (I-9005; Hillaire-Marcel, 1976), but that sample was collected at an elevation of only 5 m, far below the position of sea level at the time. With the exception of a value of 7760 ± 130 years (QU-143; Quebec II, 1977, p. 442), determination GSC-1543 is the oldest on basal peat from the many palsa bogs along the east coast of Hudson Bay (cf. Hamelin and Cailleux, 1969; Heim, 1976; Payette et al., 1976; King, 1979). NaOH leach omitted. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-2354. Poste-de-la-Baleine (II) 4780 ± 110

Basal peat (sample LK-C_{14}; 20.0 g) from a palsa bog 8 km southeast of Poste-de-la-Baleine, Quebec (55°14'N, 77°40'W), at an elevation of 110 m. The sample was excavated from the base of a 1.75 m-thick bed of frozen peat overlying silt. A clean section was obtained by digging away the unfrozen side of the palsa. Collected 1975 by L. King, Universität Heidelberg, Heidelberg, Germany.

GSC-2432. Poste-de-la-Baleine (III) 4580 ± 80

Basal peat (sample LK-D_{15}; 17.9 g) from a palsa bog 15 km east-northeast of Poste-de-la-Baleine, Quebec (55°18'N, 77°34'W), at an elevation of 90 m. The sample was excavated from the base of a 2.8 m-thick deposit of frozen peat overlying silt. As with GSC-2354 (this series), a clean section was obtained by digging away the unfrozen side of the palsa. Collected 1975 by L. King.

Comment (L. King): Both dates indicate the time at which peat growth was initiated and give a minimum age for postglacial emergence of the respective sites. Pollen analyses of both samples show mainly tundra species (King, 1979).

Comment (W. Blake, Jr.): GSC-2354 is in good agreement with two other age determinations on basal peat from the same bog which gave values of 4670 ± 50 and 4840 ± 50 years (H4634-4066 and H4635-4084; both in King, 1979). Also, two dates on basal peat from palsa bogs in the Richmond Gulf area gave similar values: 4920 ± 120 and 4960 ± 120 years (LV-698 and QU-140; both in Heim, 1976, cf. also Quebec II, 1977, p. 442 for two additional determinations near Richmond Gulf: 4720 ± 120 and 4870 ± 180 years (QU-142 and QU-144)). Both peat samples, which contained traces of silt and clay, were stored in a freezer and then air dried prior to their submission to the laboratory. NaOH leach omitted from the pretreatment of both samples. Samples mixed with dead gas for counting. Each date based on two 1-day counts in the 2 L counter.

Ontario

GSC-2614. Crysler 10 900 ± 100
$\delta^{13}C = -2.1‰$

Marine pelecypod shells (sample RAB-74-27; 30.0 g; **Macoma balthica** and **Macoma calcarea**, identified by M.F.I. Smith, National Museum of Natural Sciences, Ottawa) from a sand pit in a Champlain Sea beach deposit 4.5 km east of Crysler, Stormont County, Ontario (45°13'25"N, 75°05'30"W), at an elevation of approximately 70 m. Collected 1974 by S.H. Richard.

Comment (S.H. Richard): GSC-2614 dates shells from the lowest beach of the Champlain Sea found in South Nation valley south of Casselman. It was believed that this sample would date the last phase of marine inundation in the Ottawa valley lowland at a time when early Ottawa River was building its last major delta into the Champlain Sea at an elevation of 75 to 70 m, some 13 to 16 km to the north between Casselman and Bourget. This event has already been dated by GSC-1553 (10 000 ± 320 years; GSC XIII, 1973, p. 19) on marine pelecypod shells (**Macoma balthica** and **Macoma calcarea**) recovered from a low-level Champlain Sea beach at a similar elevation near Russell, Ontario, some 12 km west of Crysler (Scott, 1972, p. 148). It was believed that GSC-2614 would document further the age of this last stand of the Champlain Sea in the area, but the age of 10 900 ± 100 years rules out this possibility.

The age of the sample indicates that it most likely consisted of redeposited material reworked from older marine deposits which were originally emplaced in a higher part of the gravel and sand deposit and were subsequently washed down to the foot of the beach ridge as sea level dropped. It is the same age as GSC-2312 (10 900 ± 100 years) on **Hiatella arctica** shells recovered from a bed of silty, sandy clay in a gravel and sand ridge at approximately 98 m near Kars in Rideau Valley, some 41 km west of Crysler (Cronin, 1976; GSC XVI, 1976, p. 6-7).

Comment (W. Blake, Jr.): Only the two **Macoma** species were used for dating, although small **Hiatella arctica** valves also were present in the sample. The shells were thin, pitted, and some were encrusted (X-ray diffraction showed the encrustations to be a mixture of calcite and aragonite, whereas the shells themselves were aragonite). The largest valve was 2.0 cm wide, 1.8 cm high. Date based on one 3-day count in the 2 L counter.

GSC-2053. Clarksburg >36 000

Twigs (sample WN-73-13; 12.4 g) from washed-in organic-bearing silts exposed in a section along Grier Creek in Beaver valley, 2.5 km west of Clarksburg, Ontario (44°32'02"N, 80°30'00"W), at an elevation of 244 m. The 0.4 m-thick organic silt unit underlies 5.2 m of reddish brown lacustrine silt and 0.6 m of waterlaid till which merges upward into 5.0 m of basal till. The section is capped by 0.9 m of colluvium. Collected 1973 by A.J. Ward, then at University of Guelph, Guelph; now Auckland, New Zealand.

Comment (A.J. Ward): Preliminary examination of beetle fragments in the organic unit, the organics themselves, and the age suggest deposition during a cool tundra phase, probably the Port Talbot Interstadial of mid-Wisconsin age (Dreimanis and Karrow, 1972). The till resembles the Catfish Creek Till with which it is tentatively correlated.

Comment (W. Blake, Jr.): Vascular plants from the silt (unpublished GSC Bryological Reports No. 269 and 270 by M. Kuc) include: **Carex** sp. rhizomes, leaves and stems of **Dryas integrifolia,** branches, buds, and leaves of **Salix** sp., and leaf fragments of **Ledum** sp. cf. **decumbens;** mosses: **Distichium capillaceum** aggr., **Dicranum** sp., **Bryum** sp. (at least 3 species), **Barbula** sp., **Hypnum** sp., **Desmatodon** sp., **Drepanocladus revolvens, D. vernicosus, Campylium polygamum, Philonotis tometella,** and **Catascopium nigritum.** GSC-2053 supersedes a previous determination (BGS-182A, 31 500 ± 1000 years; Burwasser, 1974) on the same organic-rich unit (cf. also Cowan et al., 1978). Sample mixed with dead gas for counting. Date based on three 1-day counts in the 5 L counter.

Glen Allan Series

GSC-1711. Glen Allan (I) >39 000

Charred wood (sample S-3574; 19.7 g; **Picea** sp.; identified by R.J. Mott) from the north bank of a small tributary to Conestogo River; 5.1 km southeast of Glen Allan, Ontario and 30 m north of the middle of three bridges (43°38'N, 80°39'W), at an elevation of 363 m. The wood is from 1 m of glaciolacustrine(?) silt and clay underlying 0.6 m of alluvial terrace sand and gravel. Nearby, these lacustrine deposits underlie Tavistock Till (youngest), Catfish Creek Till, and an unnamed brown sandy till, and overlie a stony clay till and gravel at the top of which is evidence of weathering. Collected 1972 by P.F. Karrow, University of Waterloo, Waterloo.

GSC-2141. Glen Allan (II) >41 000

Organic detritus and a few twigs in silt (sample S-3574(2); 77.0 g) from the same site as GSC-1711. Collected 1974 by A.J. Cooper, then Ontario Geological Survey, Toronto, now Gartner and Lee Associates, Markham, Ontario; submitted by P.F. Karrow.

Comment (P.F. Karrow): The date suggests a Port Talbot Interstadial age. The stratigraphy near the site is complex, and detailed correlation between nearby exposures has been difficult. Associated pollen is typical of interstadial deposits, being predominantly pine (63%) and spruce (25%) (unpublished GSC Palynological Report No. 72-8 by R.J. Mott).

Comment (W. Blake, Jr.): M. Kuc (unpublished GSC Bryological Report No. 316) reported leaves of several species of pleurocarpous mosses in the detritus layer from which GSC-2141 was collected. Each date based on one 3-day count in the 5 L counter.

GSC-2049. Drysdale 7660 ± 140

Wood (sample GB-44; 5.7 g; **Abies balsamea;** identified by R.J. Mott) from mollusc-bearing sand and gravel in a stream terrace graded to the level of Lake Algonquin in the Huron Basin. Two metres of clay overlies 0.6 m of sand and gravel over 4.6 m of St. Joseph Till. The site is GB-44, on the north bank of a small stream just west of a prominent nickpoint where terrace dissection begins; 21.2 km north of Grand Bend, Ontario and 0.5 km east of Lake Huron (43°29'45"N, 81°42'20"W), at an elevation of 190 m. Collected 1974 by A.J. Cooper and P.F. Karrow; submitted by P.F. Karrow.

Comment (P.F. Karrow): The date is for the transition between the draining of Lake Algonquin and the rise to the Nipissing level, when fluvial reworking of sediments on a terrace graded to the Algonquin level was still continuing (Cowan et al., 1975).

Comment (W. Blake, Jr.): Only the single largest piece of wood (17 by 4 by 1.5 cm maximum thickness) was used for dating. The rounded ends suggested transport. The wet sample was dried in an electric oven; the weight decreased from 61 to 31 g. Adhering mud was scraped off. Date based on one 3-day count in the 2 L counter.

GSC-2190. Shashawandah Creek 5770 ± 100

Wood (sample K-16(A); 6.3 g; **Thuja occidentalis;** identified by L.D. Farley-Gill) from 1.3 m of sand with basal gravel and wood underlying 1 m of clay and overlying 0.6 m of grey silty till. Site is station K-16, 4.4 km south-southeast of Kettle Point and 3.6 km west of Ravenswood on the north bank of Shashawandah Creek, Ontario (43°10'45"N, 82°00'45"W), at an elevation of approximately 183 m. Collected and submitted by P.F. Karrow.

Comment (P.F. Karrow): Dating was undertaken to establish the Nipissing age of sediments for study of fossil molluscs. A date of 4310 ± 130 years (GSC-1122) is on nearby wood at the base of the same unit, described by Lewis (1969) as a buff fine sand at an elevation of 179 m.

Commment (W. Blake, Jr.): Only the single largest piece of wood (19.5 cm long, maximum 1.8 cm wide by 1.3 cm thick) was used. The sample was dried in an electric oven, and the weight decreased from 28.2 to 7.1 g. After drying, all adhering sand was scraped off. Mosses present included **Drepanocladus** sp. and **Cratoneuron** sp. (unpublished GSC Bryological Report No. 319 by M. Kuc). GSC-1122 was published in uncorrected form (4250 ± 130 years) by Lewis (1969), Miller et al. (1979), and Karrow (1980). GSC-2190 based on two 1-day counts in the 2 L counter.

Western Canada

Saskatchewan

GSC-2262. Lake Athabasca sand dunes 770 ± 80

Charcoal (sample 5E; 11.0 g; **Pinus banksiana;** identified by R.J. Mott) from a charcoal layer, exposed by moving sand, which was partly covered by 12 cm of sand and a superficial layer of small ventifacts. The site is located near the southern edge of the Thomson Bay dune field just northeast of Little Gull Lake, 60 km south-southeast of Uranium City, Saskatchewan (59°03'N, 109°00'W), at an elevation of 300 m (approximately 80 m above the present level of Lake Athabasca). Collected 1975 by G.W. Argus, National Museum of Natural Sciences, Ottawa.

Comment (G.W. Argus and H.M. Raup, Harvard Forest, Petersham, Massachusetts): A sample was obtained from this site in an effort to corroborate a previous radiocarbon date of 4890 ± 60 years (S-648; Hermesh, 1972; Saskatchewan VI, 1975, p. 332) that was obtained from a similar elevation near Yakow Lake, 55 km to the east. The deposit, however, no doubt merely represents the burial of forest by sand, possibly by blowouts following the fire that produced the charcoal (Raup and Argus, in press).

Comment (W. Blake, Jr.): The sample consisted of large clean pieces of charcoal. Date based on two 1-day counts in the 5 L counter.

Alberta

GSC-2965. Kananaskis Valley 10 400 ± 110
$\delta^{13}C = -27.4‰$

Wood fragments (sample WLK-1; 5.8 g; **Populus** sp.; identified by R.J. Mott) from marl 295 cm below the former mud/water interface in a fresh face exposed in the course of the excavation of Wedge Lake, located 100 m east of the Kananaskis Road and 10 km south of the Kananaskis Ranger Station, Alberta (50°52'N, 115°10'W), at an elevation of 1700 m. Collected by G.M. MacDonald, then University of Calgary, Calgary; now Scarborough College, West Hill, Ontario.

Comment (G.M. MacDonald): GSC-2965 provides a minimum age for the Canmore advance in Kananaskis valley. Pollen analysis and examination of the plant macrofossils and molluscan fauna encountered at this level in the section indicate the presence of a **Picea** dominated forest in the region (MacDonald, 1980a, b). An unidentified wood sample, obtained 70 cm higher up in the section, provided a radiometric age of 9395 ± 215 years (GX-6767). A 10 cm-thick horizon of tephra was found 125 cm above the **Populus** sample level.

Comment (W. Blake, Jr.): The sample submitted to the laboratory consisted of four pieces, the largest three of which were 1.6 to 1.7 cm in maximum width and were flattened; the largest piece was 5.5 cm long. The wood could not be properly sectioned and some was strongly lignified and compressed. Date based on two 1-day counts in the 2 L counter.

British Columbia

GSC-3047. Wheeler Creek 2530 ± 90

Charcoal (sample JJ-79RC-1; 2.8 g) in gravels overlain by a 1 m-thick debris flow deposit 21 km southeast of Sparwood, British Columbia (49°37'N, 115°51'W), at an elevation of 1525 m. Collected 1979 by L.E. Jackson, Jr.

Comments (L.E. Jackson, Jr.): The date indicates that only one debris flow large enough to reach the sampling site has occurred in this basin over the past 2530 years.

Comment (W. Blake, Jr.): The collector examined the sample under a microscope and noted the presence of fine plant rootlets, hence he separated the sample into two fractions, one containing rootlets, one free of them. Because of the small sample size it was necessary to use both fractions, but the sample was picked over carefully to exclude all rootlets. Younger humic materials should have been removed by the standard treatment with NaOH. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

Tonquin Pass Series

Wood and peat from streambank sections (within 30 m of one another) on the floor of Tonquin Pass, British Columbia, approximately 1 km west of the Continental Divide (52°44'N, 118°22'W), at an elevation of 2000 m.

GSC-2927. Tonquin Pass (I) 4400 ± 220

A badly splintered branch or small stem (sample TcBHL; 3.4 g; **Picea** sp.; identified by R.J. Mott) from a peat face. Collected 1977 by B.H. Luckman, University of Western Ontario, London.

Comment (B.H. Luckman): This sample is from an adjacent but contiguous section to the Tonquin Creek site (see GSC-2969 and -2648 in Luckman and Osborn, 1979, Fig. 5). Two tephras occur within this section. The lower tephra is Mazama and lies immediately below a log dated at 6570 ± 70 years (GSC-2648). Sample GSC-2927 was recovered from the peat immediately below the upper tephra in the section. The date of 4400 ± 220 years indicates that the overlying tephra is the St. Helen's Y tephra which has been dated elsewhere in this area as ca. 4300 years old (Westgate, 1977).

Comment (W. Blake, Jr.): The largest piece measured approximately 11 by 2 by 0.5 cm. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-2969. Tonquin Pass (II) 8040 ± 130

Peat (sample TC18; 6.4 g). Collected 1977 by M.S. Kearney, then University of Western Ontario, London, now University of Maryland, College Park, Maryland.

Comment (B.H. Luckman and M.S. Kearney): This sample is from a depth of 51 cm in the Tonquin Creek Section (Luckman and Osborn, 1979, Fig. 4, 5; Kearney and Luckman, in press, Fig. 8). It was submitted to provide a date on the abrupt rise of **Picea** in the pollen diagram constructed for the site. The rapid spruce rise was thought to indicate the inception of the Hypsithermal at this site. The date of 8040 ± 130 years is slightly younger than anticipated; dates from other sites in the Jasper area – Excelsior Basin, 8450 ± 170 years (GSC-2682) and Watchtower Basin, 8060 ± 90 years (GSC-2615) – suggest that treeline was higher than present between 8000 and 8500 years ago. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-2855. Penticton 1880 ± 90

Wood (sample 1; 11.7 g; **Betula** sp.; identified by R.J. Mott) collected from an excavation on Shingle Creek fan, Penticton, British Columbia (49°28'40"N, 119°35'50"W), at an elevation of 334 m. The sample was collected from a log buried in the fan deposits at a depth of 4.25 m. Drillhole data indicate that the fan deposits average 12 m thickness at this point near the junction of Shingle Creek and Okanagan River. Collected 1978 by E.C. Halstead, National Hydrology Research Institute, Vancouver.

Comment (E.C. Halstead): It was thought that the sample would be much older, but the date provides a record of fan deposition and suggests that the fan accumulation, which caused the separation of Skaha Lake from Okanagan Lake, was a more recent geological event than anticipated.

Comment (W. Blake, Jr.): The sample was soaking wet on receipt by the laboratory. After oven drying it became hard, brittle, and reduced in size; it was characterized by a strong sulphurous odour. It appeared somewhat lignitized on the surface but was relatively fresh towards the centre. A narrow inner section of wood was cut away for dating. Date based on three 1-day counts in the 5 L counter.

GSC-2056. Drynoch landslide 900 ± 50

Charcoal (sample VF-73-92; 11.42 g) from a firepit near the head scarp of Drynoch landslide, 8 km south of Spence's Bridge, British Columbia (50°22'N, 121°21'W), at an elevation of 735 m. Collected 1973 by D.F. VanDine, Queen's University, Kingston, Ontario.

Comment (D.F. VanDine): The sample was collected from chinks between stones which line the hemispherical-shaped firepit. The firepit is located on a slight topographical high between two small creeks. It had been excavated in a clayey sandy diamicton (probably slide debris) and presently is covered by approximately 16 cm of fine sand (possibly a recent eolian deposit). The age of the charcoal indicates human activity within the head scarp of the

landslide between 950 and 850 years ago. The original slide in the area must have occurred earlier. It could be postulated that this portion of the slide was relatively stable at the time the firepit was in use, and it is stable today (VanDine, 1974, in press). A tree trunk in the failure zone beneath slide debris has been dated at 3175 ± 150 years (I-462; Isotopes III, 1963, p. 66) and charcoal in a midden (below an ash layer) beneath the toe of the slide is 7530 ± 270 years old (GSC-530; GSC VIII, 1969, p. 31-32).

Comment (W. Blake, Jr.): Large pieces of charcoal (many >2 cm in length) were examined carefully and were split open to remove all visible rootlets. Date based on two 1-day counts in the 5 L counter.

GSC-2964. Summit Creek 10 000 ± 90

Waterlogged wood (sample Nestel; 11.2 g; **Populus** sp.; identified by L.D. Farley-Gill) from stony clay at Placer Lease #7391 (F. Nestel's workings) on Summit Creek, 7 km northeast of Wells, British Columbia (54°08.5'N, 121°31.5'W), at an elevation of 1215 m. Collected 1979 by G. Klein, British Columbia Ministry of Energy, Mines and Petroleum Resources, Prince George; submitted by W.H. Mathews, University of British Columbia, Vancouver.

Comment (W.H. Mathews): The date of 10 000 ± 90 years, although less than expected (the submitter had thought that the sample was buried by advancing ice, although the evidence for this was not as clear as with GSC-2974, this list), provides a minimum date for the disappearance of Cordilleran ice from the central interior of British Columbia.

Comment (W. Blake, Jr.): Determination GSC-2964, together with GSC-2974, is considerably older than previous dates from the Quesnel area; cf. GSC-825 (5790 ± 140 years) and GSC-853 (6640 ± 140 years), wood in terrace deposits of Fraser and Cottonwood rivers, respectively (GSC VII, 1968, p. 227; Clague, 1980). The wood was partly oven dried in Vancouver and was dried again in Ottawa; the weight decreased from 260.5 to 77.7 g. The cross-sectional measurements were 5 by 2.5 cm. Date based on one 3-day count in the 5 L counter.

GSC-2475. Farrell Creek 5830 ± 80

Charcoal (sample 208V; 3.2 g) from a buried Ah horizon in a 5 m-thick section of calcareous eolian silt near the top of an eroded terrace face on the north side of Peace River just east of Farrell Creek, 25 km northeast of Hudson Hope, British Columbia (56°10'N, 121°34'W), at an elevation of 485 m. The sample was taken 3.5 m below the surface of the terrace; the fairly old exposure, with grasses growing on the face, was excavated back 1 m to expose a clean face. Modern rootlets which extended into this layer were excluded during sampling of the locality, which is archeological site HaRk-1. Collected 1976 by K.W.G. Valentine, Agriculture Canada, Vancouver, British Columbia.

Comment (W. Blake, Jr.): According to the collector and colleagues, "only two lithic items and fragments of unidentifiable bone have been retrieved from the fifth cultural component (Ahcab2 horizon, 5830 ± 80 yr. B.P.)" (Valentine et al., 1980, p. 192-193). GSC-2475 is the oldest date, whereas the youngest charcoal, 40 cm below the surface and representing the second cultural component (3887 items), was dated at 1530 ± 70 and 1630 ± 100 years (WSU-1950 and -1951, respectively). NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-2462. Parsnip River 8170 ± 70

Peat (sample WHM-77-1 (PR-77-1B); 21.0 g) from a 15 cm-thick unit recovered from a borehole 3 km at N67°W from the outlet of Arctic Lake, at the head of Parsnip River, British Columbia (54°26.5'N, 121°45'W), at an elevation of 745 m. The dated peat overlies a 0.5 m-thick layer of silt and peat (which extends to the bottom of the hole at 10.4 m) and is overlain, in turn, by 2.7 m of soft grey silt, 1.8 m of soft grey clay with some silt, and 4.0 m of wet peat containing sticks, roots, and decomposed leaves. Collected 1977 by D. Cattenach, British Columbia Hydro and Power Authority, Vancouver; submitted by W.H. Mathews.

Comment (W.H. Mathews): The date of 8170 ± 70 years provides a minimum age for the abandonment of the Pacific Lake – Arctic Lake – Parsnip River spillway from an ice-dammed lake in the upper Fraser River watershed. Some additional time since this abandonment must be assumed to allow for deposition of the silt and for the establishment and growth of the peat underlying this sample. The result compares favourably with a date of 9280 ± 200 years (GSC-1497) for a horn of **Ovis canadensis** in ice-contact fluvial gravel on the Finlay-Parsnip Access Road (Rutter et al., 1972; Rutter, 1977; GSC XIX, 1979, p. 27).

Comment (W. Blake, Jr.): The pollen assemblage in the peat is dominated by **Betula** (unpublished GSC Palynological Report No. 77-5 by L.D. Farley-Gill). A 67.5 g sample of wet peat was dried to produce 21.0 g. NaOH leach omitted from sample pretreatment. Date based on one 3-day count in the 5 L counter.

GSC-2974. Mary Creek 8820 ± 80

Wood (sample Toop; 11.8 g; **Pinus** cf. **P. contorta;** identified by L.D. Farley-Gill) from a 1+ m-thick band of blue-black boulder clay overlying 0.5 m of pay gravel above rotted argillite and overlain by 2 m of well sorted but poorly layered fine sand at Placer Lease #7141 (T. Toop's workings), 35 km northeast of Quesnel, British Columbia (53°04'N, 122°05'W), at an elevation of 970 m. Collected 1979 by G. Klein; submitted by W.H. Mathews.

Comment (W.H. Mathews): The date of 8820 ± 80 years is less than originally expected (as with GSC-2964, this list, the submitter believed that the sample had been buried by advancing ice), and it appears to record some undetermined postglacial event.

Comment (W. Blake, Jr.): The wood was partly oven dried in Vancouver and was dried again in Ottawa; the weight decreased from 286.3 to 78.8 g. The cross-sectional measurements were 9.5 by 4.5 cm. Date based on one 3-day count in the 5 L counter.

Westcoast Transmission Pipeline Trench Series

Organic muck exposed in a trench constructed by Westcoast Transmission Company Ltd., for a hot gas pipeline. The site is approximately 48 km southwest of Fort Liard, Northwest Territories, in the northeastern corner of British Columbia (59°59'N, 124°12'W), at an elevation of 420 m. The thin, undulating organic band was exposed about 2.1 m below the ground surface; it is underlain by clayey till which contains no shale boulders (only granite, gneiss) and is overlain by buff silt (loess?) and a thin capping of buff to black organic material on the ground surface. Collected 1972 by E.B. Owen. Two determinations were made:

GSC-1698. Pipeline Trench (I) 2920 ± 140

About 1360 g (wet) of sample WC-1 was utilized. NaOH leach was omitted. Date based on two 1-day counts in the 5 L counter.

GSC-1698-2. Pipeline Trench (II) 2950 ± 140

For the second determination 705 g (wet) of sample WC-1 was used. The NaOH leach was included in the sample pretreatment. Date based on one 3-day count in the 5 L counter.

Comment (W. Blake, Jr.): A considerable time elapsed between the deposition of till and the accumulation of this layer of muck, which contains wood chips and amorphous detritus. According to M. Kuc (unpublished Bryological Report No. 172) the small amount of silt present indicates that the deposit is in situ; the uniform material, strongly oxidized and rotten, is interpreted as the product of a forest or semi-forest vegetation deposition under rather dry conditions. The agreement between the two determinations, using different pretreatment, is excellent.

GSC-2627-2. East Delta, Fraser Lowland >48 000

A clast of highly compressed peat (sample FAB181W; 64.3 g) from 20 cm behind the surface of a vertical, eroding face at the south end of the abandoned Kiewit gravel pit (now used as a firing range by the Delta Municipal Police) in the southwest slope of the Surrey Upland, 10 km south of New Westminster, British Columbia (49°06.7'N, 122°54.0'W). The sample was collected at an elevation of 25 m from 30 cm of till in a complex (at least 6 m thick) of interbedded tills and layered clayey to sandy silt. The complex apparently conformably overlies sand, silt, and gravel (at least 3 m thick, from which GSC-60, >37 000 years (GSC II, 1963, p. 47) was collected) and is apparently conformable with an overlying sequence of beige fine to medium sand (5 m), Quadra-type medium sand (up to 10 m), sandy gravel (2 m), Vashon Drift, and Capilano sediments (together up to 5 m). Collected 1977 by S.R. Hicock.

Comment (S.R. Hicock): The peat clast was reworked from a nonglacial unit whose age, stratigraphic position, and geographic location are unknown. Such has been the case for many other organic clasts (including GSC-60) collected from Quaternary sediments throughout southwestern British Columbia (cf. those listed in Clague, 1980), and many of them have resulted in 'greater than' ages. The sub-Vashon glacial complex lies in a shallow basin about 100 m long, and it may belong to Coquitlam or older drift (S.R. Hicock and J.E. Armstrong, unpublished manuscript).

Hicock (1980) described the complex as containing: (1) glaciomarine clayey to sandy silt rich in marine dinoflagellate cysts (mainly **Spiniferites**-type) and nematode (crustacean) crawl traces; (2) submarine stony flow tills with folded lobate noses (enveloped by glaciomarine material) and layering in places; and (3) layered submarine meltout tills with dropstones. The complex may have been deposited from a floating ice margin or icebergs which released subglacial debris into the basin as alternating flows down basin flanks and as particle rains through the water column onto the seafloor to form meltout tills. Between the sudden deposition of relatively large volumes of debris, glaciomarine deposits, probably formed as subglacial clasts, were released and fell as dropstones into glacial mud settling from suspension. The small basin may have been located on a shelf formed by the western slope of the ancestral Surrey Upland. The basin may have been formed by the temporary grounding and percussion of an iceberg of may even be a cross-section through a berg furrow.

Comment (W. Blake, Jr.): This determination supersedes GSC-2627, >39 000 years (GSC XVIII, 1978, p. 10). The sample for dating was 118 g of damp, highly compressed peat cut from a 1 to 1.5 cm-thick slab. All outside material was cut away. After oven drying the sample weighed 64.3 g. Sample pretreatment included leaches for one hour in hot NaOH and hot HCl. Date based on one 5-day count in the 5 L counter at 4 atm.

GSC-2809. Cordova Bay, Vancouver Island 23 700 ± 330

Wood (sample FAB197W; 11.9 g; **Salix** sp.; identified by L.D. Farley-Gill) from the actively eroding face of a sea cliff near the southern end of Cordova Bay, 9 km east-northeast of downtown Victoria, Vancouver Island, British Columbia (48°29'45"N, 123°19'30"W), at an elevation of 8 m. The sample was collected from medium to fine beige sand (up to 5 m thick) containing organic detritus (peat partings), wood fragments, and abundant marine dinoflagellate cysts (mainly **Spiniferites**-type). The sampled unit is the lower part of Alley's (1979) unit 3 (cf. his Fig. 4). The lower part subhorizontally overlies blue-grey fossiliferous (marine molluscs and wood) clayey silt to fine sand (7 m) with apparent conformity and similarly underlies a sequence of brown gravel and sand (5 m), the upper part of unit 3 (2 m), horizontally bedded Quadra Sand (25 m), and Vashon Drift (up to 2 m). The fossiliferous clayey silt overlies two tills separated by nonglacial silt, sand, gravel, and peat – the whole package having a thickness of at least 15 m. Collected 1978 by S.R. Hicock; submitted by J.E. Armstrong.

Comment (S.R. Hicock): GSC-2809 was collected stratigraphically below GSC-84, 22 600 ± 300 years (GSC II, 1963, p. 50) which was run on plant fibres from the upper part of unit 3, and it confirms that date. The pollen assemblage from the lower part of unit 3 analyzed by Hicock (1980) resembles that of Quadra Sand studied by Terasmae (in Clague, 1976, 1977; Armstrong and Clague, 1977), Mathewes (1979), and Alley (1979). Therefore, I agree with Alley (1979) in assigning unit 3 to the Quadra, even though GSC-2809 would plot in the Cowichan Head field of Clague's age relation diagram for the Quadra Sand and Cowichan Head Formation (Clague, 1977, Fig. 15). It would appear that Quadra proglacial marine sand outwash was being deposited at 48.5°N approximately 23 500 years ago in the Georgia Depression. Since Quadra sediments directly overlie the marine and glaciomarine Komas Mud member of Dashwood Drift (Hicock, 1980), the nonglacial Cowichan Head Formation of Armstrong and Clague (1977) is therefore absent at this site and the contact between unit 3 and Komas Mud is interpreted as an erosional unconformity, as suggested by Alley (1979).

Comment (W. Blake, Jr.): The sample submitted contained three pieces of wood; two were examined by L.D. Farley-Gill (unpublished GSC Wood Identification Report No. 79-7). Both pieces were lignified; one had visible features that were similar to **Salix** sp., the morphologic features of the other were not comparable to any available reference material. The piece of **Salix** measured 20 by 2 by 1 cm, the second piece was 13 by 3 by 0.8 cm; both were cleaned with a water spray and then oven dried. Some silt still adhered to both pieces. Date based on one 3-day count in the 5 L counter.

GSC-252. Island View Beach, Vancouver Island 2040 ± 130

Wood (sample FG-63-4d) from an in situ stump protruding through peat on Island View Beach, east side of Saanich Peninsula, 16 km north of Victoria, Vancouver Island, British Columbia (48°34.1'N, 123°22.0'W), at an elevation of 0 to 0.5 m (1 to 1.5 m below high tide). The stump and peat occur in the present-day intertidal zone of the beach and have a thin cover of littoral sand and gravel. The base of the stump was not exposed at the time the sample was collected, but is no higher than 0 m (1.5 m below high tide). Collected 1963 by J.G. Fyles.

Comment (J.J. Clague): Sea levels on southeastern Vancouver Island during most of the Holocene were lower relative to the land than at present (Mathews et al., 1970). A late Pleistocene and early Holocene regression culminated in this area between 6000 and 9000 years ago when shorelines were about 10 m or more below present sea level. A transgression followed, and the sea approached its present level during late Holocene time. The stumps on Island View Beach are remnants of a forest growing at this site when the sea was at least 1.5 m lower relative to the land than it is at

present. GSC-252 indicates that relative sea level has risen at least 1.5 m in the past 2000 radiocarbon years. Date based on one 3-day count in the 5 L counter.

GSC-2774. Muir Point, Vancouver Island >41 000

Wood (sample FAB189W; 11.6 g; **Abies** sp.; identified by R.J. Mott) from the surface of a vertical eroding sea cliff 3 km southwest of Sooke, Vancouver Island, British Columbia (48°21'32"N, 123°44'54"W), at an elevation of 29 m. The sample was collected from subhorizontally bedded rusty gravel and sand (up to 0.5 m thick) which apparently conformably overlies a descending sequence (at least 38 m thick) of organic silt, sand, colluvium, peat, and gravel, which overlies at least 5 m of till. The sampled unit is sharply truncated by up to 10 m of Vashon till, which is capped by up to 3 m of Capilano clayey silt. Collected 1978 by S.R. Hicock; submitted by J.E. Armstrong.

Comment (S.R. Hicock): GSC-2774 agrees with two previous dates – GSC-358, >40 300 years, peat (GSC V, 1966, p. 112) and I-9443, >40 000 years, wood (Hicock, 1980) – from the top of a 2 m-thick organic silt unit that underlies the gravel unit sampled for GSC-2774. Peat 20 m lower in the sequence also was dated >40 000 years, I-8449, wood (Hicock, 1980). No evidence of stratigraphic breaks is apparent in the nonglacial sequence between the two tills. Pollen analyses from a vertical profile through the nonglacial sequence (N.F. Alley, personal communication, 1980) and spot analyses (Hicock, 1980) indicate that warm interglacial conditions occurred in the area throughout the sequence except for the upper silt and gravel units. In these top units the pollen resembles assemblages from the Cowichan Head Formation analyzed by Terasmae (p. 1477 in Armstrong and Clague, 1977), Alley (1979), and Hicock (1980), which represent the generally cooler conditions that prevailed in the Georgia Depression during the Olympia nonglacial interval, i.e., between 65 000 and 25 000 years ago (Clague, 1978; Hicock, 1980). Most of the nonglacial sequence is thus interpreted as having been deposited during the last interglacial. Hicock (1980) has informally named the sequence the Muir Point Formation, and here, at the proposed Muir Point holostratotype, this sequence appears to directly underlie Vashon Drift. The upper two units, however, may well be Cowichan Head, on which age determinations up to $58\ 800^{+2900}_{-2100}$ years (QL-195) have been obtained in the Fraser Lowland (Clague, 1978). Quadra Sand (and possibly the Cowichan Head Formation) of Armstrong and Clague (1977) and Dashwood Drift (Hicock, 1980) are apparently missing from this section, and the unconformable lower boundary of Vashon Drift at this site may represent a major hiatus.

Comment (W. Blake, Jr.): This piece of wood was 27 cm long and 2.5 by 2.0 cm in cross-section. Its weight decreased from 68 to 31 g during oven drying. All outside wood was cut away from this brittle sample. Date based on one 3-day count in the 5 L counter.

GSC-2768. Tofino, Vancouver Island 16 700 ± 150

Slightly compressed and lignified wood (sample CIA-78-203; 11.6 g; **Pinus contorta;** identified by R.J. Mott) from a steep excavated face at the Tofino dump, 7.5 km southeast of Tofino, Vancouver Island, British Columbia (49°05.5'N, 125°50.8'W), at an elevation of about 37 m. The sample was collected from a log which protruded from poorly sorted coarse gravel overlain by up to 12 m of diamicton with indistinct subhorizontal stratification. The gravel grades downward into better sorted, stratified sediments consisting mainly of pebbly sand and pebble-cobble gravel. Up to 13 m of stratified sediments was exposed at the time the sample was collected. The diamicton and underlying stratified sediments at the sample site occur up to about 30 m above the general elevation of the surrounding low-relief Estevan Coastal Plain on the flank of a glaciated bedrock knob (Radar Hill). Collected 1978 by J.J. Clague.

Comment (J.J. Clague): The stratified sediments beneath the diamicton are outwash deposited during the advance phase of the Fraser Glaciation (late Wisconsin). The dated wood occurs in ice-contact (?) gravel, which is transitional to both the underlying better sorted outwash and the overlying till. Thus, the date is thought to delimit closely the time when the site was overridden by ice during the Fraser Glaciation (Clague et al., 1980). Because this site is near the periphery of the area covered by the Cordilleran Ice Sheet, the date marks a time when the ice sheet was near its maximum extent.

Comment (W. Blake, Jr.): The larger of two pieces had an original sample weight of 117 g, and the wood measured 16 by 5.5 by 4 cm. The outside (blackish) wood was cut away from part of the sample and only the inside (light-coloured) wood was utilized for dating, after oven drying. The surface of the wood was characterized by imbedded sand grains. Date based on one 3-day count in the 5 L counter.

GSC-2505. Island Copper Mine, Vancouver Island 20 600 ± 330

Marine pelecypod shell fragments (sample WHM-76-1; 13.7 g; **Clinocardium nuttalli;** identified by M.F.I. Smith, National Museum of Natural Sciences, Ottawa) from glaciomarine silt exposed in a newly excavated face of the Island Copper Mine, an open pit excavation 8 km east of Coal Harbour, Vancouver Island, British Columbia (51°36.5'N, 127°27.5'W), at 6 m below sea level. The shell-bearing silt unit is underlain by 10 cm of rubble on bedrock and is overlain by clean sand and by dirty gravel grading to a till-like unit. Until a few years ago the ground surface was ca. 32 m above the level of the sample. Collected 1976 by W.H. Mathews.

Comment (W.H. Mathews): The marine shells underlie deposits of the last glaciation, and the date of 20 600 ± 330 years identifies this glaciation as late Wisconsin (Clague et al., 1980). Relative sea level at this site seems to have been very little different then than it is today.

Comment (W. Blake, Jr.): This is the only sample from northern Vancouver Island in the compilation by Clague et al. (1980). The sample was entirely made up of fragments, but the shells were fresh-appearing. Because of the small sample size, only the outer 10 per cent was removed by HCl leach. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-2460. Sandspit, Queen Charlotte Islands 1720 ± 70

A single large pelecypod fragment (sample WHM-76-2; 15.2 g; **Clinocardium nuttalli;** identified by M.F.I. Smith from a fresh excavation for septic tank drains at the Sandspit Islander Hotel, Sandspit, Moresby Island, Queen Charlotte Islands, British Columbia (53°15'N, 131°49'W), at an elevation of 2.5 m above the upper limit of gravel on the modern beach (approximate high water mark). The sample is at the top of a gravel unit containing shell bands, and it is overlain by sand and topsoil (total thickness of both, 50 cm). Collected 1976 by W.H. Mathews.

Comment (W.H. Mathews): The date of 1720 ± 70 years provides the maximum time for an emergence of 2.5 m at Sandspit Peninsula and for the latest possible uplift along the nearby Sandspit fault.

Comment (W. Blake, Jr.): Other marine species present were **Saxidomus giganteus, Pododesmus macroschisma,** and cf. **Balanus** sp. (all identified by M.F.I. Smith). The shell piece utilized for dating measured 4.5 by 4.5 cm and was

3.5 mm thick. Because of the small sample size, only the outer 10 per cent was removed by HCl leach. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

Northern Canada, Mainland and Offshore Islands

Yukon Territory

GSC-2791. Donjek River 500 ± 80

Plant remains (sample 7-7-1; 6.0 g dry; **Picea** sp., **Betula** sp. samara, an achene of **Carex** sp., and insect fragments; identified by J.V. Matthews, Jr., unpublished GSC Plant Macrofossil Report No. 79-3) from the cutbank of a stream tributary to Donjek River near Donjek Glacier, Yukon Territory (61°10'N, 139°25.5'W), at an approximate elevation of 1130 m. The sample is from one of several layers of organic material and sand which occur within a bed of clay laminae in the stream cutbank. The clay is the lowermost of several such clay beds which are interbedded with gravel along both banks of the stream. Collected 1978 by M. Perchanok, Carleton University, Ottawa.

Comment (M. Perchanok): The cutbank from which the samples were collected lies 11 m below a gravel beach which is interpreted as a shoreline of a former glacier-dammed lake, and the site is upstream from a dry rock channel through which the lake overflowed. The succession of clay and gravel beds is believed to have resulted from successive periods of lacustrine and fluvial deposition in the stream valley. Material from the lowest of the clay beds therefore provides a date for the earliest Holocene occurrence of this glacier-dammed lake (Perchanok, 1980). Denton and Stuiver (1966) reported several other age determinations bearing on the Neoglacial fluctuations of Donjek Glacier.

Comment (W. Blake, Jr.): The sample (79.5 g wet) was wet sieved to remove most of the silt and clay. NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

Upper Porcupine River Series

Wood samples from a river-cut bluff section on the left bank of Porcupine River, Yukon Territory (66°56.7'N, 137°42.5'W). The locality is within Bell Basin, a thermokarst glaciolacustrine plain similar to those of Bluefish and Old Crow basins. Samples GSC-2553, -2431, -2923, -2823 and -2274 were collected near the downstream end of the bluff. There the uppermost 5.5 m of sediments consists of fine grained sand, silt, and clay with several organic layers, underlain in downward succession by 3 m of distinctly varved silt and clay with segregated ground ice, 4.95 m of silt and fine grained sand with abundant organic detritus as discrete layers and also dispersed through the unit, and 1.5 m of varved silt and clay with segregated ground ice. The remainder of the section is concealed by slumped sediment. Surface level is at about 315 m. GSC-1795 was collected about 250 m farther upstream. Stratigraphic units were not traceable continuously along the bluff, but GSC-1795 is from the base of a silt and fine grained sand unit which is thought to be the same unit that separates the two varved clay units at the downstream end of the bluff.

Immediately downstream of the main bluff is an exposure of sediments that underlie a terrace situated about 10.4 m above low water level of Porcupine River. The exposed sequence, from top down, comprises 3.4 m of woody peat grading downward into woody peaty silt, 5.75 m of silt with organic layers, 0.82 m of interbedded sand and silt with a woody layer near the base, and 0.37 m of gravel to river level. GSC-2461 was collected about 10 cm above the gravel (67°57'N, 137°42'W), at an approximate elevation of 330 m.

GSC-2553. Upper Porcupine River (I) 13 500 ± 310

Small wood fragments (sample MRA-7-14-77-1; 1.7 g; **Salix** sp.; identified by R.J. Mott) from an organic lens 2.2 m below the surface in the main bluff exposure. Collected 1977 by C.E. Schweger and N.W. Rutter, University of Alberta, Edmonton.

GSC-2431. Upper Porcupine River (II) 15 900 ± 160

Unidentified twigs, some with bark adhering (sample HH75-9(1976) 46.2 m; 5.0 g) from silt 2.74 m below the surface. Collected 1976 by O.L. Hughes.

GSC-2923. Upper Porcupine River (III) >36 000

Wood (sample MRA-7-16-77-13; 10.6 g; **Salix** sp.; identified by L.D. Farley-Gill) from fine grained sand and silt 4.0 m below the surface. Collected 1977 by J.V. Matthews, Jr.

GSC-2823. Upper Porcupine River (IV) >34 000

A small piece of wood, with bark intact (sample MRA-6-19-75-6(wood); 3.95 g; **Betula** sp.; identified by R.J. Mott) from 4.95 m below the surface. Collected 1975 by J.V. Matthews, Jr.

GSC-2274. Upper Porcupine River (V) >38 000

Wood (sample MRA-6-12-75-5; 11.1 g; **Picea** sp.; identified by L.D. Farley-Gill) from 5.0 m below the surface. Collected 1976 by J.V. Matthews, Jr.

GSC-1795. Upper Porcupine River (VI) >32 000

Wood (sample HH72-97-2; 4.5 g; **Picea** sp.; identified by R.J. Mott) from the base of a silt and fine grained sand unit overlying varved clay; the organic silt and sand is thought to be same unit that separates the two varved clay units described in the introduction. Collected 1972 by O.L. Hughes.

GSC-2461. Upper Porcupine River (VII) 9190 ± 90

Wood (sample HH72-98-1(27.21 to 27.26 m); 4.6 g; **Salix** sp.; identified by L.D. Farley-Gill) in sand from 10 cm above gravel near the base of a terrace sequence downstream from the main bluff section. Collected 1972 by O.L. Hughes.

Comment (O.L. Hughes and J.V. Matthews, Jr.): Prior to radiocarbon dating, it was assumed that the Pleistocene history of Bell Basin was similar to that of Bluefish and Old Crow basins and that the upper varved clay of this locality would prove to be correlative with the upper glaciolacustrine unit of those basins. In those basins, the upper glaciolacustrine sediments are bracketed by dates of 31 000 to 33 000 years below and 11 000 to 12 000 years above (see Old Crow Basin, Locality 12 series; Old Crow Basin, Locality 32 series; Twelvemile Bluff series; and Old Crow River terrace series, all in GSC XIX, 1979, p. 30-32).

The assumed correlation can be retained only if GSC-2923, -2823 and -2274 are rejected on the assumption that the dated wood was recycled from older deposits; such recycling has been demonstrated for Old Crow Basin and suspected for Bluefish Basin (see Old Crow Basin, Locality 12 series and Twelvemile Bluff series; GSC XIX, 1979, p. 30-31). GSC-2431 would then imply that Bell Basin drained somewhat before Bluefish and Old Crow basins because the general surface level of the former is some 20 to 30 m higher.

Alternatively, Bell Basin may not have been inundated during the upper glaciolacustrine phase experienced in Bluefish Basin and Old Crow Basin, or if it was inundated, the water was too shallow for deposition of varved sediments. On the other hand, a unit equivalent to the upper lacustrine

unit of Bluefish and Old Crow basins may have been deposited, then removed at this site during early stages of downcutting of Porcupine River. A choice between these and other possible alternative interpretations of the Bell Basin sedimentary sequence will depend upon discovery and dating of clearly autochthonous organic material in horizons where allochthonous wood has yielded "old" dates.

GSC-2461 indicates that Porcupine River was incised to its present level by about 9200 years ago. **Populus** sp. wood and macrofossils occur at the level from which GSC-2461 was collected.

Comment (W. Blake, Jr.): Only a single piece of wood was used for each of four determinations: GSC-1795, -2274, -2461, and -2823. In the case of GSC-2431 (unidentified pieces) there was little evidence of transport (ends of twigs were little rounded), nor did the wood appear compressed or lignitized. For GSC-2553 five twigs were utilized, varying from 3.2 to 7.2 cm in length and 0.6 to 1.0 cm in diameter. For GSC-2923 the two largest pieces (which perhaps derived from the same stick) were used; maximum length 8 cm, width 1.5 to 2.5 cm. The wood pieces used for GSC-1795 were perhaps the most worn of all samples. **Salix** sp. was also present in the collection used for GSC-2823. Included with GSC-1795 was a small piece of **Betula** sp. (unpublished GSC Wood Identification Report No. 72-58 by R.J. Mott), two pieces of **Bidens**, and mosses: **Drepanocladus exannulatus,** Amblystegiaceae cf. **Amblystegium, Scorpidium scorpioides, Torella** cf. **tortuosa, Ditrichum flexicaule, Mniobryum albicans, Bryum** sp. cf. **calophyllum,** and **Bryum** sp. This assemblage was interpreted by M. Kuc (unpublished GSC Bryological Report No. 208) as indicating that the "accumulation basin was a shallow and relatively still water body near or on alluvium". GSC-1795, -2431, -2461, -2553, -2823, each mixed with dead gas for counting. GSC-1795 and -2431 each based on one 3-day count in the 2 L counter; GSC-2553 based on two 1-day counts; and GSC-2461 and -2823 each based on one 4-day count, also in the 2 L counter. GSC-2274 based on two 1-day counts and GSC-2923 based on one 3-day count, both in the 5 L counter.

GSC-2157. Babbage River 1270 ± 40

Sapropel rhizome peat (sample FZ-C1; 57.2 g; containing sheaths and rhizomes of **Carex** sp. and **Eriophorum** sp.; mosses **Meesea triquetra, Drepanocladus revolvens,** and **D.** sp.; unpublished GSC Bryological Report No. 320 by M. Kuc) from the top of a peat unit of unknown thickness in a fresh right-bank exposure on Babbage River, 3 km above the delta, Yukon Territory (69°12'N, 138°20'W), 0.9 m above present mean sea level. The peat is conformably overlain by 0.80 m of stratified organic sandy silt. Collected 1974 by D.L. Forbes, University of British Columbia, Vancouver.

Comment (D.L. Forbes): GSC-2157 and another sample (S-1480, unpublished), from a cutbank exposure 6 km upstream, provide estimates of mean vertical accretion rates in this alluvial environment (0.63 ± 0.02 and 0.78 ± 0.04 mm/year, respectively) and supplement data on Holocene channel development in lower Babbage River valley. Date based on one 3-day count in the 5 L counter.

Babbage Delta Series

The samples in this series were collected from exposures and cores in Holocene sediments forming supratidal flats of the modern Babbage River delta, Yukon Territory.

GSC-2330. Babbage Delta (I) 1380 ± 80

Organic detritus from a sandy peat horizon (core sample FZ4, (42-52); 41.9 g) taken from 42 to 52 cm depth in a 2.6 m-thick unit of peat, silt, and sand on the distal Babbage delta (69°14'N, 138°27'W), 0.8 m above present mean sea level; cf. GSC-2323 from the same core. Collected 1975 by S. Hotzel and J. O'Loughlin for D.L. Forbes; submitted 1976 by D.L. Forbes.

GSC-2323. Babbage River Delta (II) 2100 ± 80

Peat (core sample FZ4, 7(255-260); 6.4 g) from the base of a 2.6 m-thick unit of ice-rich peat, organic silt, and sand overlying massive ice in distal Babbage delta (69°14'N, 138°27'W), 1.3 m below present mean sea level. At a nearby site, a 2.6 m-thick ice-rich peat and sand unit is underlain by 3.5 cm of massive ice over 16 m of icy gravel, which in turn is underlain by sediment containing unfrozen saline water. Collected 1975 by S. Hotzel and J. O'Loughlin for D.L. Forbes; submitted 1976 by D.L. Forbes.

GSC-2691. Babbage Delta (III) 2110 ± 90

Silty peat (sample FZ-P5(87); 6.9 g) from 0.87 m below the top of a fresh cutbank exposure in stratified organic silt, distal Babbage Delta (69°13'N, 138°26'W), at present mean sea level. Collected 1977 by D.L. Forbes and M. Church, University of British Columbia, Vancouver; submitted 1978 by D.L. Forbes.

Comment (D.L. Forbes): GSC-2323 supports the hypothesis that regional submergence along the central Yukon Coast continued into late Holocene time (Forbes, 1980). The result should be treated with some caution in view of the possibility that some of the material in the sample may have been reworked, and because of various uncertainties arising from the presence of massive ice underlying the peat. GSC-2330 and GSC-2691, both of which were overlain by unfrozen sediments, suggest mean sedimentation rates greater than, or equal to, 0.34 ± 0.05 and 0.41 ± 0.02 mm/year, respectively, comparable to the minimum net sedimentation rate obtained at another site on the distal Babbage delta (0.41 ± 0.02 mm/year; S-1482, 2260 ± 130 years; Forbes, 1980). These samples yield remarkably consistent results that are not incompatible with the observed annual increment at the present time. The computed sedimentation rates are regarded as minimum values, however, because another sample, collected 25 cm above GSC-2691 in the same exposure, gave a date of 3075 ± 180 years (S-1481; Forbes, 1980), suggesting that some of the sample material may have been reworked from Holocene peat exposures in the area. NaOH leach omitted from the pretreatment of GSC-2691, and GSC-2323 received only a 15 minute leach with cold NaOH. GSC-2323 and GSC-2691 mixed with dead gas for counting. GSC-2323 based on one 3-day count in the 2 L counter; GSC-2330 based on two 1-day counts in the 5 L counter; GSC-2691 based on two 1-day counts in the 2 L counter.

Northwest Territories

'John Klondike' Bog Series

A series of bog and pond sediment samples from a 470 cm-long core taken in 'John Klondike bog' (informal designation), a peat plateau adjacent to a small lake in Fisherman Lake valley, District of Mackenzie, Northwest Territories (60°21.4'N, 123°38.8'W), at an approximate elevation of 460 m. Collected 1972 with a split-tube corer by J.V. Matthews, Jr. then University of Alberta, Edmonton, now Geological Survey of Canada; and C.E. Schweger, University of Alberta, Edmonton.

GSC-1888. John Klondike bog, 40-50 cm 930 ± 70
$\delta^{13}C = -26.5‰$

Organic detritus (sample J.Kl.Lk. 4-5; 6.7 g dry) from 40 to 50 cm below the surface. Date based on one 1-day count in the 2 L counter.

GSC-1786. John Klondike bog, 250-260 cm — 4320 ± 130; $\delta^{13}C = -25.5‰$

Organic detritus (sample J.Kl.Lk 25-26; 6.7 g dry) from 250 to 260 cm below the surface. NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-1787. John Klondike bog, 330-350 cm — 6660 ± 290; $\delta^{13}C = -27.8‰$

Organic detritus (sample J.Kl.Lk. 33+; 3.7 g dry) from 330 to 350 cm below the surface. NaOH leach omitted from sample pretreatment. Date based on two 1-day counts in the 2 L counter.

GSC-1871. John Klondike bog, 385-400 cm — 8700 ± 350; $\delta^{13}C = -28.3‰$

Organic detritus (sample J.Kl.Lk. 39(-); 1.45 g dry) from 385 to 400 cm below the surface. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-1890. John Klondike bog, 465-470 cm — 9590 ± 320; $\delta^{13}C = -0.1‰$

Marl (sample J.Kl.Lk. 45; 4.6 g) with much segregated ice from the base of the bog, 465 to 470 cm below the surface. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

Comment (J.V. Matthews, Jr.): Relative pollen frequencies and macrofossil studies indicate changing local conditions – from pond to raised bog (Matthews, in press). Spruce percentages are high throughout the entire sequence. Alder pollen percentages rise abruptly ca. 8700 years B.P., indicating the migration of **Alnus** into Fisherman Lake region; GSC-1871 (Zone A) immediately predates the rise in the alder curve, GSC-1787 postdates it (Zone B). The percentage increase in pine pollen between 6660 ± 290 (GSC-1787) and 4320 ± 130 years ago (GSC-1786) may indicate movement of **Pinus contorta** into sub-alpine sites. GSC-1786 (immediately below the C1-C2 zonal boundary) also marks the initial rise of the **Myriophyllum** curve, a feature related to local pond history. GSC-1888 provides a maximum age for the base of Zone C4 and for the formation of the raised bog.

Comment (W. Blake, Jr.): All samples except the uppermost one were frozen when collected. The samples were allowed to thaw and then were sieved through a Tyler No. 100 screen (opening 150 μm); the residue (for ^{14}C) was air dried. All samples except the basal one were treated with 20 per cent HCl by the collector to remove carbonates; GSC-1871, the smallest sample, received no additional treatment in the laboratory. GSC-1888 was characterized as **Carex-Eriophorum** peat by M. Kuc (unpublished GSC Bryological Report No. 227).

Coppermine River Series

Peat and wood from a bluff on Quicksand Creek, 3 km west of the nearest rapids on Coppermine River, District of Mackenzie, Northwest Territories (66°49'30"N, 116°21'W), at an approximate elevation of 325 m. The samples are from a 4 m-thick sequence of channel fill deposits inset into 25 m of varved clay of glacial Lake Coppermine (St-Onge, 1980) and about 60 m above the level of Coppermine River. Collected 1979 by D.A. St-Onge, Université d'Ottawa, Ottawa.

GSC-2998. Quicksand Creek (I) — 3210 ± 60

Peat (sample DS-79-7E; 26.5 g) from the top unit of the organic-rich channel fill deposits, a massive compact peat 30 cm in thickness. The peat is underlain by silty sand and is overlain by 1 to 2 m of windblown sand and silt which caps the entire section.

GSC-2959. Quicksand Creek (II) — 8400 ± 80

A single piece of wood (sample DS-79-7A; 7.2 g; **Salix** sp.; identified by L.D. Farley-Gill) from the basal unit of the channel fill deposits.

Comment (D.A. St-Onge): Date GSC-2959 marks the time when an area of the delta ceased to be an active channel and infilling commenced. GSC-2998 indicates that the 4 m-thick organic-rich sequence was deposited over a period of about 5000 years.

Comment (W. Blake, Jr.): Examination of this fibrous and felted peat indicated that it is autochthonous; much of it appears to be bryophyte stems. A few seeds of **Empetrum nigrum** and **Carex** sp. are present. Insect remains include predacious diving beetles, rove beetles, wasps, and ants (unpublished GSC Fossil Anthropod Report No. 79-4 by J.V. Matthews, Jr.). GSC-2959 based on one 3-day count and GSC-2998 on two 1-day counts; both samples were counted in the 5 L counter.

Castle Island Series

Marine pelecypod shells (**Mytilus edulis**; identified by B.G. Craig) from the modern beach and raised marine beaches at various elevations on Castle Island, Northwest Territories, 46 km north of Poste-de-la-Baleine (Great Whale River), Quebec. The modern beach sample is from the ground surface at present high tide line, the raised beach samples are from 5 to 20 cm depth in coarse stony shingle. All elevations are based on altimeter traverses, with at least five determinations for each site. Collected 1975 by B.G. Craig and R.I. Walcott, the latter then with Earth Physics Branch, Department of Energy, Mines and Resources, now at Department of Scientific and Industrial Research, Wellington, New Zealand.

GSC-2070. Castle Island (I) — 3330 ± 60

Sample CD-4-74 (41.8 g) from a raised marine beach (55°34'53"N, 77°19'00"W), at an elevation of 58 ± 1 m. Date based on two 1-day counts in the 5 L counter.

GSC-2348. Castle Island (II) — 2760 ± 80; $\delta^{13}C = +1.4‰$

Sample CD-8-74 (15.0 g) from a raised marine beach (55°34'47"N, 77°18'14"W), at an elevation of 44 ± 1 m. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 5 L counter.

GSC-2129. Castle Island (III) — 2030 ± 60; $\delta^{13}C = +0.9‰$

Sample CD-10-74 (25.8 g) from a raised marine beach (55°34'39"N, 77°18'25"W), at an elevation of 29 ± 1 m. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 5 L counter.

GSC-2074. Castle Island (IV) — 1790 ± 50

Sample CD-9-74 (45.0 g) from a raised marine beach (55°34'33"N, 77°18'29"W), at an elevation of 22 ± 1 m. Date based on two 1-day counts in the 5 L counter.

GSC-2470. Castle Island (V) — 0 ± 60; $\delta^{13}C = +0.6$

Sample CD-2-74 (27.0 g) from high tide line of the modern beach (55°35'11"N, 77°20'00"W), at an elevation of 0 m. Date based on two 1-day counts in the 2 L counter.

Comment (B.G. Craig): The samples were collected to define the rate of emergence in southeastern Hudson Bay during the last few thousand years. GSC-2070 and -2074 indicate that between approximately 3300 and 1800 years ago the land emerged at a rate of 21 to 25 mm per year (Walcott and Craig, 1975).

Comment (W. Blake, Jr.): The sample used for determination GSC-2470 consisted of 11 intact pairs; the two largest were 4.6 by 2.4 cm, the smallest measured 2.8 by 1.4 cm. Most of the periostracum was intact on all valves.

Northern Canada, Arctic Archipelago

Hudson Strait

GSC-2946. Hudson Strait 9120 ± 480
$\delta^{13}C = +1.0$ ‰

Marine pelecypod shells (2.2 g; **Nuculana pernula;** identified by F.J.E. Wagner) from the 200 to 300 cm level of piston core Hu77-021-154. The core is from 933 m water depth in the inner basin of Hudson Strait, Northwest Territories (60°53.7'N, 65°26.6'W). Shells from 102 to 110 cm in the same core were previously dated at 8730 ± 250 years (GSC-2698; GSC XVIII, 1978, p. 13). In both cases the enclosing sediment was a marine mud, probably deposited by turbidity currents (Fillon, 1980). A current-winnowed, ice-rafted sand unit caps the sequence above a depositional break at a depth of 15 cm in the core. Collected 1977 by R.H. Fillon.

Comment (R.H. Fillon): The two dates in this core, which is in the basin west of the moraine pile, provide a minimum sedimentation rate estimate of 130 cm/1000 years. Extrapolation of this rate to the bottom of the 7.5 m cored turbidite section results in a maximum age estimate of 13 000 years for the base of the core.

Comment (W. Blake, Jr.): Because of the very small size (2.2 g) of this sample of aragonitic shells, the HCl leach was omitted. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

Baffin Island

GSC-3015. Jackman Sound 8480 ± 280

Pelecypod shells (sample GRL-762-S; 7.0 g; **Macoma calcarea;** identified by W. Blake, Jr.) from a silty clay-rich diamicton of presumed glaciomarine origin on the west side of the southeastern bay in Jackman Sound, Baffin Island, Northwest Territories (62°18'N, 66°15'W), at approximately 3 m below high tide level. Collected 1979 by D.S. Muller, then University of Colorado, Boulder; now Amoco, Denver.

Comment (D.S. Muller): Sample GRL-762-S was collected from a sand lens within a shell-bearing diamicton unit, which is overlain by a Holocene alluvial terrace. The sample may pre-date a jökulhlaup delta 100 m north of the site whose surface drops from an elevation of 49 m at its northern margin to 40 m at its southern margin. Dates of 8135 ± 210, 7980 ± 175, and 8140 ± 250 years were obtained from the north side of the delta (QC-883, SI-4181, and QC-882, respectively; Muller, 1980). The interpretation is of a readvance of Terra Nivea outlet glacier I-29 following withdrawal of Frobisher Bay based ice from the region ca. 9000 years ago. The readvance occurred between 8480 ± 280 and 8135 ± 210 years ago (GSC-3015 and QC-883, respectively; Muller, 1980); but by the latter time retreat had occurred also. This interpretation is based upon the assumption that the Holocene terrace is a cut terrace, incised into gravels from the delta's continuation; however, this cannot be unequivocally demonstrated. Evidence supporting this view of ancestral Terra Nivea glacier I-29 readvancing and depositing this delta include: its elevation relating to a sea level of approximately 40 m above high tide, the presence of thickened till north and south of this glacier, the presence of at least one submerged moraine ridge towards the middle of Jackman Sound (parallel to the long axis of Jackman Sound), the southward slope of the delta surface, and the limiting date of GSC-1903 (9010 ± 380 years; GSC XIII, 1973, p. 37). Outlet glacier I-28 has been near its present position since at least 8400 years B.P.

Comment (W. Blake, Jr.): Adhering mud was removed from the aragonitic shells by scraping. The dated sample comprised two intact valves (3.8 by 2.8 cm and 3.5 by 2.7 cm), not a pair, and fragments of the hinge area of at least six other valves. No lustre or periostracum remained, but neither were the shells chalky. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-2982. Valley south of York Sound 8950 ± 160

Fragments of cirriped shells (sample GRL-757-S; 12.0 g; **Balanus balanus;** identified by W. Blake, Jr.), from soliflucting silt and clay within a boulder field in the first valley south of York Sound, Baffin Island, Northwest Territories (62°25'N, 66°25'W), at an approximate elevation of 30 m. Collected 1979 by D.S. Muller.

Comment (D.S. Muller): The sample was obtained from a marine plain proximal to a subdued moraine, the crest of which was located in the col at the head of the valley. The next valley south contains rock-glacierized limestone-bearing till. This till is thought to be equivalent to Miller's (1980) Hall drift. The date is one of the oldest obtained thus far for retreat of ice from the York Sound area. Miller (1980) has obtained several dates of greater than 10 000 years for the retreat of ice in Frobisher Bay from the north side of the bay. Other dates of interest include GSC-463 and -463-2, 8840 ± 160 and 8710 ± 180 years, respectively (Blake, 1966; GSC VI, 1967, p. 182), GSC-1903, 9010 ± 380 years (GSC XIII, 1973, p. 37), SI-4368, 8820 ± 110 years (Muller, 1980), and GSC-2991, 8790 ± 380 years (Muller, 1980; this list).

Comment (W. Blake, Jr.): As much of the adhering mud as possible was scraped off, but some remained in wall pores. No encrustations or pitting were present on these shell fragments. Only the outer 10 per cent of shell was removed by HCl leach (small sample). Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-2991. York Sound 8790 ± 380

Pelecypod shell fragments (sample GRL-758-S; 5.0 g; **Hiatella arctica;** identified by W. Blake, Jr. and D.S. Muller), from a small valley trending 340° below an extensive washed bedrock knob, west of a delta surface at 22 m a.s.l. on the north side of York River, Baffin Island, Northwest Territories (62°25'N, 66°30'W), at an approximate elevation of 55 m above high tide level (altimeter determination). Collected 1979 by D.S. Muller.

Comment (D.S. Muller): The sample was obtained from the silty clay fraction of a marine diamicton. A fairly extensive marine plain is present 13 m lower, at about 42 m above high tide. GSC-2991 coincides well in age with GSC-463, GSC-463-2, GSC-1903, and SI-4368 (see comments for GSC-2982, this list) which give similar ages for the deglaciation of York Sound. Miller's (1980) dates suggest a retreat of Frobisher Bay ice at ca. 10 600 years ago on the opposite side of the bay. Thus a satisfactory explanation for the absence of older dates in the area is needed. It is possible that the north side of the bay became deglaciated first, with ice flowing off of Meta Incognita Peninsula continuing to occupy the outer coast in the York Sound area until ca. 9000 years ago. The similarity of marine limit values on both sides of the bay, however, argues against much "restrained rebound" having occurred along the south side of

the bay. If, however, Meta Incognita Peninsula also had a significant ice load, in addition to the isostatic depression caused by Hudson Strait ice, whereas Hall Peninsula did not have a significant ice load, the comparable emergence values may merely be coincidental.

Comment (W. Blake, Jr.): The aragonitic shell fragments sent to the laboratory were all <1 mm in thickness. Some pieces were clearly **Hiatella arctica,** other fragments probably were but they could not be identified with certainty. Thick shell fragments (up to 3 mm) were not utilized, nor were other fragments identified as **Mya** sp. Some fragments had been abraded. Only the outer 10 per cent of the shell was removed by HCl leach (small sample). Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-1889. Watts Bay — 250 ± 80
$\delta^{13}C = +3.4‰$

A single valve of the pelecypod **Chlamys islandicus** (sample B-121(1952); 9.2 g; identified by W. Blake, Jr.) from just above high tide level on the inner east side of Watts Bay, Frobisher Bay, Baffin Island, Northwest Territories (62°39.5'N, 66°48'W). Collected 1952 by W. Blake, Jr., then McGill University, Montreal, now Geological Survey of Canada.

Comment (W. Blake, Jr.): This intact yet fragile shell (7 by 7 cm) was interpreted as having been thrown up on the shore a relatively short time before it was collected; the ligament was still intact, and the interior was lustrous, although the exterior bore a few worm tubes and encrusting bryozoa. Since it was collected in 1952, prior to the advent of nuclear bomb testing and the resultant addition of much ^{14}C to the atmosphere, it gives an approximation for the 'apparent age' of marine shell samples collected in the vicinity (Table 5 in Blake, 1975). Because of the small sample size only the outer 5 per cent was removed by HCl leach. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-2797. Clyde River — >39 000
$\delta^{13}C = +1.5‰$

Marine mollusc shells and fragments (sample GRL-701-S; 47.0 g; **Astarte borealis** and **A. elliptica;** identified by I. Lubinsky, University of Manitoba, Winnipeg) from sand exposed in a stream-cut section 200 m north-northwest of the hamlet of Clyde River, Baffin Island, Northwest Territories (70°28'N, 68°34'W), at an elevation of 21 to 24 m. Collected 1978 by W.N. Mode, then University of Colorado, Boulder; now Ohio State University, Columbus.

Comment (W.N. Mode): The sampled sequence underlies a terrace at 25 m a.s.l. which cuts the lowest recessional moraine on the Clyde foreland. The date supports the contention that the foreland has not been glaciated during the past 40 000 years (Miller et al., 1977). The shell collection contained a diverse molluscan fauna including **Mya pseudoarenaria,** an indication that marine waters were warmer than those presently prevailing in the nearshore of the Clyde area (Andrews et al., in press).

Comment (W. Blake, Jr.): The entire sample was examined by I. Lubinsky. Although the majority of aragonitic individuals submitted for dating were **Astarte borealis,** some **A. elliptica** was also present. Only two **A. borealis** valves were intact – both were 2.5 by 2.1 cm; the periostracum and some internal lustre were retained, and the same was true of a number of shell fragments utilized. Pieces that were especially pitted or chalky or those with a pronounced yellowish coating on the interior surface were not used. Date based on one 3-day count in the 5 L counter.

Devon Island

GSC-1952. Port Refuge — 3070 ± 70

Driftwood log (sample 1972-4; 13.4 g; **Larix** sp.; identified by L.D. Farley-Gill) embedded in a gravel beach 280 m inland from the west coast of Port Refuge, Devon Island, Northwest Territories (76°17'N, 94°49'W), at an elevation of 16.5 m (determined by hand levelling from sea level, not from the surface of the ice foot). Collected 1972 by R. McGhee, then Memorial University of Newfoundland, St. John's; now National Museum of Man, Ottawa.

Comment (R. McGhee): The date is consistent with a series of dates on driftwood charcoal associated with Arctic Small Tool Tradition sites higher on the beaches: GSC-1931 (4120 ± 120 years, at 24 ± 1 m), GSC-1940 (4360 ± 90 years, at 22 ± 1 m), and GSC-1949 (3480 ± 140 years, at 22 ± 1 m; all in GSC XIV, 1974, p. 9; McGhee, 1979). Date based on two 1-day counts in the 5 L counter.

Dundas Island

GSC-1914. Dundas Island — 4380 ± 80

Driftwood log (sample 1972-5; 13.0 g; **Picea** sp.; identified by L.D. Farley-Gill) embedded in a gravel beach 420 m inland from the north coast of Dundas Island, Northwest Territories (76°07'N, 94°54'W), at an elevation of 26.5 m (determined by hand levelling from sea level, not from the surface of the ice foot). Collected 1972 by R. McGhee.

Comment (W. Blake, Jr.): The date is consistent with the ages and elevations of driftwood in the Jones Sound area to the east which suggest that the 5000 year-old shoreline should be close to 30 m in elevation in the vicinity of Dundas Island (Blake, 1975). Date based on two 1-day counts in the 5 L counter.

Ellesmere Island

Cape Storm Series (VI)

Whale bone samples from raised beaches north of Cape Storm, Ellesmere Island, Northwest Territories. All elevations were determined with a levelling instrument using the surface of the ice foot as high tide level. Collected 1967 and 1970 (BS-70-205) by W. Blake, Jr. At least two age determinations were made on each sample.

GSC-980. Cape Storm, whale bone, 1.5 m — 980 ± 60
$\delta^{13}C = -15.8‰$

A whale vertebra (sample BS-79-67), 20 cm in diameter, partially imbedded in vegetation and beach shingle (frozen in) in the first swale behind the modern beach, 4.8 km north-northeast of Cape Storm (76°22.5'N, 87°30'W), at an elevation of 1.5 m. A sample weighing 364 g was treated with 3N HCl to remove the carbonate fraction, the NaOH leach was omitted; 30 g was burnt. Date based on two 1-day counts in the 5 L counter.

GSC-980-2. Cape Storm, whale bone, 1.5 m — 940 ± 70
$\delta^{13}C = -23.7‰$

A subsample of the same vertebra (BS-79-67; 526 g) was given a 1-hour leach in 0.1N NaOH, then 3 g was burnt. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-1227. Cape Storm, whale bone, 3.0 m — 1610 ± 50
$\delta^{13}C = -13.8‰$

A posterior cranial fragment of a whale (sample BS-22-67; 500 g; **Balaena mysticetus;** identified by C.R. Harington, National Museum of Natural Sciences, Ottawa) resting on the surface of a raised beach, 8 km north-northeast of Cape Storm (76°24'N, 87°30'W), at an elevation

of 3 m. Pretreatment to recover the collagen fraction included a 1-hour leach in 0.1N NaOH; 19.0 g was burnt. Date based on one 3-day count in the 5 L counter.

GSC-1227-2. Cape Storm, whale bone, 3.0 m — 1870 ± 90; $\delta^{13}C = -13.8‰$

A subsample of the same bone (BS-22-67; 590 g) was treated with acetic acid to obtain the bone apatite fraction; this fraction was then treated with H_3PO_4 in the shell apparatus to obtain the CO_2. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-1021. Cape Storm, whale bone, 16.5 m — 4490 ± 60; $\delta^{13}C = -16.3‰$

A whale rib (sample BS-185-67) associated with mandibles (**Balaena mysticetus**; identified by C.R. Harington) imbedded in beach gravel 7.5 km north of Cape Storm (76°24'N, 87°30'W), at an elevation of 16.5 m. The exposed part was 38 cm long. A sample weighing 1100 g was split into two portions. GSC-1021 was given a 24-hour leach with 0.1N NaOH; 16.6 g of collagen was burnt. Date based on one 2-day count in the 5 L counter.

GSC-1021-2. Cape Storm, whale bone, 16.5 m — 4580 ± 60; $\delta^{13}C = -15.9‰$

The second portion of the original 1100 g sample (BS-185-67) was given a 1-hour leach with 0.1N NaOH; 14.5 g of collagen was burnt. Date based on one 3-day count in the 2 L counter.

GSC-1021-3. Cape Storm, whale bone, 16.5 m — 4450 ± 70; $\delta^{13}C = -11.9‰$

A subsample of the same rib (BS-185-67; 698 g) was treated with acetic acid to obtain the bone apatite fraction; this fraction was then treated with H_3PO_4 in the shell apparatus to obtain the CO_2. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-979. Cape Storm, whale bone, 23.0 m — 5600 ± 60; $\delta^{13}C = -16.1‰$

A whale rib (sample BS-186-67), 66 cm long, associated with a cranium (probably referable to **Balaena mysticetus**; C.R. Harington, personal communication, 1972) imbedded in beach gravel and exposed in a stream gully 7.5 km north of Cape Storm (76°24'N, 87°30'W), at an elevation of 23 m. A sample weighing 2365 g was split into two portions. For GSC-979 the NaOH leach was omitted; 27.2 g of collagen was burnt. Date based on two 1-day counts in the 5 L counter.

GSC-979-2. Cape Storm, whale bone, 23.0 m — 5420 ± 70; $\delta^{13}C = -16.0‰$

The second portion of the original 2365 g sample was given a 1-hour leach with 0.1N NaOH; 13.5 g of collagen was burnt. Date based on one 2-day count in the 5 L counter. The $^{13}C/^{12}C$ value of -16‰ is an estimate based on the results obtained for other bone samples.

GSC-979-3. Cape Storm, whale bone, 23.0 m — 5050 ± 180; $\delta^{13}C = -11.3‰$

A subsample of the same rib (BS-186-67) was treated with acetic acid to obtain the bone apatite fraction; this fraction was then treated with H_3PO_4 in the shell apparatus to obtain the CO_2. Date based on one 2-day count in the 1 L counter.

GSC-1498. Cape Storm, whale bone, 38.0 m — 7260 ± 80; $\delta^{13}C = -15.2‰$

A whale bone (sample BS-70-205; possibly a skull fragment), more than 2 m long, was imbedded in frozen beach gravel 7.5 km north of Cape Storm (76°24.5'N, 98°30'W), at an elevation of 38 m. A 1043 g sample was given a 1-hour leach with 0.1N NaOH; 15.5 g of collagen was burnt. Date based on two 1-day counts in the 5 L counter.

GSC-1498-2. Cape Storm, whale bone, 38.0 m — 6560 ± 170; $\delta^{13}C = -11.9‰$

A subsample of the same bone (BS-70-205; 590 g) was treated with acetic acid to obtain the bone apatite fraction; this fraction was then treated with H_3PO_4 in the shell apparatus to obtain the CO_2. Date based on one 3-day count in the 1 L counter.

GSC-1498-3. Cape Storm, whale bone, 38.0 m — 7240 ± 80; $\delta^{13}C = -16.4‰$

A portion (15 g) that remained of the original collagen preparation was burnt and then the KOH method was used (cf. GSC XVII, 1977, p. 2-3). Date based on two 1-day counts in the 5 L counter.

Comment (W. Blake, Jr.): With the exception of GSC-1498-3, this series of determinations was reported and discussed in Blake (1975). In a general way the determinations using collagen are in agreement with the dates on associated driftwood. The apatite dates on two of the younger bones (GSC-980-2 and -1021-3) are in close agreement with the collagen ages, whereas in the case of GSC-1227-2 the result on the apatite fraction is actually older. For older bones (GSC-1498-2, this list) higher on the beaches, however, the apatite fraction is younger; cf. also GSC-1496-2 (GSC XIX, 1979, p. 43), the highest whale bone collected at Cape Storm, and GSC-964-3 (GSC XV, 1975, p. 21-22), the highest whale bone collected at nearby Baad Fiord. The bone used for GSC-1498 was not as well preserved as the bones at lower elevations; it had been penetrated by rootlets in places (these parts were not used), lemming droppings were present (the interior of the bone had been used as a burrow), and the bone was more rotten. Most of the rotten material was removed in the field while the sample was air drying. In spite of the fact that the condition of this bone left something to be desired, the two age determinations on the collagen fraction, carried out in 1973 and 1976, are both virtually identical with the age of nearby driftwood imbedded 5.5 and 7.0 m higher on the raised beaches.

Bathurst Island

Polar Bear Pass Peat Series

Peat samples from two sites along the northern side of Polar Bear Pass, Bathurst Island, Northwest Territories. Collected 1963 by W. Blake, Jr.

GSC-1876. Polar Bear Pass, peat (I) — 2870 ± 50

Surface peat (sample BS-296-63; 45 g dry) from an abandoned river valley 4.3 km north of the eastern (larger) lake in Polar Bear Pass, Bathurst Island (75°45'N, 98°28.5'W), at an elevation of approximately 50 m (altimeter determination on traverse). The site is where a small tributary stream joins the underfit stream issuing from a valley parallel to, and west of, the valley of 'Goodsir River'. The dry peat surface is overlain by a thin cover of till and/or colluvium, and in many places the stream has incised at least 1.5 m into the peat.

Comment (W. Blake, Jr.): The peat was expected to be less than 8000 years old (if it was of Holocene age), as the site is below the limit of postglacial marine submergence. The date shows that the inorganic debris on top of the peat is clearly the result of slopewash or some similar process. The two subdominant mosses are **Calliergon trifarium** and **Drepanocladus latifolius** (water form); also present are **Calliergon giganteum, Meesea triquetra, Drepanocladus revolvens** (all associating species), and rare **Orthothecium chryseum** and **Campylium stellatum;** this assemblage was interpreted by M. Kuc (unpublished GSC Bryological Report No. 236) as a "typical eutrophic High Arctic pond deposit – the bio-product of an aquatic moss community." It would appear that wetter conditions must have prevailed in this valley when this moss community flourished. Date based on one 3-day count in the 5 L counter.

GSC-1883. Polar Bear Pass, peat (II) 2760 ± 70

Surface peat (sample BS-298-63; 35.0 g dry) adjacent to a small pond 1 km west of the National Museum of Natural Sciences base camp and 2 km north of the eastern (larger) lake in Polar Bear Pass, Bathurst Island (75°43.7'N, 98°28'W), at an elevation of 60 m (altimeter determination on traverse). This dry, compact and compressed peat is overlain by a veneer of inorganic material, interpreted as reworked beach gravel as it contains shell fragments.

Comment (W. Blake, Jr.): This site, as with the peat used for GSC-1876 (this series), is below the limit of postglacial marine submergence, but both samples were dated on the slim chance that they might be 'old', as are a number of other peat samples on Bathurst Island (cf. Blake, 1974; GSC XV, 1975, p. 25-26). The dominant moss at this site is **Scorpidium scorpioides,** with **Drepanocladus latifolius** as an associating species; according to M. Kuc (unpublished GSC Bryological Report No. 239) "this peat is a bio-product of aquatic tundra. Large mats of both species form at present around shallow arctic pools or on their bottoms if they are seasonally dry." Both GSC-1876 and -1883 appear to mark the end of a peat-forming episode some 2700 to 2900 years ago. Date based on one 1-day count in the 5 L counter.

Banks Island

Banks Island Lake Sediment Series

Samples collected from four lakes on Banks Island in 1974 by R.J. Mott using a Livingstone corer and operating from a raft constructed from two aluminum boats.

GSC-2250. Johnson Point, 116-121 cm 6580 ± 120; $\delta^{13}C = -35.9‰$

Organic sediment (sample MS-74-13; 110.0 g wet) from a small lake in a moraine along the western coast of Prince of Wales Strait, 40 km northeast of Johnson Point, Banks Island, Northwest Territories (73°02'N, 117°33'W). The lake is at an elevation of about 30 m and has a maximum depth of 6 m. Banded black sapropel, which becomes clayey at 121 cm depth, overlies greyish brown clay with some black streaks and thin moss layers to a depth of 170 cm. This unit overlies beige and grey clay with minor organic content to a depth of 211 cm. Below this is firm, brown and grey silt and clay with pebbles. The sample was black, clayey sapropel from the base of the continuous organic unit at 116 to 121 cm below the sediment/water interface.

Comment (R.J. Mott): The date provides an age for the beginning of continuous organic sediment accumulation in the basin. NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-2260. Sachs Harbour area, 246-252 cm 9480 ± 340; $\delta^{13}C = -27.0‰$

Basal organic sediment (sample MS-74-11; 85 g wet) from a small lake in a moraine along the coast of Thesiger Bay, 40 km southeast of Sachs Harbour, Banks Island, Northwest Territories (75°46'N, 124°16'W). The lake is at an elevation of about 45 m and has a maximum water depth of 9 m. A total of 265 cm of mottled black to dark grey clayey lake sediment with some mossy layers, grading into brownish grey clay with some moss content above 252 cm, overlies brownish grey clayey silt with some pebbles (till?). The sample was mottled grey and brownish grey clay from an interval of 246 to 252 cm below the sediment/water interface.

Comment (R.J. Mott): The date provides a minimum age for the beginning of organic accumulation in this lake on the moraine formed during the Sand Hills Readvance of the Amundsen Glaciation (Vincent, 1978, 1980). NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-2654. Stewart Point area, 123-153 cm 9080 ± 160; $\delta^{13}C = -32.8‰$

Fragments of moss (sample MS-74-12; 3 g dry; **Drepanocladus badius;** identified by J.A. Janssens, University of Alberta) washed out of basal silty clay from a small lake on the highland about 18.5 km west of Stewart Point, Banks Island, Northwest Territories (72°22'N, 119°50'W). The lake is at an elevation of about 220 m and has a maximum water depth of 15 m. The core showed about 85 cm of greenish grey, noncalcareous silty gyttja overlying and grading into black, noncalcareous silty gyttja to a depth of 106 cm. This overlies, with a sharp contact, brownish grey, calcareous clay with some organic content and black and grey-brown calcareous silty clay to 122 cm depth. Below this is greyish black to grey silty calcareous clay with layers of moss fragments to 159 cm depth, overlying dark grey-black, highly calcareous, pebbly, silty clay. The moss fragments were washed from the grey silty clay at 123 to 153 cm below the sediment/water interface.

Comment (R.J. Mott): The date provides a minimum age for beginning of vegetation growth in the area following retreat of Amundsen ice which covered the east coastal area of Banks Island (Vincent, 1978). NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-2673. Shoran Lake area, 275-280 cm 10 200 ± 130; $\delta^{13}C = -26.2‰$

Moss fragments (sample MS-74-15; 14 g dry; **Calliergon giganteum, Drepanocladus aduncus, Meesea triquetra,** and **Scorpidium scorpioides;** identified by J.A. Janssens, University of Alberta) washed out of calcareous silty clay from a small lake in Thomsen valley 2 km east of Shoran Lake, Banks Island, Northwest Territories (73°32'N, 120°13'W). The lake is at an elevation of 120 m and has a maximum depth of 8.5 m. The lake sediment core shows 266 cm of black and mottled or banded black to dark grey silty clay which becomes less organic with depth, contains shells, and is slightly calcareous below 220 cm. Below this level the sediment is dark grey to black, silty calcareous clay with abundant moss remains to 297 cm. Underlying this is a calcareous, dark brown grey, stiff silt to fine sand with pebbles. Moss fragments were washed from the silty clay at 275 to 280 cm depth below the sediment/water interface.

Comment (R.J. Mott): The area in which this lake is situated was covered by ice of the Thomsen Glaciation but was beyond the limit of the Amundsen Glaciation

(Vincent, 1978, 1980). Despite being on a much older glaciated surface, the date indicates that the organic sediment sampled did not begin to accumulate until after the Amundsen Glaciation. NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

Schuyter Point Sea Series

The following age determinations were made on materials collected in Schuyter Point Sea sediments along Prince of Wales Strait, Banks Island (Vincent, 1978, 1980). This sea, of late Wisconsin – Holocene age, submerged the southern and eastern coasts of Banks Island to a maximum elevation of 25 m. Its sediments overlie the early or mid-Wisconsin Jesse Till deposited by the Prince of Wales Lobe during the M'Clure Stade of the Amundsen Glaciation. The Schuyter Point Sea did not abut an ice margin on Banks Island. Inundation of the east coast of Banks Island is thought to have resulted from glacio-isostatic depression caused by late Wisconsin ice that did not reach the island but stood to the east on Victoria Island or to the northeast in Viscount Melville Sound. The dates generally indicate a progressive lowering of relative sea level between 11 200 and 10 200 years ago. Date GSC-49 (10 920 ± 100 years; GSC I, 1962, p. 23), an age determination on **Hiatella arctica** shells collected in 1960 by J.G. Fyles from the surface of gullied clay at an elevation of 15 to 18 m and 1.6 km west of Cape Cardwell, is also related to deposits of the Schuyter Point Sea; Fyles recorded shells and indistinct shorelines near to that site at elevations up to 24 m.

GSC-2413. Prince of Wales Strait (I) 11 000 ± 400
$\delta^{13}C = +1.5‰$

Pelecypod shell (sample VH-75-062; 6.3 g; **Hiatella arctica;** identified by J-S. Vincent) from the coast of Prince of Wales Strait, 79 km northeast of Johnson Point, Banks Island, Northwest Territories (73°13.5'N, 116°37'W), at an approximate elevation of 16 m (measured by altimeter). Collected 1975 by J-S. Vincent.

Comment (J-S. Vincent): The dated sample is one of a collection of poorly preserved whole shells (some of which were paired) from the surface of a sandy, ill-defined strandline. The date relates to a water plane of the Schuyter Point Sea which stood at 16 m.

Comment (W. Blake, Jr.): Nearly all the valves were heavily encrusted, most were pitted on the exterior surfaces, and several had lichens growing in crevices. The majority were also discoloured or stained. Because of the extremely poor quality of the shells comprising this collection, only a single right valve was utilized for dating; it measured 4.8 by 2.3 cm and had some thin encrustations on the exterior surface but some lustre still remained in the interior. Sample mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

This sample is the farthest north in the series collected by Vincent, and as such it is nearest to GSC-1437 (10 600 ± 270 years; GSC XIII, 1973, p. 45), **Hiatella arctica** fragments collected by D.M. Barnett at 85 to 88 m a.s.l. 16 km north-northwest of Parker Point. The elevation of this sample from the north coast is more than 60 m higher than the highest elevation attributed to the samples in the Schyter Point series from the coast of Prince of Wales Strait (this list). Vincent (1978) suggested that the high elevation of the Parker Point sample may have resulted from marine sediments being pushed upward by the readvance of a lobe of ice in Viscount Melville Sound – M'Clure Strait (cf. also Prest et al., 1968).

GSC-2099. Prince of Wales Strait (II) 10 200 ± 170
$\delta^{13}C = -0.4‰$

Paired pelecypod shells (sample VH-74-042; 8.8 g; **Hiatella arctica;** identified by J-S. Vincent) from a section on the south side of a small east-flowing stream on the coast of Prince of Wales Strait, 14 km northeast of Johnson Point, Banks Island, Northwest Territories (73°00.8'N, 117°33'W), at an elevation of 8 m (measured by altimeter). Collected 1974 by T.J. Day, now Inland Waters Directorate, Environment Canada, and J-S. Vincent.

Comment (J-S. Vincent): The paired valves are from a 50 cm-thick shell-rich horizon of stratified silt and sand underlying 2 m of poorly stratified silt, sand, and gravel interpreted as being morainic deposits reworked by the sea. Many valves in the collection were paired, and abundant **Portlandia arctica** (identified by W. Blake, Jr.) were found with **Hiatella arctica.** The sequence of sediments is thought to have been laid down in shallow water. The sample, therefore, dates a water plane of the Schuyter Point Sea which stood at or close to 8 m.

Comment (W. Blake, Jr.): Only a single pair of intact valves was submitted to the laboratory, as the large size and robustness of the shells in this collection suggested that they might be 'old'; utilizing a single pair removes the possibility of dealing with a mixed sample. The shells were 4.2 by 2.4 cm (the largest in the collection were 5.0 by 2.8 cm). The ligament was still intact as well as part of the periostracum. There was no pitting or encrustation, and the interior retained its lustre. Only the outer 5 per cent was removed by HCl leach (small sample size). The sample was mixed with dead gas for counting. Date based on one 3-day count in the 2 L counter.

GSC-2633. Prince of Wales Strait (III) 10 500 ± 110
$\delta^{13}C = +0.7‰$

Shells (sample VH-77-101; 35.1 g; **Hiatella arctica;** identified by J-S. Vincent) from the coast of Prince of Wales Strait, 24 km south of Jesse Harbour, Banks Island, Northwest Territories (72°02.8'N, 120°14.2'W), at an elevation of 10 m (measured by altimeter). Collected 1977 by J-S. Vincent.

Comment (J-S. Vincent): The well preserved whole valves were collected in a thin exposure of nearshore and littoral sediments overlying Jesse Till. The well preserved shells were collected from the surface in fine sand; in places this sand was overlain by a veneer of medium sand and fine gravel. The shells date a water plane of the Schuyter Point Sea which stood at or close to 10 m.

Comment (W. Blake, Jr.): The sample utilized for dating comprised 12 right and eight left valves (the largest measured 4.2 by 2.0 cm) plus eight fragments. The moderately thick aragonitic shells were not pitted, but some interior surfaces had slight encrustations. Because of the small sample size, only the outer 10 per cent was removed by HCl leach. Sample mixed with dead gas for counting. Date based on one 3-day count in the 5 L counter.

GSC-2545. Prince of Wales Strait (IV) 11 200 ± 100
$\delta^{13}C = +1.4‰$

Shells (sample VH-77-103; 28.0 g; **Hiatella arctica;** identified by J-S. Vincent) from the coast of Prince of Wales Strait, 25 km south of Jesse Harbour, Banks Island, Northwest Territories (72°02.2'N, 120°15.7'W), at an elevation of 21 m (measured by altimeter). Collected 1977 by J-S. Vincent.

Comment (J-S. Vincent): These well preserved whole valves were collected in a thin exposure of nearshore and littoral sediments overlying Jesse Till. The shells were embedded in fine sand overlying silt and underlying medium sand and fine gravel. The shells date a water plane of the Schuyter Point Sea which stood at or close to 21 m.

Comment (W. Blake, Jr.): A few valves showed slight encrustations, otherwise the aragonitic shells were thin but hard and well preserved. There was little chalkiness and some internal lustre was preserved. Date based on one 3-day count in the 2 L counter.

GSC-2539. Prince of Wales Strait (V) 160 ± 60

Wood (sample VH-77-111; 11.2 g; **Picea** sp.; identified by L.D. Farley-Gill) from the surface of a small valley slope 28 km south of Jesse Harbour, Banks Island, Northwest Territories (72°00.6'N, 120°19.8'W), at an elevation of 26 m (measured by altimeter). Collected 1977 by J-S. Vincent.

Comment (J-S. Vincent): The dated wood is from a 1.1 m-long log which was slightly embedded in the surface and which was found in association with other wood fragments which were well embedded or completely covered by sediment. The site where the wood was collected appeared to be a good location for floating debris to have stranded. It was thought, therefore, that the wood would date a water plane of the Schuyter Point Sea situated at approximately 26 m. The result clearly indicates that the field interpretation was erroneous. The wood may have been brought to the collection site, from the modern beach, by native people. Date based on one 1-day count in the 5 L counter.

GSC-2324. Stewart Point, north 2130 ± 70

Peat (sample VH-74-036; 62.0 g) from a section in a deep gully, 1.3 m below the surface, 0.5 km west of Prince of Wales Strait and 14.5 km north of Stewart Point, Banks Island, Northwest Territories (72°30.5'N, 119°15.7'W), at an elevation of approximately 50 m. Collected 1974 by C.M. Tucker, now Defence Research Establishment Suffield, Ralston, Alberta, and J-S. Vincent.

Comment (J-S. Vincent): The peat, interstratified with silt, overlies silt deposited in the pre-Wisconsin Big Sea (Vincent, 1980). The sample was collected at the contact with the underlying marine sediments. Date based on one 3-day count in the 5 L counter.

Stewart Point Series

Wood and peat from a section exposed in a nivation hollow facing Prince of Wales Strait, 18 km southwest of Stewart Point, Banks Island, Northwest Territories (72°15.6'N, 119°42.5'W), at an elevation of 40 m (altimeter determination). Collected 1977 by J-S. Vincent.

GSC-2656. Stewart Point (I) 7600 ± 90

Wood (sample VH-77-173; 11.8 g; **Salix** sp.; identified by R.J. Mott) from 30 cm below the surface.

Comment (J-S. Vincent): The wood was extracted from a woody peat which overlies a moss peat above Jesse Till; this till was deposited during the M'Clure Stade of Amundsen Glaciation during the early or mid-Wisconsin (Vincent, 1980). The sample was collected from the same section as GSC-2723 (9360 ± 90 years; this series).

Comment (W. Blake, Jr.): The largest twig in the sample measured 10.5 cm in length and 0.5 cm in diameter. All the twigs had fresh breaks and attached bark, showing that they were autochthonous. A total of 35 pieces were selected to make up the sample for dating. Date based on two 1-day counts in the 5 L counter.

GSC-2723. Stewart Point (II) 9360 ± 90

Moss peat (sample VH-77-171; 50.8 g dry) from 60 to 100 cm below the surface.

Comment (J-S. Vincent): The moss peat overlies Jesse Till laid down during the M'Clure Stade of Amundsen Glaciation during the early or mid-Wisconsin (Vincent, 1980). This sample was collected in the same section but 30 to 70 cm below GSC-2656 (7600 ± 90; this series).

Comment (W. Blake, Jr.): A considerable time interval may be represented by GSC-2723, since it represents a 40 cm-thick accumulation of peat. Sparse wood was present in the sample, but only moss was used for dating. The sample was wet sieved to remove sand, then oven dried. Ostracods (unidentified) were noted by R.J. Richardson in the sample. Date based on two 1-day counts in the 5 L counter.

GSC-2127. 'Ivitaruk' River Basin 9770 ± 80

Moss-peat (sample VH-74-043; 38 g; **Drepanocladus-Scorpidium** peat; identified by M. Kuc) from 4 m below the surface in a gully on the left bank of a small southern tributary to 'Ivitaruk' River, 37 km south-southeast of Shoran Lake, Banks Island, Northwest Territories (73°12'N, 120°04.7'W), at an elevation of approximately 120 m. Collected 1974 by J-S. Vincent and T.J. Day.

Comment (J-S. Vincent): This peat overlies the pre-Wisconsin Bernard Till deposited during Banks Glaciation (Vincent, 1980). The peat, collected frozen, was from a horizon slightly above the contact with the underlying till.

Comment (W. Blake, Jr.): Because the peat overlies a till assigned a pre-Wisconsin age, it was expected that it would be 'old' (perhaps beyond the range of radiocarbon dating). However, the date is similar to the age of moss fragments at 275 to 280 cm depth near the base of a sediment core in a small lake in Thomsen River valley 2 km east of Shoran Lake (GSC-2673; 10 200 ± 130 years; Vincent, 1980; this list). The moss peat comprising GSC-2127 was interpreted as being of the type that develops in seasonal tundra pools; mosses present included **Drepanocladus brevifolius** (common), **Meesea triquetra** (frequent), and **Drepanocladus exannulatus, Campylium polygamun,** and **Scorpidium scorpioides** (all rare). The rare vascular plant remains included **Carex** sp. (rhizomes), cf. **Eriophorum** (sheaths), and **Equisetum** sp. (small fragments) (unpublished GSC Bryological Report No. 310 by M. Kuc). Date based on one 3-day count in the 5 L counter.

GSC-2286. Muskox River basin 1440 ± 40

Peat (sample VH-74-037; 51 g) from 2 m below the surface in a section on the left bank of a north tributary of Muskox River, 1.6 km upstream from where the tributary joins Muskox River, Banks Island, Northwest Territories (75°49.2'N, 120°20'W), at an elevation of approximately 60 m. Collected 1974 by J-S. Vincent and T.J. Day.

Comment (J-S. Vincent): The peat overlies 20 m of outwash sand and gravel believed to have been deposited during retreat of the pre-Wisconsin Banks Glacier (Vincent, 1980). The peat was collected at the contact with the underlying sand. Date based on one 3-day count in the 5 L counter.

GSC-2652. Muskox River 3380 ± 70

Wood (sample VH-75-039; 6.9 g **Salix** sp.; identified by L.D. Farley-Gill) from 1 m below the surface in a river terrace section on the left bank of Muskox River, 15 km from its junction with Thomsen River, Banks Island, Northwest Territories (73°48'N, 120°21.5'W), at an elevation of approximately 45 m. Collected 1975 by J-S. Vincent.

Comment (J-S. Vincent): The wood is from an 11 cm-thick woody peat which is underlain by 2.5 m of outwash sand and gravel, believed to have been deposited during retreat of the pre-Wisconsin Banks Glacier (Vincent, 1980), and Kanguk

Formation silt; the woody peat is overlain by 87 cm of colluvium. The peat was collected at the contact with the underlying sand and gravel. Date based on two 1-day counts in the 2 L counter.

GSC-2387. Woon River 3050 ± 90

Peat (sample VH-74-023; 40.0 g) from 0.5 m below the surface in a river terrace section, on the right bank of Woon River, 31 km from its mouth in M'Clure Strait, Banks Island, Northwest Territories (74°10.3'N, 121°07'W), at an elevation of approximately 90 m. Collected 1974 by J-S. Vincent.

Comment (J-S. Vincent): The peat was collected at the contact with the underlying fluvial sand and gravel terrace in an area that has not been glaciated during the last (Wisconsin) glaciation (Vincent, 1980).

Comment (W. Blake, Jr.): The sample was frozen when excavated. After thawing in a polyethylene bag some fungi were noticed by the collector. These were removed, the sample was dried at 95°C, and it was again stored in a plastic bag. Upon receipt by the laboratory the sample was wet sieved to remove a large amount of sand (distilled water was used to recover the coarse fraction used for dating). The sample was mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-2098. Masik River 5020 ± 70

Wood (sample VH-74-033; 7.5 g; **Salix** sp.; identified by L.D. Farley-Gill) from an exposure in a gully, 4.6 m below the surface, on the north slope of Masik River valley 16 km northeast of its mouth, Banks Island, Northwest Territories (71°35.7'N, 123°26.0'W), at an elevation of approximately 55 m. Collected 1974 by H.M. French, University of Ottawa, Ottawa, and J-S. Vincent.

Comment (J-S. Vincent): The sediments overlying the horizon where the detrital wood was collected are colluvial deposits derived, by active layer detachment failures, from unstable valley-wall slopes cut into clay and silt of the Cretaceous Christopher Formation. The wood was probably carried to the collection site during one of the slope failure episodes, which seem to be recurring events in the area.

Comment (W. Blake, Jr.): The single branch used for dating was at least 30 cm long and was up to 1.2 cm in diameter. Sample mixed with dead gas for counting. Date based on one 3-day count in the 5 L counter.

GSC-2776. Bernard River basin 8970 ± 140

Peat (sample VH-G-75-025, 3.95-4.06 m; 12.6 g) from 4 m below the surface 22 km southeast of the mouth of Bernard River, Banks Island, Northwest Territories (73°25.5'N, 123°42'W), at an elevation of approximately 60 m. The sample was obtained by drilling with a small portable drill in the bottom of a 3 m-deep gully which had developed by the melting of ice wedges formerly present in organic deposits that filled a small valley. The frozen organic matter retrieved was 0.95 to 1.06 m below the surface. Collected 1975 by J-S. Vincent.

Comment (J-S. Vincent): The peat is not basal but it overlies the pre-Wisconsin Bernard Till laid down during Banks Glaciation (Vincent, 1980).

Comment (W. Blake, Jr.): The sample was wet sieved using a #80 sieve to remove silt and fine sand, then oven dried. A small coleopteran fauna was present as well as fossils of **Carex aquatilis, Carex** sp., and **Dryas integrifolia** (unpublished GSC Fossil Arthropod Report No. 79-3 by J.V. Matthews, Jr.). The sample was mixed with dead gas for counting. Date based on two 1-day counts in the 2 L counter.

GSC-2160. Big River basin 7800 ± 70
$\delta^{13}C = -29.0‰$

Wood (sample VH-74-064; 10.9 g; **Salix** sp.; identified by L.D. Farley-Gill) 5 m below the surface in a gully 35 km east-southeast of Sea Otter Island and 7 km north of Big River, Banks Island, Northwest Territories (73°31'N, 124°07'W), at an elevation of approximately 75 m. Collected 1974 by J-S. Vincent and C.M. Tucker.

Comment (J-S. Vincent): The wood was extracted from peat overlying Bernard Till, laid down during the pre-Wisconsin Banks Glaciation (Vincent, 1980). The peat, collected frozen, was from slightly above the contact with the underlying till, which was exposed nearby in the gully. Date based on one 3-day count in the 5 L counter.

GSC-2246. Hooded Lake 8240 ± 140
$\delta^{13}C = -27.7‰$

Wood (sample VH-75-104; 3.3 g; **Salix** sp.; identified by R.J. Mott) from a coastal cliff on Thesiger Bay, 2 km southeast of Hooded Lake on the Sachs outwash plain (Vincent, 1980), Banks Island, Northwest Territories (71°52.9'N, 124°58.5'W), at an elevation of 5 m and 5 m below the ground surface. Collected 1975 by J-S. Vincent.

Comment (J-S. Vincent): The dated wood is from a thin peat horizon which is located between two differing suites of sediments. Underlying the peat is a 5 m-thick sequence of finely stratified fluvial sands believed to have been laid down in a prograding delta associated with the lowering phase of the Meek Point Sea (related to the M'Clure Stade of the Amundsen Glaciation of early or mid-Wisconsin age) which submerged the west coast of Banks Island up to 20 m (Vincent, 1978, 1980). Overlying the peat unconformably is lake silt containing mosses and freshwater shells. These sediments were deposited in a small thermokarst lake which was drained when active coastal erosion on Thesiger Bay breached the lake. It was hoped that dating this material would provide a minimum age for the Meek Point Sea; however, the date is younger than expected and cannot be related to sea level. Organic remains in colluvium (collected by J.G. Fyles) and overlying a marine terrace at 10 m a.s.l. at the northwestern extremity of the single emerged delta(?) of Masik River, a feature probably built into the Meek Point Sea, gave an age of 10 660 ± 170 years (GSC-240; GSC IV, 1965, p. 38-39).

Comment (W. Blake, Jr.): Only the single largest piece of wood (20.5 cm long by 1.1 cm in diameter) was used for dating; oven drying reduced its weight from 12.5 to 3.3 g. Sample mixed with dead gas for counting. Date based on one 3-day count in the 5 L counter.

Svalbard

Svalbard Driftwood Series (I)

Driftwood embedded in raised beaches at various locations in Nordaustlandet, Svalbard. With one exception (GSC-1728), the samples are related to a prominent beach characterized by an abundance of pumice. This series of age determinations was carried out as inter-laboratory checks on samples from the same driftwood logs that had been dated previously at Gakushuin University, Tokyo, Japan; all Gakushuin ages cited below are uncorrected for isotopic fractionation. The two first determinations in the series were reported earlier (GSC XI, 1971, p. 318-319). Elevations were determined by levelling instrument but in most cases were rounded off to the nearest metre. Collected 1966 by W. Blake, Jr.

GSC-1521. Zordragerfjorden, ca. 12 m — 6350 ± 70; $\delta^{13}C$ = -24.8‰

Driftwood log (sample WB-149-66; 11.5 g; **Populus** sp.; identified by L.D. Farley-Gill) half-embedded in beach gravel. This well preserved and solid log, 2 m long and 22 cm in diameter, was from the northernmost group of samples collected along the east side of Zordragerfjorden (80°26'N, 22°50'E). Gakushuin age: 4260 ± 90 years (GaK-1415).

GSC-1556. Zordragerfjorden, ca. 12 m — 6580 ± 70; $\delta^{13}C$ = -24.1‰

Driftwood log (sample WB-148-66; 11.6 g; **Larix** sp.; identified by R.J. Mott) half-embedded in beach gravel. This log was solid at one end (where the sample was taken) and splintered at the other; it was 4.6 m long and 30 cm in diameter. A little moss was growing on the log, but not where it was sampled. This log was from the northernmost group of samples collected along the east side of Zordragerfjorden (80°26'N, 22°50'E). Gakushuin age: 6450 ± 100 years (GaK-1210).

GSC-1691. Zordragerfjorden, ca. 13 m — 6990 ± 110; $\delta^{13}C$ = -22.8‰

Driftwood log (sample WB-152-66; 12.95 g; **Pinus sylvestris;** identified by R.J. Mott) partly embedded in horizontal position in a shingle beach. The somewhat splintered log was 2 m long and 15 cm in diameter; 10 annual rings comprised the sample submitted for dating. This log was one of two collected at the southernmost site visited along the east side of Zordragerfjorden (80°23.5'N, 22°50'E). Gakushuin age: 7330 ± 110 years (GaK-1214).

GSC-1728. Søre Repøya, ca. 17 m — 7940 ± 140; $\delta^{13}C$ = -22.4‰

Driftwood log (sample WB-182-66; 12.2 g; **Larix** sp.; identified by R.J. Mott) mostly embedded in beach shingle and mud; it was 30 cm in length and 10 to 15 cm in diameter. At this locality, the northernmost visited (80°24.5'N, 24°09'E), the pumice was concentrated at approximately 16 m a.s.l., i.e., slightly below the level at which the log was collected. Gakushuin age: 8220 ± 110 years (GaK-1209).

GSC-1824. Zordragerfjorden, ca. 11.5 m — 6290 ± 80; $\delta^{13}C$ = -23.5‰

Driftwood log (sample WB-146-66; 12.0 g; **Picea** sp.; identified by R.J. Mott) half-embedded in beach shingle. This splintered log, 3.7 m long and 20 cm in diameter, was one of the northernmost logs collected on the east side of Zordragerfjorden (80°26'N, 22°50'E). Gakushuin age: 4950 ± 130 years (GaK-1413).

GSC-1951. Zordragerfjorden, ca. 12 m — 6030 ± 80; $\delta^{13}C$ = -22.7‰

Driftwood log (sample WB-150-66; 11.8 g; **Picea** sp.; identified by R.J. Mott) half-embedded in beach gravel. This solid log, which exhibited only a little splintering, was 2 m long and 30 cm in diameter. It was the northernmost of six logs collected near camp on the east side of Zordragerfjorden (80°26'N, 22°50'E). Gakushuin age: 5690 ± 120 years (GaK-1337).

GSC-2220. Zordragerfjorden, ca. 12 m — 6010 ± 70; $\delta^{13}C$ = -26.2‰

Driftwood log (sample WB-147-66; 12.7 g; **Larix** sp.; identified by R.J. Mott) embedded horizontally in beach gravel and mud. This splintered log, with a considerable amount of mud in the cracks, was 3 m long and 20 cm in diameter. It was one of the northernmost group collected on the east side of Zordragerfjorden (80°26'N, 22°50'E). Gakushuin age: 5800 ± 120 years (GaK-1414).

GSC-2441. Rijpfjorden, ca. 14 m — 6150 ± 60; $\delta^{13}C$ = -24.4‰

Driftwood log (sample WB-100-66; 11.5 g; **Picea** sp.; identified by L.D. Farley-Gill) embedded horizontally (flush with the surface) in beach gravel. This log, which measured 90 cm in length and 30 cm in diameter, was at the level of a slightly lower group of pumice near Camp 5 on the west side of Rijpfjorden (80°07'N, 21°52'E). Gakushuin age: 5070 ± 100 years (GaK-1215).

Comment (W. Blake, Jr.): The results clearly confirm the earlier group of ^{14}C age determinations from Uppsala made on 1957 and 1958 collections; all dates on driftwood logs associated with the pumice concentration on a pronounced raised beach (which commonly has a niche cut in bedrock at its inner edge) are in the range of 6000 to 7000 years. The GSC determinations show far less spread than do the determinations from Gakushuin University (cf. discussion in Blake, 1980). All samples were wet when collected; they were stored wet and/or frozen until being dried in an electric oven. GSC-1521, -1691, and -1728 were each based on two 1-day counts, GSC-1951 was based on one 2-day count, and GSC-1556, -1824, -2220, and -2441 were each based on one 3-day count, all in the 5 L counter.

ARCHEOLOGICAL SAMPLES

Eastern Canada

Labrador

GSC-3076. San Juan Site, Red Bay — 270 ± 40; $\delta^{13}C$ = -23.7‰

Wood (sample 24M14N11-2; 11.1 g; **Picea** or **Larix,** probably **Larix** sp.; identified by L.D. Farley-Gill) from the underwater excavation of the suspected Basque whaling ship **San Juan** (1565), 42 m north of the northeast corner of Saddle Island in the harbour at Red Bay, Labrador, Newfoundland (51°43'31"N, 56°25'40"W), at a depth of 9.0 m. The sample was taken from a short log likely used to brace casks of whale oil in the hold of the vessel. The sample was found in dark brown clay 15 cm below the seabed surface in close association with wooden cask parts. As the sample was probably cut locally for use aboard the vessel, it should date the time of sinking. Collected 1979 and submitted 1980 by R.J. Ringer, Parks Canada, Environment Canada, Ottawa.

Comment (W. Blake, Jr.): This wood sample (bark missing) was wet when submitted as it was stored in a vat of tap water for half a year following its collection. A slice 1 cm thick (approximately 15 annual rings) was cut off parallel to the log's surface, but after oven drying (the weight decreased from 72.2 to 24.7 g) only the outermost eight rings were used for dating. If the 270 year age (based on the 5568-year half-life) is converted to a radiocarbon date using the 5730-year half-life, a value of 280 years (therefore, AD 1670) is obtained (after rounding off). Following the MASCA conversion table (Ralph et al., 1973), the age in calendar years for this sample falls into the range of AD 1610 to 1530, i.e., it includes the period of time when the **San Juan** is known to have sunk. Date based on one 3-day count in the 5 L counter.

Ontario

GSC-2663. Dunsmore Site — 620 ± 60

Wood (sample BcGw-10 (square 1 L.H. #279); 11.1 g; possibly **Castanea dentata;** identified by R.J. Mott) from an undisturbed midden deposit adjacent to a large tributary of Willow Creek, near the centre of Lot 17, Concession 3, Vespra Township, Simcoe County, Ontario (44°25'50"N, 79°42'30"W), at an elevation of 265 m. The sample was

stratigraphically sealed in level 4 within cultural debris, 30 cm below the surface. Collected 1977 by J.R. Hunter, Midland, Ontario.

Comment (J.R. Hunter): The age of sample GSC-2663 (620 ± 60 years) reflects an early component of the early prehistoric Huron which would appear to be contemporaneous with the Beswetherick site, a Uren-Middleport substage of the Ontario Iroquois tradition dated at 590 ± 100 years (M-1526; Michigan X, 1965, p. 139; Wilmeth, 1969).

Comment (W. Blake, Jr.): The material in this sample was very carbonized with the wood structures partially destroyed. Large rootlets were removed by hand; the weight of any remaining small rootlets was insignificant in relation to the size of the sample. Date based on two 1-day counts in the 5 L counter.

Western Canada

British Columbia

Garden Island Site Series

Human bone from the Garden Island site (GbTo-23), Venn Passage, Prince Rupert Harbour, British Columbia (54°19'05"N, 130°23'15"W), at an elevation of 3 m. The site is a shell midden covering a small island in the Coast Tsimshian area. Collected 1967 by G.F. MacDonald, National Museum of Man, Ottawa; submitted 1979 by J.S. Cybulski, National Museum of Man.

GSC-2886. Garden Island site, Burial XVII-B-201 — 2660 ± 260; $\delta^{13}C = -16.9‰$

Human left femur (sample X-201; NMC-1056; 178.3 g) from Burial XVII-B-201, square 2B, 2.6 m below datum. The sample is from part of a multiple burial and is expected to date the lowest cultural level in this square.

GSC-2888. Garden Island site, Burial XVII-B-197 — 2620 ± 70; $\delta^{13}C = -14.3‰$

Human left humerus (sample X2-197; NMC-1055; 82.7 g) from Burial XVII-B-197, square 2B, 2.6 m below datum. The sample is from part of a multiple burial and is expected to date the lowest cultural level in this square.

Comment (J.S. Cybulski): These dates are part of a series of age determinations on human bone from five shell midden sites in the Prince Rupert Harbour region. GSC-2888 was submitted following receipt of an unacceptably much older bone date from the same skeleton (NMC-1004 = S-1596, 6230 ± 75 years). Burials 197 and 201 are believed to have been deposited at the same time as part of a multiple burial of seven individuals. GSC-2886 and GSC-2888 are slightly older than originally expected by the excavator (G.F. MacDonald), but they agree well with the chronological distribution of bone and charcoal dates that are accumulating from Garden Island and from the other four sites (cf. Wilmeth, 1969).

Comment (W. Blake, Jr.): One end of the femur was sawed off to remove a spot of dried glue; otherwise the bone was clean with no rootlets. The humerus was also clean bone. GSC-2886 mixed with dead gas for counting. Each date based on two 1-day counts in the 2 L counter.

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