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GEOLOGICAL SURVEY OF CANADA RADIOCARBON DATES XXVII

W. BLAKE, JR.

Canada

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The present date list, GSC XXVII, is the sixteenth 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 XXVII

Abstract

This list presents 380 radiocarbon age determinations made by the Radiocarbon Dating Laboratory. Age determinations (323) on geological samples from various areas are as follows: Newfoundland (24); Nova Scotia (2); New Brunswick (2); Quebec (15); Ontario (36); Manitoba (12); British Columbia (57); Yukon Territory (10); Northwest Territories, mainland (43); Northwest Territories, Arctic Archipelago (121); Washington (1). Age determinations (57) on archeological samples are as follows: Newfoundland (1); Labrador (3); Nova Scotia (1); Ontario (5); Northwest Territories, Arctic Archipelago (47). Tables 1 and 2 summarize details of background and standard for the 2 L and 5 L counters during the period from August 1, 1986 to November 17, 1986; 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 380 datations effectuées par le Laboratoire de datation au radiocarbone. Les datations (323) effectuées sur les échantillons géologiques proviennent des régions suivantes: Ile de Terre Neuve (24); Nouvelle-Ecosse (2); Nouveau-Brunswick (2); Québec (15); Ontario (36); Manitoba (12); Colombie- Britannique (57); Yukon (10); Territoires du Nord-Ouest, continent (43); Territoires du Nord-Ouest, archipel Arctique (121); Washington (1). Les datations (57) effectuées sur les échantillons archéologiques sont: Ile de Terre-Neuve (1); Labrador (3); Nouvelle-Ecosse (1); Ontario (5); Territoires du Nord-Ouest, archipel Arctique (47). Tableaux 1 et 2 résument les valeurs de mouvement propre et de l'étalonnage des compteurs 2 L et 5 L, pour la période allant du 1 aout 1986 au 17 novembre 1986; 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 présente le nombre de préparations de gaz pour le mouvement propre et pour l'étalonnage utilisées pour le comptage.

INTRODUCTION[1]

During the period from August, 1986 through November 1986, both the 2 L counter (Dyck and Fyles, 1962) and the 5 L counter (Dyck et al., 1965) were operated continuously. The 2 L counter was operated at 2 atmospheres (atm), and the 5 L counter was operated at 1 atmosphere throughout this period.

The average background and oxalic acid standard counting rates which were used for age calculations are shown in Tables 1 and 2, respectively. On a monthly basis, the counting rates were within statistical limits. Table 3 lists the number of one-day counts used to determine the average background and oxalic acid standard counting rates for the period noted above, and Table 4 gives the number of different background and (oxalic acid) standard-gas preparations used.

Table 1. Monthly average count for background during the period August 1, 1986 to November 17, 1986

Month	2 L Counter (2 atm) cpm*	5 L Counter (1 atm) cpm*
August, 1986	1.593 ± 0.027	3.343 ± 0.039
September	1.805 ± 0.066	3.613 ± 0.097
October	2.018 ± 0.047	4.040 ± 0.101
November	2.204 ± 0.032	4.359 ± 0.096

*cpm = counts per minute

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

[1] Data for the tables in the introduction were supplied by R.N. McNeely, Laboratory Supervisor since November 1981. The introduction follows the style developed by J.A. Lowdon. The date list has been compiled by W. Blake, Jr. from descriptions of samples and interpretations of age determinations provided by the collectors and submitters.

Table 2. Monthly average count (N_0)* for oxalic acid standard during the period August 1, 1986 to November 17, 1986

Month	2 L Counter (2 atm) cpm	5 L Counter (1 atm) cpm
August 1986	18.151 ± 0.100	28.190 ± 0.128
September	18.056 ± 0.159	28.183 ± 0.210
October	18.107 ± 0.107	28.368 ± 0.173
November	18.041 ± 0.138	28.301 ± 0.195

*N_0 = 0.95 of the net counting rate of the NBS oxalic acid standard

Table 3. Number of one-day counts used to determine average counting rates for background and oxalic acid standard during the report period

Month	Background 2 L	Background 5 L	Standard 2 L	Standard 5 L
August 1986	4	4	3	3
September	4	4	3	3
October	4	4	3	3
November	3	2	1	1

Table 4. Number of monthly background and standard gas preparations used during the report period

Month	Background 2 L	Background 5 L	Standard 2 L	Standard 5 L
August 1986	2	3	2	2
September	2	2	2	2
October	2	2	2	2
November	2	2	1	1

review of laboratory operations the reader is referred to Lowdon (1985).

Age calculations during the report period were done on 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' (BP), 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 and Blake, 1973). Finite dates are based on the 2 σ criterion (95.5% probability) and 'infinite' dates on the 4 σ criterion (99.9% probability).

If $^{13}C/^{12}C$ ratios were available, a correction for isotopic fractionation was applied to the sample date, and the $\delta^{13}C$ value reported. The "normal" values used for correction relative to the PDB standard are $\delta^{13}C$ = -25.0‰ for wood, terrestrial organic materials, and bones (terrestrial and marine), and 0.0‰ for marine shells. All $^{13}C/^{12}C$ determinations were made on aliquots of the sample gas used for age determinations. Since 1975 all $^{13}C/^{12}C$ ratios have been determined under contract by Professor P. Fritz and R.J. Drimmie of the Department of Earth Sciences, University of Waterloo, Waterloo, Ontario, or by Waterloo Isotope Analysts, Inc., Kitchener, Ontario (R.J. Drimmie, chief analyst) using the same equipment as at the University of Waterloo. Prior to that time some $^{13}C/^{12}C$ ratios were determined by the GSC Geochronology Section (R.K. Wanless, Head) and by Teledyne Isotopes, Westwood, New Jersey.

Acknowledgments

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Amino acid ratios reported in this paper were carried out, under contract, at the Department of Geology, University of Alberta, Edmonton by

I. Moffat, under the direction of N.W. Rutter. Accelerator mass spectrometry (AMS) ^{14}C dates mentioned in the text were done, under contract, at the IsoTrace Laboratory, University of Toronto, Toronto by R.P. Beukens (A.E. Litherland, Director; W.E. Kieser, Manager). A.C. Roberts and R.N. Delabio, Mineralogy Section, made the X-ray diffraction determinations on shell samples. T.W. Anderson, GSC, has kindly permitted me to include an unpublished GSC date on one of his samples from Newfoundland, and P.J.H. Richard, Université de Montréal, Montréal, has done the same with an unpublished AMS date from Quebec. The inclusion of these two age determinations has made the present report more meaningful. Naturhistoriska Riksmuseet, Stockholm, Sweden, supplied the shells used for GSC-3671 (northern Baffin Bay), and the National Museum of Natural Sciences, Ottawa, provided the shells used for GSC-474 (Mould Bay, Prince Patrick Island).

M. Lanoix, R.J. Richardson, J.A. Snider, J.E. Dale, and K.E. Rolko, all former summer students or technical assistants, assisted in the processing and examination of samples prior to their submission to the laboratory. J.A. Snider and K.E. Law checked the data in many write-ups, and K.E. Rolko, now Science North, Sudbury, Ontario, helped extensively with the compilation of this report.

GEOLOGICAL SAMPLES

Eastern Canada

Newfoundland

GSC-4323. St. Anthony Airport — 8560 ± 80; $\delta^{13}C = +1.2‰$

Marine pelecypod shells (sample 86-GS-28; 41.6 g; **Mya truncata uddevalensis**; identified by D.R. Grant) at an elevation of 18 m above high tide level, exposed in a borrow pit in a gravel deposit at the junction of Highway 430 and entrance road to new St. Anthony airport, a few kilometres west of head of Hare Bay, northern Newfoundland (51°22.7'N, 56°05.7'W). Collected September 17, 1986 by D.R. Grant[1].

Comment (D.R. Grant): The shells were 5 x 8 cm in size, up to 10 mm thick, and had chalky exterior, smooth interiors. They occurred intact in life position in poorly stratified, subangular dolomite pebble-cobble gravel in which some clasts are striated. The site is in the central area of a former remnant marine-based ice cap that was grounded in Hare Bay (Grant, 1986a, in press). The sediment was thought to be an ice-marginal submarine deposit at a penultimate grounding line. An onshore basal gyttja date (GSC-4253, 7000 ± 130 BP (corrected); gyttja above grey sandy clay; T.W. Anderson, personal communication to W. Blake, Jr., February 1988) from Crémaillière Hill Pond (51°21.05'N, 55°37.10'W; elevation 112 m), 4 km southwest of St. Anthony, suggests that the glacier might have persisted later than the Younger Dryas-age readvance recorded for the nearby upland glacier. This date was to test that possibility. The younger-than-expected age, however, tends to argue against the original depositional interpretation. Instead, the deposit is more likely to be normal littoral or sublittoral sediment that was disturbed by shorefast ice. If so, its age and elevation accord well with the position of regressing sea level based on numerous beach-sediment dates in the area (Grant, 1972). Date is based on two 2-day counts in the 5 L counter.

GSC-4304. Parsons Pond Bridge — 8950 ± 90; $\delta^{13}C = -0.1‰$

Marine pelecypod shells (sample 84-GS-23; 50.6 g; **Mytilus edulis**; identified by D.R. Grant) at an elevation of 11 m above high tide level in emerged gravel beach exposed in borrow pit, west side of Highway 430, 4.8 km north of bridge over tidal inlet at Parsons Pond, west coast of Newfoundland (50°04.25'N, 57°42.00'W). Collected July 11, 1984 by D.R. Grant.

Comment (D.R. Grant): The shells occurred intact in life position in a dense cluster interpreted as a "mussel bank". The date was needed to constrain the poorly-known Holocene sea-level history and specifically to substantiate the contention of Brookes and Stevens (1985) that, while Newfoundland had a generally continuous postglacial emergence, the central west coast experienced emergence until about 7000 BP, followed by re-submergence. Together with GSC-4026 (7690 ± 90 BP) and GSC-4060 (9320 ± 100 BP; both in GSC XXV, 1986, p. 4), the date tends to support their hypothesis. Date is based on two 1-day counts in the 5 L counter.

GSC-4306. Stanford River — 40 ± 60; $\delta^{13}C = -25.0‰$

Wood (sample 80-GS-59; 9.4 g; **Abies balsamea**; unpublished GSC Wood Identification Report No. 86-30 by H. Jetté) at an elevation of 7 m above high tide level, exposed in a deflation hollow in coastal sand dunes, 0.1 km north of the mouth of Stanford River,

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

Gros Morne National Park, western Newfoundland (49°57.28'N, 57°45.50'W). Collected July 19, 1980 by D.R. Grant.

Comment (D.R. Grant): The wood is from the fresh inner part of a small 5-cm tree stump, as one of many in a buried forest horizon rooted in sandy black humus and overlain by an extensive 10 to 20 cm-thick layer of sphagnum peat which undulates gently through the dune field. The organic layer is the uppermost of two or three that occur in all dune areas. It is interpreted to be a paleosol representing a former period when the surface was flat and stabilized by vegetation. The peat has very rare sand grains, as if wind action was minimal. The purpose of dating was to learn the age of the most recent stabilization, which might reflect cooler, wetter climate, less wind, or reduced sand supply on the shore which, in turn, might be related to the rate of modern sea-level rise and consequent erosion. The very young age indicates that there have been rapid alternations between eolian and vegetated conditions in recent time, but the reason is unclear. Date is based on two 1-day counts in the 2 L counter.

Sandy Head series

Shell samples from a coastal cliff section exposing littoral gravel over, in succession downward, muddy diamicton, chaotic, cross-bedded gravel, sand with shells, and red-brown laminated silty sand at Sandy Head, Bonne Bay, western Newfoundland (49°31.23'N, 57°53.20'W). Collected July 1984 by D.R. Grant.

GSC-4013. Sandy Head (I) 9460 ± 90
$\delta^{13}C = +0.1‰$

Marine pelecypod shells (sample 84-GS-31; 48.0 g; **Mytilus edulis**; identified by D.R. Grant) intact in life position as a "mussel bank" at an elevation of 22 m above high tide level. The shells were well preserved, though fractured; no periostracum, pitting or incrustations; clean. Enclosing gravel 5 to 10 m thick as veneer reworked from underlying gravel.

GSC-4151. Sandy Head (II) 10 000 ± 110
$\delta^{13}C = +0.2‰$

Marine pelecypod shells (sample 84-GS-32; 17.0 g; **Mya truncata**; identified by D.R. Grant) associated with **Astarte** sp. and **Serripes** in lower clean sand bed at an elevation of 6 m above high tide level. Shells intact in life position; some internal lustre, periostracum.

Comment (D.R. Grant): The purpose was to date the glacial readvance apparently represented by the supposed ice-contact gravel bed and the overlying compact diamicton with striated stones (till?), as well as to constrain the latter part of the sea-level history for which no dates previously were available. GSC-4013, together with GSC-4158 and GSC-4279 (this list), indicates that relative sea level had fallen to 20 m by 10 000 BP, and possibly to present level by about 7000 BP as Brookes and Stevens (1985) postulated. That there was a readvance over this site between the times of deposition of the shell beds is evidently impossible (Grant, 1987), because older ages are found in marine sediments farther up both arms of the Bonne Bay fiord from which the ice must have flowed (cf. GSC-1575 (in GSC XIII, 1973, p. 8) and GSC-4158 and GSC-4279 (both in this list)) nearby at Muddy Brook and Glenburnie, respectively. No alternative explanation is offered for the diamicton and chaotic gravel between the shell beds.

Comment (W. Blake, Jr.): GSC-4013 contained well preserved shells, although they fractured and broke while being collected. The shells were somewhat chalky but clean; there were no bits of periostracum, pitting, or incrustations. GSC-4151 was a single right valve (3.0 by 2.5 cm, <1 mm thick) plus seven fragments. All fragments (largest was 4.8 cm long) exhibited the typical truncated end, some internal lustre, and some periostracum, and little wearing. Both samples given only a 10% leach. GSC-4151 was mixed with dead gas for counting; date is based on one 3-day count in the 2 L counter. GSC-4013 is based on one 3-day count in the 5 L counter.

Trout River series

Further dates in and near a large ice-marginal marine delta built by an intermontane ice tongue issuing from the interior Newfoundland ice cap; the age of the feature and of concurrent relative sea-level changes are not yet well defined.

GSC-4074. Trout River (I) 11 900 ± 120
$\delta^{13}C = +0.8‰$

Marine pelecypod shells (sample 84-GS-42; 37.5 g; **Mya truncata**; identified by D.R. Grant) at an elevation of 31 m above high tide level in grey silty sand with intact single valves of **Nuculana pernula**, on the west side of Trout River Pond along Chimney Cove road, 4.0 km south of Trout River wharf, western Newfoundland (49°26.65'N, 58°07.10'W). Collected July 15, 1984 by D.R. Grant.

GSC-4295. Trout River (II) 12 400 ± 170
$\delta^{13}C = +0.7‰$

Paired marine pelecypod shells (sample 85-GS-35; 41.0 g; **Hiatella arctica**; identified by D.R. Grant) at an elevation of 13 m above high tide level at base of a stream gully that cuts through the rear side of an ice-marginal marine delta near the main highway; 1.4 km southeast of Trout River wharf, west coast of Newfoundland (49°28.21'N,

58°07.23'W). Collected August 23, 1985 by D.R. Grant.

GSC-4360. Trout River (III) 12 000 ± 130
$\delta^{13}C = +1.3‰$

Marine pelecypod shells (sample 86-GS-15; 41.0 g; **Mesodesma arctatum**; identified by D.R. Grant) at an elevation of 50 m above high tide level in foreset beds of a delta exposed in a gravel pit on the Chimney Cove road, 2.1 km south of Trout River wharf, western Newfoundland (47°27.58'N, 58°07.60'W). Collected September 11, 1986 by D.R. Grant.

Comment (D.R. Grant): GSC-4295 corresponds to GSC-2936 (12 500 ± 120 BP; GSC XX, 1980, p. 3) in dating the marine submergence that followed the initial Late Wisconsinan retreat of the Trout River valley glacier prior to construction of the ice-marginal delta (Grant, 1987). GSC-4074 records marine incursion behind the delta; thus the two dates bracket the glacier stillstand which produced the delta. No climatic control is inferred; the calving front was presumably stabilized when the grounding line retreated onto the shallow rock bar between the deeper offshore and Trout River trough. GSC-4360 provides a fix on relative sea level intermediate between GSC-2936, which relates to marine limit at 70 m, and the delta top at 35 m, which is approximated by GSC-2487 (11 900 ± 160 BP; GSC XVIII, 1978, p. 3; cf. also C.R. Harington and I.A. Brookes, Radiocarbon dated whale (cf. Balaenidae) vertebra from Late Pleistocene marine sediments at Trout River, Newfoundland, unpublished manuscript).

Comment (W. Blake, Jr.): GSC-4074 comprised five left valve fragments plus one whole right valve and four fragments. The largest left valve was 6.5+ cm x 4.0+ cm in size; the shells were 1 to 2 mm in thickness for the most part, but up to 3 to 5 mm thick at the hinge. All fragments exhibited the truncated posterior end, and only the cleanest, non-discoloured valves were used. For GSC-4074, only the outer 10% of shell material was removed with HCl leach. GSC-4074 and -4295 each based on one 3-day count in the 5 L counter; GSC-4360 based on one 3-day count in the 2 L counter.

GSC-4158. Muddy Brook 12 100 ± 160
$\delta^{13}C = +1.0‰$

Marine pelecypod shells (sample 80-GS-71; 11.3 g; **Macoma calcarea**; identified by W. Blake, Jr.) at an elevation of 20 m above high tide level in sandy foreset beds of the deglacial emerged delta of Muddy Brook where it debouches into the mouth of Bonne Bay fiord, western Newfoundland (49°29.48'N, 57°55.57'W). Collected July 24, 1980 by D.R. Grant.

Comment (D.R. Grant): The shell-bearing layer is immediately underlain by till over striated bedrock, and is therefore considered to approximate the inception of the delta which is graded to a local marine limit at 79 m. It provides both a minimum age for the deglaciation of outer Bonne Bay fiord (following the Late Wisconsinan stadial maximum which terminated at a major submarine end moraine offshore) as well as an intermediate point in the regional relative sea-level history (Grant, 1987). It tends to support the view of Brookes and Stevens (1985) that sea level fell to its present level ca. 7000 BP.

Comment (W. Blake, Jr.): Other species present in this sample include **Hiatella arctica**, **Balanus** sp., and an unidentified brachiopod fragment. The sample used for dating comprised 15 intact valves of **Macoma calcarea** plus numerous fragments. No periostracum remained, there was no lustre, and some valves were discoloured with a thin encrusting layer. The largest whole valve was 3.1 by 2.2 cm; all shells were <1 mm thick except at the hinge. Because of the small sample size, only the outer 10% of shell material 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-4279. Glenburnie 11 200 ± 150
$\delta^{13}C = -2.2‰$

Well preserved and articulated marine pelecypod shells (sample 85-GS-37; 32.5 g; **Cyrtodaria siliqua**; identified by D.R. Grant) at an elevation of 15 m above high tide level in a mud layer forming the floor of a gravel pit. The site is in an emerged delta at the mouth of an unnamed stream near the village of Glenburnie, head of west arm of Bonne Bay fiord, west coast of Newfoundland (49°26.08'N, 57°53.85'W). Collected August 23, 1985 by D.R. Grant.

Comment (D.R. Grant): The enclosing mud, which also contains other pelecypods as well as gastropods and barnacles, is interpreted as the bottomsets of the overlying progradational delta. The date is therefore taken as a minimum age for the relative sea level of 42 m which formed the delta surface, and it thereby gives a minimum age for the calving retreat of the tidewater glacier in Bonne Bay (Grant, 1987). The date is consistent with GSC-4158 (12 100 ± 160 BP; this list) at the fiord mouth, and with GSC-1575 (10 500 ± 300 BP; GSC XIII, 1973, p. 7) at the head of the other arm of the fiord. Because of the sample size, only the outer 10% of shell material was removed by HCl leach. Date is based on one 3-day count in the 5 L counter.

GSC-4272. . Dancing Point 12 700 ± 300
$\delta^{13}C = -0.8‰$

Marine pelecypod shells (sample 80-GS-73; 11.6 g; **Macoma balthica**; identified by D.R. Grant) at an elevation of 15 m above high tide level, in a muddy lens within sand and gravel foreset beds of a kettled glacier-marginal kame delta, near Dancing Point at the head of Humber Arm fiord (Bay of Islands), 4.5 km east of the city of Corner Brook, western Newfoundland (48°57.25'N, 57°53.14'W). Collected July 31, 1980 by D.R. Grant.

Comment (D.R. Grant): The shells were mostly whole, and a few were articulated as if possibly in life position. They therefore date an ice-proximal delta, built over chaotic, cross-bedded ice-contact gravel and sand, as well as the relative sea level of 36 m represented by the delta top. The date may thus give a minimum age for stabilization of the outlet glacier after retreat by calving from the deep (280 m) water of the Bay of Islands. However, its similarity to GSC-1462 (GSC XIII, 1973, p. 8), which is 40 km downglacier at the mouth of the fiord and is assigned to the marine limit, suggests either that the latter does not represent the time of deglaciation, or that this date is slightly too old perhaps because of the meltwater effect (Grant, 1987). Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-4346. Campbells Creek 13 300 ± 120
$\delta^{13}C = +1.0‰$

Marine pelecypod shells (sample 86-GS-11; 30.3 g; **Hiatella arctica**; identified by D.R. Grant) at an elevation of 11 m above high tide, exposed in a roadside ditch, 0.2 km east of the stream entering Campbells Cove at the hamlet of Campbells Creek, north side of St. Georges Bay, western Newfoundland (48°31.50'N, 58°51.17'W). Collected September 3, 1986 by D.R. Grant.

Comment (D.R. Grant): The dated sample consisted of intact **Hiatella arctica** about 1 x 3 cm, associated with juvenile **Macoma** sp., in brown laminated silt. The sediment was contorted and injected by wedges of the overlying till, and the shells were fractured. The deposit overlies limestone bedrock with two stossed facets (230 crossed by 185 degrees). The shelly sediment evidently dates from the initial marine inundation after the westward-flowing piedmont glacier presumably calved landward (eastward) from St. Georges Bay submarine depression. Deformation and emplacement of overlying till presumably indicates southward readvance of ice remaining in Port au Port Bay. The movement seems to correlate with the Robinsons Head Readvance ca. 12 700 BP (Brookes, 1977), but whether it was climatically induced or a simple mechanical readjustment to an oversteepened ice profile, remains an important question. Site is the only dated record of the final southward movement of the Port au Port ice mass, which is well represented by striations. Date is based on one 3-day count in the 2 L counter.

Romaines series

Various materials (shells, plant matter, marl) from proglacial and postglacial sediments deposited during rapid sea-level changes associated with the marginal zone of the so-called Robinsons Head Readvance, near Stephenville, western Newfoundland.

GSC-4095. Romaines (I) 13 100 ± 180
$\delta^{13}C = +1.2‰$

Marine pelecypod shells (sample 84-GS-67; 11.2 g; **Mya truncata**; identified by D.R. Grant) at an elevation of 3 m above high tide level exposed in a coastal cliff near the village of Romaines, 0.7 km west of the mouth of Romaines River, St. Georges Bay, western Newfoundland (48°33.22'N, 58°41.02'W). Collected July 24, 1984 by D.R. Grant.

GSC-4017. Romaines (II) 12 700 ± 110
$\delta^{13}C = -34.6‰$

Grassy plant debris (sample 84-GS-69; 54.3 g; **Carex** spp. (?); identified by D.R. Grant) at an elevation of 1 m above high tide level, exposed at the base of a modern stream gully at the present coast, near village of Romaines, 0.9 km west of the mouth of Romaines River, St. Georges Bay, western Newfoundland (48°33.26'N, 58°41.12'W). Collected July 24, 1984 by D.R. Grant.

GSC-4291. Romaines (III) 11 500 ± 100

Plant debris (sample AP-14-85; 100.6 g wet) at an elevation of 1.5 m above high tide level, exposed in the coastal cliff of St. Georges Bay, 0.95 km west of the mouth of Romaines River, western Newfoundland (48°33.26'N, 58°41.12'W). The sample was overlain in turn by clay and marly clay (7 cm) and by 2 m of fossiliferous marl to the surface. Collected July 30, 1985 by T.W. Anderson.

Comment (D.R. Grant): GSC-4095 was intended to check the 12 700 BP date inferred by Brookes (1977) for the culmination of the Robinson's Head Readvance, because it refers to marine gravels deposited on top of the ice-contact facies (recognized here as a melange of thrusted sand and gravel, lenses of melt-out till, huge ice-rafted erratics, sand blocks, slump and thermokarst structures). However, the fact that it is significantly older suggests that the readvance culminated earlier, that the shells are reworked from pre-advance sources and re-

sedimented intact, or that the date is anomalously old because of the meltwater effect.

GSC-4017 comes from the base of a marl sequence filling a kettle depression in the ice-contact deposits. It overlies grey marine clay with sparse small shells and, because the freshwater sediments are undeformed, they record lacustrine sedimentation at that level after sea level had fallen below its present level. While the validity of the date might be questioned because of the material used, it accords with GSC-4291 (11 500 ± 110 BP; this series) which is slightly higher in the sequence, and GSC-4017 is therefore taken to mark the minimum date for the time when relative sea level fell from its glacial high stand to below present level, prior to its subsequent re-submergence, as reflected by GSC-4243 (2840 ± 80 BP; this list).

Comment (T.W. Anderson): Pollen analysis shows that the sample dates the top of the herb-shrub pollen zone (tundra phase) and the rise towards the **Picea** pollen maximum (forest phase).

Comment (W. Blake, Jr.): The sample used for GSC-4017 was air dried, March 1985. The sample used were those lumps which contained a minimum of silt. The sample received the standard pretreatment with NaOH, HCl (no reaction), and distilled water rinses. For GSC-4095 only **Mya truncata** was used; five intact or nearly intact right valves, plus 12 fragments, all with the typical truncated posterior end. Some traces of periostracum remained, plus some internal lustre, some external chalkiness, and no incrustations. The largest whole valve measured 3.8 x 2.7 cm; all shells were thin, mostly <1 mm and everywhere <2 mm. Other species present were **Hiatella arctica** and **Macoma calcarea**. Because of the small sample size, only the outer 10% of shell material was removed with HCl leach. GSC-4095 was mixed with dead gas for counting. Pretreatment of GSC-4291 was as for GSC-4017. GSC-4017 based on one 3-day count in the 5 L counter. GSC-4095 based on one 2-day count plus one 1-day count in the 2 L counter. GSC-4291 based on three 2-day counts in the 5 L counter.

GSC-4292. Two Guts Pond 2110 ± 80

Peat (sample 85-GS-39; 18.9 g after pretreatment) from an elevation of 1.10 m below high tide level, exposed in the bank of a tidal creek cutting through salt marsh sediment on the west shore of Two Guts Pond, Port au Port Bay, 1 km south of Point au Mal P.O., western Newfoundland (48°38.94'N, 58°39.27'W). Collected August 25, 1985 by D.R. Grant.

Comment (D.R. Grant): The sample comes from the basal one centimetre of a 1 m-thick wedge of salt marsh that is overlapping a sandy, formerly subaerial, surface. Scattered driftwood occurs in the salt marsh peat. Initial field interpretation that the horizon records the brackish-water transition from terrestrial conditions to full-marine salt-water sedimentation, is borne out by the interpretation of J.V. Matthews Jr. (unpublished GSC Plant Macrofossil Report No. 86-20) that the material is detritus from a brackish-water environment adjacent to a salt marsh that was receiving wood, grasses, rhizomes, needles and leaves from the nearby forest. The date was intended to provide a fix on the latter part of the recent submergence that is affecting southern Newfoundland and the rest of the Maritimes region. It generally accords with the trend outlined by Brookes et al. (1985) for the area, is consistent also with GSC-4243 (2840 ± 80 BP; this list). Sample received the standard pretreatment in NaOH and HCl, plus distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

GSC-4243. Victor Brook 2840 ± 80

Wood fragments (sample 85-GS-42; 15.3 g) from an elevation of 3.2 m below high tide level, as debris in basal 5 cm of Davis core through coastal salt marsh to underlying grey clay and sand, 25 m from the edge of the highway, crossing the estuary of Victor Brook, 0.2 km south of the village of West Bay, Port au Port Bay, western Newfoundland (48°37.75'N, 58°58.50'W). Collected August 25, 1985 by D.R. Grant.

Comment (D.R. Grant): Coring was intended to extend the recent submergence trend outlined by Brookes et al. (1985). That the sampled horizon was judged to be the driftwood zone at the inner margin of the salt marsh is borne out by the interpretation of J.V. Matthews, Jr. (unpublished GSC Plant Macrofossil Report No. 86-18) which noted remains of the brackish-water plant **Carex pseudo-cyperus** and the beetle **Melagonum** which lives in swampy habitats (unpublished GSC Fossil Arthropod Report No. 86-16). The date is therefore taken to mark the first arrival of salt-water conditions at that level. It is consistent with GSC-4292 (this list), but suggests that UQ-646 (2770 ± 300 BP; in Brookes et al., 1985) is slightly too young for its -2.8 m depth. Sample received the standard pretreatment with NaOH and HCl plus distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

GSC-4270. Butter Brook 13 600 ± 190
$\delta^{13}C = 0.0‰$

Marine pelecypod shells (sample 84-GS-81; 48.0 g; **Hiatella arctica**; identified by D.R. Grant) at an elevation of 20 m above high tide level in a coastal cliff 0.2 km north of the mouth of Butter Brook, St. Georges Bay, western Newfoundland (48°09.87'N, 58°56.48'W). Collected July 28, 1984 by D.R. Grant.

Comment (D.R. Grant): The site lies between the terminal moraine of the Robinsons Head Readvance

and the inferred Late Wisconsinan stadial limit. As the sequence indicated that the shell layer related to the pre-readvance marine transgression, the date was intended to check the inferred 12 700 year-age of the readvance. Half of the shells were intact, paired juveniles about 2 cm long; the rest about 5 cm. Enclosing material was massive compact grey silt overlying till deposited by a coastward-flowing piedmont glacier. The shell layer is overlain by barren silt (proglacial to end moraine?), by 8 to 10 m of stratified sand (offlap during regression?), and is capped by 2 to 3 m of (littoral?) gravel. The date is consistent with the inferred age of the readvance, and is in accordance with GSC-598 (13 420 ± 190 BP; GSC VII, 1968, p. 210) from nearby Highlands where the sequence was not as well exposed. Date is based on one 3-day count in the 5 L counter.

GSC-4229. Stormy Point 14 100 ± 130
$\delta^{13}C = +1.4‰$

Marine pelecypod shells (sample 84-GS-85; 28.2 g; **Hiatella arctica**; identified by D.R. Grant) at an elevation of 13 to 14 m above high tide level, exposed in a coastal cliff on the north side of Stormy Point, near the mouth of Codroy River, 5 km south of Codroy village, southwestern Newfoundland (47°50.40'N, 59°22.40'W). Collected July 31, 1984 by D.R. Grant.

Comment (D.R. Grant): The shells are generally intact and articulated, but fractured. At the base of the sequence is 2+ m of pebbly sand (foreset beds?), overlain by 10+ m of horizontally stratified muddy boulder gravel (proximal outwash?), overlain by red silty diamicton with shells (this sample) which may be till or marine sediment overridden by glacier ice. The sequence is topped by stratified littoral gravel that pinches out at a local 15 m marine limit. The date is considered to relate to the marine phase that preceded a glacial advance (Grant, 1987), which thus might correlate with the Robinsons Head episode ca. 12 700 BP. Date accords with GSC-2113 (13 800 ± 260 BP; GSC XV, 1975, p. 6) in similarly overridden sediments nearby at Wreckhouse. Date is based on one 3-day count in the 2 L counter.

Baie Verte Peninsula and White Bay series

A group of samples have been taken, mainly in ice-marginal marine deposits, in an effort to date major glacier stillstands and the associated relative sea levels.

GSC-4247. Jacksons Arm 11 200 ± 100
$\delta^{13}C = +2.3‰$

Marine pelecypod shells (sample 80-GS-23; 39.7 g; **Mya truncata**; identified by D.R. Grant) at an elevation of 22 to 28 m in a borrow pit on the east side of Highway 420, at the head of Jacksons Arm, west side of White Bay, northern Newfoundland (49°51.70'N, 56°48.95'W). Collected June 26, 1980 by D.R. Grant.

Comment (D.R. Grant): The complete sequence of sediments in a major ice-frontal marine delta is exposed. Bedrock, stossed 090° by the Long Range ice cap, is overlain by +10 m of chaotic-bedded gravel with flow-till lenses (=subaquatic outwash?), by planar-bedded shell-bearing sand and silt about 10 m thick (=delta bottomset beds?), and by coarse sand which forms the delta top at the local marine limit of 41 m. The shells thus date the ice-frontal glaciomarine sedimentation corresponding to a stillstand of Long Range ice on the side of White Bay. While the recessional halt might be a purely mechanical response to the preceding period of rapid calving in deep White Bay and would therefore have no particular climatic significance, it is similar enough to dates in comparable settings to suggest otherwise. The stillstand might correlate with the Younger Dryas cool period that affected Atlantic Canada ca. 10 to 11 ka BP (Mott et al., 1986). Date is based on one 3-day count in the 5 L counter.

GSC-4023. Sops Arm 10 200 ± 100
$\delta^{13}C = +0.6‰$

Marine pelecypod shells (sample 83-1113; 24.5 g; **Mya truncata**; identified by W. Blake, Jr.) at an elevation of 27 m above sea level, from a backhoe test pit in the base of a gravel pit, 200 m south of Corner Brook Pond, south of the head of Sops Arm, western White Bay, Newfoundland (49°43.50'N, 56°55.70'W). Collected July 12, 1983 by F. Kirby, Newfoundland Department of Mines and Energy, St. John's.

Comment (D.R. Grant): The sample was submitted to date the recession of glaciers in southern White Bay. It is situated in a reentrant between a southward-retreating lobe of the interior lowland ice mass and the eastern front of the Long Range ice cap, of which a large ice-marginal delta backs the head of Sops Arm. The younger age compared to GSC-4247 (this list) might reflect diachronous deglacial marine invasion up White Bay, but the two dates are still close enough to suggest a Younger Dryas age for the Sops Arm ice-marginal stand.

Comment (W. Blake, Jr.): The dated sample comprised 19 left valves (4 whole, 15 partial) plus 14 right valves (all partial). All partial valves exhibited the typical truncated posterior end. Some Fe-stain but most valves retained good internal lustre and traces of periostracum. No incrustations were present. Because of the small sample size, only the outer 10% of shell material was removed with HCl leach. Date based on one 3-day count in the 2 L counter.

GSC-4311. Rattling Brook 11 700 ± 110
$\delta^{13}C = +1.2‰$

Marine pelecypod shells (sample 80-GS-25; 49.1 g; mainly **Mya truncata** fragments; identified by D.R. Grant) at an elevation of 9 to 16 m above high tide level, exposed in a borrow pit near the main highway, on the east side of Rattling Brook at its mouth on Southwest Arm, Notre Dame Bay, northern Newfoundland (49°37.25'N, 56°10.52'W). Collected June 27, 1980 by D.R. Grant.

Comment (D.R. Grant): The shells come from beneath a surficial gravel, in a stony diamicton interpreted as glaciomarine drift that appears to be the distal bottomset beds of a large ice-marginal kame delta 1 km up the bay. If so, the date approximates the age of an important glacier stillstand, and thus compares reasonably closely to GSC-4247 (11 200 ± 100 BP, this list). Date is based on two 1-day counts in the 5 L counter.

GSC-3957. Kings Point Highway 11 800 ± 200
$\delta^{13}C = -18.4‰$

Clay-gyttja as the basal 5 cm of 536 cm-long Davis core of lake sediment (sample KPS 531-536; 24.4 g) at an elevation of approximately 102 m, from the headwater pond of Davis Brook, a tributary of Indian Brook, located alongside Highway 391, 8.5 km west-northwest of town of Springdale (49°31.05'N, 56°10.65'W). Collected June 24, 1984 by J.B. Macpherson, Memorial University of Newfoundland, St. John's, Newfoundland.

Comment (D.R. Grant): The site is a short distance inside the South Brook kame delta which is equal to, or less than, 12 000 BP (GSC-1733; GSC XXIII, 1983, p. 6) and, as expected, the postglacial lake sediment is younger. However, the difference seems too small and therefore either the shell date is too young (an unlikely possibility) or the gyttja is somewhat too old. NaOH leach omitted from sample pretreatment, and the sediment showed no reaction with HCl. The sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-4214. Fleur de Lys 9930 ± 130

Marine pelecypod shells (sample 85-GS-32; 15.9 g; fragments of **Mya truncata** and **Mya** sp.; identified by W. Blake, Jr.) at an elevation of 20 m above high tide level, exposed in a gravel pit (now a playing field) on the west side of the highway, head of Fleur de Lys harbour, Baie Verte Peninsula, northern Newfoundland (50°07.10'N, 56°09.55'W). Collected August 22, 1985 by D.R. Grant.

Comment (D.R. Grant): The shells were originally seen in 1977 and collected as mainly intact juveniles, but the sample was lost. This collection is damaged material from the graded surface. The shells occur in laminated grey silty sand beneath 6 m of surface gravel. The shell bed is interpreted as sublittoral bay-bottom mud. As the locality is at the extremity of the peninsula (cf. Grant, 1986b) and would have been deglaciated relatively early, it was hoped that the date would substantiate this inference. However, the date is somewhat younger than others in the area, and therefore has only incidental value as a limiting control on the sea level history.

Comment (W. Blake, Jr.): At least six of the fragments (the largest is 2.2 cm in maximum dimension) exhibited the truncated posterior end typical of **M. truncata**. No lustre, periostracum, pitting, or incrustations; although a little chalkiness was noted, and some Fe-staining. Most shells were worn and a few were partly translucent. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Nova Scotia

GSC-4303. Little Bass River 1380 ± 80
$\delta^{13}C = -28.2‰$

Wood (sample 85-GS-48; 17.2 g; **Abies balsamea**; unpublished GSC Wood Report No. 86-29 by H. Jetté) at an elevation of 2.6 m below spring high tide level, as the root of a small tree stump exposed in cut-bank of tidal estuary, east side of the mouth of Little Bass River, north shore of Minas Basin, Nova Scotia (45°23.93'N, 63°48.30'W). Collected August 29, 1985 by D.R. Grant.

Comment (D.R. Grant): The tree stump is one of several forming a submerged forest on a sloping till surface that has been onlapped by tidal sediments during the Late Holocene transgression. Forest layer has humus layer associated, and is cleanly overlain by silty salt-marsh peat containing driftwood. Date considered to mark the first arrival of salt water onto the terrestrial substrate. It thus helps to define a poorly known interval of the recent submergence, and accords well with GSC-922 (GSC IX, 1970, p. 53), which is higher and younger. The well preserved wood, which retained the bark intact, was oven dried in the field. The outer 5 mm of wood was stripped away in the laboratory. Date is based on two 1-day counts in the 5 L counter.

GSC-4268. Saints' Rest 860 ± 70
$\delta^{13}C = -23.5‰$

Pine cones (sample 85-GS-46; 33.7 g; cf. **Pinus strobus**; identified by D.R. Grant) at an elevation of 1.7 m below high water at spring tides, exposed on the current-eroded foreshore, just north of the lighthouse at Saints' Rest, west side of the mouth of Bass River, north shore of Minas Basin, Nova Scotia

(45°23.9'N, 63°47.9'W). Collected August 28, 1985 by D.R. Grant.

Comment (D.R. Grant): Cones occur in grey pond clay overlying a peaty forest layer, and under salt marsh mud which dates 1260 ± 140 at its base (GSC-922, in GSC IX, 1970, p. 53). Date was an attempt to refine the age estimate for the transition from freshwater to saltwater conditions, by dating what was regarded as an intermediate brackish-water lagoonal pond. Unless GSC-922 is grossly in error, this date should have been about 1500 BP to accord with other indications. Its much younger age is puzzling. Date is based on two 1-day counts in the 2 L counter.

New Brunswick

GSC-5. Green River 10 140 ± 160

Peat (sample LC-886-5b; 15 g burned) from the basal 1 cm of a bog layer (peat) 0.4 m-thick, exposed in a section on the east bank of Green River, approximately 3.2 km north of its confluence with Saint John River and a few kilometres northwest of the Grand Falls map-area, New Brunswick (47°19'N, 68°07'W). The peat unit underlies 3.0 m of gravel and 0.6 m of silt, and it is underlain by 4 m of clay, 1.2 m of gravel, and 0.6 m of till. Collected 1956 by H.A. Lee, then GSC, now Lee Geo-Indicators, Ltd., Stittsville, Ontario.

Comment (W. Blake, Jr.): This sample was dated to provide an inter-laboratory check on I (GSC)-2 (10 220 ± 350 BP; Lee, 1959; Isotopes I, 1961, p. 50), carried out on a portion of the same sample. GSC-5 was also reported in Table 1 in GSC I (1962, p. 15), although it was listed there as wood, not peat. Agreement is good between the two determinations, although the GSC result is preferable because of the smaller error term. The sample received the standard pretreatment with NaOH, HCl and distilled water rinses. Counted in the 2 L counter.

GSC-28. Grand Falls 870 ± 60

Wood (sample LC 61-BH1-8; 8.2 g) from a borehole in town of Grand Falls, New Brunswick, on the south side of Broadway between Terrace and Main Streets (47°02'35"N, 67°44'45"W), at an elevation of 140 m. The wood, from clay 4.9 m below the surface, was collected with a Shelby tube sampler. The stratigraphy at the drilling site, from the top downward, included 2.7 m of sandy fill and slopewash, 2.7 m of gyttja, 3.4 m of organic clay (Lake Madawaska and oxbow lake sediments), 4.0 m of gravel and sand, 5.2 m of gravelly clay till, and 34.4 m of gravel and sand above Paleozoic limestone and argillaceous limestone. Collected March 8, 1961 by H.A. Lee.

Comment (H.A. Lee): The wood was expected to be older than the gyttja, dated at 9830 ± 160 BP (GSC-56; GSC II, 1963, p. 40) a date on basal peat nearby. The modern age of the wood signifies that the wood was dragged downward from the uppermost sandy unit during the drilling process. The sample was treated with NaOH, HCl and hot water rinses. Counted in the 2 L counter.

Quebec

GSC-76. Rivière-du-Loup modern

Wood (sample LC-61-570; 11.6 g moist after pretreatment; unidentified) from an oxidized silty-sand exposed in a ditch at Rivière-du-Loup, Québec (48°02.6'N, 69°18.6'W). **Mytilus edulis** shells (identified by H.A. Lee) occurred with pieces of driftwood, and the silty-sand unit was overgrown by marsh grass, which became covered by the sea during high storms. Collected August 29, 1961 by H.A. Lee.

Comment (H.A. Lee): The sample, from below the 50 ft. contour (15 m), was collected to date the low terrace sands (Lee, 1962). An age between 5 years and 6000 years was estimated. The modern age reflects the spring runoff down the St-Lawrence River, including the effects of ice rafting. Date is based on one 1-day count in the 2 L counter.

GSC-100. Ste-Modeste 19 800 ± 400

Marine pelecypod shell fragments (sample LC-62-1; 543 g, including sediment; **Portlandia arctica**; identified by H.A. Lee) from clay exposed along the bank of Rivière Isle Verte at Ste-Modeste, Québec (47°59.7'N, 69°19.9'W). The sample was collected from the exposed face to 30 cm behind new slide material in a fresh damp face with some rootlets. A red stony clay grades upward into the **Portlandia arctica** phase of the early Champlain Sea clay. Collected June 1962 by H.A. Lee.

Comment (W. Blake, Jr.): The submitter stated that "the stony marine clay is believed to be an ice front deposit where the last ice lobe, the St. Antonin, reached its maximum extent down the St. Lawrence". Judging by the dates available at that time, an age of 11 000 to 12 000 years was considered probable; cf. GSC-61 (10 340 ± 130 BP), GSC-63 (11 410 ± 150 BP), GSC-69 (9690 ± 150 BP), and GSC-70 (10 600 ± 170 BP; all in GSC II, 1963, p. 42-43). It is important to remember, however, that because the shell fragments were disseminated in clay, a bulk sample of sediment and shells was used for dating. After soaking the sample overnight in distilled water to remove some of the clay, the shells and clay were treated with acid. Although the rocks in the drift are non-calcareous, the possibility that the presence of 'old' carbonates in the sediment enclosing the shells is responsible for the anomalous age cannot be excluded. Date is based on one 3-day count in the 2 L counter.

GSC-1492. Harricanaw River 4770 ± 140
$\delta^{13}C = -1.2‰$

Marine pelecypod shells (sample SJA-70-75; 45 g; **Macoma** sp., probably **Macoma balthica**; identified by R.G. Skinner and W. Blake, Jr.) from a mud layer with boulders, exposed in a river cut bank, 13 km east of the Ontario-Quebec boundary, on the right bank of the Harricanaw River, Quebec (50°46'N, 79°17'W), at an elevation of 60 ± 3 m. The shells were concentrated behind boulders on the upstream side of the bank, 29 m above river level. The sampled layer (which also contained a single **Mytilus** sp. shell) was overlain by successive layers of silt and sand, sand and gravel, and sand; and underlain successively by sand, 14 m of deltaic silt and fine sand, rhythmites, and till. Collected July 13, 1970 by R.G. Skinner.

Comment (W. Blake, Jr.): Shells are slightly younger than submitter's estimated age of 5000 to 5200 years. Date is based on two 1-day counts in the 5 L counter.

GSC-1493. Birthday River 3920 ± 130
$\delta^{13}C = -27.5‰$

Basal peat (sample SJA-70-71; 240 g wet) from a 2 m-thick peat layer exposed on the left bank of Birthday River, 0.4 km upstream from its confluence with the Harricanaw River, Quebec (50°43'N, 79°20'W), at an elevation of 60 ± 3 m. This fresh exposure consists of the following layers (from the surface downward): string bog vegetation, loose 'young' peat, slightly humidified sands, spruce stumps within alternating humified and unhumified peat (containing GSC-1493 at the base), sand and gravel, silt and clay, red and blue clay, conglomerate, rhythmites, gravel and, finally, 5 m of till. Collected July 13, 1970 by R.G. Skinner.

Comment (W. Blake, Jr.): The peat is younger than the submitter's estimate of 4900 to 5100 years. The sample received the standard treatment with NaOH, HCl, and distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

GSC-3121. Baie de Cabbage Willows 1660 ± 200
$\delta^{13}C = -3.4‰$

Marine pelecypod shells (sample PC-1980-1; 3.1 g; **Macoma balthica**; identified by P. Champagne, Longueiul, Québec), from clayey silt exposed in the bank of la rivière le Novide where it cuts through a tidal marsh, Baie de Rupert, Québec (51°34'N, 79°15'W), at an elevation of 0.3 m. Collected August 25, 1980 by P. Champagne.

Comment (P. Champagne): The date provides a minimum age for the deposition of an estuarine unit at the base of a complete intertidal sequence in la baie de Cabbage Willows. As the sample was collected 1.3 m below the present beach surface, the rate of sedimentation is <1 mm/year for the whole sequence. This value is minimal because it is an average of an extremely slow rate of sedimentation in the upper part of the section with a much more rapid rate in the middle and lower parts.

Comment (W. Blake, Jr.): This small collection of aragonitic shells included whole valves, fragments, and some intact pairs. The shells were thin, retained periostracum, and had internal lustre. The largest valve measured 1.3 x 1.1 cm. **Mytilus edulis** fragments in the sample were not used for dating. Because of the small sample size, only the outer 5% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Poste-de-la-Baleine series

Marine pelecypod shells from two sites along Great Whale River, Nouveau Québec, about 10 km above its mouth in Hudson Bay (55°17'N, 77°46'W). Collected August 13, 1969 by J.P. Portmann, Université Neuchâtel, Neuchâtel, Switzerland.

GSC-1322. Poste-de-la-Baleine (I) 6280 ± 390

Marine pelecypod shells (sample Portmann 1562; 4.0 g; **Macoma calcarea**, **Nucula belloti**, **Yoldia** sp., cf. **Y. hyperborea**; identified by A.H. Clarke, Jr., then National Museum of Natural Sciences, Ottawa) from low tide level in marine clay which forms the bed of the river.

Comment (W. Blake, Jr.): The shell-bearing unit above the clay was interpreted by Portmann (1970, 1971) as a basal till. The second age determination, on a stratum higher in the section (GSC-1703, 6620 ± 190 BP, this series) showed that those shells were at least not younger (the dates overlap because of the large error term attached to each), and hence the till-like unit must have another origin. **Nucula belloti** was the most common species, but **Macoma calcarea** made up most of the weight. Intact pairs of both species were present. Although some of the shells exhibited chalkiness, no pitting or incrustations were noticed. Because of the small sample size, no shell material was removed with HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-1703. Poste-de-la-Baleine (II) 6620 ± 190

Marine pelecypod shells (sample Portmann 1561; 8.2 g; **Mya truncata**; identified by W. Blake, Jr.) from a section along the south side of Great Whale River, at an elevation of ~5 to 6 m. The shells derived from coarse sand layers in a 50 cm-thick sand unit, overlain by 1 m of clay and 1.2 cm of sand. Collected August 13, 1969 by J.P. Portmann.

Comment (W. Blake, Jr.): Other species present included **Chlamys islandica, Hiatella arctica, Balanus** sp., **Clinocardium ciliatum, Mytilus edulis, Macoma calcarea,** and an unidentified gastropod. The **Mya truncata** used for dating were well preserved, and only fragments were used for dating. The date confirms that the area was free of glacier ice prior to 7000 years ago (cf. comments for GSC-1322, 6280 ± 390 BP, this series; Portmann, 1970, 1971). Because of the small sample size only the outer 5% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Richmond Gulf series (I)

Marine pelecypod shells from four sites along the peninsula separating Richmond Gulf from Hudson Bay. All samples collected by G.M. Haselton, Clemson University, Clemson, South Carolina, U.S.A.

GSC-1326. Richmond Gulf (I) 4070 ± 140 $\delta^{13}C = +3.4‰$

Marine pelecypod shells (sample HIA-69-6(A); 50 g; **Hiatella arctica**; identified by W. Blake, Jr.) from thin-bedded beach sands 19 km north of Castle Peninsula, Richmond Gulf, Quebec (56°21'N, 76°26'W), at an elevation of 24 m (altimeter determination). Valves of **Hiatella** were intact. The collection was made on the surface of a sandy bank which is being actively undercut by a stream.

Comment (G.M. Haselton): The amount and state of preservation of shelly material at this location is most unusual; a veritable shell bank exists. No other site provided such numbers and varieties of species. Suggested rebound rates at this time must have exceeded 2 cm/yr.

Comment (W. Blake, Jr.): Other species present include **Mya truncata, Chlamys islandica, Macoma** sp., limpets, high-spired gastropods (2 species?), barnacles (2 species?), and echinoid spines. Date is based on two 1-day counts in the 5 L counter.

GSC-1328. Richmond Gulf (II) 6390 ± 180 $\delta^{13}C = +0.2‰$

Marine pelecypods fragments (sample HIA-69-1(A); 10.6 g; **Mytilus edulis**, identified by W. Blake, Jr.) approximately 10 km north of Castle Peninsula, Richmond Gulf, Quebec (56°17'N, 76°29'W), at an elevation of 77 m (altimeter determination). The shells were collected from a trench dug in cobbly to pebbly beach material.

Comment (G.M. Haselton): Whole paired valves of both **Mytilus edulis** and **Hiatella arctica** were present. However, because the date is anomalously old for this low elevation, it would appear that the pelecypods lived in deep water.

Comment (W. Blake, Jr.): Many **Hiatella arctica** valves, the species which makes up the bulk of the collection, were in position of growth, according to the collector. Also numerous fragile **Mytilus** shells were still intact, indicating little transport. **Mytilus** shells became fragmented during transport to Ottawa. No pitting or incrustations were noted, nor was vegetation present on the beaches. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-1287. Richmond Gulf (III) 6000 ± 160 $\delta^{13}C = +1.6‰$

Marine pelecypod shells (sample HIA-69-2(A); 33 g; **Mytilus edulis**, identified by W. Blake, Jr.) from sands exposed in a gully cut in a high delta west of Richmond Gulf, Quebec (56°17'N, 76°30'W), at an elevation of approximately 139 m.

Comment (G.M. Haselton): Other pelecypods found at this site include: **Hiatella arctica, Mya truncata, Clinocardium ciliatum, Chlamys islandica** and **Balanus** sp. (all identified by W. Blake, Jr.). All **Mytilus edulis** collected were paired. The limit of Holocene marine submergence in this sector is approximately 262 m. The rate of postglacial rebound at this time was approximately 8.5 cm/yr. Date is based on two 1-day counts in the 2 L counter.

GSC-1364. Richmond Gulf (IV) 6230 ± 220 $\delta^{13}C = +0.1‰$

Marine pelecypod shell fragments (sample HIA-69-8(A); 9.0 g; **Mytilus edulis**; identified by W. Blake, Jr.) from a high bank of marine sands and silts exposed in a stream cut 29 km north of Castle Peninsula, Richmond Gulf, Quebec (56°27'N, 76°30'W), at an elevation of 154 m. This location is one of a flight of beaches on the west regional dip slope of the Richmond Gulf Cuesta.

Comment (G.M. Haselton): As the shells had to be extracted from ground ice they were easily broken when separated from the matrix.

Comment (W. Blake, Jr.): The **Mytilus edulis** fragments (mostly <1 cm in length) used for dating were picked out of damp sand, then oven-dried, and the rest of the adhering sand was removed by scraping. Date is based on one 3-day count in the 1 L counter.

GSC-1725. Richmond Gulf (V) 6000 ± 210

Marine pelecypod shells (sample HIA-69-11; 26.3 g; **Hiatella arctica**; identified by W. Blake, Jr.) from silt and sand in a large, wet frost boil 29.5 km

north of Castle Peninsula, Richmond Gulf, Quebec (56°27'N, 76°25'W), at an elevation of 153 m. The collection was made entirely on the ground surface.

Comment (W. Blake, Jr.): Some whole shells and fragments were thickened, but those exhibiting secondary precipitates were excluded from that portion of the collection used for dating. This determination overlaps with GSC-1364 (6230 ± 220 BP), a nearby collection from a similar elevation. Date is based on two 1-day counts in the 2 L counter.

Richmond Gulf series (II)

Marine shells were collected from cross-bedded beach sands in a stream bank exposure, south side, approximately 9.6 km north of Castle Peninsula, Richmond Gulf, Quebec (56°16'N, 76°30'W), at an elevation of 175 m. The top of the exposure in which the shells were found is at 181 m. The shells derived from a single inclined bed, 15 to 20 cm in thickness, and the collection was made over a vertical distance of at least 3 m along this bed, which was the only one containing significant numbers of shells. Collected July 21, 1969 by G.M. Haselton. Two determinations were made:

GSC-1238.	Richmond Gulf (VI)	6720 ± 150 $\delta^{13}C = +2.9‰$

Marine pelecypod shells (sample HIA-69-7(a); 32 g; **Hiatella arctica**, identified by W. Blake, Jr.).

Comment (G.M. Haselton): Many valves were paired and found in the presence of paired valves of **Mya truncata**, **Mytilus edulis**, and **Macoma** sp. (identified by W. Blake, Jr.). Also encountered were **Balanus** sp. and several small limpets. The existence of this fragile community strongly suggests little transportation by waves or currents. These are the highest and oldest shells found along this portion of the east coast of Hudson Bay. The limit of Holocene marine submergence is above this elevation. Rebound rates at this time were in the order of 8.5 cm/yr. Date is based on two 1-day counts in the 2 L counter.

GSC-1261.	Richmond Gulf (VII)	6430 ± 150 $\delta^{13}C = +1.0‰$

Marine pelecypod shells (sample HIA-69-7(b); 14.5 g; **Mytilus edulis**; identified by W. Blake, Jr.).

Comment (G.M. Haselton): Sample was taken to cross-check the ages of two different species of pelecypods for radiometric consistency. Shells at this location were the highest ones found on the peninsula between Richmond Gulf and the sea. Even higher boulder beaches in the area may contain organic material bearing on the date of deglaciation along this portion of the coast of eastern Hudson Bay. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Comment (W. Blake, Jr.): Further data on the spectacular raised beaches in the Richmond Gulf area and on both the glacial history and the history of the Tyrrell Sea in the region can be found in papers by (Archer, 1968; Haselton, 1970; Fairbridge and Hillaire-Marcel, 1977; and Hillaire-Marcel, 1976, 1979, 1980). The oldest dates farther south, at elevations slightly above 200 m, were GSC-2135 (7360 ± 100 BP) and GSC-2161 (7120 ± 110 BP; both in GSC XVII, 1977, p. 7-8; Vincent, 1977), but Hillaire-Marcel (1976) reported a date of 7625 ± 120 (I-9005) on **Macoma calcarea** shells at 5 m at Poste-de-la-Baleine. A date on marine shells in clay beneath lake sediments in Sakami Lake, at an elevation of ~174 m (i.e., identical to that of the shells in this Richmond Gulf series), gave a similar result: 6640 ± 180 BP (GSC-1928; GSC XIII, 1973, p. 17). Finally, an unpublished date on shell fragments (**Hiatella arctica**, **Mytilus edulis**, **Balanus crenatus**, and **Chlamys**?; all identified by P.J.H. Richard, Université de Montréal, Montréal) from 280 to 297 cm depth in a core from 1.4 km south of Lac Leblois (54°01'40"N, 76°38'40"W; elevation, 200-210 m) gave 7110 ± 60 (TO-69) and the basal organic sediment in the same core (at 220 to 240 cm depth) gave 6450 ± 190 (GX-4971; Richard, 1979).

GSC-1588.	Puvirnituq	3380 ± 130

Marine pelecypod shells (sample P.119-1970; 47 g; **Mytilus edulis**; identified by W. Blake, Jr.) from coarse sand on a ridge 4 km northwest of Puvirnituq (Povungnituk), Nouveau-Québec (60°03.5'N, 77°19.5'W), at an elevation of 35 m (altimeter determination). Collected July 25, 1970 by J.P. Portmann, Université Neuchâtel and Centre d'Etude Nordique, Université Laval, Québec.

Comment (W. Blake, Jr.): The date was the first obtained on marine pelecypod shells in this area. Obviously there has been a significant amount of emergence in the last 3250 to 3510 years. The collection was a large one, with many intact valves, but only fragments (from valves >4 cm long) were used for dating. No pitting or incrustations were present on these well preserved shells. H_3PO_4 rather than HCl was used to dissolve the shells after the outer 20% of shell material was removed (standard treatment). Date is based on one 3-day count in the 5 L counter.

Ontario

GSC-3743.	Navan	10 800 ± 90 $\delta^{13}C = -1.8‰$

Marine pelecypod shells (sample FI-83-1; 100.0 g; **Macoma balthica**; identified by C.G. Rodrigues, University of Windsor, Windsor, Ontario) from 3 m of pebbly sand overlying 2 m of interstratified, fossiliferous, clay and sand in a gravel pit 3.5 km northeast of Navan, Ontario (45°26'40"N,

75°24'00"W) at an elevation of approximately 95 m. Collected July 11, 1983 by R.J. Fulton. Two determinations were made:

GSC-3743. Outer fraction 10 700 ± 100
$\delta^{13}C = -1.7‰$

Outer fraction of shells (10 to 60%) after outermost 10% was removed by HCl leach. Date is based on two 1-day counts in the 5 L counter.

GSC-3743. Inner fraction 10 800 ± 90
$\delta^{13}C = -1.8‰$

Inner fraction of shells (60 to 100%). Date is based on one 3-day count in the 5 L counter.

Comment (R.J. Fulton): The **Macoma balthica** shells, which were in growth position, are from a unit interpreted as littoral deposits which truncate the top of a ridge consisting largely of ice contact sand and gravel. In the exposure where the sample was collected, this unit overlies deeper water marine sediments which, in turn, overlie slumped sand and gravel, possibly of ice contact origin. **Balanus hameri** plates from a clay lens near the top of the ice contact (?) gravel were dated 11 000 ± 90 BP (GSC-3706; GSC XXIV, 1984, p. 10). Foraminiferal and ostracode assemblages, collected from the sediments, indicate marine water salinities were as high as 34‰ during deposition of the material containing **Balanus hameri**, were between 15 and 25‰ during deposition of the interstratified sand and clay, and fell to 15‰ or less during deposition of the upper unit (Rodrigues, 1987). This date indicates there was little time between deposition of the **Balanus hameri** unit in highly saline bottom water and the imposition of low salinity littoral conditions on this ridge.

Comment (W. Blake, Jr.): The dated sample was composed of nearly all whole valves, and some were pairs. The shells were, in general, well preserved, with chalky exterior surfaces plus some adhering silt, but no incrustations. Some Fe-stain was present on a few valves, and some valves retained good internal lustre. Dimensions: 2.0 x 1.8 cm to 0.7 x 0.6 cm; all shells were <1 mm in thickness (many <0.5 mm).

Herbert Corners series

Cirriped plates (**Balanus hameri**; identified by C.G. Rodrigues, University of Windsor, Windsor, Ontario, and the late S.H. Richard) from sandy gravel in the wall of an active sand and gravel pit 1.4 km north-northeast of Herbert Corners and 10.5 km east of Manotick, Ontario (45°13'40"N, 75°33'45"W), at an approximate elevation of 93 m. Many of the barnacles were still in growth position, with basal plates attached to pebbles, at the base of a 3 to 4 m-thick fossiliferous sequence. The basal shelly bed is overlain by a 3 m-thick fossiliferous marine clay unit and is underlain by non-fossiliferous sands. Collected July 7, 1982 by the late S.H. Richard and C.G. Rodrigues. Two determinations were made:

GSC-4113. Herbert Corners (I) 11 200 ± 110
$\delta^{13}C = 0.0‰$

Cirriped plates (sample RAB-82-20; 23.5 g) representing the best preserved shells in the collection. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Date is based on one 3-day count in the 2 L counter.

GSC-4113-2. Herbert Corners (II) 11 200 ± 110
$\delta^{13}C = +0.8‰$

Cirriped plates (sample RAB-82-20; 34.0 g) representing those in the collection which had a yellow-brown surface discolouration. The sample was given no pretreatment. Date is based on one 3-day count in the 5 L counter.

Comment (W. Blake, Jr.): **Balanus hameri**, a species indicative of high bottom water salinity in the western basin of the Champlain Sea (Rodrigues, 1987) is not one of the abundant species that has been used for dating (cf. Table 7 in Fulton and Richard, 1987). It is characteristic of the assemblage found at the base of the successions, as is the case with **Portlandia arctica** or **Hiatella arctica** (Rodrigues, 1987). The second determination was carried out to determine whether the yellow-brown surface discolouration (grey in places) of the calcitic shells represented a secondary precipitate of younger calcite, common on shells in Arctic localities. This is apparently not the case, as the two dates are identical; the first determination was produced in December 1985, the second in June 1986. The barnacle fragments used had a maximum length of 6.2 cm, and some were >2 cm wide, but shorter. The fragments rarely exceeded 2 mm in thickness.

Clayton series

Two shell samples were obtained from the same sand unit in an active sand and gravel borrow pit, 5.6 km north of Clayton, Lanark County, Ontario (45°14'15"N, 76°19'00"W), at an elevation of approximately 167 m (from topographic map).

GSC-1859. Clayton (I) 12 800 ± 220

Marine pelecypod shells (sample SK-72-7; 7.2 g; **Macoma balthica**; identified by W. Blake, Jr.). Collected October 4, 1972 by the late S.H. Richard. Because of the small sample size only the outer 10% of shell material was removed with HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2151. Clayton (II) 12 700 ± 100
$\delta^{13}C = -0.2‰$

Marine pelecypod shells (sample RAB-74-34; 80.5 g; **Macoma balthica**; identified by W. Blake, Jr.). Collected September 12 and 27, 1974 by the late S.H. Richard, G. Menard, W. Blake, Jr., E.W. Blake, and S.C. Blake. Two determinations were made:

GSC-2151. Outer fraction 12 800 ± 100
$\delta^{13}C = -0.2‰$

Outer fraction of shells (11 to 55%) after removal of the outermost 10% of shell material. Date is based on one 3-day count in the 5 L counter.

GSC-2151. Inner fraction 12 700 ± 100
$\delta^{13}C = -0.2‰$

Inner fraction of shells (56 to 100%). Date is based on one 3-day count in the 5 L counter.

Comment (S.H. Richard): These dates provide a minimum age for final deglaciation of the Clayton area and for the first arrival of marine waters along the western rim of the Champlain Sea basin. This fossiliferous marine beach deposit, at an elevation of approximately 167 m, represents the highest well defined Champlain Sea shoreline in the area (Richard, 1974, p. 219; 1975, p. 113-115). The dates are the oldest obtained for marine fossils from the Champlain Sea basin.

Comment (W. Blake, Jr.): This series of age determinations has proved to be as controversial as any the GSC laboratory has carried out (e.g., see Gadd, 1980; Terasmae, 1980; Hillaire-Marcel, 1981; Karrow, 1981; Gadd, 1981; Clark and Karrow, 1984; Anderson et al., 1985). The much larger second collection was made in order that a thorough check of the first result (GSC-1859) could be carried out, and GSC-2151 certainly verifies GSC-1859. However, a more recent determination on sample RAB-74-34 (the same sample used for GSC-2151), carried out via accelerator mass spectrometry at the IsoTrace Laboratory, University of Toronto, gave a result at variance with the GSC determinations. The IsoTrace result was 12 180 ± 90 years (TO-245). Although a 610 mg sample (115 valves, all aragonitic) was submitted to IsoTrace, only 207 mg were used. The outer 20% of shell material was leached away (as is done in the standard treatment of shells at the GSC). For recent summaries and discussion of late Pleistocene events and deglaciation chronology the reader is referred to Gadd (1987), Rodrigues (1987), Fulton and Richard (1987) and Anderson (1987).

The largest shell in the original collection (SK-72-7), used for GSC-1859, was 1.8 cm long, but many valves were <0.5 cm long. The small valves all retained their internal lustre. No periostracum remained, but nor was there any chalkiness. In the case of sample RAB-74-34, most valves were whole, and many were pairs. All the shells were thin, some Fe-staining was noted, and the shells were damp when collected. The largest valves were 1.7 to 1.9 cm long and ~1.6 cm high. The shells were air dried in the office. Many juvenile individuals were present.

GSC-3110. White Lake/ Waba 12 100 ± 100
$\delta^{13}C = -0.6‰$

Marine pelecypod shells (sample RAB-80-5; 96.0 g; **Macoma balthica**, identified by S.H. Richard) from an active sand and gravel borrow pit in a Champlain Sea marine beach deposit, located 1.2 km east of White Lake and 1.0 km west of Waba, Renfrew County, Ontario (45°21'15"N, 76°28'25"W), at an elevation of approximately 170 m. Collected July 29, 1980 by the late S.H. Richard. Three determinations were made:

GSC-3110. Outer fraction 12 100 ± 100
$\delta^{13}C = -0.6‰$

Outer third of shell material, which were not given any pretreatment. Date is based on one 3-day count in the 5 L counter.

GSC-3110. Middle fraction 12 200 ± 100
$\delta^{13}C = -0.5‰$

Middle fraction of shells. Date is based on one 3-day count in the 5 L counter.

GSC-3110. Inner fraction 12 100 ± 100
$\delta^{13}C = -0.6‰$

Inner fraction of shells. Date is based on one 4-day count in the 5 L counter.

Comment (S.H. Richard): GSC-3110 provides a minimum age for deglaciation of the Ottawa River valley as far west as White Lake and for the arrival of marine waters along the western rim of the Champlain Sea basin in the Arnprior-Renfrew area. The marine sand deposit is found at the western limit of the area filled with marine sediments in the Waba Creek valley, and the upper part of the deposit, at approximately 182 m, represents the marine limit in this valley (Richard, 1984). Above this elevation the glacial and meltwater deposits abandoned by the retreating Laurentide Ice Sheet lie unmodified. The date is the oldest for postglacial marine submergence in the Ottawa Valley west of Arnprior. The three ages obtained are substantially older than the age of 11 500 ± 90 BP (GSC-2269, GSC XIX, 1979, p. 13) obtained by C.R. Harington 2.1 km west of White Lake (some 3 km west of where the shell sample for GSC-3110 was recovered), for bone material from the humerus of a large, arctic-adapted bowhead whale (**Balaena mysticetus**). The whale remains were found in a marine sand beach deposit lying at a similar elevation of approximately 170 m, at or near

the marine limit (Harington, 1977, p. 525; GSC-2269, 11 500 ± 90; GSC XIX, 1979, p. 13).

GSC-4019.	Plastic Lake, 326.5-329.5 cm	11 600 ± 140 $\delta^{13}C$ = -20.9‰

Organic lake sediment (sample 84KDA 53000, 54000; 288.1 g wet) from 326.5 to 329.5 cm below the sediment/water interface in Plastic Lake, 9 km southeast of Dorset, Ontario, and 2.5 km east of Highway 35 (45°11'N, 78°49'15"W), at an elevation of 376.43 m ± a.s.l. The cores were taken in approximately 15.25 m of water in an isolated depression in the western half of the lake. The corer penetrated 3.295 m of gyttja and organic silt. Collected October 1984 by C.A. Kaszycki and T.W. Anderson.

Comment (C.A. Kaszycki): This date provides a minimum estimate for deglaciation within the region and concurrent inundation by Glacial Lake Algonquin. Plastic Lake is located in upland terrain north of the northernmost extension of Lake Algonquin in this region, approximately 70 km north of the Kirkfield outlet through the Trent River. The elevations of ice proximal deltas within the basin of the Gull River, a northern extension of the Trent River, are coincident with those proposed for Main Lake Algonquin within the region. This suggests that this lake phase evolved in response to deglaciation of the Kirkfield outlet prior to 11 600 ± 140 BP (Kaszycki, 1985). NaOH leach omitted from sample pretreatment and the sample showed no reaction with HCl. Sample was mixed with dead gas for counting. Date is based on one 4-day count in the 2 L counter.

GSC-1097-2.	Amable du Fond River	8730 ± 80 $\delta^{13}C$ = -24.6‰

A log (sample JEH-1-68; **Picea** or **Larix**, probably **Picea** sp.; unpublished Wood Identification Report No. 76-34 by R.J. Mott) was extracted from a gravel bed 7.5 cm thick at the base of a 2.4 m-high section of well sorted sand containing four other evenly-spaced organic-rich horizons. The sand unit, on the west side of Amable du Fond River, Ontario, 13.3 km upstream from its mouth (46°11'N, 78°57'W), at an elevation of approximately 290 m, is underlain by an undetermined thickness (>2.1 m) of varved clay. Collected August 1968 by J.E. Harrison. Six determinations were made, to determine what effect, if any, various reagents had on the age obtained:

GSC-1097-2.	Amable du Fond (II)	8730 ± 80 $\delta^{13}C$ = -24.6‰

A 15.0 g (dry) subsample was dated in order to use the KOH method (cf. Lowdon et al., 1977, p. 2-3). As Lowdon (1985) has pointed out, the $\delta^{13}C$ value obtained is identical to that obtained on the original determination, which was reported in uncorrected form as 8670 ± 140 BP (GSC-1097; GSC XV, 1975, p. 13; using the $\delta^{13}C$ value of -24.6‰ this original date becomes 8680 ± 140 BP). GSC-1097-2 is based on two 1-day counts in the 2 L counter.

GSC-1097-A.	Amable du Fond (III)	9030 ± 150 $\delta^{13}C$ = -25.5‰

A 6.5 g (dry) subsample was dated as one of four splits derived from a 43.4 g sample submitted to W. Podolak (formerly GSC). The entire sample was ground to approximately 0.125 mm size (personal communication from W. Podolak, Sept. 1976). Split A was untreated. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-1097-B.	Amable du Fond (IV)	8800 ± 80 $\delta^{13}C$ = -25.3‰

A 6.5 g (dry) subsample was immersed in Canlab technical grade acetone, stirred, and allowed to soak for approximately 50 hours. During soaking the sample was sealed in a plastic bag to prevent other contamination as well as evaporation of the acetone. After soaking the sample was filtered and air-dried for approximately 48 hours. Date is based on one 3-day count in the 2 L counter.

GSC-1097-C.	Amable du Fond (V)	8770 ± 80 $\delta^{13}C$ = -25.0‰

A 6.5 g (dry) subsample was immersed in Geoloquids bromoform (S.G. = 2.86), stirred, and allowed to stand for approximately 50 hours in a sealed plastic bag. The sample was then filtered, washed with acetone (2 to 4 times the volume of bromoform) and air dried for approximately 48 hours. Date is based on one 3-day count in the 2 L counter.

GSC-1097-D.	Amable du Fond (VI)	8640 ± 90 $\delta^{13}C$ = -25.1‰

A 7.0 g (dry) subsample was immersed in Geoloquids bromoform as for sample GSC-1097-C. After soaking and filtering only slight acetone washing was used. Date is based on one 3-day count in the 2 L counter.

GSC-1097-E.	Amable du Fond (VII)	11 000 ± 100 $\delta^{13}C$ = -25.3‰

A 10.7 g (dry) subsample of wood was thoroughly contaminated by having 3 in 1 brand household oil dripped onto pieces of dry wood. Date is based on one 3-day count in the 5 L counter.

Comment (W. Blake, Jr.): The ages of the three subsamples (GSC-1097-B, -C, -D) immersed in acetone and/or bromoform did not differ from the first determination in this series (GSC-1097-2;

8730 ± 80 BP). The reason why GSC-1097-A, 9030 ± 150 BP), untreated with any organic solvents, gave a result at variance with the others is not clear (although a much smaller sample, only 1.8 g, was burned), as the pretreatment of all samples included NaOH and HCl leaches, plus distilled water rinses, and then recovery of CO_2 using the KOH method (Lowdon, 1985). It is clear, however, that the standard pretreatment will not remove contamination caused by exposure to oil.

GSC-4077. Kesagami Lake 4390 ± 80
$\delta^{13}C = -25.6‰$

A single piece of wood, probably a root (sample 5 B2; 7.4 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 85-16 by R.J. Mott) from the uppermost part of a till layer, underlying a 4 m-thick peat bluff, bordering Kesagami Lake, 6.3 km west of Kesagami Lake Lodge on Opimicon Peninsula, Ontario (50°20'30"N, 80°16'00"W), at an elevation of 260 m. The uppermost part of the till layer (into which the root had penetrated) was approximately 10 cm below the lake level. The sample was collected approximately 10 to 20 cm in from the face of the bluff. A thin layer of blue clay may overlie the till and the root may have been enclosed by it). Collected August 15, 1983 by G.D. Mackenzie, Ohio State University, Columbus, Ohio, and D.I. Mackenzie, University of Waterloo, Waterloo, Ontario.

Comment (G.D. McKenzie and D.I. McKenzie): GSC-4077 dates the initiation of peat formation on a till plain modified by glaciolacustrine processes near the northern margin of the Abitibi Upland in northeastern Ontario. The unusually thick (4 m) peat is exposed as bluffs on the shore of Kesagami Lake (Bell, 1904; McKenzie and McKenzie, 1984). Assuming uniform conditions, but realizing variations caused by fire and climatic change have occurred, the mean rate of peat formation is approximately 1 mm/yr.

Peatland development is probably related to climatic change (as noted by Wright and Glaser, 1983) within the Northern Conifer Floristic Province described in Cushing (1965), although drainage changes by rebound and beaver may have played a role. Similar ages have been reported elsewhere in this floristic province. To the northwest in the Hudson Bay Lowland on the Attawapiskat River (53°08'N, 85°18'W), Sjörs (1959; cf. also Terasmae and Hughes, 1960) collected basal peat with a date of 4700 ± 80 BP (GRO-1925). To the southwest within this province, in the Glacial Lake Agassiz peatlands of Minnesota, basal peat was dated at 4300 BP (reported in Wright and Glaser, 1983).

The semicircular bays and arcuate shorelines suggest growth of part of the lake through coalescence of pools in peat. This process probably proceeds through microbial and erosional degradation (Engstrom, 1984). No quantitative assessment of erosion rates is available; however, if the radius of curvature of a bay is related to the age of the bay, it is possible to speculate on the rate of shore recession. This approach, subject to much error, suggests minimum rates of 15 to 30 cm/yr, much higher than the rates of gully and slope erosion in peat from sites in the Pennines (Tallis, 1985).

Comment (W. Blake, Jr.): The dated piece of wood was 44 cm long, 1.1 cm in diameter, somewhat twisted, and it had a generally smooth surface with some bark attached. Date is based on two 1-day counts in the 2 L counter.

Mattagami River series

One shell and two wood samples from a relatively fresh exposure along the left bank of the Mattagami River, Ontario, at Big Bend (50°33'30"N, 80°34'33"W), at an elevation of 51 m. The section, from the ground surface downward, consists of successive layers of: (1) silty sand, (2) fine sand to silt laminations with medium sand, (3) gravel, (4) marine clay, and (5) till (at the base).

GSC-1323. Mattagami River (I) 4180 ± 140
$\delta^{13}C = -23.4‰$

A single piece of wood (sample SJA-69-78; 85 g wet; species unidentified) enclosed in fine to medium grey sand within layer 2, and situated at some distance laterally (and slightly lower stratigraphically) than GSC-1396. The sand was wet and had a stagnant odour. Collected August 4, 1969 by R.G. Skinner, then GSC, now Department of Energy, Mines and Resources, Ottawa.

Comment (W. Blake, Jr.): This date was the first obtained from the Big Bend site. Only the main piece of wood was used (6 to 7 cm in diameter and 20 cm in length) to avoid the danger of including older wood fragments. All of the outer black wood and wood at the ends was cut off, together with adhering sediment. Date is based on two 1-day counts in the 5 L counter.

GSC-1396. Mattagami River (II) 4830 ± 130
$\delta^{13}C = -4.6‰$

Marine pelecypod shells (sample SJA-70-2; 45 g; **Macoma** sp.; identified by R.G. Skinner) enclosed in fine sand and silt within layer 2, 20 to 40 cm behind the natural face, and some distance laterally from the wood used for GSC-1323. The enclosing material was wet but not oxidized. Collected June 13, 1970 by R.G. Skinner.

Comment (W. Blake, Jr.): The $^{13}C/^{12}C$ ratio shows that a brackish water environment existed at the site, which may have affected the apparent age of the shells. The shells were well preserved, and 90%

were hinged. They were extracted from the enclosing sediment with a knife, washed clean in creek water and air dried. Only the outer 10% of shell material was removed with HCl leach. Date is based on one 4-day count in the 5 L counter.

GSC-1531. Mattagami River (III) 4140 ± 130 $\delta^{13}C = -23.9‰$

A single piece of wood (sample SJA-70-5; 11.3 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 71-12 by R.J. Mott) from a beach(?) gravel (layer 3), situated stratigraphically lower than GSC-1323 and mid-way between the point where that wood sample and the shells comprising GSC-1396 were found. Collected June 13, 1970 by R.G. Skinner.

Comment (W. Blake, Jr.): The date is nearly identical with GSC-1323 (4180 ± 140 BP, this series; Skinner, 1973). The single piece of wood measured 13.5 x 2.5 x 1.0 cm; it was Fe-stained, had sand grains imbedded in its outer surface, and the ends were well rounded, implying transport. Date is based on two 1-day counts in the 5 L counter.

GSC-1535. Abitibi River >19 000

Pelecypod shell fragments (sample SJA-70-160; 1.95 g; **Hiatella** sp., **Macoma** sp., and **Portlandia arctica**; identified by R.G. Skinner and W. Blake, Jr.) from silty clay exposed close to river level on the right (east) bank of Abitibi River, northeast of Coral Rapids, Valentine Township, Ontario (50°19'00"N, 81°37'30"W), at an elevation of 76 to 84 m. The collection site is topographically below two tills and postglacial marine deposits. Collected September 1970 by R.G. Skinner.

Comment (W. Blake, Jr.): Dating was carried out to determine whether the shell material was Holocene or older, and in this case there was some doubt about the stratigraphic position of the clay. Because of the small sample size, no shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-1241. Otter Rapids 7160 ± 160 $\delta^{13}C = +3.8‰$

Whole shells and fragments (sample SJA-69-89(a); 10.0 g; **Hiatella arctica**; identified by W. Blake, Jr.) from coarse sand to fine gravel, 500 m due west of section on Ontario National Railway track, Otter Rapids, Ontario (50°16'30"N, 81°39'00"W), at an elevation of 135 m. The shells were collected over an area of nearly a hectare from a flat sand and gravel surface which was used for borrow for the railroad and a dam. Collected August 11, 1969 by R.G. Skinner.

Comment (W. Blake, Jr.): The sample, representing the highest marine shells found in the Moose River basin, provides a minimum age for deglaciation and approximates the time at which the Tyrrell Sea reached its maximum extent south of James Bay, although slightly older dates on shells do exist (cf. Terasmae and Hughes, 1960; Craig, 1969; Skinner, 1973). The shells making up this small sample were clean for the most part, although some pitting, chalkiness, and discolouration (incrustation?) were present. The sample comprised fragments and juvenile whole shells, some <1 cm in length. Large and/or thick shells and fragments, as well as worn shells, were excluded from the dated sample. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-1475. Kwataboahegan River >37 000 $\delta^{13}C = +2.2‰$

Marine pelecypod shells (sample SJA-70-67; 90 g; **Hiatella arctica**; identified by R.G. Skinner and W. Blake, Jr.) from the south bank of Kwataboahegan River, 0.2 km downstream from the mouth of Mistuskwia River, Ontario (51°08'20"N, 82°07'00"W), at an elevation of approximately 75 m. The shells occurred in blue-grey sand below a faulted and sheared peat bed 5 cm thick. Above the peat was a unit of clay/silt rhythmites, overlain by till and a covered interval (Skinner, 1973). Collected July 6, 1970 by R.G. Skinner. Two determinations were made:

GSC-1475. Outer fraction 38 200 ± 2000

This determination was based on the 21 to 60% fraction after the outermost 20% of shell material was removed by HCl leach. Date is based on one 3-day count in the 5 L counter.

GSC-1475. Inner fraction >37 000

This determination is based on the 61 to 100% fraction. Date is based on one 3-day count in the 5 L counter.

Comment (W. Blake, Jr.): Only whole shells and fragments of **Hiatella arctica** were submitted for dating. Other species present included **Mya** sp., **Macoma** sp., **Clinocardium** sp., and **Balanus** sp. (identified by R.G. Skinner and W. Blake, Jr.). A number of species of foraminifera were also present in the sand unit (Skinner, 1973). The shells were sieved to separate them from the enclosing sand in the field (river water). Additional washing in rain water and air-drying was carried out at field camp. Complete valves were picked out and adhering dirt was scraped off. Many **Hiatella** shells were articulated, most were chalky, but only a few had tiny bits of incrustations(?), and there was no pitting or vegetal growth. Many valves retained their

internal lustre. Most of the fragile **Hiatella** shells were 1 to 2 cm long; none were >2 mm thick.

Obviously the correct value to use for GSC-1475 is the date of >37 000 BP on the inner fraction, for dates from other sites on the forest-peat member of the Missinaibi Formation, which is stratigraphically above the shell-bearing sand, are older; i.e., >50 000 years (GrN-1435; Groningen X, 1972, p. 7; cf. Terasmae and Hughes (1960) and McDonald (1971), where the date is referred to as Gro-1435, >53 000 years), >54 000 BP (GSC-1185; McDonald, 1971; Blake, 1974), and >72 500 BP (Stuiver et al., 1978).

GSC-1430. Kipling Dam 7380 ± 160

Whole shells and fragments (sample SJA-70-151; 26 g; **Macoma calcarea**; identified by R.G. Skinner and W. Blake, Jr.) from gravel and sand in a borrow pit excavated in a strandline to the southeast of Kipling dam, 10 km north of Smoky Falls, east of the Mattagami River, Ontario (50°08'N, 82°13'W), at an elevation of 128 m (or more). Beaches at the site are well developed. Collected September 1, 1970 by R.G. Skinner, both on and below the surface of the pit floor. Two determinations were made:

GSC-1430. 1st determination 7550 ± 220

The standard 20% of shell was removed by HCl leach. Date is based on one 3-day count in the 1 L counter.

GSC-1430. 2nd determination 7380 ± 160

Same gas counted in the 2 L counter, which has better counting characteristics. Date is based on two 1-day counts.

Comment (W. Blake, Jr.): The shells were collected just below the limit of Holocene marine submergence in the area, at approximately 137 m (cf. Skinner, 1973), and the date is quite close to the submitter's estimate of 7700 to 7800 years. The preservation of the shells was good, in general, although many valves were broken and many exhibited chalkiness. The shells used for dating had no pitting or incrustations. **Mya truncata** was also present in the collection, but it was not used for dating.

Opasatika River series

Shells from two sites along the Opasatika River, Ontario. Collected June 1970 by R.G. Skinner.

GSC-1489. Opasatika River (I) 6890 ± 220

Whole shells and fragments (sample SJA-70-15; 10 g; **Hiatella arctica**; identified by R.G. Skinner) from a 10 cm-thick brick red pebbly/clay conglomerate in a section (station SJA-70-10) on the left bank of the Opasatika River, McCausland Township, 10 km upriver from its junction with Missinaibi River (50°18'00"N, 82°22'30"W), at an elevation of approximately 85 m. The sampled layer was overlain successively by: 80 to 100 cm of silt, sand and clay with sand lenses at the top of the layer, followed by topsoil. The pebbly conglomerate was underlain successively by 5 cm of blue clay conglomerate, 30 cm of silt and clay beds, followed by an unknown thickness of till at the base of the section. The shells were collected by excavating back into the section to a depth of approximately 75 cm. Also present in the sampled layer were **Macoma calcarea** and **Clinocardium ciliatum** (identified by R.G. Skinner and W. Blake, Jr.), also **Mytilus edulis**, **Mya** sp., a small unidentified gastropod and two pelecypods (noted in the sample by W. Blake, Jr.).

Comment (W. Blake, Jr.): The dating result was close to the younger of the submitter's two estimates, 6900 years or 7800 to 7900 years. The submitted sample comprised both whole shells and fragments of **Hiatella arctica**; some juvenile individuals were <1 cm long, none were over 2.5 cm. All shells were thin and fragile, with no pitting or incrustations; exterior surfaces were chalky but most shells retained good internal lustre. Because of the small sample size, only the outer 5% of shell material was removed with HCl leach. Date is based on one 3-day count in the 1 L counter.

GSC-1499. Opasatika River (II) 6620 ± 240

Shell fragments (sample SJA-70-24; 15.5 g; **Mytilus edulis**; identified by R.G. Skinner) from a 15 cm-thick sand/gravel/cobble layer in a section (station 70-28A) on the right bank of Opasatika River, Acres Township (50°11'30"N, 82°21'00"W), at an elevation of approximately 100 m. The sampled layer is overlain successively by: 40 cm of sand and silt with cut and fill features at the base of the layer, and 50 cm of soil. Below the shell-bearing unit are 100 cm of diamicton (blue and red clay), a 10 cm-thick band containing 18+ rhythmites, and an unknown thickness of 'Cochrane-like' till at the base. The shells were collected by excavating back into the section to a depth of 50 to 80 cm.

Comment (W. Blake, Jr.): This intermediate elevation sample gave a date close to the submitter's estimate of 6700 years. The **Mytilus edulis** shells were articulated in the gravel, but because of their soft, moist and fragile nature, they broke up upon handling. Date was based on two 1-day counts in the 1 L counter.

GSC-1309. Pivabiska River 7630 ± 170

Whole marine pelecypod shells (sample SJA-69-35; **Hiatella arctica**; identified by W. Blake, Jr.) from a 20 cm-thick bed of medium to coarse sand and

silty medium sand exposed at the top of a section on the left bank of the Pivabiska River, approximately 4 km upstream of its confluence with the Missinaibi River, Ontario (50°18'N, 82°53'45"W), at an elevation of 110 m. The sampled layer is overlain by humus and underlain by a layer of massive silt, which contains rare **Mya truncata** at an exposure immediately upriver. The shells were articulated and filled with sand. Collected July 21, 1969 by R.G. Skinner.

Comment (W. Blake, Jr.): This date, the only one from shells along the Pivabiska River, was estimated to be between two previous dates of 7280 ± 80 BP (Gro-1698) and 7875 ± 200 BP (I(GSC)-14; both along Missinaibi River and reported by Terasmae and Hughes, 1960). The fragile and somewhat chalky shells were originally whole and many were articulated. All shells were <2.5 x 1.5 cm in size. The shells retained little periostracum, but had no pitting or incrustations. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Missinaibi River series

Two marine shell samples exposed on the banks of the Missinaibi River, Ontario. Collected June and September 1970 by R.G. Skinner.

GSC-1418. Missinaibi River (I) 7500 ± 160

Whole shells and fragments (sample SJA-70-59; 25.0 g; **Macoma** sp. (identified by R.G. Skinner), probably **Macoma calcarea**; identified by W. Blake, Jr.) from a 5 m-thick layer grading downwards from coarse sand to silty clay, on the north bank of the Missinaibi River, across from Algocen Mines, 10 km upstream from the mouth of the Pivabiska River, Ontario (50°11'N, 82°59'W), at an elevation of 113 ± 3 m. The exposure was fresh and the shells were collected by excavating 20 to 100 cm into the bank. Two determinations were made:

GSC-1418. 1st determination 7390 ± 220

The sample was given the normal pretreatment with HCl, to remove the outer 20% of shell material. Date based on one 3-day count in the 1 L counter.

GSC-1418. 2nd determination 7500 ± 160

The same gas was counted for two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): The site is further upstream along the Missinaibi River than the shells used for I(GSC)-14 (7875 ± 200 BP; Terasmae and Hughes, 1960; Isotopes I, 1961, p. 49). The shells were washed clean of adhering sediment in the field and then were air-dried. The sample included both intact valves and fragments, in numerous cases bits of periostracum remained.

GSC-1436. Missinaibi River (II) 7280 ± 150

Whole shells (sample SJA-70-159; 27.1 g; **Hiatella arctica**; identified by W. Blake, Jr.) from a 10 cm-thick pebbly silt-sand layer, exposed on the right bank of the Missinaibi River, 1 km downstream from the mouth of Pivabiska River, Ontario (50°13'00"N, 82°51'13"W), at an elevation of 103 to 106 m. The sampled layer (23 m above the river level) is underlain by at least 1 m of stiff silt-clay, followed by brownish-grey till at the base. The exposure was fresh. Two determinations were made:

GSC-1436. 1st determination 7390 ± 240

The sample was given the normal pretreatment with HCl to remove the outer 20% of shell material. Date is based on three 1-day counts in the 1 L counter.

GSC-1436. 2nd determination 7280 ± 150

The same gas was counted for one 4-day count in the 2 L counter.

Comment (W. Blake, Jr.): The collection was made at the site where the shells used for Gro-1698 (7280 ± 80 BP; Terasmae and Hughes, 1960) were found, and agreement between the two determinations is good. However, when the date was reported as GrN-1698 (Groningen X, 1972, p. 12), the date was given as 7520 ± 80, and neither the coordinates nor location agree with this location! Many of the fragile shells comprising GSC-1436 were scraped to remove Fe-staining. Eighty-two valves, between 1.5 and 3 cm in length, were used, all of which retained good internal lustre.

Shagamu River series

Two samples of shell fragments from beach gravels exposed along the banks of the Shagamu River, Ontario. Collected July 26 and 28, 1967 by B.C. McDonald.

GSC-1561. Shagamu River (I) 5940 ± 140

Shell fragments (sample MR-67-149; 47.1 g; **Mytilus edulis**; identified by B.C. McDonald) from 0.9 to 1.8 m below the surface of a 6.7 m-thick beach gravel layer exposed on the right bank of the Shagamu River (55°25'24"N, 86°51'36"W), at an elevation of 88 ± 5 m. The beach gravel also contained **Hiatella arctica** and rare **Macoma** sp., and is underlain by a 6.7 m-thick layer of marine clay.

Comment (W. Blake, Jr.): The date is close to the estimated age of 6000 to 6500 years, in an area

where the limit of Holocene marine submergence is close to 150 m. Date is based on one 2-day count in the 5 L counter.

GSC-1567. Shagamu River (II) 3270 ± 190

Shell fragments (sample MR-67-163; 26.0 g; **Mytilus edulis**; identified by B.C. McDonald) from the ground surface to a depth of 1.8 m in beach gravels and pebbly sand, along the left bank of the Shagamu River (55°39'00"N, 86°56'36"W), at an elevation of 40 ± 3 m. The beach gravel also contained articulated **Macoma** sp., and is underlain by approximately 6.1 m of till.

Comment (W. Blake, Jr.): The local limit of Holocene marine submergence is at 150 m. Only fragments were used for dating. Date is based on one 2-day count in the 2 L counter.

Western Canada

Manitoba

Nelson River Series

Marine molluscs were collected from stratigraphic sections along the Nelson River between Gillam, Manitoba and the Hudson Bay coast in order to construct a minimum emergence curve for the area (Dredge and Cowan, in press), to put age limits on key stratigraphic sections (Dredge and Nielsen, 1985; Schreiner et al., 1987) and to date events associated with the Tyrrell Sea regression and development of the Nelson River estuary. Most shells dated from in the region are at least 7000 years old, regardless of elevation or enclosing materials. This fact suggests that environmental conditions were particularly favourable for molluscs at that time. Molluscs of younger age, including modern shells, are rare. All samples collected June 1984 by E. Nielsen, Manitoba Department of Energy and Mines, Winnipeg, Manitoba, and L.A. Dredge.

GSC-3904. Nelson River (I) 7250 ± 80
$\delta^{13}C = +0.9‰$

Marine pelecypod shells (sample 84DU-89; 47.0 g; **Hiatella arctica**, identified by L.A. Dredge and E. Nielsen) from an exposure of marine deposits, overlying lacustrine varves, at the junction of Angling River and Nelson River, Manitoba (56°45.0'N; 93°36.5'W). The top of the section is at an elevation of 35 m; the sample was collected from 15 m depth. The gravel unit which encloses the abundant shells is overlain by a marine offlap sequence of sand, underlain by a thick unit of grey silty clay. The gravel unit is the lowermost Tyrrell Sea unit, and it represents a higher energy, possibly shallower, environment than do the clays above.

Comment (W. Blake, Jr.): Only the better quality aragonitic **Hiatella arctica** shells were selected after the sample was washed in distilled water and air dried. These shells were somewhat chalky, but a few bits of periostracum remained. Most shells retained their internal lustre, but a few grey spots (of unknown origin) were present. Some shells were characterized by worn exterior surfaces, some retained good ornamentation. **Mya truncata** and **Macoma calcarea** (identified by W. Blake, Jr.) were also present in the sample, but they were not used for dating. Date is based on two 1-day counts in the 5 L counter.

GSC-3916. Nelson River (II) 7760 ± 80
$\delta^{13}C = -1.5‰$

Marine pelecypod shells (sample 84DU-136; 48.8 g; **Macoma calcarea**; identified by L.A. Dredge), mostly very fragile paired valves with some periostracum from a 20 m-high section on the left bank of the Nelson River, 1.4 km below Long Spruce dam, Manitoba (56°24'55"N; 94°20'00"W). The top of the section is at 30 m; the sample is from 15 m below the surface. The shells were upright in a thick sequence of ripple drift cross beds which mark the onset of regressive estuarine conditions in the Nelson River valley. The shell-bearing sediment unit is underlain by blue marine clay and is overlain by shallower estuarine and tidal deposits (Schreiner et al., 1987).

Comment (L.A. Dredge): GSC-3916 agrees with a Brock University date of 8000 ± 200 BP (BGS-812) from the same site.

Comment (W. Blake, Jr.): The sample included a number of well preserved aragonitic whole valves (largest: 3.2 by 2.2 cm) with some periostracum on nearly all valves. Some unidentified grey spots were present. Most valves retained reasonably good internal lustre, and none of the shells were pitted, encrusted, or chalky. After washing in distilled water the shells were air dried. Date is based on two 1-day counts in the 5 L counter.

GSC-3921. Nelson River (III) 7020 ± 100
$\delta^{13}C = +1.3‰$

Marine pelecypod shells (sample 84DU-80; 28.1 g; **Hiatella arctica**, identified by L.A. Dredge) from the upper unit of a section on the left bank of the Nelson River, 4.5 km upstream from Port Nelson, Manitoba (57°01.6'N; 92°38.0'W). The sample is at an elevation of 16 m in silty clay marine rhythmites which cap a section containing multiple till sheets and interglacial inorganic sediment.

Comment (L.A. Dredge): The sample dates the uppermost unit of this reference section (Dredge and Nielsen, 1985).

Comment (W. Blake, Jr.): The sample was washed in distilled water and air dried. Only **Hiatella arctica** was used for dating, although

Macoma calcarea and **Clinocardium ciliatum** (identified by W. Blake, Jr.) were also present. The maximum size of the aragonitic **Hiatella arctica** valves was 3.4 by 1.6 cm. All valves exhibited good external ornamentation and good internal lustre. The shells were not pitted or encrusted, but some had grey spots. No periostracum was preserved. Date is based on two 1-day counts in the 2 L counter.

GSC-3928. Nelson River (IV) 6900 ± 130
$\delta^{13}C = -0.4‰$

Marine pelecypod shells (sample 84DU-94; 7.4 g; **Clinocardium ciliatum**, identified by L.A. Dredge and W. Blake, Jr.) from a section exposed on an island in the Nelson River, Manitoba (56°50.4'N; 93°30.0'W), at an elevation of 15 m. The shells are in fine sand with climbing ripples, interstratified with thin clay beds. The sands are part of an estuarine deposit indicative of rapid sedimentation under fluctuating current conditions. The fossil assemblage includes **Mya truncata**, **Hiatella arctica**, **Macoma calcarea**, and **Mytilus edulis**.

Comment (W. Blake, Jr.): Many of the shells, especially **Mya truncata**, **Hiatella arctica**, and **Macoma calcarea** exhibited worn exterior surfaces, little lustre, no periostracum, and considerable chalkiness, all features that suggested transport. Thus **Clinocardium ciliatum** was used for dating, as because of its fragile nature it breaks easily during transport. The aragonitic shells of this species retained good internal lustre and good external ornamentation, suggesting less transport. The largest intact valve measured 3.6 by 3.5 cm. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3930. Nelson River (V) 7370 ± 90
$\delta^{13}C = +1.8‰$

Marine pelecypod shells (sample 84DU-69; 37.0 g; paired valves of **Mya truncata** with periostracum; identified by L.A. Dredge) from Flamborough Head on the north shore of the Nelson River, 13 km upstream from Port Nelson, Manitoba (56°58.1'N; 92°47.0'W), at an elevation of 30 m. The shells were extracted from silty marine sand which caps a section containing two tills separated by interglacial sand and peat (Dredge and Nielsen, 1985).

Comment (L.A. Dredge): The shells provide a minimum age for the tills and glaciolacustrine deposits, and date the marine (Tyrrell Sea) unit.

Comment (W. Blake, Jr.): Only **Mya truncata** was used for dating, although **Macoma calcarea** and **Hiatella arctica** were represented in the collection. Thirty left valves and 16 right valves were used; all retained some periostracum and some internal lustre. Some of the aragonitic valves were iron-stained, but none were pitted or encrusted. The largest whole valve measured 3.5 by 2.3 cm. All shells were <1 mm thick except at the posterior end and in the hinge area. Because of the sample size only the outer 10% of shell material was removed by HCl leach. Date is based on two 1-day counts in the 5 L counter.

GSC-3926. Stupart River 7110 ± 90
$\delta^{13}C = +1.0‰$

Marine pelecypod shells (sample 84DU-52; 48.0 g; paired valves of **Mya truncata**, identified by L.A. Dredge) from a 40 m-thick section along Stupart River near the mouth of Fox River, Manitoba (55°59'N; 93°23'W), at an elevation of approximately 90 m (estimated from map and helicopter altimeter). The shells are from marine sands and gravels which overlie glaciolacustrine deposits and multiple till sheets separated by intertill sediments. Collected June 1984 by L.A. Dredge and E. Nielsen.

Comment (L.A. Dredge): The shells provide a minimum age for the unit in the section (described in Dredge and Nielsen, 1985) and date the Tyrrell Sea deposits in this area.

Comment (W. Blake, Jr.): The sample submitted for dating consisted of 11 left valves and 12 right valves (nearly all whole. The largest valve was 4.8 cm long and >3 cm high. Most of these aragonitic shells retained some periostracum and some internal lustre; none were pitted or encrusted. Date is based on two 1-day counts in the 5 L counter.

North Knife River – Owl River series

Marine pelecypod shells were collected from riverbank exposures in order to reconstruct and constrain an emergence curve for the Churchill area, northern Manitoba. The new minimum emergence curve is shown in Dredge and Cowan (in press). All samples collected in June and July, 1978 by L.A. Dredge.

GSC-3851. North Knife River 4000 ± 90
$\delta^{13}C = 0.0‰$

Marine pelecypod shells (sample DU 78-64-29/6/9; 51 g; **Mytilus edulis**; identified by W. Blake, Jr.) from a fresh exposure along North Knife River, Manitoba (58°53.5'N; 94°58.0'W), approximately 21 km upstream from the river mouth. The shells were enclosed in silts above a silty till and are underlain by 3 m of fossiliferous sand and tidal silt. The surface of the section is at an elevation of 30 m.

Comment (W. Blake, Jr.): Most of the sample dated consisted of fragments of **Mytilus edulis**. The largest valve of this species remaining in the sample measured 6.0 by 2.8 cm. The large valves are

generally >1.00 mm in thickness, but smaller valves are thinner. Date is based on two 1-day counts in the 5 L counter.

GSC-3855. Owl River (I) 6880 ± 130
$\delta^{13}C = +1.6‰$

Marine pelecypod shells (sample DU78-329-22/7/4; 27.5 g; **Mya truncata**, some with periostracum intact; identified by W. Blake, Jr.) from an exposure along Owl River, approximately half way between Churchill and Gillam, Manitoba (57°36'N; 93°32'W), at an elevation of 59 m. The shells are from fine sands overlain by 5 m of littoral sand and gravel containing shell fragments.

Comment (W. Blake, Jr.): The dated sample comprised six right and six left valves, including at least two intact pairs. The remainder of the sample was fragments, but most included the truncated posterior end characteristic of this species. The largest valve was 4.0 cm long and probably close to 3 cm in height. Nearly all shells were <1 mm thick, except in the hinge areas and at the truncated ends. Date is based on three 1-day counts in the 2 L counter.

GSC-3856. Owl River (II) 5310 ± 80
$\delta^{13}C = +1.4‰$

Marine pelecypod shells (DU78-214-15/7/2; 26.5 g; **Astarte borealis**, identified by W. Blake, Jr.) from a 5 m-high section along Owl River, northern Manitoba (57°41.5'N; 93°21.5'W). The shells are from a marine offlap sequence overlying silty till. The shells are from a sand bed, 1 m below the top of the river bank, which is at an elevation of 50 m. The sands are overlain by tidal silt and underlain by marine clay.

Comment (W. Blake, Jr.): The shells in this sample were well preserved, although none of the 12 valves used retained the periostracum. All valves had good internal lustre and exhibited no chalkiness. The sample consisted of seven left valves (5 intact, 2 fragments) and five right valves (4 intact, 1 fragment). Valves ranged in size between 3.3+ by 3.0 cm to 2.4 by 2.1 cm. The shells were, for the most part, <1 mm in thickness. Date is based on two 1-day counts in the 2 L counter.

GSC-3896. Owl River (III) 5290 ± 70
$\delta^{13}C = +1.3‰$

Marine pelecypod shells (DU78-83; 37.5 g; **Chlamys islandica**; identified by W. Blake, Jr.) from a 6 m-high fresh section along Owl River, Manitoba (57°46.3'N; 93°11.0'W), 28 km from the river mouth. The sequence consists mainly of marine deposits overlying silty till. The shells are from a medium to coarse sand bed in the lower part of the marine sequence, 5 to 6 m below the surface, which is at 37 m. The shell bearing unit is separated from an upper littoral sand unit by 3 m of stony clayey diamicton.

Comment (L.A. Dredge): The stoney diamicton probably represents an extensive period of increased ice rafting in Hudson Bay and/or a small sea level fluctuation. The top of the section is at an elevation of 37 m. The date was used in constructing an emergence curve for the region (Dredge and Cowan, in press), and it also gives a maximum age for the time of ice rafting.

Comment (W. Blake, Jr.): The sample comprised six whole valves, ranging in size from 5.2 cm wide by 6.2 cm high to 3.4 cm wide by 3.8 cm high, plus numerous fragments. All shells were clean, with no incrustations or pitting. The nacreous layer (aragonite plus calcite) retained good lustre. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Date is based on two 1-day counts in the 5 L counter.

GSC-3074. Mountain Rapids >32 000

Slightly compressed twigs (sample DU79-35; 2.3 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 80-16 by R.J. Mott) from a 1 m-thick bed of silty sand underlying Lake Agassiz glaciolacustrine deposits and a brown till containing shell chips, which overlies three other till and non-till units. The site is located along a fresh cut bank at Mountain Rapids on the Churchill River, Manitoba (57°19'N; 95°47'W). The top of the section is at an elevation of 180 m and the sample was taken from approximately 10 m below the surface. The sampled material also contains tiny peat fragments. Collected July 28, 1979 by L.A. Dredge.

Comment (L.A. Dredge): The wood and pollen assemblage, dominated by **Picea** sp., **Pinus** sp., and **Betula** sp., suggests that the organics developed under environmental conditions similar to those at present, and that the deposit may be interglacial in age (unpublished GSC Palynological Report No. 81-5 by R.J. Mott). If the organics are contemporaneous with the enclosing material, then the section spans a long time interval, and records multiple glacial events. The peaty fragments, however, have rounded, abraded edges, which suggests that they may have been transported from a deposit that is stratigraphically below the enclosing sand. The interpretation of this section is discussed more fully in Dredge and Nielsen, 1985.

Comment (W. Blake, Jr.): The largest twigs ranged in length between 6.0 and 2.5 cm; all were <0.5 cm in diameter. The damp sample was dried in an electric oven. Sample mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2632. North Knife River 2560 ± 100

Twigs (sample DU77-456; 2.4 g; **Alnus** sp. and **Salix** sp.; unpublished GSC Wood Identification Report No. 77-62 by R.J. Mott) found in sandy fluvial deposits containing detrital organics, from an exposure on the right bank of North River, Manitoba (58°24'N; 96°49'W). The 4 m-section, whose top lies at an elevation of 245 m, consists of fluvial beds overlying compressed peat and Lake Agassiz silts. Collected August 3, 1977 by L.A. Dredge and F.M. Nixon.

Comment (L.A. Dredge); The sample gives a maximum age for the glaciolacustrine silts and a minimum age for the North Knife river system, but was considerably younger than expected. The sample, examined by R.J. Richardson, appeared to be a forest litter containing wood, beetles, and plant remains. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

British Columbia

Cowichan Head series at Mary Hill (I)

Seventeen wood samples and one sample of peat (sedgy detrital sapropel) were collected from a gravel pit near Mary Hill, 2 km south of Port Coquitlam, British Columbia. According to Armstrong and Hicock (1975, p. 99):

> "Mary Hill is surrounded by wide, flat-bottomed valleys of the Fraser, Pitt, and Coquitlam rivers. The hill is approximately 3050 m long, 1500 m wide, and 95 m in elevation. The southern part of the hill has been the site of a major gravel and sand operation since 1928. The pit is approximately 750 m by 1200 m in area and over the years at least 20 million m^3 of material has been removed..... Armstrong examined the pit on many occasions between 1951 and 1965 and drew many cross-sections, revising them each time new information was obtained. The reconstructed cross-section (Fig. 1) incorporates this previous material obtained by Armstrong with that observed by both writers in 1974. Hicock established the contact between the Quadra Sediments and Semiahmoo Drift, and in so doing uncovered a buried landscape.
>
> The topographic form of Mary Hill results from late glacial and postglacial river erosion and from marine erosion during the deglaciation period of the last major glaciation. The hill is not recognizable as a glacial geomorphological landform".

The samples are listed here by elevation, the highest (in terms of both topography and stratigraphy) being the youngest. All samples were submitted by J.E. Armstrong, formerly GSC, Vancouver. Rather than including the submitter's comments for each of these 18 age determinations, as his views and interpretations changed as more dates became available, instead the reader is referred to a series of publications dealing with the Mary Hill site specifically and with the regional stratigraphy and glacial history in general (Armstrong and Hicock, 1975, 1976; Armstrong and Clague, 1977; Armstrong et al., 1985; Clague et al., 1980; Hicock and Armstrong, 1981, 1983, 1985; Hicock et al., 1982). All of the samples received the standard leaches with NaOH and HCl plus distilled water rinses, except where indicated.

GSC-2194. Mary Hill (I) 18 600 ± 190

Wood (sample FAB152W; 11.5 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 75-49 by L.D. Wilson) from a 5 cm-thick fissile peat layer (49°13'58"N, 122°46'59"W), at an eleva-tion of 61 m. The sampled layer, believed to be the youngest of the Quadra peat layers, is overlain by Quadra sand and is underlain by compact organic colluvium which is, in turn, underlain by probable Semiahmoo Drift. Collected April 10, 1975 by J.E. Armstrong from the surface of a fresh but wet exposure.

Comment (W. Blake, Jr.): Only one (34 x 5.3 cm) of two large pieces of black, spongy, wet wood was used. Upon oven drying its weight decreased from 526 to 258 g. Date is based on two 1-day counts in the 5 L counter.

GSC-2344. Mary Hill (II) 18 700 ± 170

Wood (sample FAB152W-2B; 12.5 g dry; cf. **Taxus brevifolia**; unpublished GSC Wood Identification Report No. 76-32 by R.J. Mott) from a 5 cm-thick fissile peat layer (49°13'58"N, 122°46'59"W), at an elevation of 61 m. The sampled layer is overlain by Quadra type sand and underlain by approximately 10 cm of compact organic colluvium, which is, in turn, underlain by probable Semiahmoo Drift. This sample was a recollection of wood from the layer used for GSC-2194 (this series), and it is believed to be the youngest of the Quadra peat layers. Collected April 6, 1976 by J.E. Armstrong from the surface of a fresh but wet exposure.

Comment (W. Blake, Jr.): The sample used was piece B (17 x 4 x 1 cm) of the new collection. Upon oven drying its weight decreased from 232 to 113 g (including adhering dirt). Date is based on one 3-day count in the 5 L counter.

GSC-2273. Mary Hill (III) 25 800 ± 310

Wood (sample FAB159W; 12.0 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 75-80 by R.J. Mott) from a silt layer (49°13'53"N, 122°46'51"W), at an elevation of 50 m. The sampled

layer is underlain by a rusty sandy gravel and overlain by a lag boulder layer which is, in turn, overlain by Quadra Sand. The sample is from an exposure less than one year old, between two other sections containing Quadra and Highbury peat sequences, respectively. Collected September 18, 1975 by J.V. Matthews, Jr.

Comment (W. Blake, Jr.): Upon oven drying the weight of this damp and partly lignitized wood decreased from 708 to 215.8 g (still including some dirt). Date is based on one 3-day count in the 5 L counter.

GSC-2263. Mary Hill (IV) 27 000 ± 490

Wood (sample FAB148W_1; 11.5 g dry; **Picea** sp. (cf. **P. sitchensis**); unpublished GSC Wood Identification Report No. 75-81 by R.J. Mott) from the highest fissile peat layer (20 to 40 cm-thick) in the sequence, at an elevation of 49 m (49°13'55"N, 122°46'53"W). The unit sampled is overlain by Quadra Sand and underlain by organic colluvium. The sample was taken from the surface of an exposure only a few years old. Collected April 14, 1975 by S.R. Hicock, University of Western Ontario, London, Ontario.

Comment (W. Blake, Jr.): A portion of this large piece of damp wood (35 x 15 x 5 cm) and weighing approximately 2 kg, was oven dried. Date is based on one 4-day count in the 5 L counter.

GSC-2301. Mary Hill (V) 26 100 ± 290

Wood (sample FAB167W; 8.1 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 76-14 by R.J. Mott) from a stony organic colluvium (49°13'55"N, 122°46'53"W), at an elevation of 49 m. The sampled layer is directly overlain by a fissile peat layer containing wood which dated 27 000 ± 490 BP (GSC-2263, this series), which in turn is overlain by Quadra Sand. The colluvium overlies Semiahmoo? glacial sediments. Collected January 21, 1976 by J.E. Armstrong from a ditch exposure a few years old.

Comment (W. Blake, Jr.): A single piece of wood (out of five) was used. Its dimensions were 12 x 1.9 x 0.9 cm, and upon oven drying its weight decreased from 10.4 to 8.1 g. Date is based on one 4-day count in the 5 L counter.

GSC-2308. Mary Hill (VI) >42 000

Wood (sample FAB166W; 11.8 g dry; morphological features most closely resemble those of **Tsuga** sp.; unpublished GSC Wood Identification Report No. 76-22 by L.D. Farley-Gill) from a stony glaciomarine clayey silt (49°14'00"N, 122°46'37"W), at an elevation of 46 m. The sampled layer overlies Cowichan Head contorted sand, gravel and organic colluvium and underlies Coquitlam Drift. Collected November 11, 1975 by S.R. Hicock from a fresh exposure.

Comment (W. Blake, Jr.): A single piece of hard, brittle and dry wood was cleaned of adhering silt. Date is based on one 3-day count in the 5 L counter.

GSC-2167. Mary Hill (VII) 40 500 ± 1700

Wood (sample FAB147W; 11.5 g dry; features closely resemble those of **Tsuga heterophylla**; unpublished GSC Wood Identification Report No. 75-42 by R.J. Mott) from a layer of silty colluvium, located 116 m southwest of GSC-2191 (49°13'54"N, 122°46'52"W), at an elevation of 45 m. The layer sampled is overlain by known Cowichan Head Formation and underlain by Semiahmoo? Drift. Collected April 14, 1975 by S.R. Hicock, at the surface of an exposure less than one year old.

Comment (W. Blake, Jr.): The larger pieces of wood (with bark) in this sample fitted together perfectly when wet. Upon oven drying the weight decreased from 469.1 to 221.1 g (including some dirt). The single fragment used (28.5 x 3.5 cm diameter) weighed 54.0 g. All outside wood and dirt along cracks was cut off. Date is based on one 3-day count in the 5 L counter.

GSC-2107. Mary Hill (VIII) 27 400 ± 420

Wood (sample F19A-PW-1; 51.8 g dry; **Picea** sp., probably **P. sitchensis**; unpublished GSC Wood Identification Report No. 74-44 by R.J. Mott) at an elevation of 41 m (49°13'45"N, 122°46'30"W). Sample is from a stump (30 cm diameter) with roots extending at least 2 m radially from the trunk through the second fissile peat layer in the sequence and into underlying silty fine sand. Collected June 9, 1974 by J.E. Armstrong from the surface of a fresh but wet exposure.

Comment (W. Blake, Jr.): Several pieces were received, all from the same stump. The two largest pieces, which fitted together, were oven dried (358 to 99 g). The wood was solid and clean, with no trace of coalification. All outside wood and wood along cracks was cut off. Pretreatment included 1 hour hot NaOH leach and 1 hour hot HCl leach. Date is based on two 1-day counts in the 5 L counter.

GSC-2349. Mary Hill (IX) 27 500 ± 360

Wood (sample FAB164W_2; 12.0 g dry; unidentifiable; deciduous wood, strongly compressed and lignified; unpublished GSC Wood Identification Report No. 76-31 by R.J. Mott) from a stony organic colluvium layer (49°13'57"N, 122°46'53"W), at an elevation of 41 m. The sampled layer is the same layer from which GSC-2167 (40 500 ± 1700 BP, this list) was collected. It is unconformably underlain by Cowichan Head sediments. Collected November 20,

1975 by J.E. Armstrong from the surface of a fresh exposure.

Comment (W. Blake, Jr.): A single dry, hard, compressed piece of wood (12.5 x 3.0 x 0.6 cm) was used. Some bark was still present. About 25 g were present before the wood was scraped and cleaned. Date is based on one 3-day count in the 5 L counter.

GSC-2191. Mary Hill (X) 26 200 ± 320

Wood (sample FAB150W; 11.6 g dry; **Tsuga heterophylla**; unpublished GSC Wood Identification Report No. 75-52 by L.D. Wilson) from the same layer of sandy gravel as GSC-2277, 26 000 ± 310 BP, this series (49°13'55"N, 122°46'49"W), at an elevation of 40 m. Sample was from a large log/root, 3 m long and 30 cm in diameter. Collected April 14, 1975 by S.R. Hicock.

Comment (W. Blake, Jr.): A large piece of wet wood (52 x 14.5 x 5.7 cm) was submitted. Upon oven drying its weight decreased from 1500 to 689 g. Date is based on one 3-day count in the 5 L counter.

GSC-2277. Mary Hill (XI) 26 000 ± 310

Wood (sample FAB160W; 11.3 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 75-79 by R.J. Mott) from a rusty sandy gravel layer located 3 m southwest of GSC-2191 (26 200 ± 320 BP, this series) from the same stratigraphic position (49°13'55"N, 122°46'49"W), at an elevation of 40 m. The sampled layer was deposited on a paleoslope developed on a stony colluvial organic layer containing GSC-2137 (40 200 ± 430 BP; this list). The sample, which is from a fresh exposure over which water was running, was overlain by a fossiliferous glaciomarine (?) layer that underlies the Quadra Sand. Collected September 18, 1975 by S.R. Hicock.

Comment (W. Blake, Jr.): This somewhat contorted and fractured piece of wood was at least 35 cm long, 2.5 m in diameter. Upon oven drying the weight decreased from 265 to 96 g. Date is based on one 3-day count in the 5 L counter.

GSC-2139. Mary Hill (XII) 28 200 ± 200

Wood (sample F144AP2; 36.0 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 75-5 by L.D. Wilson) from the third fissile peat layer (10 to 30 cm thick) at an elevation of 38 m (49°13'45"N, 122°46'30"W). Collected January 1975 by J.E. Armstrong from the surface of a fresh but wet exposure.

Comment (W. Blake, Jr.): On receipt the wood in this sample was damp and was coated with silty, somewhat peaty material. Upon oven drying the weight of the single largest piece decreased from 265 to 104.5 g. All adhering silt was cut off with the outside wood. Pretreatment included a 1-hour hot NaOH leach and a 1-hour hot HCl leach. Date is based on one 1-day plus one 3-day count in the 5 L counter at 4 atmospheres.

GSC-2217. Mary Hill (XIII) 26 900 ± 320

Wood (sample FAB149W; 11.0 g dry; **Abies** sp.; unpublished GSC Wood Identification Report No. 75-53 by L.D. Wilson) from a sandy silt layer, 183 m east of GSC-2191, 26 200 ± 320 BP, this series (49°13'56"N, 122°46'42"W), at an elevation of 37 m. The sample is from a log 30 cm in diameter, protruding a length of 2 m from the surface. The layer sampled is overlain by sand and gravel which is in turn overlain by a fossiliferous glaciomarine (?) layer; both layers are overlain by Quadra Sand. The sample is from the surface of a fresh exposure. Collected April 14, 1975 by S.R. Hicock.

Comment (W. Blake, Jr.): This sample consisted of two large pieces of wood (the larger measured 51 x 10 x 7 cm; the smaller was 36 cm long) taken from the same log. Oven dried (1800 to 829 g). Date is based on one 3-day count in the 5 L counter.

GSC-2140. Mary Hill (XIV) 29 600 ± 200

Sedgy detrital diatomaceous sapropel (sample F144AP1; 355.0 g; unpublished GSC Bryological Report No. 314 by M. Kuc) from the fourth (lowest) sapropel layer (5 to 10 cm thick) at an elevation of 34 m (49°13'45"N, 122°46'30"W). The sampled layer is overlain by recent slope wash material and underlain by silty fine sand containing disseminated organic material. Collected January 3, 1975 by J.E. Armstrong, 10 cm below the surface of a wet exposure a few years old.

Comment (W. Blake, Jr.): This peat/sapropel sample contained the following diatoms (unpublished GSC Diatom Report No. 75-4 by S. Lichti-Federovich): "**Cyclotella comta, Cymbella cistula** (fragment), **Eunotia arcus, Eunotia exigua, Eunotia alpina**? (fragment), **Eunotia lunaris** var. **subarcuata, Eunotia praerupta, Eunotia robusta, Eunotia robusta** var. **diadema, Melosira distans, Eunotia valida**? (fragment), **Pinnularia viridis** var. **sudetica**? (fragment), **Pinnularia viridis, Rhopalodia gibba, Tabellaria flocculosa**. Due to excessive fragmentation, critical identification was at times difficult and uncertain, allowing only a partial listing of a diatom taxa present in the assemblage. It also precludes a detailed ecological interpretation. However, the dominance of species comprising the genera **Eunotia** and **Pinnularia** suggests an oligotrophic, calcium-poor bog environment".

The slightly damp peat/sapropel was oven dried. Pretreatment included a 1-hour hot NaOH leach and a 1-hour hot HCl leach. Date is based on one 3-day count in the 5 L counter at 4 atmospheres.

GSC-2137. Mary Hill (XV) 40 200 ± 430

Wood (sample F9AP9; 37.8 g dry; probably **Picea** sp.; unpublished GSC Wood Identification Report No. 75-4 by L.D. Wilson) from a stony organic colluvium up to 4 m thick, located 6 m south of GSC-2191 (49°13'45"N, 122°46'30"W), at an elevation of 34 m. The layer sampled is overlain by rusty sandy gravel, which underlies a fossiliferous glaciomarine (?) layer and Quadra Sand. Collected June 9, 1974 by J.E. Armstrong.

Comment (J.V. Matthews): The following beetles were identified in the peat enclosing GSC-2137: a pronotum of **Agonum consimile** Gyllenhall, a ground beetle; and pronata, elytra, and heads of **Olophrum boreale** (Payk.), a rove beetle. The species in this sample are northern and are not living in the Vancouver area today. A relict population of **A. consimile** is thought to be living today in the vicinity of Duncan on Vancouver Island, but otherwise all collecting records are from localities in northern British Columbia. It is also found in other parts of Canada: from Edmonton north in Alberta; Churchill and The Pas, Manitoba; Fort Severn, Ontario; Ungava region of Quebec; Cape Breton Island, Nova Scotia; and in Newfoundland and southern Labrador. **A. consimile** lives near standing water where the substrate is soaked and vegetation is abundant. The distribution of **O. boreale** is less perfectly known, but it would be entirely unexpected in the Vancouver area today. In the Northwest Territories and Alaska it may be collected in the same biotopes that **A. consimile** occupies. Campbell (1983) lists **O. boreale** from four localities in northernmost British Columbia, and I have collected it in the southern part of Yukon Territory. It seems quite likely, in view of these fossils, that the peat from which they come was deposited during a period of climate colder than at present.

Comment (W. Blake, Jr.): This single piece of damp wood (28 x 4.5 x 2.5 cm) was oven dried and its weight decreased from 108.3 to 62.6 g. After removing the adhering silt 37.8 g remained, which had coaly conchoidal fracture on breaking. After pretreatment the sample was burned in two batches of 16.2 and 15.5 g. Because the amount of CO_2 produced was barely enough for high pressure counting, an additional 2.9 g sample was pretreated (1.8 g burned). Pretreatment of both samples included a 1-hour NaOH leach and a 1-hour HCl leach. Date is based on four 1-day and one 2-day counts in the 5 L counter at 4 atmospheres.

GSC-2390. Mary Hill (XVI) 28 400 ± 580

Wood (sample FAB9P11; 11.5 g dry; strongly compressed, distorted, and lignified wood; has some microscopic features of **Betula** sp. but identification cannot be certain; unpublished GSC Wood Identification Report No. 76-30 by R.J. Mott) from a peat bed (49°13'59"N, 122°46'48"W), at an elevation of 33 m. The layer sampled apparently rests unconformably against stony colluvium from which wood dated 40 200 ± 430 BP (GSC-2137, this series) was obtained. The material is from the base of the younger Cowichan Head section at this site, which is overlain by Coquitlam Drift. The underlying materials cannot be seen. Collected November 2, 1975 by S.R. Hicock.

Comment (W. Blake, Jr.): This sample included many pieces but two large pieces fitted together (total length – 26 cm; 7 x 1 cm in cross-section). The wood was damp, compressed and soil-covered. It was partially lignitized and many rootlets were removed. On oven drying the weight was reduced from 134 to 64.5 g. Date is based on one 3-day count in the 5 L counter.

GSC-2091. Mary Hill (XVII) >44 000

Wood (sample F8AW-5; 10.0 g dry; **Abies** sp.; unpublished GSC Wood Identification Report No. 74-38 by L.D. Wilson) from rhythmically laminated glaciolacustrine (?) silts, collected 300 m south-southeast of GSC-2191 (49°13'45"N, 122°46'30"W), at an elevation of 23 m. The layer sampled overlies glaciomarine sediments of Semiahmoo? Drift and is thought to underlie the stony organic colluvium containing GSC-2137 and -2167 (this list). M. Stuiver (University of Washington, Washington) dated a piece of wood from the same laminated silt layer at >62 000 BP (QL-194) and thereby extended the corresponding GSC date (GSC-2120, >48 000, this series), which is a rerun of GSC-2091. Collected June 9, 1974 by J.E. Armstrong from the surface of a wet exposure less than one year old.

Comment (W. Blake, Jr.): The damp wood was oven dried (64.0 to 26.0 g). After drying all adhering silt was removed from the hard and brittle wood. Date is based on one 3-day count in the 5 L counter.

GSC-2120. Mary Hill (XVIII) >48 000

Wood (sample F8AW-5; 10.0 + 26.6 g) as described for the previous determination (GSC-2091, >44 000 BP), and the site and stratigraphic position are the same for this second determination, at high pressure.

Comment (W. Blake, Jr.): The CO_2 used for GSC-2091 was retained. To obtain the additional gas needed for a high pressure determination the remainder of the original sample (13.0 g) was first used. Then a second, similar-appearing piece of wood (F8AW-5(A)) was used (10 x 1.5 cm; 13.6 g). Total treated weight was 26.6 g. Pretreatment of this second batch included a 1-hour hot NaOH leach and a 1-hour hot HCl leach. Date is based on three 1-day counts plus one 3-day count in the 5 L counter at 4 atmospheres.

GSC-3295. Muir Point 43 600 ± 660

Wood (sample NFA-MP-A; 51.0 g dry; this poorly-preserved wood had undergone some compression and considerable lignification but the discernible features are similar to those of **Tsuga** sp.; unpublished GSC Wood Identification Report No. 81-23 by R.J. Mott) from a fresh exposure in a sea cliff at Muir Point 3.0 km southwest of Sooke, British Columbia (48°21'32"N, 123°44'54"W), at an elevation of 28 m. The organic-rich silt, sand, and gravel unit from which the wood was extracted underlies Vashon till and a glaciomarine diamicton and overlies a succession of gravel, silt, sand, and peat units, as well as a pre-Semiahmoo till. Collected May 1975 by N.F. Alley, then Environment and Land Use Committee, Province of British Columbia, Victoria; now Department of Mines and Energy, South Australia, Eastwood, South Australia.

Comment (W. Blake, Jr.): GSC-3295 is the first finite age determination from the organic-rich silt, sand and gravel unit (see, for example GSC-2774, >41 000; GSC XX, 1980, p. 12). Alley and Hicock 1986, p.. 375) state: "At Muir Point, a radiocarbon date of 43 600 ± 660 years BP (GSC-3295) from Unit 6 suggests that this unit correlates with the mid-Wisconsin Cowichan Head Formation of the Olympia nonglacial interval (Hicock and Armstrong, 1983), whose age probably extends back about 65 000 years BP (Gascoyne et al., 1981). The high frequencies of pollen of **Pinus** (in particular, diploxylon type), **Picea**, **Abies**, and **Tsuga heterophylla** and the rarity of **Pseudotsuga menziesii** in conjunction with the presence of marine dinoflagellates suggest a correlation with pollen assemblages from the early Olympia nonglacial interval on eastern Vancouver Island (Alley, 1979). The marine dinoflagellates also show that local relative sea level was 28 m higher than at present".

The dated sample comprised slightly damp chunks, all derived from the same piece and some of which had a faint whitish covering. Upon oven drying the sample weight decreased from 81.6 to 75.0 g. The sample was given the standard treatment with NaOH, HCl (no reaction) and distilled water rinses. Date is based on one 5-day count in the 5 L counter at 4 atmospheres.

Fraser Delta series

Peat samples from beneath the surface of the modern tidal flats as salt marsh at sites around Boundary Bay, British Columbia. All samples collected 1980 by J.E. Shepperd, then University of British Columbia, Vancouver.

GSC-3181. Fraser Delta (I) 3910 ± 60

Peat (sample 112-3-(12-14 cm); 47.7 g dry) from the base of a peat bed 12 to 14 cm below the present surface of tidal flats, 300 m seaward of the mean higher high tide line in eastern Boundary Bay at 112th Street, South Delta, British Columbia (49°05'N, 122°55'W). The peat is 12 cm thick, overlies silt and is in turn overlain by 2 cm of silty clay. Collected from the wall of a hand dug pit.

Comment (J.E. Shepperd): "A former salt marsh peat is now partially buried and being actively eroded where exposed near 112th Street, South Delta, in eastern Boundary Bay. A paleoenvironmental reconstruction suggests the peat started developing in freshwater, with ferns, sedges, **Typha**, and **Nuphar**. Later, it was successively inundated by marine water and a salt marsh developed, as seen by an increase in the abundance of chenopod pollen. Subsequent emergence of the salt marsh was accompanied by the development of an increasingly diverse vegetation" (Shepperd, 1981, Abstract, p. iii-iv).

Comment (W.C. Barnes, University of British Columbia): GSC-3181 is related to GSC-3194 and GSC-3202 (both in this series). The dated peat also may be the same peat that was collected by Kellerhals and Murray (1969) and dated as GX-0781 (4350 ± 110 BP).

Comment (W. Blake, Jr.): The peat received the standard treatment with NaOH, HCl and distilled water rinses. Date is based on one 3-day count in the 5 L counter.

GSC-3186. Fraser Delta (II) 320 ± 70

Peaty silt layer (sample 64.5-(30-35 cm); 78.1 g dry) 30 to 35 cm below the surface of the modern salt marsh 450 m seaward of the dyke in western Boundary Bay at 64th Street, South Delta, Boundary Bay, British Columbia (49°03'N, 123°02'W). The peat layer contains rootlets, abundant grass and some chenopod pollen, indicating the base of the salt marsh. The 5 cm-thick dated layer is overlain and underlain by fine silty sands. Collected from the wall of a hand-dug pit.

Comment (J.E. Shepperd): "The development of a late Holocene salt marsh was studied on the inactive part of the Fraser Delta at Boundary Bay, southwestern British Columbia. Present-day vegetation zones near 64th Street, South Delta, in the western part of the Bay, were distinguished in the salt marsh and were related to zones found in cores obtained in a transect across the marsh. A sequence of development, related to elevation, was determined. **Salicornia** and **Triglochin** are pioneer colonizers of the tidal flats and are sometimes associated with areas elevated by algal mats. As the area was elevated, sediments were trapped by vegetation and stabilized by rhizomes, and other halophytes grew, including **Cuscuta**, **Sperqularia**, **Atriplex**, **Distichlis**, **Grindelia**, and **Plantago**. A zone characterized by abundant **Atriplex** represents positions of former strandlines. As further

emergence occurred, mesophytes became dominant and, in the landward, most emergent zone, a diverse flora of **Malus**, **Sidalcea**, **Aster**, **Achillea**, **Solidago**, **Elymus**, **Angelica**, **Juncus**, and grasses developed. A radiocarbon date on **Salicornia**-rich organic silts at a depth of 35 to 40 cm in core 5 suggests that salt marsh development commenced 320 ± 70 years BP (GSC-3186)" (Shepperd, 1981, Abstract, p. iii).

Comment (W. Blake, Jr.): NaOH leach was omitted from the pretreatment of GSC-3186. Date is based on two 1-day counts in the 2 L counter.

GSC-3194. Fraser Delta (III) 2600 ± 60

Peat (sample 112-1-(14 cm); 27.2 g dry) from the base of a 14 cm-thick peat layer exposed at the surface of the modern tidal flats in eastern Boundary Bay. Collected near the pumping station where 112th Street, South Delta, British Columbia intersects the dyke at the inner margin of the tidal flats (49°05'N, 122°55'W). Peat overlies fine silty sand. Collected from the wall of a hand-dug pit.

Comment (W.C. Barnes): GSC-3194 came from the same area as GX-0781, which was collected by Kellerhals and Murray (1969) and dated at 4350 ± 110 BP. As the exact location of the sample collected by Kellerhals and Murray is not known, there is no way to determine whether this sample and GX-0781 are from the same peat. Only one peat appears to occur in the area, however.

Comment (W. Blake, Jr.): If there is indeed only one peat layer, the discrepancy between GSC-3194 and GX-0781 is difficult to explain, especially as GSC-3194 was collected from the base of the peat unit. The peat received the standard treatment with NaOH, HCl and distilled water rinses. Date is based on one 3-day count in the 5 L counter.

GSC-3202. Fraser Delta (IV) 3130 ± 50

Clayey peat (sample 112-2-(41-44 cm); 74.7 g dry) collected 41 to 44 cm below the surface of the modern tidal flats in eastern Boundary Bay. The collecting site is 100 m seaward of the dyke at 112th Street, South Delta, British Columbia (49°05'N, 122°55'W). The sample is from the base of a 28 cm-thick peat which overlies fine silty sands and is in turn overlain by clayey silt. Collected from the wall of a hand-dug pit.

Comment (W.C. Barnes): From the same peat layer at that of GSC-3194.

Comment (W. Blake, Jr.): The discrepancy between this date and GSC-3194 is large enough (a minimum of 420 radiocarbon years) to suggest that some factor inhibited peat development at the landward site for several hundred years after it had started 200 m farther seaward. NaOH leach omitted from the pretreatment of this sample. Date is based on one 3-day count in the 5 L counter.

Fraser River Delta slope series

The following four samples were extracted from Vibro-cores obtained along the delta slope to determine sedimentation rates. GSC-2714 and GSC-2862 are determinations made on two pieces of wood at different levels in the same core. Comments on this series also relate to the samples used for reservoir age determinations (Strait of Georgia/Puget Sound series). All samples collected July 1976 by J.L. Luternauer and R.D. MacDonald.

GSC-2714. Fraser River Delta slope (I) 6600 ± 90

A single piece of wood (sample END-76-12; 11.3 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 78-27 by L.D. Farley-Gill) from mud at the base of a 2.95 m-long core collected from the sea floor, 10 m below local chart datum (the sample is thus approximately 13 m below lowest normal water level). The sample site is located 2.02 km at 323°T from Point Grey, British Columbia (49°16.8'N, 123°16.8'W). Date is based on two 1-day counts in the 5 L counter.

GSC-2862. Fraser River Delta slope (II) 2110 ± 80

A single piece of wood (sample END-76-12 (C14-1); 4.6 g; tentatively identified as **Salix** sp.; unpublished GSC Wood Identification Report No. 79-19 by R.J. Mott) from mud 1.72 m below the top of the same core (the sample is thus approximately 12 m below lowest normal water level). Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3010. Fraser River Delta slope (III) 810 ± 160

Shell fragments (sample END-76-06; 4.1 g; **Macoma brota**; identified by F.J.E. Wagner, then Atlantic Geoscience Centre) from sand 2.03 m below the top of a core collected from the sea floor 61 m below local chart datum (the sample is thus approximately 63 m below lowest normal water level). The sample site is located at the head of Roberts Bank slope, halfway between Sand Heads Light and Westshore Terminals, British Columbia (49°02.4'N, 123°15.7'W). Because of the small sample size the HCl leach was omitted. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter. Shells are aragonitic.

GSC-3012. Fraser River Delta slope (IV) 530 ± 110 $\delta^{13}C = +3.5‰$

Shell fragments (sample END-76-01; 7.4 g; **Pecten (Patinopecten) caurinus** Gould; identified by F.J.E. Wagner) from sand 2.75 m below the top of a core collected from the sea floor 19 m below chart datum (the sample is thus approximately 22 m below lowest normal water level). The sample site is located 0.7 km southwest of Westshore terminals on southern Roberts Bank, British Columbia (49°00.7'N, 123°10.2'W). Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter. Shells are calcite + dolomite-rhodocrosite series (trace).

Comment (J. Luternauer): The two radiocarbon dates on wood (GSC-2714 and -2862) indicate that sedimentation rates near the mouth of the North Arm of the Fraser River are exceedingly low (<1 mm/yr). Most detritus probably is accumulating farther offshore in deeper water. It is also possible that the area of the delta from which the samples were obtained has been far removed, until relatively recently, from major distributary mouths. The ages determined for the shell fragments in Roberts Bank slope sediments (GSC-3010 and -3012) indicate that sedimentation rates, on average, also are low there (2.5 mm/yr and 5.2 mm/yr for cores END-76-06 and END-76-01, respectively). These results are compatible with independent evidence suggesting that the bulk of sediment discharged from the Fraser River is carried away from southern Roberts Bank. Adjustment of GSC-3010 and -3012 radiocarbon ages to compensate for the reservoir age of **Saxidomus giganteus** (GSC-3178, 100 ± 60 years; this list) from Departure Bay, Nanaimo, would not appreciably alter the above sedimentation rates. Consideration of the reservoir age established for **Pecten caurinus** (GSC-3130, 440 ± 40 years; this list), from an unknown locality in Puget Sound, Washington, would result, however, in a two-fold increase of the average sedimentation rates determined for core END-76-06 and a six-fold increase of the average rate for core END-76-01. Further radiocarbon age determinations are required both for the Roberts Bank slope and the Sturgeon Bank slope to the north (which is presently the principal locus of sedimentation) before representative local sedimentation rates can be confidently established.

GSC-3178. Departure Bay 100 ± 60

Shell (sample J.Y-1947-1; 45.5; **Saxidomus giganteus**); identified by W. Blake, Jr.) from an unknown location within Departure Bay, Nanaimo, British Columbia (centre of bay 49°12'N, 123°57.3'W). Collected September 1947 by J. Yarwood; submitted 1980 by J.L. Luternauer.

Comment (W. Blake, Jr.): A single intact pair of aragonitic shells was used for dating – all of the left valve and a portion (hinge area excepted) of the right valve. The exterior of the shells was clean, the interior exhibited good lustre, and the ligament was intact. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 5 L counter. For comments related to this sample see Fraser River Delta slope series (GSC-2714, -2862, -3010, and -3012, this list).

Dashwood series

Four wood samples were collected from a sea cliff 1.6 km northwest of Dashwood township, Vancouver Island, British Columbia (49°22'N, 124°31-32'W). The exposure, from the ground surface down, consists of 24.0 m of Quadra Sands underlain by 2.4 m of compact peat, 1.45 m of stony mud containing wood and peat lenses, 0.75 m of peat, 0.50 m of beach gravel and a paleosol, and at least 10 m of the marine member of the Dashwood Drift (Alley, 1979) at the base of the section.

GSC-2050. Dashwood (I) 32 600 ± 550

A single piece of wood (sample FI-5.7.73 = DW5B; 13.0 g; **Pseudotsuga menziesii**; unpublished GSC Wood Identification Report No. 74-10 by R.J. Mott) from the base of the compact peat unit underlying the Quadra Sand, at an elevation of approximately 18 m. Collected July 1973 by N.F. Alley, then GSC, now Department of Mines and Energy, South Australia, Eastwood, South Australia, and R.J. Fulton.

Comment (N.F. Alley): The date indicates a correlation with the Olympia Interglacial Quadra Sediments of Fyles (1963). The date, and the stratigraphic position of the peat bed below the Quadra Sands, suggests that the bed is probably correlative with the plant bearing silt, gravel and sand member of the Quadra Sediments. Dates of 31 420 ± 1130 BP (I-9333) and 29 010 ± 920 (I-8448) on unidentified deciduous wood were obtained from the top of the peat bed immediately below the Quadra Sands. GSC-2050 also fixes a level in the pollen diagram (Alley, 1979).

Comment (W. Blake, Jr.): This single piece of 'old-appearing' wood was received wet and was oven-dried. It was hard and brittle, with conchoidal fracture across the grain, and with a lustrous-glassy interior. Date is based on one 4-day count in the 5 L counter.

GSC-2314. Dashwood (II) 32 600 ± 600

Wood (sample NFA-DW2B-Bag 1(A); 11.3 g; possibly **Populus** sp.; unpublished GSC Wood

Identification Report No. 76-29 by R.J. Mott) from the lower part of pebbly floodplain mud, at an elevation of approximately 10 m. The wood-bearing unit is overlain by compact peat from which GSC-2050 (32 600 ± 550 BP, this series) was extracted and is underlain by peat lenses, beach lag and stony marine clay. Collected April 1976 by N.F. Alley.

Comment (N.F. Alley): The date, the lithology, and stratigraphic position with respect to dated beds above and below indicate that the pebbly mud is correlative with the plant bearing silt, gravel and sand member of the Quadra Sediments. GSC-2314 marks the boundary between pollen zones DW-1 and DW-2 of Alley (1979). Zone DW-1 is dominated by the Polypodiaceae (50-70%) and an arboreal pollen component characterized by a high proportion of spruce (**Picea**) associated with western hemlock (**Tsuga heterophylla**), fir (**Abies**), alder (**Alnus**) and sporadic occurrences of Douglas-fir (**Pseudotsuga**) (identified by N.F. Alley). Zone DW-2 records a diminution of spruce, increases in alder, sedge (Cyperaceae) and a slight in grass (Gramineae), whereas other arboreal spectra remain constant.

Comment (W. Blake, Jr.): This sample plus NFA-DW-2A were collected to replace DW2A (collected 1973) which was numerous small pieces of wood. The present sample (26 x 6.5 x 2.5 cm), upon oven drying, decreased in weight from approximately 330 to 110 g. The adhering silt was scraped off the hard and brittle wood, which appeared to be compressed and partly lignitized. Date is based on one 3-day count in the 5 L counter.

GSC-3035. Dashwood (III) 22 500 ± 230

Wood (sample NFA-DW-2A; 11.8 g; although this wood was highly compressed and contorted, with few morphological features, the discernible features suggest that the wood may be **Alnus** sp.; unpublished GSC Wood Identification Report No. 80-12 by L.D. Farley-Gill) from the base of the unit containing GSC-2314, at an approximate elevation of 9 m. Collected May 1975 from a fresh exposure (because of a landslide) by N.F. Alley.

Comment (W. Blake, Jr.): The age of this sample was expected to be older than GSC-2314 (32 600 ± 600 BP) collected higher in the section (Alley, 1979). Only the single largest piece, 20 cm long, 4 to 7.5 cm wide, and 2 cm in maximum thickness, was used for dating. This flattened wood, with adhering sand, decreased in weight from 92.0 to 34.7 g upon oven drying. Date is based on one 3-day count in the 5 L counter.

GSC-2192. Dashwood (IV) >39 000

Wood (sample DW1A; 15.0 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 75-41 by L.D. Wilson) from the junction of a peat unit containing rounded pebbles and wood and the underlying cobbles and sand (beach lag). The peat underlies the pebbly mud from which GSC-2314 was extracted (Alley, 1979). GSC-2192 is from approximately 28 m below the surface (the lowest of the dated samples reported here) and is at an elevation of 6 m. Collected July 1973 by N.F. Alley.

Comment (N.F. Alley): The infinite date for GSC-2192, the stratigraphic position, and the microfloras of the dated bed indicates that the peat is correlative with the earlier part of the Cowichan Head Formation (Alley, 1979; cf. also Armstrong and Clague, 1977, and Armstrong et al., 1985). GSC-2192 fixes the base of the pollen diagram and dates a microfloral assemblage consisting of 36% arboreal pollen and 54% non-arboreal pollen and spores. Arboreal pollen consists of 9% **Picea sitchensis**, 8% **Pinus contorta**, 3% **P. monticola**, 13% **Alnus**, 2% **Salix** and 1% or less of **Abies**, **Pseudotsuga**, **Thuja/Chamaecyparis**, **Tsuga heterophylla** and **Betula**. Fern spores (especially Polypodiaceae) constitute 50% of the non-arboreal element (Alley, 1979).

Comment (W. Blake, Jr.): The single moist piece of wood used was 18.0 cm long, 2.5 m in diameter. After oven drying all outside wood was cut away. Date is based on one 4-day count in the 5 L counter.

Broken Island series

Three shell samples from Cambrian and Lovett islands of the Broken Islands group, located off the southwest coast of Vancouver Island, British Columbia. Collected August 1982 by D.E. Howes, Ministry of the Environment, Province of British Columbia, Victoria.

GSC-3545. Broken Islands (I) 1230 ± 50

Whole marine shells and fragments (sample Camblain Island Cave; 52 g; **Mytilus californianus** identified by R. Hebda, British Columbia Provincial Museum, Victoria) from a coarse to medium textured beach sand in a sea-carved cave, on Camblain Island approximately 15 km west-northwest of the town of Bamfield, British Columbia (45°52'40"N, 125°21'20"W), at an elevation of 1.2 m above high high water line (HHWL).

GSC-3588. Broken Islands (II) 1300 ± 50
$\delta^{13}C = +0.3‰$

Fragments of marine shells (sample Levett Island #1; 48.2 g; **Mytilus californianus**; identified by R. Hebda) from a sandy pebble beach gravel

overlain by a capping of cobble gravel in a sea-carved cave, on Lovett Island approximately 19 km northwest of the town of Bamfield, British Columbia (48°54'20"N, 125°22'50"W), at an elevation of 3.4 m above HHWL.

GSC-3617. Broken Islands (III) 13 000 ± 110 $\delta^{13}C = -1.5‰$

Marine shells (sample Lovett #2; 50.0 g) from a sandy silty glaciomarine sediment overlying till and overlain by beach sand and gravels in a sea cliff, on Lovett Island approximately 19 km northwest of the town of Bamfield, British Columbia (48°54'20"N, 125°22'50"W), at an elevation of 13.5 m above HHWL.

Comment (D.E. Howes): The Lovett Island cave (Broken Islands (II)) is located at an exposed site on the outer part of the Broken Group. The beach sediments here are thought to have been deposited by storm waves up to 2 m above the then high high water line. In contrast, the Camblain Island cave is situated in a sheltered site protected by several nearby islands. The beach sediments in this cave are thought to have been deposited very near the then high high water line. If these interpretations are correct, these sites indicate about 1.5 to 2 m of emergence in the past 1200 to 1300 years for the Broken Group, a value which is similar to that proposed for the west side of Vancouver Island (Clague et al., 1982).

GSC-3545 provides further documentation that Fraser Glaciation ice had commenced deglaciation prior to 13 000 years ago on the west coast of Vancouver Island (see Clague et al., 1982, and Howes, 1981). Relative sea level at this time was at least >15 m above present sea level.

Comment (W. Blake, Jr.): For GSC-3545 six right valve fragments (all over 5 cm in length and with the umbonal area intact) were used for dating. The largest whole valves in the collection were over 10 cm long. For GSC-3588 a total of 19 large, robust fragments (the largest is 5+ cm long, 3 cm high – no intact valves were used) were used, and 11 of them included the hinge area. One valve only was quite worn. GSC-3545 and -3588 are each based on two 1-day counts in the 5 L counter; GSC-3617 is based on one 3-day count in the 5 L counter.

GSC-3027. Tofino 1540 ± 60

Driftwood (sample LBH-4; 9.0 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 80-4 by L.D. Farley-Gill), from an auger hole immediately in front of an abandoned marine scarp at Schooner Cove, 11.3 km southeast of Tofino, British Columbia (49°04.1'N, 125°47.9'W), at 1 m above HHW (3.0 m above MWL). Sample appears to be part of a log line deposit which lies above relict beach deposits. Collected November 29, 1979 by J. Harper, then Woodward Clyde Consultants, Victoria, British Columbia, now Dobrocky Seatech, Dartmouth, Nova Scotia.

Comment (J.R. Harper): The sample was collected immediately seaward of an abandoned marine scarp, and if interpreted as a log line deposit, dates the approximate abandonment period of the scarp. Elevation of the sample above the present log line also provides an estimate of the recent tectonic uplift rate of the outer coast of Vancouver Island (elevation approximately 1.0 m above the present HHW level gives an emergence rate of 0.65 mm/yr). Further discussion is included in a paper by Clague et al. (1982).

Comment (W. Blake, Jr.): Only the largest piece of wood was used, and its weight decreased from 27.0 to 10.8 g upon oven drying. Date is based on two 1-day counts in the 5 L counter.

Ogden Mountain series

Peat from a bog on the north flank of Ogden Mountain, British Columbia (55°52'N, 125°50'W), at an elevation of approximately 1678 m. The bog is in the lower part of a north-facing cirque. Collected August 25, 1973 using a Hiller peat corer, by N.F. Alley, then GSC, now Department of Mines and Energy, South Australia, Eastwood, South Australia.

GSC-2073. Ogden Mountain (I) 3840 ± 60

Peat (sample OM2A; 21.5 g dry) 145 cm below the surface of a bog. The peat/detrital sapropel unit is overlain by coarse **Carex** peat (unpublished GSC Bryological Report No. 288 by M. Kuc), and is underlain by 5 cm of silt, another horizon of **Carex** peat, and another layer of silt between 170 and 180 cm.

GSC-2033. Ogden Mountain (II) 5180 ± 60

Basal peat/detrital sapropel (sample OM2B; 25.0 g dry; possibly **Carex**; unpublished GSC Bryological Report No. 276 by M. Kuc) 220 to 230 cm below the surface of the bog. Wood in the peat, although not used for dating, was identified as **Salix** sp. (unpublished GSC Wood Identification Report No. 74-24 by R.J. Mott).

Comment (N.F. Alley): GSC-2073 fixes the age of a level in the pollen profile and also the time of a change in sedimentation. GSC-2033 defines the age of the lowest level in the pollen profile. The bog is located between the middle and outer moraines; one other moraine and a rock glacier are located between the inner moraine and the cirque headwall. Thus the date provides a minimum age for the outer moraine and a maximum age for the inner moraine. The

dated sample occurs below a layer of silt and coarse feldspathic sand believed to be deposited in front of ice that formed the inner moraine.

Comment (W. Blake, Jr.): Upon oven drying, weights decreased as follows: from 128.5 to 25.0 for GSC-2033; from 141.0 to 21.5 g for GSC-2073. GSC-2033 is based on one 3-day count in the 5 L counter. GSC-2073 is based on two 1-day counts in the 5 L counter.

Bella Coola Valley series

Wood from two sites near Hagensborg in the Bella Coola Valley, British Columbia.

GSC-3964. Bella Coola Valley (I) 9550 ± 80

A single piece of wood (sample 2; 11.1 g dry; Angiosperm, although too poorly preserved to be certain; unpublished GSC Wood Identification Report No. 84-43 by R.J. Mott) from a clayey-silt layer (which also contains marine shells), in a stream cut bank, 1.0 km north of Hagensborg, British Columbia (52°24'N, 126°33'W), at an elevation of 61 m. The collection was made across the Bella Coola River from the townsite. The sample was overlain, in succession, by 150 cm of glaciomarine clayey-silt, 80 cm of brown and grey silt and finally 300 cm of moderately to well rounded, clast-supported boulder gravel. Collected September 1984 by J.R. Desloges and P.J.M. Desloges, University of British Columbia, Vancouver.

Comment (J.R. Desloges): The dated glaciomarine clayey-silt represents sedimentation along the submerged fiord wall with sea level 61 m or higher than present. Dated marine clays from the middle coast (Andrews and Retherford, 1978; Clague, 1982) indicate lower sea levels there, suggesting continued isostatic depression at this time along the inner coast and fiord head areas.

Comment (W. Blake, Jr.): The piece of wood utilized was 11 cm long and 3.7 x 1.7 cm in cross-section (maximum dimensions). This wet piece of wood (38.2 g) was hard, had a smooth surface and rough ends. Date is based on one 3-day count in the 5 L counter.

GSC-3980. Bella Coola Valley (II) 9580 ± 80

A single piece of wood (sample 1; 9.9 g dry; **Pinus** cf. **contorta**; unpublished GSC Wood Identification Report No. 84-57 by R.J. Mott) from the 76 m level of a drill borehole (water well), 3 km west of Hagensborg, British Columbia (52°23'N, 126°36'W), at 38 m below sea level. The well (No. 7) is located on the west bank of Snootli Creek (on the Snootli Fish Hatchery property) downstream from Highway 20. The wood was enclosed in clayey silt of glaciomarine origin immediately below the contact with the overlying 76 m of sandy gravel which grades into sandy cobble-gravel towards the top. Collected August 1984 by J. Desloges and T. Millard, University of British Columbia, Vancouver.

Comment (J.R. Desloges): The transition from glaciomarine to deltaic (sand/gravel) sedimentation commenced shortly after the deposition of this dated clayey-silt. The overlying sand and gravel suggest rapid progradation of sediments derived from an advancing main valley delta or tributary alluvial fan/deltas.

Comment (W. Blake, Jr.): The largest piece of clean wood (at a branch or knot) is 10 cm long by 2.5 x 3.0 cm in cross-section. It had a rough surface and splintered ends. Date is based on one 3-day count in the 5 L counter.

GSC-1640. Four Lakes 8970 ± 190

Organic lacustrine sediment (sample 595-0-605; 7.6 g dry) 595 to 605 cm below the pond bottom from a 610 cm-thick organic unit, underlain by 50 cm of blue clay which is, in turn, underlain by gravel. The sample site is located 150 m east of the largest of the lakes in the Four Lakes site, Ocean Falls, British Columbia (52°13'N, 127°46'W) at an elevation of approximately 115 m. Collected June 1971 by H. Nichols, University of Colorado, Boulder, Colorado, using a modified and strengthened Hiller corer.

Comment (H. Nichols): The date provides control at the base of a pollen diagram (in preparation, Nichols) and a minimum age for the site emergence of the site from the sea (Andrews and Retherford, 1978).

Comment (W. Blake, Jr.): A subsample from the same 10 cm-long increment used for dating was examined by M. Kuc (unpublished GSC Bryological Report No. 140) who described the sediment as "diatomaceous sapropel". Macrofossils present included a 'cone' of **Alnus** sp., **Picea** sp. needles, and moss leaves (**Sphagnum** Sec. **Cymbifolia**). Because of the small sample size, NaOH leach was omitted from the sample pretreatment. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Brooks Peninsula series

One wood and two shell samples from Brooks Peninsula, Vancouver Island, British Columbia. Collected August 1981 by D.E. Howes, Ministry of Environment, Province of British Columbia, Victoria.

GSC-3627. Brooks Peninsula (I) 1570 ± 50 $\delta^{13}C = +0.1‰$

Marine pelecypod shells (sample BP-11; 48.2 g) from beach sand with rounded pebble and cobble gravels that is overlain by a thin veneer of cultural materials in a sea-carved cave, on the south coast of the Brooks Peninsula approximately 2.9 km northeast of Quineex Indian Reserve 8 (50°06'15"N, 127°45'30"W), at 4 m above high tide line (aht).

GSC-3598. Brooks Peninsula (II) 1640 ± 50

Marine pelecypod shells (sample BP-6; 50.3 g dry) from beach sediments (coarse sand with pea-sized gravels) mixed with water-worn cultural materials that overlie sterile beach sand in a sea-carved cave, on the south coast of the Brooks Peninsula approximately 1.8 km northeast of Quineex Indian Reserve 8 (50°06'N, 127°46'W), at 3.5 m above high tide line.

GSC-3449. Brooks Peninsula (III) 30 800 ± 510

Wood (sample BP-2; 9.5 g dry; somewhat compressed and lignified coniferous wood, not otherwise identifiable; unpublished GSC Wood Identification Report No. 82-11 by R.J. Mott) from an interbedded lacustrine silt and diamicton overlain by a metre of fluvial gravels in an escarpment 2 km north of the mouth of Amos Creek (50°06'10"N, 127°48'30"W), at an elevation of 36 m. The pollen assemblage from the upper bed of the interbedded silt and diamicton consists of 56% tree pollen, predominantly **Picea**, and diverse herbaceous types. It is thought to indicate that the temperature was cooler than present at the time of deposition. Collected by D.E. Howes and W.H. Mathews, University of British Columbia, Vancouver.

Comment (D.E. Howes): The floors of the two caves are presently 4.4 (Brooks Peninsula I) and 3.9 m (Brooks Peninsula II) above present high water line. The presence of water-worn artifacts in the beach sediments at the latter site suggests that these littoral deposits formed by occasional marine incursion, possibly by catastrophic storm waves or as the result of a tsunamis, when the cave floors were 1 to 2 m above the then high tide line. Thus, these sites indicate 2 to 3.5 m of emergence in the past 1600 years for the Brooks Peninsula (unpublished manuscript entitled 'Quaternary geology of the Brooks Peninsula' by D.E. Howes, W.H. Mathews, and R.J. Hebda). This rate is similar to that proposed for the west side of Vancouver Island by Clague et al. (1982).

The diamicton layer (dated by GSC-3449) is thought to represent mudflow material that descended from the adjacent slopes into a lake situated in the lower part of Amos Creek (Howes et al., in draft). The origin of the lake is unknown. It may have formed by temporary damming of the creek by an earlier landslide or by ice that flowed out of Nasparti Inlet during the advance of Fraser Glaciation ice. Of the two alternatives, a landslide origin is presently favoured because: 1) the pollen assemblage from the silts is similar to that of a slightly earlier non-glacial period recorded in the Vancouver area (Hebda et al., 1983); 2) the major ice advance of the Fraser Glaciation on northern Vancouver Island occurred after 20 000 years ago (Howes, 1983); and 3) the lacustrine deposit is of limited local extent, although, it may have in part been eroded by Fraser ice.

Comment (W. Blake, Jr.): In the case of GSC-3598, there were no complete valves in the sample. Most fragments were 1 to 3 mm in thickness, some were up to 5 mm. Maximum shell size: 4.5 x 3.0 cm, GSC-3598 and -3627 are each based on two 1-day counts in the 5 L counter. For GSC-3449, upon oven drying the weight of the damp sample decreased from 62.9 to 58.9 g (including adhering silt). Date is based on one 3-day count in the 5 L counter.

GSC-1658. Fisher Channel 7870 ± 180

Organic lacustrine sediment (sample 290-5-300; 8.4 g dry) 295 to 300 cm below the surface at the side of a small pond approximately 1 km east of the coast of Fisher Channel, British Columbia (52°05'N, 127°52'W), at an elevation (estimated) of 55 m. The organic sediments conformably overlie blue silty clay. Collected June 1971, using a strengthened and modified Hiller corer, by H. Nichols, Institute of Arctic and Alpine Research, University of Colorado, Boulder, Colorado.

Comment (H. Nichols): GSC-1658 provides a date at the base of a pollen diagram (in preparation), and a minimum age for site emergence from sea.

Comment (W. Blake, Jr.): An examination of the sample revealed the presence of one **Pinus** sp. needle, rhizones and sheaths of **Carex** sp., **Sphagnum** sp. stems, and the finest material present was characterized as diatomaceous sapropel (unpublished GSC Bryological Report No. 144 by M. Kuc). NaOH leach omitted from sample pretreatment. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-4024. Kluachon Lake, 169-174 cm 2100 ± 70 $\delta^{13}C = -28.1‰$

Lake sediment (sample Kluachon 3a (21-26 cm); 50.3 g dry) from 21 to 26 cm below the sediment/water interface in a 190 cm-long core from Kluachon Lake, northern interior British Columbia (57°51'N, 130°01'W), at an elevation of 827 m. Major sedimentological breaks are not evident and carbon

analysis using an induction furnace indicates that organic material sufficient for dating is restricted to the sampled portion of the core. Collected December 1983 by D. Friesen and G. Stuart, University of Calgary, Calgary, with a modified Livingstone piston sampler.

Comment (D. Friesen): Pollen data from the site indicate that boreal forest vegetation similar to the extant assemblage has persisted for approximately 2200 years (Friesen, 1985). However, some vegetational changes are evident suggesting that climatic fluctuations have occurred. In addition, long periods of subclimax forest dominated by **Pinus contorta** are the result of forest fires. These lengthy fire intervals cannot be attributed entirely to natural causes. NaOH leach omitted from sample pretreatment. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Morcheau Lake series

Two lake sediment samples were extracted from a 333 cm-long core from Morcheau Lake, in the northern interior of British Columbia (57°59'N, 130°05'W), at an elevation of 914 m. Core stratigraphy consists of alternating organic gyttja and clay layers, and a horizon of calcareous gyttja, gastropods and pelecypods at 261 to 331 cm. Collected December 1983 by D. Friesen and G. Stuart, with a modified Livingstone piston sampler. All measurements were made from the sediment/water interface.

GSC-4125. Morcheau Lake, 250-255 cm — 7660 ± 90; $\delta^{13}C$ = -30.3‰

Lake sediment (sample M 1b (250-255 cm); 42.6 g wet). NaOH leach was omitted from sample pretreatment. Date is based on two 1-day counts in the 5 L counter.

GSC-4100. Morcheau Lake — 6570 ± 120

Lake sediment (sample M 2 (331-333 cm); 17.7 g wet). NaOH leach was omitted from sample pretreatment. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Comment (D.E. Friesen): At present, there is no ready explanation for the discrepancy between these dates (the apparent reversal of stratigraphy), as pollen analysis has not been carried out on the core. Sediment contamination does not appear to be a problem, so slumping of sediments offers the only plausible reason for the reversed stratigraphy. Sediment basin testing indicated relatively gentle slope of the bottom sediments in the vicinity of the coring site. However, this does not preclude potentially steeper dips of older sediments. Core stratigraphy is characterized by alternating clay and gyttja horizons which may be the result, at least in part, of slumping (Friesen, 1985).

GSC-3742. Louise Island — 8920 ± 90; $\delta^{13}C$ = -24.4‰

A single piece of wood (sample MB-5-2-9(a); 12.0 g dry; **Tsuga** cf. **heterophylla**; unpublished GSC Wood Identification Report No. 84-5 by R.J. Mott) from the bank of an unnamed creek approximately 100 m north of Rockfish Harbour, Louise Island, Queen Charlotte Islands, British Columbia (52°53'N, 131°48'W), at an elevation in the range of 7 to 10 m. The deposit was overlain by 0.5 m of pebbly fluvial material and 1 to 2 m of sandy gravelly debris flow material. Pelecypods, identified as **Macoma** cf. **inquinata** by J.E. Dale (then GSC, now Queen's University, Kingston), were also noted in the sampled layer. Collected September 29, 1983 by D.A. Dunkley and T.P. Rollerson, Land Use Planning Advisory Team, MacMillan Bloedel Limited, Nanaimo, British Columbia.

Comment (D.A. Dunkley and T.P. Rollerson): The sample age is similar to other dates from the Queen Charlotte Islands, i.e. GSC-2738 (8610 ± 80 BP), GSC-2867 (9040 ± 80 BP), GSC-2734 (8860 ± 120 BP), GSC-2884 (9060 ± 90 BP), GSC-3129 (9160 ± 90 BP), GSC-3120 (9350 ± 80 BP), all in GSC XXII, 1982, p. 10-11; and GSC-242 (8620 ± 150 BP, GSC XI, 1971, p. 301). All of these dates indicate higher relative sea level than at present (from 4 to 8 m a.s.l.). **Tsuga** cf. **heterophylla** (Western Hemlock), one of the predominant tree species in the Queen Charlotte Islands today, likely occupied nearby slopes and stream flow carried wood fragments into the estuarine-marine environment.

Comment (W. Blake, Jr.): The piece of wet wood (15 cm long and 4.2 x 1.5 in maximum cross-section dimensions), upon oven drying decreased in weight from 51.0 to 19.7 g. Date is based on two 1-day counts in the 5 L counter.

GSC-2650. Mary Point — 5640 ± 70; $\delta^{13}C$ = -25.9‰

Wood (sample QC-32; 11.7 g; **Picea sitchensis**; unpublished GSC Wood Identification Report No. 78-11 by L.D. Farley-Gill) recovered from organic- and wood-rich sand and gravel, in a sea cliff exposure on the south side of Mary Point, at the mouth of Naden Harbour, Queen Charlotte Islands, British Columbia (54°03'N, 132°34'W), at an elevation of approximately 10 m. The sample is underlain by 70 to 80 cm of sandy gravel with massive layers of wood, spruce cones and shells, 20 cm of gravelly beach lag containing wood and shells, and at least 6.0 m of glaciomarine silty clay. Above the sample are 1.3 m of horizontally stratified beach sand and gravel, and 55 cm of shell midden. The surface of the deposits represents the 12 m shoreline. Collected

July 1977 by N.F. Alley, then Ministry of the Environment, Province of British Columbia, Victoria; now Department of Mines and Energy, Parkside, South Australia.

Comment (N.F. Alley): The date provides a maximum age for the 12 m shoreline which occurs consistently for a considerable distance along this part of the coast. GSC-2650 shows reasonably good agreement with I-9170 which dates the 12 m shoreline in south-western Naden Harbour lowland (see GSC-2639, 5380 ± 60 BP; this list). For some distance along the coast to the east of Mary Point, the 12 m shoreline is characterized by a coastal terrace 100 to 500 m in width and backed by a steep, relict sea cliff. The size and continuity of the shoreline here suggests that sea level stabilized for a significant period of time around 5000 BP.

Comment (W. Blake, Jr.): The piece of wood submitted was very hard, dense, and well preserved, although it had been bored by marine organisms. Date is based on two 1-day counts in the 5 L counter.

Lignite Creek series

Two samples of wood recovered from gravelly deltaic foreset beds in the lower reaches of Lignite Creek, 0.5 km southeast of Naden Harbour, Graham Island, Queen Charlotte Islands, British Columbia (53°58'N, 132°36'W). The base of the beds was not exposed; the foreset unit is overlain by 2.5 m of poorly sorted topset gravel forming a terrace approximately 4.0 m above present sea level. The foreset beds contain abundant wood, shells, leaf litter, and cones of **Picea sitchensis** (identified by N.F. Alley). Collected July 1977 by N.F. Alley.

GSC-2639. Lignite Creek (I) 5380 ± 60
$\delta^{13}C = -27.3‰$

Wood (sample QC-30; 11.9 g dry; **Picea sitchensis**, unpublished GSC Wood Identification Report No. 78-14 by R.J. Mott and L.D. Farley-Gill) recovered from the west bank of Lignite Creek, at an elevation of approximately 1 m above high tide level.

Comment (N.F. Alley): The date was thought to represent the maximum age for a 4.0 m sea level around Naden Harbour lowland, i.e., as represented by the surface of the overlying topset beds. GSC-2639 indicates, however, that the surface of the delta does not represent the sea level of the time, as two other dates (GSC-2650, 5640 ± 70 BP, this list and I-9170) made on shoreline gravels show that sea level probably stood at 12.0 m at approximately 5000 BP. Alley and Thomson (1978, p. 19) incorrectly reported that sea level at approximately 4500 BP (I-9169) and 5000 BP (I-9170) stood at elevations of 15 m and 18 m, respectively. These dates were actually made on the 6 m (I-9169) and 12 m (I-9170) sea levels. This provides reasonable agreement between the sea level dated by I-9170 and the level dated by GSC-2650. Thus, GSC-2639 points out the danger in using delta foresets and surfaces to determine former positions of the sea. The delta surface in this instance is probably a river gravel deposited on an erosional surface formed when the topset beds were scoured away during a subsequent lowering of sea level. GSC-2639 dates a microflora dominated by **Alnus, Picea sitchensis** and **Tsuga heterophylla** with very minor amounts of **Pinus, Thuja, Salix** and **Pseudotsuga** (identified by N.F. Alley).

Comment (W. Blake, Jr.): The damp, slightly decomposed wood, very compressed, appeared 'old'. Upon oven drying the weight was reduced from 220 to 54.2 g. Dimensions: 37 x 10 x 3.5 cm. Date is based on one 3-day count in the 5 L counter.

GSC-2657. Lignite Creek (II) 2050 ± 70

Wood (sample QC-29; 11.9 g dry; **Tsuga** sp.; unpublished GSC Wood Identification Report No. 78-10 by L.D. Farley-Gill), from the east bank of Lignite Creek, approximately 0.5 m below high tide level.

Comment (N.F. Alley): GSC-2657 represents the maximum age for the late Holocene 2.0 m shoreline (formed here by the delta surface) around the Naden Harbour lowland.

Comment (W. Blake, Jr.): The piece of wood submitted, 25 x 12 x 6 cm, is from a large log. The outside surface was blackened, but the wood was fresh-appearing and well preserved 2 cm in. Upon oven drying the damp wood decreased in weight from 130 to 52.5 g. The piece submitted for dating had 25 annual rings. Date is based on two 1-day counts in the 5 L counter.

GSC-2443. Naden Harbour 8460 ± 80
$\delta^{13}C = -27.5‰$

A single piece of wood (sample NFA-QC27; 11.6 g; **Abies** sp.; unpublished GSC Wood Identification Report No. 77-11 by L.D. Farley-Gill) from marine mud exposed in a stream bank along the lower reaches of Lignite Creek 1 km from the present coast and 2 km southeast of Naden Harbour, Queen Charlotte Islands, British Columbia (53°58'N, 132°37'W), at an elevation of approximately 10 m. The mud contains a variety of marine shells, abundant wood, cones (**Picea sitchensis, Alnus rubra**, identified by N.F. Alley) conifer needles, seeds and organic detritus. The base of the marine unit is not exposed; the unit is overlain by 2.0 m of fluvial gravel and 1.0 m of fluvial sand, silt and gravel. Collected October 1976 by N.F. Alley and B. Thomson, both then Environment and Land Use Committee, Province of British Columbia, Victoria.

Comment (N.F. Alley): This date indicates that in the Naden Harbour lowland the sea stood at least

10 m higher relative to the land in early Holocene times, and tongued at least 1 km up valleys from the present coastline (Alley and Thomson, 1978). It also provides an age for marine faunas and microfloras contained in the marine mud. The shells (identified by S. Crockford Dawson and G. Boehm, British Columbia Provincial Museum, Victoria) are abundant and varied and are typical of protected, shallow-water, intertidal, brackish coastal sites. Microfloras are dominated by **Alnus rubra, Tsuga heterophylla**, and **Picea sitchensis** with very low frequencies of **Pinus (contorta** and **monticola), Picea glauca, Thuja, Pseudotsuga menziesii, Tsuga mertensiana, Salix** and **Acer** (identified by N.F. Alley). Surprisingly no **Abies** was encountered even though the wood dated was from this genus. Fern spores of the Polypodiaceae were also common. Date is based on two 1-day counts in the 5 L counter.

Haines River series

One wood and two shell samples from marine sediments exposed on the south bank of Haines River, 1 km from the present coast and 27 km west-southwest of Naden Harbour, Graham Island, Queen Charlotte Islands, British Columbia (53°56'N, 133°06'W).

GSC-2534. Haines River (I) 8850 ± 90
$\delta^{13}C = +1.0‰$

A marine pelecypod shell (sample NFA-QC28E; 39.0 g; **Protothaca tenerrima** (Carpenter); identified by M.F.I. Smith, formerly National Museum of Natural Sciences, Ottawa) at an elevation of approximately 0.50 m below high tide level. The base of the unit was not exposed; the shelly sand was overlain by 1.0 m of sand, 0.50 m of paleosol, 4.0 m of alternating sand and shell layers and a number of regosols, and 5.9 m of sands, shoreline gravels and shell beds. Collected October 1976 by N.F. Alley and B. Thomson.

Comment (N.F. Alley): The date indicates that on northwest Graham Island the sea stood at least 1 km inland from present coast during early Holocene time (Alley and Thomson, 1978). Many shells (identified by S. Crockford Dawson and G. Boehm, British Columbia Provincial Museum, Victoria) are characteristic of high energy, sandy and gravelly coastlines. The date indicates a correlation with the early Holocene marine transgression recognized in Naden Harbour lowland (see GSC-2443, 8460 ± 80 BP, this list).

Comment (W. Blake, Jr.): The sample contained fragments of several large valves, the largest of which weighed 74.0 g. None were chalky, pitted, or encrusted. The dated sample was a single fractured valve, 12 cm long and 11 cm high, aragonitic. The hinge portion was not used. Because of the particular sample size, only the outer 10% of shell material was removed by HCl leach. Date is based on two 1-day counts in the 5 L counter.

GSC-2623. Haines River (II) modern

Wood (sample QC28D; 11.8 g; **Tsuga** sp.; unpublished GSC Wood Identification Report No. 78-8 by L.D. Farley-Gill) from the Ah horizon of a paleosol developed in marine sediments, at an elevation of approximately 1.7 m. The paleosol (a podzol) was underlain by at least 3.6 m of marine shelly sand, and was overlain by 4.0 m of alternating sand and shell layers and a number of regosols, followed by 5.9 m of sands, shoreline gravels and shell beds. Collected July 1977 by N.F. Alley and D. Wilford.

Comment (N.F. Alley): The modern date is inexplicable. The shell unit below is dated at 8850 ± 90 BP (GSC-2534, this series) and shells above at an elevation of 3.2 m are dated at 8780 ± 90 BP (GSC-2635, this series). There was no evidence that the wood was a modern root, but rather a branch of a tree deposited in sand in which the podzol developed.

Comment (W. Blake, Jr.): This damp but well preserved piece of wood, 29.0 cm long by 4.5 cm in diameter, had thick bark (0.4 to 0.5 cm). The sample was oven-dried. Date is based on one 1-day count in the 5 L counter.

GSC-2635. Haines River (III) 8780 ± 90
$\delta^{13}C = +1.3‰$

Marine pelecypod shell (sample QC28C; 51.0 g; **Hinnites multirugosus** (Gale); identified by M.F.I. Smith) from shelly beach gravels at an elevation of approximately 3.2 m. The shell-bearing unit was underlain by 3.2 m of sands, a paleosol, and shelly sands, and was overlain by 8.8 m of shelly sands, regosols and shoreline gravels. Collected July 1977 by N.F. Alley and D. Wilford.

Comment (N.F. Alley): Although GSC-2635 is separated from GSC-2534 (8850 ± 90 BP, this series) by over 3 m of marine sediments, in which a podzol had developed prior to the deposition of the shell located at an elevation of 3.2 m, the dates are surprisingly similar. It was hoped that GSC-2635 would date the recommencement of Early/Mid Holocene marine submergence after the formation of the paleosol (from which the wood used for GSC-2623 was extracted) and thus would provide evidence of the rate of Early Holocene marine submergence in the area. Although deposits in which the dated shell occurs appear to be beach gravels, the shells identified (by S. Crockford Dawson and G. Boehm, British Columbia Provincial Museum, Victoria) are suggestive of slightly quieter and deeper water than is the case for the unit from which GSC-2534 was extracted.

Comment (W. Blake, Jr.): The incomplete valve used (total original weight, 95.4 g) was 8+ cm high and 7.5 cm wide. The shell was sawed in two and the hinge area was saved; at that point the aragonitic shell was 1.2 cm thick. The outer half of the shell was riddled with worm borings, but the inner, nacreous part still retained its lustre. Date is based on two 1-day counts in the 5 L counter.

GSC-2661. Massett 70 ± 40

Wood (sample QC-31; 11.8 g dry; **Thuja plicata**; unpublished GSC Wood Identification Report No. 78-6 by R.J. Mott) from a fresh exposure in a gravel pit on the west side of the highway, south side of Massett, Graham Island, Queen Charlotte Islands, British Columbia (54°00'N, 132°07'W), at an elevation of 10.8 m. The wood was found with shells in organic-rich sand above cross-stratified sand with gravel pockets. Collected July 1977 by N.F. Alley.

Comment (W. Blake, Jr.): The submitter expected the sample to date the upper surface of the deposit (= the 12 m shoreline) and the relict sea cliff some 100 to 150 m east of the collection site. The estimated age was <8000 years. Obviously the sample is much younger than expected; it was most likely a root. The piece submitted measured 44 cm long by 4 cm in diameter. The wood was damp on receipt, slightly rotted on the outside. All outside wood was cut away. The piece cut out for dating decreased in weight from 87.2 to 21.4 g on oven-drying. Date is based on one 3-day count in the 5 L counter.

Northern Canada, Mainland

Yukon Territory

'Williscroft Creek' series

Silty organic section partly exposed as a result of stream channel modifications adjacent to the Alaska Highway (Mile Post 1066) in Kluane National Park, Yukon Territory (61°05'N, 138°33'W), at an elevation of 803 m.

The section is located 22 m above Kluane Lake level in a depression flanking a perched alluvial fan of early postglacial age. The samples were collected from a trench excavated alongside Williscroft Creek in July 1983 by P. de Bastiani and M-A. Geurts, Université d'Ottawa, Ottawa, Ontario.

GSC-3731. Williscroft Creek (I) 5480 ± 70 $\delta^{13}C = -24.4‰$

Wood (sample W2; 11.0 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 83-40 by R.J. Mott) in peat recovered from 2.38 m below the surface (2.0 m below the White River Ash, Eastern Lobe – 1230 years BP). This wood fragment bore evidence of water transport suggesting active sedimentation of the lower Williscroft alluvial fan at this particular date, and lack of an established forest at the site.

GSC-3949. Williscroft Creek (II) 3590 ± 60 $\delta^{13}C = -24.2‰$

Wood (sample W1; 12.4 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 83-40 by R.J. Mott) was recovered from 1.75 m below the surface (1.37 m below the White River Ash, Eastern Lobe). This sample was taken from the stump of a tree which appears to have grown on the site, suggesting stabilization of the alluvial fan by this date and the establishment of a spruce forest.

Comment (P. de Bastiani): The peat from which GSC-3731 was extracted occurred in a gravel-sand deposit in association with a bone fragment (**Bison** sp., distal articular of right tibia, identified by C.R. Harington, National Museum of Natural Sciences, Ottawa). The dated sample provides evidence of the last known occupation of **Bison** sp. in the Southwest Yukon Territory. GSC-3949 provided an intermediate date between the White River Ash and GSC-3731 (5480 ± 70 BP, this series) allowing the calculation of sedimentation rates of critical importance to the interpretation of pollen spectra produced for the entire section.

Comment (W. Blake, Jr.): GSC-3731 was 18 cm long, 1 x 2 cm in cross-section. Upon oven drying its weight decreased from 72.8 to 25.7 g. GSC-3949 was 13 cm long and 7 x 4 cm in cross-section. During oven drying its weight decreased from 99.5 to 28.8 g. Each date is based on two 1-day counts in the 5 L counter.

GSC-3776. Gladstone Lake 2920 ± 90

Organic detritus (sample WL 225; 26.5 g damp) from 225 cm depth in a natural exposure on the left (west) bank of a small creek near the eastern edge of eastern Gladstone Lake, Ruby Range, southwestern Yukon Territory (61°22'58"N, 138°02'20"W), at an elevation of approximately 1290 m. Paleosols and humic-rich silts alternate in the section, which contained the White River ash in a continuous layer at 45 to 50 cm depth, and which was frozen below 117 cm. Collected August 8, 1981 by M-A. Geurts, Université d'Ottawa, Ottawa.

Comment (M-A. Geurts): Some traces of solifluction activity are present in the exposure. Sample WL 225, which also contained a few wood fragments, yielded the highest **Picea** percent in the unpublished pollen diagram from the section. The sample received the normal treatment with NaOH, HCl (no reaction), and distilled water rinses. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Aishihik Lake series

Two peat samples and one sample of silty organic material were collected at three different sites near the northwestern margin of Aishihik Lake, Yukon Territory. Collected August 6 and 7, 1984 by X. Wang and M-A. Geurts, both l'Université d'Ottawa, Ottawa, Ontario.

GSC-4099. Aishihik Lake (I) 8640 ± 80

Peat (sample XA-P-7; 129.9 g wet) from frozen sediments in a depression near Aishihik Lake (61°35'26"N, 137°30'57"W), at an elevation of 953 m. The sample was collected from the basal 2 cm of a 13 cm-thick organic layer. The sampled layer was underlain by dark grey organic silt, and overlain successively by 34 cm of brown silt, 52 cm of silty organic matter, 5 cm of White River Ash, and 15 cm of surface organic material.

GSC-4110. Aishihik Lake (II) 6390 ± 100

Silty organic material (sample XA-P-6 (112.5-115.0); 79.9 g wet) from a core in permafrost in a dead ice depression near Aishihik Lake (61°36'26"N, 137°31'54"W), at an elevation of 950 m. The sample was collected from the uppermost 2.5 cm of a 14 cm-thick silty organic layer. The sampled layer was underlain by fine sand, and overlain successively by 68 cm of silt and fine sand, 25 cm of organic matter with silt and fine sand, 3 cm of White River Ash, and 18 cm of surface organic material. The upper part of the profile is strongly disturbed by cryoturbation.

GSC-4089. Aishihik Lake (III) 5200 ± 70

Peat (sample XA-P-5; 120.4 g wet) from a core of peat found in dead ice kettle sediments near Aishihik Lake (61°36'23"N, 137°32'48"W), at an elevation of 954 m. The sample was from the basal 2.5 cm of a 41 cm-thick organic layer. The sampled layer was underlain by silt, and overlain successively by 13 cm of White River Ash, and 17 cm of surface organic matter.

Comment (X. Wang): The study area is located in the wastage zone of the McConnell Glaciation, where dead ice features are well developed. The three age determinations aid in reconstructing the vegetational history (pollen analysis) by providing chronologic control.

GSC-4099 gave an older age than any previously known from the drainage area of the glacial lake that occupied the basins of Sekulmun and Aishihik lakes (cf. GSC-755, 7170 ± 140 BP; GSC IX, 1970, p. 75). However, this event has been dated even earlier by LV-1475 (9790 ± 130 BP; M-A. Geurts et al., 1985). The result for GSC-4089 was close to the estimated age of 5000 years, whereas GSC-4110 was a little younger than the estimated age of 7000 years.

Comment (W. Blake, Jr.): NaOH leach was omitted from the pretreatment of all three samples. Only GSC-4110 showed a slight reaction with HCl. GSC-4089 and -4110 are both based on two 1-day counts in the 2 L counter, GSC-4099 is based on two 1-day counts in the 5 L counter.

GSC-1893. Scroggie Creek 16 200 ± 130
$\delta^{13}C = -19.8‰$

Mammoth tusk (sample Bostock 1936; 612 g; **Mammuthus** sp.; identified by C.R. Harington, National Museum of Natural Sciences, Ottawa; Scroggie Creek Locality 1 (of C.R.H.); NMC-21301) on the gravel floor of a glade on a tributary to Scroggie Creek, Yukon Territory (63°08'00"N, 138°37'30"W), at an elevation of 620+ m. Collected September 1, 1936 and submitted April 1972 by H.S. Bostock.

Comment (W. Blake, Jr.): The tusk, wet when collected, was badly cracked and somewhat stained. It weighed approximately 18 kg, was 9 cm wide at the thick end, and was 150 cm long, with a gradual taper. The original point of the tusk had been broken off, but the end had been worn smooth again. By the time it was submitted for dating, the tusk had separated into layers along the growth rings, and a fair amount of dirt had entered along these cracks. The tusk was cut into small pieces on a bandsaw so as to remove all dirty surfaces. The sample was treated with acetic acid in an aspirator, then the 23 g of material remaining was burned. Date is based on one 3-day count in the 5 L counter.

GSC-730. Old Crow River 41 280 ± 1600

Wood (sample loc. 14N-A; 110 g wet) from a fresh face exposed by stream erosion on the west bank of the Old Crow River, Yukon Territory (67°51'00"N, 139°46'10"W). Locality 14N is at a large westerly bend in the river. The excavation penetrated 1+ m in from the naturally exposed face. The enclosing material was moist, orange-coloured sand and grit. The wood-bearing stratum was the lower of two organic-rich layers, and was 1.5 m above the main bone-bearing stratum. The sand and grit unit was underlain by grey clay (unit 1) to river level and was overlain by ~3 m of slumped material (sand and silt?) to the top of the section. No plant roots penetrated to the sample area, although the wood exhibited some Fe-staining. Collected July 28, 1966 by C.R. Harington, National Museum of Natural Sciences, Ottawa. Three determinations were made:

GSC-730. Determination 1 41 280 ± 1600

For this determination a 110 g (wet)-sample was cut from a single large piece of wood. Pretreatment included the usual ½ hour leach in NaOH, ½ hour

leach in HCl, plus distilled water rinses; 14.1 g of pretreated sample was burned. Date is based on one 3-day count in the 5 L counter (at 1 atmosphere = normal pressure).

GSC-730-2. Determination 2 14 390 ± 160

In order to obtain enough CO_2 for a high pressure determination, a sample of twigs from the same collection were pretreated as above. An 18.0 g sample was burned, and the gas obtained was added to the CO_2 retained from GSC-730. Date is based on one 1-day count in the 5 L counter at 4 atmospheres.

GSC-730-3. Determination 3 ca. 4000

This determination, based on a new preparation of CO_2 derived from 250 g of small wet twigs, was not carried to completion, unfortunately. Following pretreatment as described for GSC-730, two batches of twigs were burned, 18.5 g and 19.0 g. The approximate age quoted above is based on a count of only about 4 hours. No final date was calculated.

Comment (W. Blake, Jr.): The dating was carried out because four ^{14}C dates on bone from the same locality suggested that the age was more than 20 000 years (Irving, 1968; Irving and Harington, 1973). The site was of particular interest because, in addition to bones of horse, mammoth, ? wolf, beaver, and caribou, as well as pelecypod shells, the bone-bearing stratum had produced a flesher (NMC-342) with a serrated edge, made from a caribou tibia. Part of the flesher had been used to obtain a bone apatite date of 27 000 +3000/-2000 (GX-1640; Irving and Harington, 1973), and the wood was dated in hopes of confirming the series of dates on the bones, which of course was not the result.

Recently a new series of dating was carried out on artifacts from the Yukon, including the flesher (of which 21 g remained), by means of accelerator mass spectrometry. Using a miniature power saw a 0.3 g sample was obtained, pretreated using a variation of the Longin technique and the gelatin resulting was burned to obtain CO_2. The result was 1350 ± 150 years (RIDDL-145; Nelson et al., 1986). The only caveat C.R. Harington (personal communication, December 1987) attaches to the validity of this date is that the flesher was cast prior to being dated, and if all of the latex used in the casting process was not removed by the pretreatment, this could affect the date on the young side (cf. Blake, 1987; comments re the difference between GSC-3055 and 3055-2).

Northwest Territories

Pitz Lake series

One wood and three marine shell samples from the faces of fresh stream cut exposures located west-northwest of Pitz Lake, Northwest Territories. Collected August 1968 by B.C. McDonald, then GSC, now Petro-Canada, Calgary, Alberta.

GSC-1150. Pitz Lake (I) 4950 ± 140
$\delta^{13}C = -25.2‰$

Twigs and stems (sample MR-68-110B) from stratabound concentrations of plant material on the right bank of a stream 2.4 m above stream level. The sample site is located 2.4 km west-northwest of Pitz Lake (64°02'30"N, 96°53'00"W), at an elevation of approximately 71.6 m. The organic layers are overlain by fine to medium sand followed by 1 m of modern alluvium and are underlain by a layer of fine sand (dated by GSC-1121, this series) and by 0.3 m of grey silt-clay containing **Clinocardium ciliatum** and **Hiatella arctica**. After the standard pretreatment with NaOH, HCl and distilled water rinses, 5.5 g of dry sample was burnt.

GSC-1121. Pitz Lake (II) 4900 ± 140
$\delta^{13}C = +1.6‰$

Whole and partly broken marine shells (sample MR-68-110A; 21 g; **Clinocardium ciliatum**; identified by B.C. McDonald) from the same stream exposure as GSC-1150. The sample was collected within the fine sand layer between 0.3 and 2.4 m above the stream level. The sampled layer also contained articulated **Hiatella arctica**, **Macoma calcarea**, **Mya truncata** and **Nuculana** sp. in growth position.

GSC-1083. Pitz Lake (III) 5970 ± 140

Marine pelecypod shells (sample MR-68-115; 64 g; **Hiatella arctica**; identified by B.C. McDonald) from the base of a silty sand unit, on the right bank of the stream 4.6 m above stream level. The sample site is located 8.0 km west- northwest of Pitz Lake (64°03'N, 96°58'W), at an elevation of approximately 96 m. Large boulders at the base of the silty sand unit suggest an underlying layer of till, but slumped material obscures the lower 3.0 m of the section.

GSC-1164. Pitz Lake (IV) 5910 ± 140
$\delta^{13}C = +2.4‰$

Marine pelecypod shells (sample MR-68-113A; 50 g; **Hiatella arctica**, identified by B.C. McDonald) from a unit of sandy gravel underlain by reddish, silt-rich till exposed on the right bank of a stream, 2.4 m above stream level. The sample site is located 8.9 km west-northwest of Pitz Lake (64°03'N, 96°59'W), at an elevation of approximately 101 m.

Comment (W. Blake, Jr.): This series of dates provides information on past positions of sea level, and GSC-1121 and -1150 provide an interesting comparison on the ages of terrestrial wood and marine pelecypod shells from adjacent stratigraphic horizons. GSC-1121 was mixed with dead gas for counting. GSC-1150 is based on two 1-day counts in

the 2 L counter. GSC-1083 and -1121 are each based on one 3-day count in the 2 L counter. GSC-1164 is based on one 3-day count in the 5 L counter.

GSC-2093. Pelly Bay 9450 ± 210
$\delta^{13}C = +1.3‰$

Marine pelecypod shells (sample BNA-74-264; 13.2 g; **Hiatella arctica**; identified by W. Blake, Jr.) from silt near the highest part of an island north of Korvigdsuak Island, Pelly Bay, Northwest Territories (68°58'N, 89°59'W), at an elevation of 225 m. The shells were collected 40 to 50 cm below the ground surface in a pit. Collected August 21, 1974 by A.N. Boydell, then GSC, now Department of the Environment, Vancouver, British Columbia.

Comment (A.S. Dyke): These are the highest shells collected to date in northeastern Keewatin, in an area where the marine limit is 240 to 250 m a.s.l. (Dyke, 1984, Figs. 15, 16 and 18). This is the best date available for the local marine limit and for the deglaciation of the southern Gulf of Boothia.

Comment (W. Blake, Jr.): The shells were extracted from the damp to wet silt in September 1974 and were oven dried. Fragments of **Mya truncata** were also present in the sample, but only **Hiatella arctica** was used for dating. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Netsilik Lake Solifluction series

Four samples of humus (buried soil) from beneath a solifluction lobe formed on till 2.5 km south of Netsilik Lake, Northwest Territories (69°02'15"N, 93°12'W), at an elevation of 29 m. Ages were determined on sand-sized material concentrated from bulk samples by wet sieving and decanting. Where possible only the top 2 to 5 cm of humus layers were sampled. The dates were used by Dyke (1981) to calculate average late Holocene solifluction rates and to estimate the radiocarbon age of thin arctic soils at time of burial. All samples collected July 1979 by A.S. Dyke from a trench excavated along the lobe axis. Sample and lobe designations given below follow Dyke (1981).

GSC-3100. Netsilik Lake, Lobe 1 (D) 870 ± 50

Buried A-horizon (sample 79DCA-H45), 20 cm behind the lobe front. The sampled humus was overlain by 20 cm of soliflucted till. A 51 g subsample of the 63 to 1000 µm fraction was used.

GSC-3131. Netsilik Lake, Lobe 1 (C) 1310 ± 50

Buried A-horizon (sample 79DCA-H46), 120 cm behind lobe front. The sampled humus was overlain by 60 cm of soliflucted till. A 56 g subsample of the 63 to 1000 µm fraction was used.

GSC-3168. Netsilik Lake, Lobe 1 (B) 1460 ± 60

Buried A-horizon (sample 79DCA-H48), 220 cm behind the lobe front. The sampled humus was overlain by 50 cm of soliflucted till. A 48.7 g subsample of the 63 to 1000 µm fraction was used.

GSC-3017. Netsilik Lake, Lobe 1 (A) 2210 ± 60

Buried A-horizon (sample 79DCA-H50), 320 cm behind lobe front. The sampled humus was overlain by 80 cm of soliflucted till. A 40 g subsample of the 147 to 425 µm fraction was used.

Comment (A.S. Dyke): The soil beneath this lobe had a radiocarbon age prior to burial of about 813 years. The overall long term average rate of advance of the lobe front over the past 1500 years or so was 2.2 mm/year, but rates ranged from as little as 1.3 mm/year to as much as 6.7 mm/year for the dated intervals (Dyke, 1981, Table 3.2). GSC-3017 received the standard treatment with NaOH, HCl, and distilled water rinses. For the other three samples only a cold NaOH leach was used prior to the HCl leach. Each date is based on two 1-day counts in the 5 L counter.

Lord Lindsay River series

Two dates were obtained on a 132 cm-thick peat deposit, at a site on southern Boothia Peninsula, Northwest Territories (70°06'45"N, 93°33'W), at an elevation of 150 m. The peat unit is underlain by massive ground ice with silt inclusions. A palynological report on the site is in preparation by S.K. Short, University of Colorado, Boulder, Colorado. Collected August 6, 1979 by A.S. Dyke.

GSC-3282. Lord Lindsay (I) 2080 ± 60

Peat (sample 79DCA P16; 65.0 g) from 5 to 8 cm below the surface. Date is based on two 1-day counts in the 5 L counter.

GSC-3277. Lord Lindsay (II) 4750 ± 60

Peat (sample 79DCA P15; 23.2 g) from 130 to 132 cm below the surface. The sample reacted slightly with HCl. Date is based on one 3-day count in the 5 L counter.

Comment (A.S. Dyke): The samples were submitted to provide chronological control for the first Holocene pollen diagrams from Boothia Peninsula. A pit was excavated through the frozen

peat using an electric jackhammer, and the peat was continuously sampled from one vertical face after two days of thawing. Organic accumulation began in a small wet depression about 4750 years ago and ceased because of degradation of ice wedges and subsequent draining of the site some time after 2080 BP. The top of the peat at this site does not appear to be wind eroded.

Comment (W. Blake, Jr.): GSC-3277 contained much water; upon oven drying it decreased in weight from 120.0 to 22.3 g. GSC-3282 was damp and decreased in weight from 106.0 to 65.0 g. All visible rootlets and bits of wood were removed from GSC-3282 before drying.

Boothia Peninsula Solifluction series

Eight samples of humus (buried soil) were collected from beneath three solifluction lobes on southern Boothia Peninsula. Ages were determined on sand-sized humic material concentrated from bulk samples by wet sieving and decanting. Where possible only the top 2 to 5 cm of the humus layers were sampled. The dates were used by Dyke (1981) to calculate average late Holocene solifluction rates and to estimate the radiocarbon age of thin arctic soils at the time of burial. All samples collected by A.S. Dyke during July and August 1979 from trenches excavated along lobe axes. All samples were from calcareous sub strates. Sample and lobe designations given below follow Dyke (1981).

GSC-3069. Boothia Peninsula, 940 ± 50
Lobe 2 (D)

Buried A-horizon (sample 79DCA H52), 20 cm behind front of lobe, located 7.5 km south of Sangagak Lake, Northwest Territories (70°07'N, 93°36'W), at an elevation of 150 m. The sampled humus was overlain by 20 cm of soliflucted muddy sand capped by 20 cm of humus-rich sand (surface A-horizon). A 40 g subsample of the 63-1000 µm fraction was used.

GSC-3144. Boothia Peninsula, 1100 ± 50
Lobe 2 (C)

Buried A-horizon (sample 79DCA H55), 200 cm behind front of lobe. The sampled humus was overlain by 80 cm of muddy sand. A 127.6 g subsample of the 63-1000 µm fraction was used.

GSC-3189. Boothia Peninsula, 1670 ± 60
Lobe 2 (B)

Buried A-horizon (sample 79DCA H57), 300 cm behind front of lobe. The sampled humus was overlain by 80 cm of muddy sand. A 74 g subsample of the 63-1000 µm fraction was used.

GSC-2994. Boothia Peninsula, 2170 ± 80
Lobe 2 (A)

Buried A-horizon (sample 79DCA H59), 400 cm behind front of lobe. The sampled humus was overlain by 80 cm of muddy sand. A 24 g subsample of the 147-450 µm fraction was used.

Comment (A.S. Dyke): The soil near the lobe front had a radiocarbon age of approximately 953 BP prior to burial. The overall long term average rate of advance of the lobe front over the past 1500 years or so was 3.3 mm/year, but rates ranged from as little as 1.8 mm/year to as much as 12.5 mm/year for the dated intervals (Dyke, 1981, Table 3.2). GSC-2994 based on two 1-day counts in the 2 L counter. GSC-3069, -3144, and -3189 each based on two 1-day counts in the 5 L counter.

GSC-3080. Boothia Peninsula, 710 ± 60
Lobe 3 (B)

Buried A-horizon (sample 79DCA H61), 40 cm behind front of lobe, located 8 km south of Sanagak Lake, Northwest Territories (70°07'N, 93°37'W), at an elevation of 156 m. The sampled humus was overlain by 30 cm of gravel capped by 20 cm of humus-rich gravel (surface A-horizon). A 67.5 g subsample of the 63-1000 µm fraction was used.

GSC-3011. Boothia Peninsula, 570 ± 50
Lobe 3 (A)

Buried A-horizon (sample 79DCA H64), 200 cm behind front of lobe. The sampled humus was overlain by 100 cm of gravel capped by 15 cm of humus-rich gravel. A 47.3 g subsample of the 147-1000 µm fraction was used.

Comment (A.S. Dyke): The radiocarbon age of the soil beneath this lobe at time of burial was 140 to 570 years. The lobe front advanced 2 m in less than 570 years, hence at an average rate of >3.5 mm/year. Pretreatment of GSC-3080 included a half hour leach in cold NaOH. GSC-3011 and -3080 each based on two 1-day counts in the 5 L counter.

GSC-3085. Boothia Peninsula, 410 ± 50
Lobe 4 (B)

Buried A-horizon (sample 79DCA H66), 20 cm behind front of lobe located 9.5 km south of Sanagak Lake, Northwest Territories (70°06'N, 93°38'W), at an elevation of 165 to 170 m. The sampled humus was overlain by 30 cm of gravel capped by 15 cm of humus-rich gravel (surface A-horizon). A 100 g subsample of the 63-1000 µm fraction was used.

GSC-3021. Boothia Peninsula, 1360 ± 50
Lobe 4 (A)

Buried A-horizon (sample 79DCA H67), 150 cm behind front of lobe. The sampled humus was overlain by 40 cm of gravel capped by 20 cm of

humus-rich gravel. A 28 g subsample of the 147-425 μm fraction was used.

Comment (A.S. Dyke): The radiocarbon age of the soil beneath this lobe at time of burial was about 285 years. The lobe front advanced at an average rate of 1.3 mm/year. GSC-3021 and -3085 each based on two 1-day counts in the 5 L counter.

Pasley River series

Samples of plant fragments were collected from two bluff exposures on the west side of Pasley River, Boothia Peninsula, Northwest Territories. Collected July 1982 by A.S. Dyke and G. Mercuré.

GSC-3508. Pasley River (I) >37 000

Plant fragments (sample 82 DCA M6; 31.5 g dry) from a horizontally bedded, ripple laminated sand exposed in Section 1, South bluff, 3rd gully (70°25'N, 95°34'W), at an elevation of approximately 90 m.

GSC-3510. Pasley River (II) >37 000

Plant fragments (sample 82 DCA 01; 30.9 g dry) from the top of an 11 m-thick, horizontally bedded, coarse, loose, gravel exposed in Section 2, North bluff, centre (70°25.5'N, 95°34'W), at an elevation of approximately 80 m.

Comment (A.S. Dyke): The material enclosing GSC-3508 has been termed the upper marine deltaic sand by Dyke and Matthews (1987) and interpreted as an estuarine deltaic deposit. The sand is overlain by an upper glacigenic assemblage consisting of till over proximal glaciomarine sediment and is considered to record the marine transgression immediately following deposition of the mid section fluvial gravels dated at >37 000 BP (GSC-3510) and >55 000 BP (QL-1767) and immediately preceding the last major interval of ice cover, the Wisconsin Glaciation. All plant material in the sand is rebedded and includes some elements of probable Tertiary age. Details of macrofossils in the sample are recorded by Matthews (unpublished GSC Plant Macrofossil Report No. 82-28 and unpublished GSC Fossil Arthropod Report No. 82-30).

The gravel enclosing GSC-3510 has been termed the mid-section fluvial gravel by Dyke and Matthews (1987) and interpreted as an interglacial deposit, probably of Sangamonian age. The gravel is underlain by a lower glacigenic assemblage and lower marine deltaic sand and overlain by an upper marine deltaic sand succeeded by an upper glacigenic assemblage. Material from the same sample was redated at >55 000 BP (QL-1767). Plant and insect fossils from the sample, identified by J.V. Matthews, Jr. (unpublished GSC Plant Macrofossil Report No. 82-30 and unpublished GSC Fossil Arthropod Report No. 82-32) indicate that climate was probably warmer than present during deposition of the gravel.

Comment (W. Blake, Jr.): For GSC-3508 the material dated was that retained on the 20 mesh screen (greater than 850 μm in size) after washing by J.V. Matthews, Jr., and then oven drying. For GSC-3510 the material between 5 to 80 mesh screen sizes (4.00 to 0.180 mm) was retained in the same fashion. Both samples were treated with NaOH, then with HCl. GSC-3508 showed a slight reaction and GSC-3510 a moderate reaction with HCl. Each date is based on two 2-day counts in the 5 L counter.

GSC-2917. Pasley Bay 8790 ± 80
$\delta^{13}C = -1.6‰$

Marine pelecypod shells (sample 79DCA S1; 46.8 g; **Hiatella arctica**; identified by W. Blake, Jr.) from silty fine sand bottomset beds in a delta 19 km due south of the mouth of Pasley Bay, Boothia Peninsula, Northwest Territories (70°25'15"N, 96°01'W), at an elevation of 130 m (altimeter measurement). The shells came from freshly gullied exposures and were not noticeably weathered. Collected July 6, 1979 by A.S. Dyke.

Comment (A.S. Dyke): The fossiliferous upper bottomset beds of this small glaciomarine delta are overlain by foreset beds of medium sand and are capped by about 1 m of topset gravel forming the delta terrace at 136 m. This sample provides an age on marine limit and local deglaciation. The site is 8 km north of (distal to) one of the largest end moraines on Boothia Peninsula (Dyke, 1984).

Comment (W. Blake, Jr.): The sample was composed of well preserved aragonitic shells. For dating 65 left valves and 43 right valves of aragonitic **Hiatella arctica** were used; size range: >3.5 x 1.7 cm to 1.3 x 0.7 cm. Date is based on one 3-day count in the 5 L counter.

Pasley River Solifluction series

Seven samples of buried A-horizons were collected from five trenches excavated in a large solifluction sheet composed of sand on the east side of Pasley River, Boothia Peninsula, District of Franklin, Northwest Territories (70°26'N, 95°33'W), at an elevation of approximately 70 m. Collected July 1982 by A.S. Dyke.

GSC-3587. Pasley River, Trench 2 2490 ± 70

Buried humic peat (sample 82-DCA-L46; 80.0 g dry) from the top 2 to 5 cm of peat sampled from a 10 cm-thick frozen layer underlying about 50 cm of solifluced sand. The sample point was 4 m behind riser of solifluction sheet. Buried soil overlies gravel.

GSC-3712. Pasley River, Trench 2 550 ± 50

Buried humic material (sample 82-DCA-L42; 200.9 g dry; organic carbon content 3.17 per cent) from the top 2 to 3 cm sampled from a 10 cm thick buried A-horizon. The sample point was 10 cm behind riser.

Comment (A.S. Dyke): These two samples indicate an average rate of advance of the front of the solifluction sheet between the two sample points of 1.86 mm per year. The local slope of both the surface of the solifluction sheet and the buried soil is 0°, but the surface slope increases to about 5° upslope. The front of the solifluction sheet in this vicinity is being pushed by material from upslope. The radiocarbon age of the top of the paleosol at time of burial was less than 550 ± 50 years. Both samples reacted strongly with HCl following the NaOH leach. GSC-3587 mixed with dead gas for counting. GSC-3587 based on two 1-day counts in the 2 L counter. GSC-3712 based on two 1-day counts in the 5 L counter.

GSC-3578. Pasley River, Trench 3 1720 ± 60

Buried humic peat (sample 82-DCA-L18; 308.7 g dry) from the top 2 to 3 cm of peat sampled from a 10 cm-thick frozen layer underlying about 50 cm of soliflucted sand. The sample point was 5 m behind riser of sheet.

GSC-3717. Pasley River, Trench 3 90 ± 70

Buried humic peat (sample 82-DCA-L13; 36.5 g dry; organic carbon content 12.4 per cent) from the top 2 to 3 cm sampled from a 15 cm-thick layer. Sample point was 20 cm behind riser.

Comment (A.S. Dyke): These two samples indicate an average rate of advance of the front of the solifluction sheet between the two sample points of 3.07 mm per year. The local slope of both the surface of the solifluction sheet and the buried soil is 4°. Radiocarbon age of the top of the paleosol at time of burial was less than 90 ± 70 years. The less than 850 µm size fraction used for dating. GSC-3578 showed a strong reaction with HCl following the NaOH leach. GSC-3717 received a cold NaOH leach and the sample showed only a slight reaction with HCl. GSC-3578 is based on two 1-day counts in the 5 L counter. GSC-3717 is based on one 1-day count in the 2 L counter.

GSC-3571. Pasley River, Trench 4 1460 ± 60

Buried humic peat (sample 82-DCA-L11; 211.3 g dry) from the top 2 to 5 cm of peat sampled from a frozen layer of undetermined thickness underlying 60 cm of soliflucted sand. The sample was 10 m behind the riser.

Comment (A.S. Dyke): Assuming a zero radiocarbon age for the top of the paleosol at time of burial, the average rate of advance of the riser over the last 1460 radiocarbon years has been 7.14 mm per year. The local slope of both the surface and the buried soil in the immediate vicinity of the sample is 5° but increases to 10° in the lower 5 m of the feature. The sample dated utilized plant fragments retained on a 1 mm screen. GSC-3571 showed a strong reaction with HCl following the NaOH leach. Date is based on two 1-day counts in the 5 L counter.

GSC-3556. Pasley River, Trench 5 820 ± 60

Buried humic and fibrous peat (sample 82DCA-L39; 60.3 g) from a 5 cm-thick frozen organic layer overlain by 90 cm of soliflucted sand containing two additional thinner organic layers. The sample was 160 cm behind the riser of the solifluction sheet.

Comment (A.S. Dyke): The buried soil from which the sample was taken extends 4.2 m in front of the riser and is overlain by a 10 to 20 cm-thick sand layer, identical to that within the solifluction sheet. This extension of a thin sand sheet in front of the main solifluction sheet and the presence of three thin, buried, peaty A-horizons within the solifluction sheet indicate that this part of the sheet has advanced by a series of sporadic flows, three such flows having occurred within the last 820 years. The morphology of the sheet, however, including a well developed riser with lobate outline, possibly indicates that normal solifluction processes operated between flows. The dated paleosol is slightly undulating but essentially horizontal. The solifluction sheet just above the riser has a surface slope of 11°. The sample showed a slight reaction with HCl following the NaOH leach. Date is based on two 1-day counts in the 5 L counter.

GSC-3586. Pasley River, Trench 6 1060 ± 60

Buried humic peat (sample 82-DCA-L27; 319.5 g) from the top 2 to 5 cm of peat sampled from a frozen layer of undetermined thickness underlying 80 cm of soliflucted sand. The sample was 5 m behind the riser of the solifluction sheet.

Comment (A.S. Dyke): Assuming a zero radiocarbon age of the top of the paleosol at time of burial, the average rate of advance of the riser over the last 1060 radiocarbon years has been 4.6 mm per year. The local slope of the surface of the solifluction sheet is 7°, whereas the slope of the buried soil is 4°. GSC-3586 showed a strong reaction with HCl following the NaOH leach. Date is based on two 1-day counts in the 5 L counter.

Boothia Peninsula Mudboil series

Two samples of humic material subducted beneath the vegetated border of a mudboil (nonsorted circle) formed on calcareous silty till in Wrottesley Valley, Northwest Territories (71°04'N, 95°36'W), at an elevation of approximately 140 m. The dates reported here were used, together with dates from two other laboratories on material from similar features on Somerset Island and central Keewatin, by Dyke and Zoltai (1980) to calculate long term average rates of convection within mudboils. Collected July 18, 1978 by A.S. Dyke.

GSC-2836. Boothia Peninsula 2150 ± 50 (I)

Subducted humic material (sample DCA-78-H46; 275 g dry) from a depth of 49 to 54 cm, just below the frost table on July 18, 1978. The material used was sieved through ASTM #35 screen (500 μm).

GSC-2805. Boothia Peninsula 2730 ± 50 (II)

Subducted humic material (sample DCA-78-H45; 288.9 g) from an average depth of 85 cm; material finer than 1 mm was used.

Comment (A.S. Dyke): The average rate of subduction from the upper to the lower sample, a distance of 44 cm, was 0.92 mm/year. NaOH leach was omitted from the pretreatment of both samples. Each date is based on two 1-day counts in the 5 L counter.

GSC-2180. Wrottesley River valley >30 000

A single piece of wood (sample BNA-74-209; 1.8 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 75-6 by L.D. Wilson) was recovered from 0.5 m behind the natural face near the base of a 7 m-high gully exposure of buff-coloured massive and horizontally interbedded coarse to fine sand in the Wrottesley River valley, Boothia Peninsula, Northwest Territories (71°12'30"N, 95°19'W), at an elevation of approximately 150 m. Collected August 1974 by K.A. Drabinsky.

Comment (K.A. Drabinsky): The sample represents a rare preservation in situ of meso-xeric tundra. Vascular plants present were **Dryas integrifolia** and **Saxifraga caespitosa**; mosses: **Encalypta rhabdocarpa**, **Orthothecium chryseum**, **Bryum** sp. (non Sec. **pseudotriquetra**), **Tortula ruralis**, **T. norvegica**, **T. mucronifolia**, **Barbula** sp. cf. **rigidula**, **Platydictya jungermanoides**, **Pseudostereodon procerrimum**, **Ditrichum flexicaule**, and **Myurella julacea**; of these 11 mosses, **Encalypta** and **Ditrichum** were common (unpublished GSC Bryological Report No. 315 by M. Kuc). Initial deposition of the fluvial sand occurred prior to 30 000 BP, when the meso-tundra environment dominated. Subsequent stream erosion dissected much of what was once a continuous sand plain into terraces and erosional remnants. No stratigraphic evidence of a glacial event was observed in the section, however, it appears that the sand overlaps onto the adjacent till-covered bedrock upland to the east.

Comment (W. Blake, Jr.): The wet sample was oven dried and the largest single piece of wood (6 cm long, 1.8 cm in diameter, with tapered ends) decreased in weight from 7.0 to 2.5 g. Adhering sand was then scraped off. The entire mass of twigs weighed 46.5 g wet. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Wrottesley Valley series (I)

Shells and driftwood from two localities in the Wrottesley Valley, Boothia Peninsula, Northwest Territories. Collected July 1978 by A.S. Dyke.

GSC-2722. Wrottesley Valley (I) 9040 ± 100 $\delta^{13}C = +1.1‰$

Marine pelecypod shells (sample DCA-78-S4; 27.3 g; **Mya truncata**; identified by W. Blake, Jr.) from a small pocket of silt coarsening upward to sand and filling a depression in till on the western side of Wrottesley Valley (69°57'30"N, 95°24'W), at an elevation of 123 to 126 m (altimeter determination).

Comment (A.S. Dyke): Most shells, the highest collected on northwestern Boothia Peninsula, were paired at the time of collection. The periostracum was present on many valves and some siphon sheaths were still intact. The sample relates to a relative sea level of $\geq$126 m and provides a minimum age for the local marine limit recorded by perched deltas at 155 m and hence for the date of deglaciation.

Comment (W. Blake, Jr.): In addition to **Mya truncata** the collection contained **Hiatella arctica** and **Macoma calcarea**, but only aragonitic **Mya** valves were used for dating. Paired valves of all three species were present in the collection. The **Mya** valves had some Fe-staining but in general exhibited good internal lustre. The dated samples included 13 right and 11 left valves; the size range was 3.7 x 2.5 cm to 2.5 x 1.7 cm. Date is based on two 1-day counts in the 2 L counter.

GSC-2782. Wrottesley Valley (II) 150 ± 50

Driftwood (sample DCA-78-WD1; 11.7 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 78-56 by R.J. Mott), from the surface of a raised beach ridge near the shore of Wrottesley Inlet, west of Wrottesley River (71°17'05"N, 95°35'30"W), at an

elevation of 2 m above high tide (altimeter measurement).

Comment (A.S. Dyke): The wood was expected to be about 300 years older than the age determination. The young date indicates rapid contemporary emergence of about 1 m/century, redeposition of the log, possibly by sea ice pushing, or problems inherent in dating material of very young age (material radiocarbon dated in this age range could be as much as 270 calendar years old (Stuiver, 1982; Stuiver and Pearson, 1986)). The date does demonstrate, however, that driftwood from the boreal forest belt does not spend much time in transit on the Arctic Ocean prior to being stranded on the coastlines (cf. Blake, 1975).

Comment (W. Blake, Jr.): This clean, fresh-looking wood was part of a log, with a maximum diameter of 12 cm. After the outermost 3 or 4 rings were cut away, the next 15 rings were used for dating. Date is based on two 1-day counts in the 5 L counter.

Wrottesley Valley series (II)

Two age determinations were carried out on a 120 cm- thick peat and the underlying mineral soil with organics, continuously sampled, from a pit excavated into permafrost with an electric rotary jackhammer, at a site located on northwestern Boothia Peninsula, Northwest Territories (71°04'N, 95°37'W), at an elevation of approximately 145 m. Palynology is in preparation by S.K. Short, University of Colorado, Boulder, Colorado. Collected July 19, 1978 by A.S. Dyke.

GSC-3331. Wrottesley Valley peat (I) 1240 ± 70

Dry, unfrozen peat (sample 78 DCA P2; 50.0 g dry) from 0 to 7.5 cm below surface (active layer). Date is based on two 1-day counts in the 5 L counter.

GSC-3279. Wrottesley Valley peat (II) 4580 ± 70

Peat (sample 78 DCA P23; 133.0 g dry) extracted from mineral soil (calcareous silt), 138 to 144 cm below the ground surface. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 5 L counter.

Comment (A.S. Dyke): The samples were dated to provide chronological control for the first Holocene pollen diagrams for Boothia Peninsula. Frozen peat was sampled in short increments using an 8 cm core barrel and increments were individually canned on site. Excavation exposed 120 cm of frozen peat and silty peat with variable ice contact overlying more than 35 cm of silt with peat. Organic accumulation began in a small wet depression approximately 4600 years ago and ceased due to degradation of ice wedges and subsequent draining of the site sometime after 1240 BP. The top of the peat mounds, each bounded by degraded ice wedge troughs, are presently subject to wind erosion because the active layer is excessively drained.

GSC-2720. Abernethy River 9230 ± 130
$\delta^{13}C = +1.4‰$

A single marine pelecypod shell (sample DCA-78-S8; 11 g; **Mya truncata**; identified by W. Blake, Jr.) from distal foreset sands exposed in a series of small gullies (unvegetated) incised into the foreslope of a large glaciomarine delta on the west side of Abernethy River, Boothia Peninsula, Northwest Territories, 7 km from its headwaters (71°11'15"N, 93°45'W), at an elevation of 185 m (altimeter measurement). Collected August 7, 1978 by A.S. Dyke.

Comment (A.S. Dyke): The foreset sands were deposited contemporaneously with topset gravels which form a plain at 215 m. The sediments were deposited within 1 km or so of a retreating ice margin by meltwaters which cut conspicuous proglacial and lateral channels on the bedrock immediately to the west. This delta is one in a series of 11 such features perched at the marine limit along northeastern Boothia Peninsula, all formed at nearly the same time (Dyke, 1984; GSC Map 1570A; cf. also Dyke, 1979a).

Comment (W. Blake, Jr.): The single aragonitic valve of **Mya** was cleaned in distilled water using a sonic bath. The valve measured 5.0 x 3.9 cm, had minor rusty staining on the exterior surface, and no periostracum; it was not pitted or encrusted. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Hall Beach series

Bone and tissue were collected from a whale carcass (bowhead?) excavated in frozen beach gravel from the hamlet of Hall Beach, Melville Peninsula, Northwest Territories (68° 46.5'N; 81° 13.0'W), at an elevation of 8 m. Collected August, 1983 by L. Simpson, Government of the Northwest Territories, Frobisher Bay.

GSC-3802. Hall Beach Hamlet (I) 1120 ± 60
$\delta^{13}C = -23.0‰$

Whale tissue (sample 83-MIB-HBW (1); 76.0 g dry). Date is based on two 1-day counts (2480 minutes) in the 5 L counter. Uncorrected age: 1090 ± 60 BP.

GSC-3850. Hall Beach Hamlet (II) 1130 ± 60 $\delta^{13}C = -15.1‰$

Whale bone (sample 83-MIB-HBW (2); 107.6 g dry) was treated to extract the collagen. The age estimate is based on three 1-day counts (3500 minutes) in the 5 L counter. Uncorrected age: 970 ± 60 BP.

Comment (R. McNeely): This excellently preserved material was analysed to compare the results on different fractions of the same sample, and to provide information required to assess the various treatments used on bone in preparation for radiocarbon dating.

Although insufficient sample material was available from the original collection to process the bone 'apatite' fraction, two separate fractions, tissue and collagen (83-MIB-HBW 1 and 2, respectively) have been processed and dated with excellent agreement between their corrected ages. L.D. Arnold, Environmental Isotopes Section, Alberta Environmental Centre, Vegreville, Alberta has also processed a portion of the original sample and dated the collagen extracted with excellent agreement (AECV-92C, 1130 ± 90 BP). Additional material was collected in August, 1985 by L.A. Dredge. Subsamples of this material are now available to other laboratories for cross-checking purposes.

Comment (A. Dyke): These dates agree well with GSC-961, 1020 ± 130 years B.P. on marine shells from a stony silt at Hall Beach, 7 m asl (Lowdon and Blake, 1968) and together show that emergence has proceeded at an average rate of about 0.7 m per century during the last 1000 years. Dyke (1974, Figure 3-10) showed a 7.5 m isobase on emergence since 1000 BP passing through the site and a rise in elevation of the 1000 BP shoreline southwards to northern Southampton Island where it is more than 10 m asl. Eight dates on archaeological (palaeo-coastal) sites at nearby Igloolik (Farrand, 1962) provide additional control on the middle and late Holocene sealevel positions. A site 8 m asl was dated 600 ± 150 BP (K-504); sealevel at that time was probably about 4 m above the present level. Two additional dates are useful in constraining sealevel reconstructions in the area: ivory from a site at 21 m dated 2910 ± 129 BP (P-213); and ivory from a site at 50 m dated 3958 ± 168 BP (P-207).

Comment (W. Blake, Jr.): Another comparative series of age determinations, on hair, cartillage, and horn of a Dall's sheep, was reported by Scotter and Simmons (1976; cf. also GSC XIX, 1979, p. 35). With regard to date K-504, cited above, the original comment (Tauber, 1961) was that it related to a position of sea level, relative to the land, approximately 6.5 m above the present, but the point was also made that caribou antler, which was used for the age determination, was not the most reliable material for dating. Numerous other determinations from sites near Igloolik were reported in Pennsylvania IV (1961, p. 10-11), with slightly different elevations for the two sites quoted above (cf. also Meldgaard, 1958; Copenhagen IV, 1960, p. 20-21).

Kokavingnak Island series

Mussel shells collected alive and on the modern beach in a bay on the north side of Kokavingnak Island, Bathurst Inlet, Northwest Territories (67°28'N, 108°07'W).

GSC-106. Kokavingnak Island (I) modern

Marine pelecypod shells (sample BS-325-62) **Mytilus edulis**; identified by W. Blake, Jr.) collected alive from the intertidal zone and in water up to 0.6 cm depth at low tide in a bay on the north side of Kokavingnak Island. Collected August 4 and 5, 1962 by W. Blake, Jr. Two determinations were made:

GSC-106. Inorganic fraction modern

The shell portion of the sample weighed 27.3 g. No leaching of outside shell material with HCl was carried out. Counted in the 2 L counter. Percent activity: +1.82 ± 0.53 relative to the NBS oxalic acid standard.

GSC-106. Organic fraction modern

No weight was recorded for this fraction. The sample was mixed with dead gas prior to counting in the 2 L counter. Percent activity: -3.03 ± 0.89 relative to the standard.

Comment (W. Blake, Jr.): These pelecypods were stored in seawater in bottles until they reached Ottawa. The soft parts of the animals had, for the most part, disintegrated somewhat and had run out of the shells. The activity recorded for the shells indicates some influence by the excess ^{14}C produced by nuclear bomb testing (cf. Lowdon and Dyck, 1974).

GSC-107. Kokavingnak Island (II) modern

Marine pelecypod shells (sample BS-295 & 295A-62; 37 g; **Mytilus edulis**; identified by W. Blake, Jr.) from the line of debris at high tide level on the north side of 'bars' in central Kokavingnak Island. Some shells were loose on the surface, some were tightly intertwined with marine algae in the debris layer. Collected July 30, August 1, 2, 1962 by W. Blake, Jr.

Comment (W. Blake, Jr.): A few **Mytilus** valves had some of the dried soft parts remaining, and all had intact periostracum. Most valves were articulated. Counted in the 2 L counter. Percent activity: -1.54 ± 0.52% relative to the standard.

GSC-3830. Escape Rapids 3560 ± 60

Black peat (sample ESR-3; 55.2 g damp) at a depth of 90 cm, from an exposure on the right (east) bank of a stream which has cut through a small thermokarst depression developed in postglacial marine deltaic sand and silt beds. The sample site is located 2.8 km south of Escape Rapids on the Coppermine River, Northwest Territories (67°35'32"N, 115°27'42"W), at an elevation of approximately 140 m. Collected July 24, 1981 by M-A. Geurts, Université d'Ottawa, Ottawa, Ontario.

Comment (M-A. Geurts): This date is in agreement with GSC-3393 (4470 ± 70 BP; GSC XXIII, p. 26), peat (DS-81-21) at 110 cm depth collected in the same section by D.A. St-Onge in 1981. GSC-3830 also fits with two other peat samples, ESR-1 at 30 cm depth (2550 ± 75 BP; LV-1450) and ESR-2 at 60 cm depth (3050 ± 75 BP; LV-1451), both collected by M-A. Geurts from higher in the same section in 1981. The peat is dominated by sedges, with a few twigs; for a palynological interpretation of the section see Geurts (1985). The sample received the standard pretreatment with NaOH, HCl (no reaction) and distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

Northern Canada, Arctic Archipelago

Coronation Gulf/Victoria Island

GSC-117. Coronation Gulf 230 ± 100

Marine pelecypod shells (29.9 g; **Mytilus edulis**, identified by the late W.H. Dall, U.S. Geological Survey) collected on the modern beach at four localities around Coronation Gulf, Northwest Territories; with approximate coordinates (exact localities not known), as follows: 1. Station 38, beach on Couper Island (67°55'N, 114°40'W); 2. Station 47a, beach on Richardson Island (68°30'N, 110°40'W); 3. Station 47b, bay east of Lady Franklin Point, Victoria Island (68°28'N, 113°15'W); and 4. Station 47, station at Austin Bay, Victoria Island (68°30'N, 113°00'W) (Dall, 1919). All shells were probably collected within 0.3 to 1.0 m above high tide level. Collected in March and April, 1916, by F. Johansen, Canadian Arctic Expedition; submitted 1962 by W. Blake, Jr.

Comment (W. Blake, Jr.): These shells were dated as part of a long series to obtain information on the 'reservoir effect' in waters of the Canadian Arctic, using shells collected in pre-nuclear bomb times. Obviously it was far from ideal to use shells from four different sites, but that was the only way to obtain enough shell material for counting in a conventional counter. None of the pelecypods were collected alive, and the assumption was made that they had been washed up on the beach by storm waves, or that they had been pushed up by sea ice action, within a few years of the time they were collected.

All shells had the periostracum preserved, at least in part. Several were paired valves, and in one case the valves were still articulated. The shells had been stored in boxes in the National Museum of Natural Sciences since the return of the expedition. Percent activity: -2.38 ± 0.57 relative to the standard.

Banks Island

Ballast Brook series

Samples of peat from three localities in the vicinity of Ballast Brook, northwestern Banks Island, Northwest Territories. The sample used for GSC-1088 was collected by J.G. Fyles, July 1968. The samples used for GSC-1112 and -1144 were collected July 1968 and August 1969, respectively, by L.V. Hills, University of Calgary, Calgary, Alberta; both submitted by J.G. Fyles.

GSC-1088. Ballast Brook (I) >41 000

Moss peat (sample FG-68-13b; >700 g submitted, but only about 200 g remained after sieving; **Drepanocladus intermedius**; unpublished GSC Bryological Report No. 3 by M. Kuc) exposed in a steep slide area in the east (right) wall of a valley 8 km east of Ballast Brook and 4.8 km from its mouth, Banks Island (74°25'N, 122°34'W). The moss layer (up to 5 cm thick) occurred 2.5 cm above the base of a 2.1 m-thick silt and sand unit, beneath 0.9 m of pebble gravel, and overlying >9 m of silty sand (partly exposed) plus 18 m of pebble gravel with beds of silty sand (also partly exposed). The dated moss layer was 2.7 m below the ground surface.

Comment (W. Blake, Jr.): The submitter interpreted the sediment sequence as valley-fill deposits (fluvial and lacustrine) that accumulated when the natural drainage northward was blocked by either glacier ice or a moraine. Similar deposits nearby were deformed as if by glacier ice. If this interpretation is correct, the submitter believed that the date would approximate the time of the last glacier advance to its maximum extent in M'Clure Strait (Fyles, 1969). For a more recent interpretation of the deposits and chronology on Banks Island the reader is referred to Vincent (1978, 1980, 1982, 1983a, 1983b, and 1984). The sample received the standard treatment with NaOH and HCl leaches plus distilled water rinses. Date is based on two 1-day counts in the 2 L counter.

GSC-1112. Ballast Brook (II) 8380 ± 150

Moss peat (sample FG 68/H-63-2; 103 g) from the east side of the valley of Ballast Brook, 9.6 km from its mouth (74°23'N, 123°06'W). The peat is from a

30 cm-thick peat layer just below the middle of a 2.7 m-thick unit of gravel, sand and peat beneath a 4.5 m-thick unit of yellow, cobbly gravel. The sequence of sediments containing the peat is underlain by 3 m of laminated silt.

Comment (W. Blake, Jr.): The peat-bearing deposit was interpreted by the submitter as dating from a period of alluviation following ice-marginal ponding in the valley when it was blocked by an ice tongue in M'Clure Strait and/or the moraine along the north coast of Banks Island at or shortly after the maximum of the last glaciation. The possibility of a younger age, which would seem to be the case, was noted by the submitter. For more details on Banks Island see the references by Vincent cited earlier in this series. The sample was picked over by the submitter to remove suspicious-looking rootlets, etc. The sample received the standard treatment as outlined under GSC-1088 (this series). Date is based on two 1-day counts in the 5 L counter.

GSC-1144. Ballast Brook (III) 8810 ± 150

Moss peat (sample FG-68 (H-4) depth 123"-126"; 70+ g; mainly **Drepanocladus revolvens** and **Calliergon giganteum**; unpublished GSC Bryological Report No. 5 by M. Kuc) from a relatively fresh exposure (active deep V-shaped gully) in the bottom of a valley tributary to Ballast Brook (74°18'N, 122°50'W), at an elevation of approximately 120 m. The peat represents the basal part of a valley bottom peaty fill about 3 m thick, developed on upper Beaufort Formation sands and gravels. The valley is now truncated by the wall of Ballast Brook.

Comment (W. Blake, Jr.): The submitter intended the sample to provide a comparison with GSC-112 (8380 ± 150 years, this series) from a valley some 8 km distant. The material submitted for dating was handpicked (by JGF) to avoid thin woody flakes that might have represented blown-in or washed-in Beaufort wood (the valley is cut into sediments of the Beaufort Formation). For more details on Holocene events on Banks Island the reader is referred to the references by Vincent cited under GSC-1088. Because of the small sample size only a cold NaOH leach was applied, followed by an HCl leach and distilled water rinses. Date is based on one 3-day count in the 5 L counter.

Baffin Island

Noel Harbour series

Marine shells collected alive on boulders and cobbles exposed at low tide at the head of Noel Harbour, Crooks Inlet, Baffin Island, Northwest Territories (63°10'N, 70°53'W). Collected June 25, 1965 by W. Blake, Jr. and by the late F.M. Synge, Geological Survey of Ireland, Dublin.

GSC-639. Noel Harbour (I) 0 ± 130

Marine gastropod shells (sample BS-45-65; ~290 g, including water; **Littorina saxatilis**; identified by A.H. Clarke, Jr., then at National Museum of Natural Sciences, Ottawa). Two determinations were made:

GSC-639. Inorganic fraction 0 ± 130

The shells were given no pretreatment, and 50.3 cm of CO_2 were obtained when the shells were dissolved in acid. Date is based on one 4-day count in the 5 L counter.

GSC-639. Organic fraction 0 ± 150

The 'meat' was leached overnight in phosphoric acid while the carbonate portion was reacting, rinsed twice in warm water, and given four decant washes, followed by oven-drying. 6.0 g of material was burned, producing 20.5 cm of CO_2. Date is based on two 1-day counts in the 2 L counter.

GSC-659. Noel Harbour (II) 10 ± 130

Marine cirriped shells (sample BS-46-65; ~85 g including water; **Balanus balanoides**; identified by W. Blake, Jr.). Two determinations were made:

GSC-659. Inorganic fraction 10 ± 130

The shells were given no pretreatment, and 47.5 cm of CO_2 were obtained when the shells were dissolved in acid. Date is based on two 1-day counts in the 5 L counter.

GSC-659. Organic fraction 0 ± 200

After the carbonate fraction had been dissolved in the shell apparatus, the 'meat' was given four ½ hour rinses in warm water, then dried. Only 1.0 g of material was burned; the yield was 2.8 cm of CO_2. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): The 'modern' age determined for these samples indicate some influence by the excess ^{14}C produced by nuclear bomb testing, which reached a peak in 1964 (Lowdon and Dyck, 1974). Pelecypods collected alive in 1894 off northern Baffin Island give, for example, an age of 280 ± 90 years (GSC-3671, this list).

Noble Inlet series

Five shell samples from Noble Inlet, southeastern Meta Incognita Peninsula, Baffin Island, Northwest Territories. Collected August 1981 by G.H. Miller, INSTAAR, University of Colorado, Boulder, Colorado, U.S.A.

GSC-3404. Noble Inlet (I) 8240 ± 90
$\delta^{13}C = +1.2‰$

Whole marine pelecypod valves, mostly paired (sample M81-Bsh-32; 23.6 g; **Hiatella arctica**; identified by G.H. Miller) from sandy silt bottomset beds of a marine delta in Noble Inlet, southeastern Meta Incognita Peninsula, Baffin Island (62°05.4'N, 66°08.5'W), at an elevation of 2 m above high tide level. The delta surface is at 9 m and the local marine limit is at about 45 m above high tide level.

Comment (G.H. Miller): An ice-contact glaciomarine delta complex at this site extending to approximately 45 m a.s.l., contains abundant striated limestone clasts. After ice recession up Noble Inlet (to the west), the ice-contact unit was dissected by fluvial erosion below present sea level, then back-filled by nonglacial marine sediment to 9 m above high tide level by a subsequent marine transgression. This collection dates the transgression to the 9 m level. Shells collected from the distal facies of the ice-proximal glaciomarine unit have yielded amino acid ratios suggesting a late Foxe (Wisconsinan) age for the last glaciation of the site.

Comment (W. Blake, Jr.): This well preserved sample contained shells that were all less than 2 mm thick, most were less than 1 mm. The shells were washed in distilled water to remove adhering mud, then air dried. The dated sample comprised 13 left valves (11 whole, 2 broken) plus 19 right valves (10 whole, 9 broken). All shells retained good internal lustre, good external ornamentation, but no periostracum and relatively little chalkiness. The valves are 2.0 to 3.7 cm long, 0.9 to 2.0 cm high). The smallest valves are juveniles. Because of the small sample size only the outer 10% of shell material was removed with HCl leach. Date is based on one 3-day count in the 2 L counter.

GSC-3468. Noble Inlet (II) 8660 ± 110
$\delta^{13}C = +0.7‰$

Marine pelecypod shells (sample M81-Bsh-73; 17.3 g; **Hiatella arctica**; identified by G.H. Miller and W. Blake, Jr.) from silty sand in an extensive, ice-contact delta (surface 40 m) in easternmost Kendall Strait, Baffin Island (62°09.4'N, 66°02.4'W), at an elevation of 3 to 10 m. This large ice-contact delta was created during regional deglaciation by a glacier flowing toward the northeast from a dispersal centre located south of Baffin Island. The ice-contact delta is coarse-grained and contains fragmented and abraded shell fragments, but no in-situ shells. Beyond the delta proper, the landscape is draped with sandy silt considered to represent a distal facies of the delta. Whole marine pelecypod shells occur in the silts, but not in any concentration. Shells collected from gullies eroded into the silts were submitted for radiocarbon dating.

Comment (G.H. Miller): Silts enclosing the shells contain ca. 20% carbonate in the <2 mm fraction and are clearly derived from a source other than the local Precambrian rocks. The interpretation that they are a distal facies to the main delta deposition is supported by the polished and striated surface underlying the silts indicating ice flow N15°E. The shells are considered to date the time when northeast-flowing ice paused in Kendall Strait during regional deglaciation, at a time when relative sea level stood ca 40 m above present.

Comment (W. Blake, Jr.): In addition to thin **Macoma calcarea** shells and thick **Mya truncata** shells (identified by G.H. Miller), one fragment of **Serripes groenlandicus** was found in the collection. In selecting a sample for dating, thick, corroded or encrusted **Hiatella arctica** valves, as well as those with lichens, were avoided. The dated sample comprised one intact left valve and 15 fragments plus 1 intact right valve and 17 fragments. All shells utilized were <1 mm thick except in the hinge areas and at the posterior ends. Most shell fragments retained internal lustre, but no periostracum. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3469. Noble Inlet (III) 8580 ± 150
$\delta^{13}C = -0.8‰$

Marine pelecypod shells (sample M81-Bsh-34; 12.2 g; **Macoma calcarea**; identified by G.H. Miller) from a stoney silt unit containing abundant striated limestone erratics, at Noble Inlet, Baffin Island (62°05.3'N, 66°08.4'W), at an elevation of 16 m.

Comment (G.H. Miller): Some shells were paired, usually **Macoma calcarea** which was the dominant faunal element. The fauna was relatively diverse, and included the subarctic species **Chlamys islandica**. The shells were collected at 16 m aht, and they relate to a relative sea level, probably, at about 20 m above high tide level, but possibly as high as 40 m, the local marine limit.

Comment (W. Blake, Jr.): The shells were fairly well preserved although fragments were more abundant than whole shells. The largest single valve measures 3.6 cm wide, 2.6 cm high. Some of these **Macoma** appear thicker than is normal for the species; a few individuals that were especially thick in the hinge area were excluded for this reason. The shells retained no periostracum, no internal lustre, and although they were somewhat chalky, they had no pitting or incrustations. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3648. Noble Inlet (IV) 8600 ± 110
$\delta^{13}C = +1.5‰$

Paired valves and fragmented whole valves (sample M81-BSh-65; 18.9 g; **Mya truncata**; identified by G.H. Miller) from a freshly exposed wave-eroded face in a small perched delta near the mouth of an unnamed inlet south of Noble Inlet, Baffin Island (62°0.8'N, 66°06'W), at an elevation of 10 m. The delta lip was at 20 m a.s.l., the apex at 26 m and the washing limit at 32 m. Local marine limit is considered to be between 28 and 30 m a.s.l.

Comment (G.H. Miller): Shells from this collection were originally dated by Geochron Labs at 9190 ± 195 BP (GX-8194; Osterman et al., 1985), and later the same sample was recounted at 9310 ± 220 BP (GX-9766). The difference in the reported dates between the two laboratories is because the Geochron Labs normalize all dates to a $\delta^{13}C$ of -25‰, whereas the GSC lab normalizes to 0‰, causing a built-in discrepancy of 400 years. If this amount is added to the GSC date, the ages reported by the two laboratories are not statistically different.

The delta from which the shells were collected contains abundant striated limestone erratics, rapidly changing and locally chaotic sedimentary structures, and it is located in an area presently without a significant fluvial source area, consequently its relationship to a nearby ice margin is secure. The shells date a time during regional deglaciation when northeast-flowing ice was receding from southeastern Meta Incognita Peninsula. Striae underlying the delta are oriented S 80°E, reflecting local topographic control in this east-west trending valley. Striae on the hill summits directly above the site (200 m a.s.l.) range between N 75°E and N 45°E.

Comment (W. Blake, Jr.): The dated sample comprised all fragments (10 right, 7 left) which included the truncated posterior end. The largest fragment measured >3.5 x >2.0 cm, with a maximum thickness of 2 mm. Some periostracum remained on most fragments.

GSC-3951. Noble Inlet (V) 8620 ± 100
$\delta^{13}C = +1.3‰$

Whole marine pelecypod shells (sample M81-BSh-41; 23.4 g; **Hiatella arctica**; identified by G.H. Miller) from stone-free clayey silts collected at Noble Inlet, Baffin Island (62°06'N, 66°07'W), at approximately 2 m below mean high tide level.

Comment (G.H. Miller): The fauna in GSC-3951 was composed exclusively of **Hiatella arctica**. Initial amino acid analyses of three shells suggested an age <15 ka. This date, plus GSC-3469 and -3404, outline a sequence of events in inner Noble Inlet. The glacial events are related to ice flowing out of Hudson Strait in a generally northeasterly direction across southeastern Meta Incognita Peninsula. The dates suggest that a minor readvance occurred in inner Noble Inlet during regional deglaciation. GSC-3951 (8620 ± 100 BP) heralds the approaching ice margin, GSC-3469 (8580 ± 150 BP) dates ice contact sediment in Noble Inlet, and GSC-3404 (8240 ± 90 BP) dates sediment of clearly non-glacial, normal marine origin. Collectively these three dates suggest that the readvance was brief and that Noble Inlet was finally deglaciated approximately 8400 years ago.

Comment (W. Blake, Jr.): Eight intact left valves (plus one fragment) and eight intact right valves (plus 3 fragments) were submitted for dating. Size range: 3.4 x 1.8 cm to 2.4 x 1.2 cm. Some valves were less than 1 mm in thickness. Exterior surfaces were chalky but had good ornamentation. Most valves retained good internal lustre, some Fe-stain was present, but no incrustations. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Date is based on one 2-day count in the 2 L counter.

GSC-3666. Pugh Island 8590 ± 100
$\delta^{13}C = +1.5‰$

Marine pelecypods (sample BF-82-8 (UWO-007); 27.8 g; **Hiatella arctica**; identified by G.H. Miller) collected in silty sand near the northwestern end of Pugh Island, 55 km southeast of the settlement of Iqaluit (Frobisher Bay), Baffin Island, Northwest Territories (63°15.5'N, 68°11'W), at an elevation of approximately 25 m above high tide level. Shells collected July 26, 1982 by J.D. Jacobs, University of Windsor, Windsor, Ontario, and W.N. Mode, University of Wisconsin-Oshkosh, Oshkosh, Wisconsin.

Comment (G.H. Miller): The shells were collected from this island in order to verify an earlier date on shells from the same general area and elevation collected by M. Algus (McGill University, Montreal) in August 1979. That sample dated 9875 ± 130 (QC-903; Osterman et al., 1985; Andrews and Miller, 1985). Even after adding the 400 year compensation factor to the GSC date the two dates are discordant at the two sigma confidence level. It remains uncertain whether this discrepancy is due to laboratory counting errors or that the two collections are from distinctly different shell samples. The date does provide a minimum on deglaciation of the large island chain separating inner Frobisher Bay from the more open outer two thirds of the Bay. The new GSC date is in keeping with the timing of the readvance to the Frobisher Bay moraines during the Cockburn Substage.

Comment (W. Blake, Jr.): The sample submitted to the laboratory comprised 20 right valves and 10 left valves; most were whole. The internal surfaces retained no lustre, but good ornamentation

characterized the exterior of most valves. Some staining was noticed, and some shells had started to break down into layers. The largest valve measured 3.5 x 1.8 cm; all shells were <1 mm thick. No periostracum or ligament remained. There is no reason, from a laboratory point of view, to doubt the validity of this date. The sample received the normal HCl leach to remove the outer 20% of shell material. Date is based on one 3-day count in the 2 L counter.

GSC-2771. Burton Bay 7380 ± 220

Marine pelecypod shell fragments (sample Burton #7 (GRL-591-S); 8.5 g; **Mya truncata** and **Mya** sp.; identified by W. Blake, Jr.) from a stream cut north of Burton Bay, Baffin Island, Northwest Territories (63°43'N, 68°15'W), at an elevation between 5 and 11 m. The shells were collected from the ground surface and in what appeared to be a 5 to 10 cm-thick bed of slumped bank material; the source bed was not found. The top of the bank was at 13.7 m a.s.l. Collected August 13, 1978 by L. Ostermann, INSTAAR, University of Colorado, Boulder, Colorado; submitted by G.H. Miller of the same institution.

Comment (W. Blake, Jr.): No comments were made when this date was published (cf. Andrews, 1983, p. 27). The estimated age for this site, west of the Frobisher Bay moraine, was 5700 to 6700 years, so the sample is slightly older than expected. In spite of this the date has been used in constructing an emergence curve for inner Frobisher Bay (Jacobs et al., 1985). **Macoma** sp. and **Portlandia** sp. (identified by W. Blake, Jr.) were present in the collection also. The dated sample comprised 38 fragments (of which at least 20 have typical **Mya truncata** characteristics, such as the truncated posterior end). The largest fragment measured 2.3 by 2.6 cm. Some bits of periostracum remained, and some Fe-stain was noted. None of the fragments were pitted or exceptionally chalky, and the internal lustre was intact in some cases. Because of the small sample size, only the outer 10% of shell material was removed with HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Gold Cove series

Marine pelecypod shells from three sites near the head of Gold Cove, outer Frobisher Bay, Baffin Island, Northwest Territories. Collected August 6 or 8, 1978 by G.H. Miller.

GSC-2725. Gold Cove (I) 10 100 ± 110
$\delta^{13}C = +1.4‰$

A single marine pelecypod shell (GRL-582-S; 23.0 g; **Mya truncata**; identified by G.H. Miller) enclosed in crudely stratified sediments ranging from coarse sand to sandy silt, in the main valley due east of the head of Gold Cove, Frobisher Bay (62°57'N, 65°50'W), at an elevation of 73 m above high tide level. The dated shell was part of a collection consisting exclusively of paired valves of **Mya truncata** excavated between 10 and 40 cm depth. Shells were locally abundant and other species included **Hiatella arctica** and **Balanus** cf. **balanus**.

Comment (G.H. Miller): The deposit from which the shells were collected is considered to represent the local marine limit (74 m), but this sand-silt unit is 5 m above the level of a prominent washing limit only 6 km south of this site. Similar robust valves of **Mya truncata** were located at several sites in the same valley at or slightly lower than the 73 m level. At one other site the deposit contained numerous robust unabraded paired valves of both **Mya truncata** and **Hiatella arctica** (identified by G.H. Miller). The shell-bearing beds are interpreted as intertidal deposits formed at the marine limit immediately upon deglaciation.

Comment (W. Blake, Jr.): A single right valve was used for dating. The shell material itself is aragonitic, but a small area of secondary precipitate on the internal surface (mainly calcite) was removed by scraping prior to laboratory pretreatment. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Date is based on two 1-day counts in the 2 L counter.

GSC-2778. Gold Cove (II) 10 200 ± 210
$\delta^{13}C = +2.1‰$

A single right pelecypod valve (sample GRL-586-S; 10.6 g; **Mya truncata**; identified by G.H. Miller) collected from an excavation in frost boils on a narrow terrace immediately west of the head of Gold Cove, Frobisher Bay (62°56'N, 65°52'W), at an elevation of 78 m above high tide level. The shell is one of several large angular fragments collected in unsorted to crudely stratified sediment between 10 and 50 cm below the ground surface.

Comment (G.H. Miller): A previous (1977) collection from the same terrace was dated at 12 150 ± 140 BP (QC-543), but consisted of 12 fragmented valves of **Mya truncata**. The essentially unstratified nature of the enclosing sediment, the lack of whole paired valves, and the elevation above the local marine limit all indicate transportation of the shells to their present location by a glacier. Note that in situ paired valves of **Mya truncata** from 73 m a.s.l. collected approximately 5 km east of this site gave a ^{14}C age of 10 100 ± 110 BP (GSC-2725; Miller, 1979, 1980; this series), statistically identical with this sample.

Comment (W. Blake, Jr.): The dated sample was part of a single right valve, with the truncated posterior end intact. No periostracum remained on this aragonitic shell, but the shell was not chalky

either. Some internal lustre remained. The shell was 2 to 4 mm in thickness. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2813. Gold Cove (III) 10 000 ± 200
$\delta^{13}C = +1.0‰$

A single large pelecypod shell (sample GRL-587-S; 8.0 g; **Mya truncata**; identified by G.H. Miller) from the surface of a frost boil immediately northwest of the head of Gold Cove, outer Frobisher Bay (62°56.8'N, 65°51.5'W), at an elevation of between 219 and 232 m. The till locally contains abundant limestone erratics, and the carbonate content in the fine fraction is 10 to 20%.

Comment (G.H. Miller): "A previous collection consisting of 17 fragmented valves of **M. truncata** collected from till slightly lower on the same hillslope gave an apparent age of 9725 ± 130 BP (QC-544; Miller, 1979). This new date on a single robust valve is considered more reliable and supercedes QC-544." (Miller in Andrews, 1983; cf. also Miller, 1980).

Comment (W. Blake, Jr.): Only the single largest right valve was used for dating, despite its 'old' appearance. Part of the same valve was utilized earlier for amino acid determinations. Dimensions: >4.2 cm long, >2.4 cm high, and the maximum shell thickness exceeded 4 mm. A slight adhering grey-coloured encrusting layer, present in places on both internal and external surfaces, was scraped off. No lustre remained on this hard shell; there was no chalkiness, but some pitting. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2750. Peter Force Sound 9510 ± 90
$\delta^{13}C = +1.8‰$

Mostly whole valves of marine pelecypod shells (sample GRL-573-S; 36.2 g; **Mya truncata**; identified by G.H. Miller) enclosed in sandy silt excavated from a pit dug into the wave-cut face of a marine delta at the northeast end of Peter Force Sound, outer Frobisher Bay, Baffin Island, Northwest Territories (63°02.5'N, 65°48'W), at an elevation of 16 m above high tide level. The shells were thin-walled and considerably less robust than the higher-elevation shells in Gold Cove, a few km to the southeast. The delta consists of foreset beds of medium to coarse sand grading to a terrace level of 40 m. Collected August 4, 1978 by G.H. Miller and J.D. Jacobs.

Comment (G.H. Miller): The shell bed is considered to relate to the 40 m level. Based on observations of modern deltas, the marine level to which the delta relates may be three to four metres higher than the delta surface (high tide level). Occasional limestone pebbles were encountered in the delta. In addition to **Mya truncata** (most abundant), the unit sampled contained **Hiatella arctica**, **Macoma calcarea**, **Chlamys islandica**, **Balanus** cf. **balanus**, and **Astarte** sp. (identified by G.H. Miller). This date indicates that sea level fell from approximately 75 m at 10 100 BP to between 40 and 44 m by 9500 BP.

Comment (W. Blake, Jr.): Only aragonitic **Mya truncata** shells were used for dating; 16 left and nine right valves, some of which were fragmented or had pieces missing. The largest valve measured 4.4 by 3.5 cm, the smallest whole valve was 2.7 by 2.0 cm. In general the shells were well preserved, and those with secondary precipitates were not used. Some shell fragments had traces of adhering silt and/or Fe-stain. Because of the small sample size only the outer 10% of shell material was removed with HCl leach. Date is based on one 3-day count in the 5 L counter.

GSC-2752. Osborn Bay 9960 ± 230
$\delta^{13}C = +2.4‰$

Fragments of marine pelecypod shells (sample GRL-540-S; 5.5 g; **Mya truncata**; identified by W. Blake, Jr.) from the surface of silty frost boils, west of the outlet of a prominent lake on the north side of the first large bay south of Osborn Bay, eastern Loks Land, outermost Frobisher Bay, Baffin Island, Northwest Territories (62°26'N, 64°26'W), at an elevation of 19 m. Local marine limit defined by well-developed washing limit was 20 m above high tide level. Collected August 17, 1977 by G.H. Miller.

Comment (G.H. Miller): The shells were collected immediately below a prominent washing limit developed on till. The date provides a minimum age for deglaciation. The till has a fresh appearance, includes perched boulders, and abundant limestone erratics. Other than **Mya truncata** only occasional robust fragments of **Hiatella arctica** were present (identified by G.H. Miller). This date is somewhat younger than expected, given the date on deglaciation from Countess of Warwick Sound of ca. 10 760 ± 150 BP (QC-480c; Miller, 1979) some 70 km up-bay from this site. If the Loks Land till is of late Foxe age, then the maximum transgression of the sea must have occurred a minimum of 500 and perhaps 1000 or more years after deglaciation of outermost Frobisher Bay.

GSC-2618. Allen Island 9230 ± 100
$\delta^{13}C = +0.9‰$

Marine pelecypod shells (sample GRL-556-S; 27.3 g; **Hiatella arctica**, identified by G.H. Miller)

from a wave-eroded bank in a sandy marine terrace near an outpost camp on Allen Island, Baffin Island, Northwest Territories (63°29.7'N, 64°58'W), at elevations between 2 and 6 m above high tide level. Numerous paired valves indicate that the shells were in situ, and the terrace surface to which the shells relate is at 15 m. Collected August 28, 1977 by G.H. Miller.

Comment (G.H. Miller): The terrace from which these shells were collected represents the maximum late Foxe marine transgression. The sediments were derived by the reworking of older, higher, ice-contact glaciomarine sediments in the vicinity. Amino acid ratios in shells from the higher sediments indicate a mid Foxe age (0.06 and 0.03 combined and free allo/iso ratios, respectively). The 15 m terrace level occurs at several places in the immediate vicinity of this collection. There is no evidence for late Foxe ice reaching this locality.

Comment (W. Blake, Jr.): The sample comprised relatively thick, chalky, and pitted (holes) **Hiatella arctica** shells; 12 right valves and 11 left valves were used, of which the largest measured 3.5 x 1.8 cm. Neither internal lustre nor periostracum was preserved on any of the shells. **Mya truncata** valves were also present (chalky and relatively thin), but they were not used for dating. Date is based on two 1-day counts in the 2 L counter.

GSC-2582. Cyrus Field Bay 9240 ± 80
$\delta^{13}C = +1.8‰$

Marine pelecypod shells (sample GRL-546-S; 46.7 g; **Hiatella arctica**, identified by G.H. Miller). In a greyish silty sand unit within an extensive raised marine complex at the head of Frenchman Cove, Cyrus Field Bay, eastern Hall Peninsula, Baffin Island, Northwest Territories (63°02.7'N, 65°19.5'W). The shells were collected primarily at an elevation of 5 m above high tide level, but some were collected up to 9 m. The top of deposit is at 11 m. Collected August 19, 1977 by G.H. Miller.

Comment (G.H. Miller): The raised marine complex in Frenchman Cove extends many kilometres inland and contains numerous marine levels. The uppermost water-laid deposits were located at 103 m and consisted of well-sorted stratified fine sand to gravel. Lower prominent terrace levels were located at 40, 28 and 14 m. The dated shells relate at least to the 14 m level. All higher levels were barren of shells. The maximum late Foxe transgression may have reached the 28 m level. Most shells were paired, and were clearly in situ. Other species found at the sample site were **Mya truncata**, **Balanus** sp., **Astarte** cf. **striata**, and a brachiopod (identified by G.H. Miller). If late Foxe ice was present in this valley, it was a considerable distance up-valley at the time these shells were living.

Comment (W. Blake, Jr.): The sample was composed of intact, robust valves; chalky, aragonitic, with little internal lustre, and only a few traces of periostracum remaining. For dating six left valves plus eight right valves were used; the largest measured 4.7 x 2.5 cm, the smallest 3.6 x 1.6 cm. Date is based on one 3-day count in the 5 L counter.

GSC-2568. Cornelius Grinnell Bay 8890 ± 100
$\delta^{13}C = +1.2‰$

Whole valves and fragments of marine pelecypod shells (sample GRL-552-S; 26.3 g; **Mya truncata**; identified by G.H. Miller) from silty sand in a stream-cut bank incised into a raised marine complex. The site is at the mouth of the first main west-side valley down from the head of Cornelius Grinnell Bay, eastern Hall Peninsula, Baffin Island, Northwest Territories (63°43.8'N, 65°04'W), at elevations between 8 to 14 m above high tide level. Shells were rare and most were collected as fragments in float on the cut bank surface, 7 m or more above the level of the stream. The top of cut bank was at approximately 20 m; marine limit is at 24 m. Collected August 26, 1977 by G.H. Miller.

Comment (G.H. Miller): Although the shells were not collected strictly in situ, they are considered to be indigenous to the marine complex and to date the marine limit phase. A second cut bank, 100 m or so north of this locality, revealed paired thin-walled valves of **Hiatella arctica** at the same general elevation, but in a different stratum. Sediment in the delta complex is considered to have been derived from nearby glacial runoff streams, with fiord ice either in contact, or only slightly up-fiord, at the time the molluscs lived. Several ice-contact deltas at similar elevations flank the fiord between this deposit and the fiord head, but shells were not located in any of these features. West of the shell-bearing deltaic complex are innumerable ice-stagnation features that were formed during late- or mid-Foxe time. This site is considered to lie very close to, or at, the maximum limit of late Foxe ice extent in Grinnell Bay. See also GSC-2618 (9230 ± 100 BP; Miller, 1979; this list).

Comment (W. Blake, Jr.): The dated sample comprised nine left and 10 right valves, of chalky yet aragonitic **Mya truncata**. The shells had minor pitting and staining; no internal lustre. The single intact valve, which was also the largest and thickest, measured 4.5 x 4.0 cm, and all fragments included the truncated end typical of the species. Date is based on two 1-day counts in the 2 L counter.

GSC-2474. Ptarmigan Fiord 3010 ± 80
$\delta^{13}C = +2.3‰$

Marine shell fragments (sample GRL-321-S; 10.3 g; **Mya truncata**; identified by G.H. Miller) found as surficial float and excavated from silty frost

boils below a small delta remnant on the west side of the middle reaches of the longer branch of Ptarmigan Fiord, southern Cumberland Sound, Baffin Island, Northwest Territories (64°46.5'N, 66°18'W), at an elevation of 13 m above high tide level. The silts extend to 30 m aht. Collected August 1, 1976 by G.H. Miller.

Comment (G.H. Miller): The shell locality lies within the projected extent of Cockburn-age moraines, and the delta above the shell locality has an oxidation profile 20 cm in depth, typical of other late Foxe sandy deposits. The shells must relate to a sea level $\geq$ 13 m aht, probably at least to the upper limit of silts at 17 m, but no higher than the delta surface at 30 m. The projected age of a relative sea level stand between 13 and 30 m above the present sea level would be 6000 to 9000 BP, in conflict with the radiocarbon age of 3010 BP. No ready explanation for this discrepancy is available, and the date can only be considered unreasonable. By 3000 BP in this area of Cumberland Sound, sea level should have been close to (or below) its present level. Other species at the sample site included fragments of **Macoma** sp., **Clinocardium ciliatum**, **Chlamys** sp. and **Hiatella arctica** (identified by W. Blake, Jr.).

Comment (W. Blake, Jr.): The dated sample comprised five fragments of the truncated posterior end, four umbonal fragments, plus three others. All were clean and somewhat chalky. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2466. Chidliak Bay 8660 ± 160

Marine pelecypod shells and fragments (sample GRL-317-S; 9.0 g; **Hiatella arctica**; identified by G.H. Miller) from massively-bedded blocky silts in a prominent valley 5 km from the fiord head on the west side of inner Chidliak Bay, Baffin Island, Northwest Territories (64°47'N, 66°42'W), at an elevation of between 10 and 15 m. The shells were sparsely distributed throughout the silt unit, and the shells collected by excavation were combined with those collected as float to provide sufficient material for a date. Most excavated shells were paired, some with periostracum intact. Collected July 28, 1976 by G.H. Miller.

Comment (G.H. Miller): A prominent terminal moraine loop crosses the mouth of this valley approximately 2 km west of the collection site; it is associated with an extensive ice-contact deltaic deposit. The blocky silts from which these shells were collected contained interspersed angular rock fragments up to 30 cm and greater in the long axis dimension. The silt unit is interpreted as bottom-set beds deposited as a distal glaciomarine facies, penecontemporaneously with the main ice-contact delta, and the associated angular fragments are most likely dropstones. Hence, the date on shells from these silts provides a close estimate for the period of moraine formation. Relative sea level at this time stood at 46 to 54 m above high tide level, although the silts extend only to 21 m. Other species found in the unit included paired valves of **Hiatella arctica**, **Mya truncata**, **Portlandia arctica** and **Astarte** sp. (identified by G.H. Miller).

The moraine system associated with the terminal loop up-valley from the collection site can be traced northeastward with only intermittent lapses to the head of Cumberland Sound. It almost certainly is equivalent with the Ranger Moraine of Dyke (1979a).

Comment (W. Blake, Jr.): The dated sample comprised eight left valves of aragonitic **Hiatella arctica**, plus two fragments. The pelecypods were 2.5 to 3.7 cm in length; all were thin, worn (no periostracum), chalky, and with a limited amount of internal lustre. Some shells were characterized by a blackish stain, and in general the overall aspect of the shells was not one of the best preservation. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2508. Kipisa 8750 ± 100
$\delta^{13}C = +1.9‰$

Marine pelecypod shells (sample GRL-310-S; 26.6 g; **Hiatella arctica**; identified by G.H. Miller) from a portage immediately west of the Kipisa outpost camp (winter camp), Cumberland Sound, Baffin Island, Northwest Territories (65°27'N, 66°57'W), at an elevation of 39 m above high tide level. The shells were excavated from cryoturbated silty sand, after locating the deposit by shells on the surface of a frost boil. The highest marine (?) terrace in the immediate vicinity was at 44 m. No paired valves were found, but numerous unabraded whole valves were collected, and the shells are considered indigenous. Other shelly deposits are present nearby to a maximum elevation of 40 m. Collected July 23, 1976 by G.H. Miller and M.T. Anderson.

Comment (G.H. Miller): The collection contains **Mya truncata**, **Chlamys islandica**, **Astarte** sp., **Balanus** sp. and a brachiopod in addition to **Hiatella arctica** (identified by G.H. Miller). The subarctic water-mass indicator species **Chlamys islandica** has only been found in collections younger than 8400 BP along northern Cumberland Peninsula, suggesting that the incursion of relatively warm marine waters along eastern Baffin Island penetrated Cumberland Sound a few centuries before reaching the northern Cumberland Peninsula coast. Relative sea level at the time these molluscs lived

cannot be precisely determined, but was probably ≥44 m. Moraines of Cockburn age occur up-fiord from this locality, but it is uncertain whether an earlier late Foxe advance covered the site.

Comment (W. Blake, Jr.): The sample used for dating comprised thick (up to 5 mm) valves of **Hiatella arctica** only. The exterior shell surfaces were chalky and pitted, but a few retained lustre on the interior. The sample, from which all adhering silt was removed by scraping, included four intact left valves, three intact right valves, and four fragmented right valves; the largest were 3.2 cm long, 2.0 cm high. Date is based on two 1-day counts in the 2 L counter.

GSC-2478. Kingnait Fiord 8680 ± 140
$\delta^{13}C = +2.2‰$

Marine shell fragments (sample GRL-308-S; 10.4 g; **Mya truncata**; identified by G.H. Miller) from a wave-eroded face in a low delta at the head of the first small inlet immediately southeast from the mouth of Kingnait Fiord, Baffin Island, Northwest Territories (65°47.2'N, 65°23.4'W), at an elevation of 5 m above high tide level. The site is approximately 200 m east of the main river mouth, in a limited deposit of sandy silt at 5 m above high tide level. The top of the feature and inferred relative sea level at the time the shells were living is 12 m above high tide level. Collected July 18, 1976 by G.H. Miller.

Comment (G.H. Miller): The shells are locally common, but fragmented, and the fauna is typical of early Holocene shell samples found elsewhere on Baffin Island, including **Hiatella arctica**, **Mya truncata**, **Astarte** sp., **Balanus** sp. and the brachiopod **Hemithyris psittacea** (identified by G.H. Miller). Higher marine planes were identified above the 12 m (Holocene) level, with strong levels at 46 and 84 m aht but none contained molluscan fossils. The reported date is similar to other dates in Cumberland Sound on the maximum limit of Holocene marine submergence (e.g. GSC-2083; 8480 ± 270 BP; GSC XV, 1975, p. 20; Dyke, 1979b; GSC-2466; 8660 ± 160 BP; this list).

Comment (W. Blake, Jr.): Only aragonitic **Mya truncata** shells were used for dating. The dated sample comprised 10 fragments, of which nine exhibited the typical truncated posterior end. All fragments were chalky, no periostracum was preserved, and the exterior surfaces showed some pitting. No lustre was preserved on the internal surfaces of the shells. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2211. Millut Bay 6120 ± 90
$\delta^{13}C = +1.6‰$

Whole marine pelecypod shells and fragments (sample NTB 8/6/74-#1; 21.3 g; **Mya truncata**; identified by W. Blake, Jr.) in grey clay-silt of a marine delta at the head of the first bay (unnamed) west of Millut Bay, approximately 16 km east of the head of Clearwater Fiord and 96 km northwest of Pangnirtung, Baffin Island, Northwest Territories (66°36'N, 67°40'W), at an elevation of 24.5 m. Collected August 1974 by N.W. Ten Brink, Grand Valley State College, Allendale, Michigan, U.S.A.

Comment (N.W. Ten Brink): The sample probably related to a relative sea level of 30.6 m as indicated by beach ridges and the top of the delta in which the shells were found. The shells were collected from the upper few centimetres of foreset (?) clay-silt-sand beds at the contact with the overlying 0.5 to 1.0 m-thick topset gravelly beds. The date provides a minimum estimate for deglaciation.

Comment (W. Blake, Jr.): The dated shells were associated with fragments of **Clinocardium ciliatum** and **Macoma calcarea** (identified by W. Blake, Jr.). The **Mya truncata** valves used for dating were thin, some had Fe-stain, and some were encrusted with a thicker deposit of Fe-rich material in a few places. The dated sample comprised 14 left valves plus 18 right valves; the largest was 3.7 cm long. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2479. Narpaing/Quajon fiords 9280 ± 120
$\delta^{13}C = +2.0‰$

Marine shell fragments (sample GRL-324-S; 11.5 g; **Mya truncata**; identified by G.H. Miller) from wave-eroded cliffs at the southeast end of the forelands between Narpaing and Quajon fiords, northern Cumberland Peninsula, Baffin Island, Northwest Territories (67°59.5'N, 64°46.2'W), at an elevation of 4.6 m. The shells were collected from a silty fine sand matrix with occasional pebbles, overlain by a coarse sand to cobble unit that extends to the cliff top at 7.3 m a.s.l. The shell-bearing stratum is associated with detrital organic matter. Collected August 19, 1976 by G.H. Miller.

Comment (G.H. Miller and A.R. Nelson): Paired valves of both **Mya truncata** and **Astarte** cf. **striata** were collected from this site. A coarse sandy cobble unit overlying the shell stratum is expressed at the surface as well-preserved beach ridges, and this unit is interpreted as a regressive beach facies. Detrital organic matter (GRL-356-O) associated with the shells was collected a few tens of meters northwest of this site and has a ^{14}C age of 9950 ± 185 BP (QC-453; Miller, 1979, p. 39).

The shells were deposited in shallow water when sea level was >5 m, probably during the regression

following the limited late Foxe ice advance. The difference in ^{14}C age between this sample and others from the top of the lower beds of the Kangaajuk Member (QC-454, 9092 ± 50 BP; QC-451, 9935 ± 165 BP; and GSC-2731, 9600 ± 100 BP; all in Miller, 1979) suggests relative sea level may have fluctuated between 8 and 15 m during the period 9000 to 10 000 BP, although some of this age difference is probably the result of the analysis of different materials by different dating laboratories.

Comment (W. Blake, Jr.): The dated sample comprised chalky, thick, and clean **Mya truncata** fragments (three truncated posterior ends, one hinge area, and one other large fragment). No periostracum remained on these aragonitic shells. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Qivitu Peninsula series

Marine algae, organic detritus, and matted peat from three sites on the Qivitu Peninsula, northern Cumberland Peninsula, Baffin Island, Northwest Territories. All samples collected by A.R. Nelson, then INSTAAR, University of Colorado, Boulder, Colorado; Colorado, U.S.A.; now Engineering and Research Center, U.S. Bureau of Reclamation, Denver, Colorado.

GSC-2684. Qivitu Peninsula (I) 8580 ± 120 $\delta^{13}C$ = -24.4‰

Marine algae (sample GRL-352-0; 4.1 g; interbedded with coarse stratified sands in a wave eroded cliff section 60 m east of Section 41-16 (Nelson, 1978), Qivitu Peninsula (68°02'08"N, 64°56'25"W), at an elevation of 3.9 m. Collected March 8, 1977.

Comment (A.R. Nelson): This matted seaweed within the middle beds of the Kangaajuk Member may have been deposited on a beach by wave action (W. Blake, Jr., personal communication, 1978) and thus indicates that sea level had fallen to approximately this elevation on the Qivitu Peninsula following its previous stand at 8 to 15 m at some time between 9000 to 10 000 BP. Correlations of the middle beds of the Kangaajak Member, which overlie this organic horizon, with a series of beach ridges at 15 m suggest relative sea level subsequently rose to 15 m after this date.

Comment (W. Blake, Jr.): Such fluctuations of the sea relative to the land seem rather extreme, and it is more likely that the marine algae accumulated on sand in a few metres of water. The sample consisted mainly of black marine algae (woody stems, holdfasts, branches), and only this type (unidentified as to species) was used for dating. The fragments used were up to 10 cm in length. NaOH leach omitted from sample pretreatment. After HCl leach, distilled water rinses, and drying, a 2.9 g sample was burnt. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2716. Qivitu Peninsula (II) >38 000

Organic detritus (sample GRL-354-0; 13.5 g) preserved as laminae (0.5 cm) in fine marine sand. Collected from a cliff exposure located at section 50 of Nelson (1978) outer Qivitu Peninsula (67°59'N, 64°45'05"W) at an elevation of 6.6 m. Collected August 10, 1977.

Comment (A.R. Nelson): Most of this organic material appeared to be seaweed which was deposited in shallow water or on a beach by wave action (W. Blake, personal communication, 1978) at the top of the Qavig Member of the Qivitu Formation. No fossil pollen is present (W.M. Mode, personal communication), but the oxidized upper 20 cm of this sand unit suggested soil development. This date provides a minimum age for the regression at the end of the Ayr Lake stade on the Qivitu Peninsula (Nelson, 1978, 1981).

Comment (W. Blake, Jr.): The estimated age for this sample was 8000 BP, so the sample was older than expected. In the laboratory the sample was soaked in distilled water to separate clay-silt-sand from the organics, which appeared to be marine algae. The sample was wet sieved, then rinsed again in distilled water. After drying 62 g remained; after sieving 13.5 g of the material remaining on a #35 ASTM sieve (>0.5 mm in diameter) a sample was separated out for dating. The sample received the standard pretreatment with NaOH, HCl, and distilled water rinses. Date is based on two 1-day counts in the 2 L counter.

GSC-2731. Qivitu Peninsula (III) 9600 ± 100 $\delta^{13}C$ = -24.5‰

Matted peat beds (sample GRL-330-0; 26.7 g) in sandy facies with silt from Section 37-24 (Nelson, 1978), outer Qivitu Peninsula (68°02'40"N, 64°58'15"W), at an elevation of 9.5 m. Collected November 11, 1976.

Comment (A.R. Nelson): The fibrous peat was deposited in alternating 2 to 5 cm-thick layers with sandy silt in shallow water at the top of the lower beds of the Kangaajuk Member. It contained some shells and marine organic material (algae?), but a pollen assemblage with 10% **Betula** may indicate terrestrial material deposited during a somewhat warmer period than present (W.N. Mode, personal communication). These dates probably mark the appropriate sea level position during a regression following the very limited late Foxe ice advance prior

to 10 000 BP, an advance which is represented on the Qivitu Peninsula by the lower Kangaajuk beds.

Comment (W. Blake, Jr.): A 43.4 g sample of the same material was dated as QC-451, 9935 ± 165 BP (Nelson, 1978, 1981; Miller, 1979). Agreement is reasonable between the two determinations. A bulk sample was wet sieved to concentrate the organics; during this process the weight decreased from 110 to 40 g. The sample received the standard pretreatment in NaOH, HCl and distilled water rinses. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 5 L counter.

GSC-2175. Cape Hooper 6520 ± 70
$\delta^{13}C = -24.0‰$

A single piece of wood (sample M 74 BT3; 11 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 75-14 by L.D. Wilson) from a stream bed dissecting a small raised marine delta at the head of an inlet (east side), 22 km west of Cape Hooper (Fox 4) airstrip, Baffin Island, Northwest Territories (68°28'N, 67°22'W), at an elevation of 5 m. The top of the delta and the local marine limit were at 13 m a.s.l. Collected September 16, 1974 by G.H. Miller.

Comment (G.H. Miller): Due to the protected nature of the inlet, the storm beach was at 1 m above high tide level, above which was well-vegetated ground. The area is not a human travel route, hence the sample is considered to be derived from the delta. Marine shells, including **Mytilus edulis**, were found in the stream bed and presumably were derived from the delta, although frozen ground prevented excavation. Driftwood is rare on Baffin Island, and this is the oldest sample yet dated (driftwood collected by B.G. Craig from northern Baffin Island dated 940 ± 130 BP (GSC-239, GSC IV, 1965, p. 44). The date for this sample falls within the main driftwood accumulation episode in the high arctic (Blake, 1972), and this period was also of optimum marine and terrestrial climate on Baffin Island (Miller, 1973). The sample elevation of 5 m is lower than predicted for 6500 ± BP emergence (cf. Andrews et al., 1970) who suggested a value of approximately 10 to 15 m a.s.l. (their figure 12), or close to the apparent marine limit.

Comment (W. Blake, Jr.): The single piece of wood, measuring 29 x 3 x 5 cm, was stored wet. On oven drying at the GSC its weight decreased from 309.6 to 81 g. All outside wood (punky) and wood along cracks was cut off; the inside wood was solid. Date is based on two 1-day counts in the 5 L counter.

GSC-2384. Pitchforth Fiord 8770 ± 120
$\delta^{13}C = +2.1‰$

Fragments of marine pelecypod shells (sample M 74 Bsh 96; 12.7 g; **Mya truncata**; identified by G.H. Miller) from a stream bed cut into coarse marine sediments 6 km west of Arguyartu Point on the north side of outer Pitchforth Fiord, Home Bay, Baffin Island, Northwest Territories (69°01'N, 67°53'W), at an elevation between 32 and 42 m. The marine limit lies at 55 m a.s.l. Collected by G.H. Miller September 15, 1974.

Comment (G.H. Miller): The highest marine sediments in this valley (approximately 1.5 km inland) consist of a thin veneer of crudely stratified coarse sand and gravel with scattered cobbles that extend to 55 m a.s.l. Above that elevation, the valley sides slope up steeply and consist of unsorted, unstratified angular colluvium. Although the shells were not in situ, they are believed to have been washed down by the stream from deposits relating to the marine limit phase; thus the shells date the marine limit. The lack of a substantial volume of sediment at the marine limit and the absence of 'fresh' moraines indicate that outlet glaciers of Laurentide ice did not reach this site during late Foxe time. An extensive fossiliferous delta at 20 m a.s.l. is as yet undated, but it represents a period of increased runoff and sediment transport during early Holocene time (probably sometime between 6000 and 8000 BP).

Comment (W. Blake, Jr.): The aragonitic shells used for dating were 13 pieces identifiable (truncated ends) as **Mya truncata**, plus 11 fragments (left valves) of the hinge area and four fragments (right valves) of the hinge area. The shells were noticeably worn, white, and chalky, with no periostracum preserved. The uncorrected date, 8730 ± 120 BP, was reported by Miller (1979). Because of the small sample size, only the outer 10% of shell material was removed with HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2506. Cape Henry Kater 8320 ± 140
$\delta^{13}C = +1.3‰$

Paired whole valves and fragments of marine bivalves (sample M74-BSh-84; 10.0 g; **Mya truncata**; identified by G.H. Miller, and **Mya** sp.; identified by W. Blake, Jr.) in sand from an excavation in a cut bank 17 km west-northwest of Cape Henry Kater, Henry Kater Peninsula, Baffin Island, Northwest Territories (69°12'N, 67°11'W), at an elevation of 17 m. The shells are thin-walled and fragile, not abundant, but a sufficient number of paired valves were located to suggest that the shells are indigenous to the deposit. The marine limit is somewhat obscured, but shell-bearing sands abut till at 24 m a.s.l., and this elevation is taken as the local marine limit. Collected September 12, 1974 by G.H. Miller.

Comment (G.H. Miller): The shells are considered correlative with the marine limit phase at 24 m a.s.l. A lower marine plane, traceable for

several kilometres as an erosional notch, lies at 13 m a.s.l. Thick valves of **Hiatella arctica** collected from till beneath the Holocene marine sediments yielded amino acid ratios of mid Foxe age. Marine sediments above the late Foxe limit have also yielded mid Foxe amino acid ratios, suggesting that the deglaciation of Cape Henry Kater occurred during mid Foxe time and that late Foxe ice did not reach the cape. The late Foxe marine sediments suggest marine and fluvial reworking of the pre-existing sediments, rather than an ice/meltwater derivation.

Comment (W. Blake, Jr.): The conclusion reached by Miller (1979 and above) differs from that arrived at earlier by King (1969, p. 195), who stated, "Henry Kater Peninsula was ice covered at least between 34,000 and 10,000 BP". The reader is referred to King's (1969) paper for a compilation of radiocarbon dates obtained earlier. The shells making up GSC-2506 were chalky and worn; most had the truncated posterior end typical of **Mya truncata**. None of the shells were pitted, nor did they have periostracum or secondary precipitates. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2215. Itirbilung Fiord 9110 ± 160
$\delta^{13}C = +1.0‰$

Fragments of marine pelecypod shells (sample M74-Bsh-86; 13.2 g; **Mya truncata**, identified by G.H. Miller) in marine silts approximately 1 km inland from a major bay on the north side of Itirbilung Fiord, Baffin Island, Northwest Territories (69°19'N, 68°06'W), at an elevation of 49 m. The shells relate to a marine limit of 54 m on the distal side of a low moraine in this bay. Collected September 13, 1974 by G.H. Miller.

Comment (G.H. Miller): The site was visited in an attempt to resolve King's (1969) assignment of the low moraine as a Cockburn equivalent with Miller and Dyke's (1974) map showing the Cockburn ice margin lying several tens of kilometres inland. Shells from the distal side of the moraine must postdate the moraine formation, hence deny King's interpretation as Cockburn-age equivalent. King's original site that dated 8670 ± 140 (I-3236) at 48 m asl appeared to be soliflucted till rather than glacially deposited till overlying the fossiliferous marine sands.

Comment (W. Blake, Jr.): All the shells in this collection were chalky and the fragments (15) used had worn surfaces and rounded corners, indicating transport. Only nearly whole valves or those displaying the truncated posterior end typical of the species were used. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2283. Inugsuin Fiord 8300 ± 90
$\delta^{13}C = +0.9‰$

Whole marine shells and fragments (sample M74-Bsh-72; 26.7 g; **Mya truncata**; identified by G.H. Miller) in fine marine sands from a river-cut bank in a raised delta, on the east side of outer Inugsuin Fiord, 39 km southwest of Halliday Point, Baffin Island, Northwest Territories (70°02'N, 68°33'W) at an elevation of 8.5 m, 1.5 m below the delta surface. The delta grades to the local marine limit at 12 m a.s.l. Collected September 4, 1974 by G.H. Miller.

Comment (G.H. Miller): Most valves were paired and the collection is considered in situ. The date relates to the marine limit phase and is slightly older than a sample collected from the same area dated 7750 ± 135 BP (I-2831). A sample a few tens of kilometres up-fiord gave an age of 8190 ± 120 BP (Y-1705) relating to a marine plane at 28 m a.s.l. (both dates in Andrews and Ives, 1972).

Comment (W. Blake, Jr.): The sample submitted to the laboratory consisted entirely of thin and fragile aragonitic shells, some intact valves plus a larger number of fragments. Nearly all fragments retained some periostracum and most pieces included the truncated posterior end typical of the species. The largest intact valves were 4.2+ cm long by 3 cm high. Date is based on one 3-day count in the 2 L counter.

GSC-2201. Clyde Cliffs 9880 ± 200

Plant remains (sample M74-B027; 50.0 g dry; primarily well-preserved fragments of the moss **Scorpidium turgescens**; identified by W.A. Weber, University of Colorado, Boulder, Colorado) from a marine delta back-filled into the Clyde Cliffs, approximately 4 km southeast of the mouth of the Kogalu River, Baffin Island, Northwest Territories (71°12'N, 71°22'W), at an elevation of approximately 25 m. The delta top is at approximately 29 m a.s.l. The sample was exposed in a stream-cut bank, excavated back 30 cm to near the permafrost boundary to avoid contamination. No modern rootlets were noted. Collected August 29, 1974 by G.H. Miller.

Comment (G.H. Miller): Because the delta is inset into the main cliff section, it indicates a marine transgression postdating the last major episode of cliff formation. The sample age may be slightly older than the true age of the delta as organic detritus in a lower delta along the Kogalu River was several thousand years older than the ^{14}C age of in situ shells (cf. SI-2613, 6110 ± 170 BP, and SI-2614, 11 360 ± 320, both in Andrews, 1976).

Comment (W. Blake, Jr.): The statement by Miller (in Andrews, 1976, p. 36) that "Mandibles of tadpole shrimp and ephippia of **Daphnia** (id. by J.V. Matthews, Jr., GSC) testify as to the marine origin of the delta sediments" is erroneous. Both **Lepiduris** and **Daphnia** are freshwater crustaceans. The bulk of this sample comprised well preserved moss fragments, and neither amber nor coal fragments were observed (unpublished GSC Plant Macrofossil Report No. 75-2 by J.V. Matthews, Jr. The sample received the standard pretreatment with NaOH, HCl and distilled water rinses. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2199. Dexterity Island 5340 ± 170
$\delta^{13}C = -0.4‰$

Marine pelecypod shell fragments (sample M74-Bsh-16; 26.7 g; **Mytilus edulis**; identified by G.H. Miller) in marine sands from an extensive valley fill in the main valley on the north side of Dexterity Island, outer Dexterity Fiord, Buchan Gulf, Baffin Island, Northwest Territories (71°38'N, 72°53'W), at an elevation of 10 to 12 m, 1.5 km inland from the coast. The top of the cut bank was 15 m a.s.l., and local marine limit is considered to be 16 m a.s.l. Collected August 14, 1974 by G.H. Miller.

Comment (G.H. Miller): Alluvial fill in this valley on Dexterity Island is extensive and extends many kilometres inland. Active glaciers are still present at the valley head. Although the local marine limit in the vicinity of the shell collection was approximately 16 m a.s.l., the true marine limit for the area may have been considerably higher, as shell-bearing strata were horizontally bedded and the terrace surface had a gentle gradient increasing towards the interior. This date is several millenia younger than other marine limit dates in the area (see, for example, Hodgson and Haselton, 1974). Other shells at the sample site included abundant whole, paired valved of **Hiatella arctica, Mya truncata, Mytilus edulis, Clinocardium ciliatum, Astarte** sp., **Acmaea** sp., a gastropod and pieces of baleen (identified by G.H. Miller). The **Mytilus edulis** valves were large and robust, suggesting a favorable marine environment. The date lies within the Holocene marine optimum (Andrews, 1972). The date provides an estimate for the age of a relative sea level approximately 16 m above present.

Comment (W. Blake, Jr.): These shells, composed of approximately 80% calcite and 20% aragonite (blue shell material), were not whole at the time of submission. The largest fragments were up to 5.7 cm in length. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Northern Baffin Bay

GSC-3671. Baffin Bay 280 ± 90
$\delta^{13}C = -0.4‰$

Marine pelecypod shells (sample 181; 12.0 g; **Portlandia arctica**; identified by W. Blake, Jr.) dredged from a muddy (ooze) bottom in northern Baffin Bay, 11 km east-southeast of Cape Macculloch, Baffin Island and 25 km north of Nova Zembla Island, Northwest Territories (72°27'N, 74°52'W), in a water depth of 20 m. Collected August 30, 1894 by E. Nilsson, Kristianstad, Sweden, aboard the whaling ship, 'Eclipse'.

Comment (W. Blake, Jr.): This date is one of a series of age determinations carried out on pelecypods and cirripeds collected alive in pre-nuclear bomb time from northern Baffin Bay and adjacent waters (cf. GSC XXVI, 1987, p. 24, 27, 28, 34, 35 and 44). The dates provide information on the exchange time between the atmosphere and the surface ocean waters in this part of the Arctic. Sample 181 as submitted comprised 225 pairs. All shells retained good internal lustre, and the periostracum was intact on all valves. The internal soft parts were removed before the sample was submitted to the laboratory. Maximum shell size was 1.5 x 0.8 cm. Because of the small sample size (12.0 g), only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Devon Island

GSC-1502. Radstock Bay 9260 ± 150
$\delta^{13}C = +1.9‰$

Marine cirriped fragments (sample McCann-104; 46.1 g; **Balanus** sp., probably **B. balanus**; identified by W. Blake, Jr.) from a small bench of silt and clay among bouldery debris on a talus slope on the west side of Radstock Bay, Devon Island, Northwest Territories (74°40'N, 91°25'W), at an estimated elevation of approximately 105 m. Collected August 1969 by S.B. McCann, McMaster University, Hamilton, Ontario, and P.J. Howarth, then McMaster, now University of Waterloo, Waterloo, Ontario.

Comment (W. Blake, Jr.): The age determination on this well preserved sample of barnacles is the oldest date on Holocene materials along the southern coast of Devon Island (cf. GSC-1479, 8180 ± 160 BP, GSC XVI, 1976, p. 15-16), but it is identical with date GSC-866 (9260 ± 100 BP; GSC XV, 1975, p. 24) from Cape Hawes on the Jones Sound coast of Devon Island. The date contributes to a study of postglacial emergence and provides a minimum age for the retreat of glacial ice and invasion of Radstock Bay by the sea. The **Balanus** fragments were up to 4.5 cm

long, and all of the submitted pieces were >2.5 cm long. Some exhibited minor Fe-staining. Adhering silt was scraped off, and the shells were broken open to remove silt. The sample received the normal 20% leach in HCl. Date is based on two 1-day counts in the 5 L counter.

Coburg Island

Coburg Island series (IV)

Marine pelecypod shells and crustose coralline algae from the lower part of a 15 m-high sea cliff exposure on the west side of the isthmus connecting Marina Peninsula with Coburg Island proper, Northwest Territories (75°52.5'N, 79°02'W).

GSC-1098. Coburg, 5.5-5.8 m — 33 600 ± 700

Fragments of crustose coralline algae (sample BS-134-68; 69.0 g dry; **Lithothamnion** sp.; identified by R.K.S. Lee, formerly National Museum of Natural Sciences, Ottawa) from boulders and cobbles in a zone, at an elevation of 5.5 to 5.8 m, between a horizon characterized by **Mytilus edulis** (>38 000 years old, GSC-1425) and a zone characterized by particularly robust **Hiatella arctica** valves (>40 000, GSC-1062; both in GSC XXVI, 1987, p. 26). Collected August 12, 1968 by W. Blake, Jr. The outer 20% of algal material was removed by HCl leach, following the standard GSC treatment for shells. Date is based on one 3-day count in the 5 L counter.

GSC-1536. Coburg, 5.5-5.8 m — 39 500 ± 1300, $\delta^{13}C = -3.3‰$

Fragments of crustose coralline algae (sample BS-70-143; 176.0 g dry; **Lithothamnion** sp., probably **Lithothamnion lemoineae**; identified by W.H. Adey, National Museum of Natural History, Smithsonian Institution, Washington, D.C.; personal communication, 1974) from the same zone described above for GSC-1098 (this series). Collected July 31, 1970. The sample submitted for dating comprised 11 pieces; the largest measured 9.5 by 6.5 cm and all pieces are >3 cm in length and width. All pieces are <1.3 cm in thickness, and most are <1 cm. Two determinations were made of this calcitic material:

GSC-1536. Outer fraction — 38 200 ± 1400

Outer half of algal material after the outermost 20% was removed by HCl leach. Date is based on two 1-day counts in the 5 L counter.

GSC-1536. Inner fraction — 39 500 ± 1300, $\delta^{13}C = -3.3‰$

Inner half of algal material. Date is based on two 2-day counts in the 5 L counter.

GSC-1536-2. Coburg, 5.5-5.8 m — 25 500 ± 1700, $\delta^{13}C = -19.1‰$

Organic fraction of crustose coralline algae (sample BS-70-143; 27.4 g dry (including weight of filter paper)), remaining after an original 710.0 g-sample was first given a leach (10%) in HCl to remove the outer layer of algal material, followed by a distilled water rinse and then the inner 90% was dissolved in H_3PO_4. The liquid remaining was partially evaporated, then it was filtered through a Buchner funnel using glass filter paper. The residue retained on a series of filter paper varied in colour from black to dark brown to grey. The four filter papers were cut into strips and then burned, leaving 22.8 g of ash and giving 1.22 cm of CO_2. Sample was mixed with dead gas for counting. Date is based on one 4-day count in the 1 L counter (cf. Tables 1 to 4 in Lowdon et al., 1971).

GSC-1617. Coburg, 4.8-5.5 m — 46 400 ± 2000, $\delta^{13}C = +2.4‰$

Fragments of marine aragonitic pelecypod shells (sample BS-70-169; 410.0 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the lower 15 cm of the 70 cm-thick band of shelly debris at 4.8 to 5.5 m which was dominated by robust and intact **Hiatella arctica** valves, plus fragments. Collected August 20, 1970 by W. Blake, Jr. Whole shells and fragments (up to 1 cm in thickness) were wet when collected, and they were stored wet. After the adhering mud and sand was scraped off they were air dried for a week. Two determinations were made:

GSC-1617. Outer fraction — >38 000

Outer fraction (61 to 70%) of shell material after the outermost 60% was removed by HCl leach. Date is based on one 3-day count in the 5 L counter.

GSC-1617. Inner fraction — 46 400 ± 2000, $\delta^{13}C = +2.4‰$

Inner fraction (71 to 100%) of shell material. Date is based on one 3-day count and two 1-day counts in the 5 L counter at 4 atmospheres.

GSC-1926. Coburg, 3.0-3.2 m — 43 700 ± 800, $\delta^{13}C = +2.0‰$

Fragments of marine pelecypod shells (sample BS-70-263; 400.0 g; **Mya truncata**; identified by W. Blake, Jr.) from the lowest stratum seen at this section on Coburg Island, at an elevation of 3.0 to 3.2 m. A pit was excavated in the snowbank which forms a fringe along the lower part of the section in early August, then thawing was allowed to proceed for two weeks before the site was revisited and samples collected from the section exposed in the pit on August 16, 1970. The aragonitic shells were chalky and fragmented and in general were not as well preserved as the Holocene **Mya truncata** shells

collected higher in the section (cf. GSC-1420, 7760 ± 160 years; GSC XXVI, 1987, p. 25). However, some shells still retained traces of periostracum. The thickest pieces were up to 6 mm thick, both in the hinge area and at the truncated posterior end. Two determinations were made:

GSC-1926. Outer fraction 41 100 ± 600
$\delta^{13}C = +3.1‰$

Outer half of shell material after the outermost 30% was removed by HCl leach. Date is based on one 4-day count in the 5 L counter at 4 atmospheres.

GSC-1926. Inner fraction 43 700 ± 800
$\delta^{13}C = +2.0‰$

Inner half of shell material. Date is based on one 4-day count in the 5 L counter at 4 atmospheres.

Comment (W. Blake, Jr.): The reader is referred to three previous series of dates on material from Coburg Island (GSC XXVI, 1987, p. 24-26). The determinations reported here, all from the lower part of the section, suggest strongly that the shell-bearing strata are beyond the range of radiocarbon dating. More work on the organic fractions of both pelecypods and algae is needed, however. The discrepancy between the carbonate (GSC-1536) and organic residue (GSC-1536-2) of **Lithothamnion** sp. may be real or it may be a result of the fact that GSC-1536-2 was based on an extremely small amount of CO_2, hence there may have been difficulty in determining the mixing ratio accurately (cf. Blake, 1975).

Southern Ellesmere Island

Cape Storm series (VIII)

Marine pelecypod shells from an exposure (GSC Fossil Locality 96377) along the north side of the river which is incised into the raised marine deposits of Andersrag Beach, 6.5 km north of Cape Storm, Ellesmere Island, Northwest Territories (76°24'N', 87°34'W).

GSC-1409. Cape Storm, 53 m shells 27 700 ± 480
$\delta^{13}C = +2.7‰$

Marine pelecypod shells (sample BS-70-112; 51.4 g; **Mya truncata**; identified by W. Blake, Jr.) collected from a shallow excavation in sand, gravel, and cobbles approximately 6 m above the level of the present-day river alluvium, 18 m below the surface of the Holocene beaches at the top of the section, and at an elevation of 53 m (altimeter determination). Collected July 23, 1970 by W. Blake, Jr.

Comment (W. Blake, Jr.): The dated aragonitic shells (three paired valves were submitted) all were well preserved and all retained part of the periostracum. This was the first sample submitted from this section, and so the age estimate was "8300 years or older", based on the age of a driftwood log on the Holocene beaches at 71.0 m (8300 ± 140 years; GSC-845; Blake, 1970, 1972, 1975; GSC XI, 1971, p. 313-314). Adhering sand and silt were scraped from the shells in the field, the sample was then washed in stream water and dried in aluminum foil over a Coleman stove. The sample received the standard HCl leach, in which the outer 20% of shell material was removed. Date is based on two 1-day counts in the 2 L counter.

GSC-1880. Cape Storm, 51-54 m shells 38 300 ± 1360
$\delta^{13}C = +2.0‰$

Marine pelecypod shells (sample BS-70-111(A); 29.5 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the ground surface on a slope just above the level of river alluvium, at an elevation of 51 to 54 m. Collected July 23, 1970 by W. Blake, Jr.

Comment (W. Blake, Jr.): This sample of aragonitic shells was dated to check the validity of GSC-1409 (27 700 ± 480 years, this series), which was a rather unusual result. The sample used for GSC-1880 comprised six intact valves (four right and two left), all well preserved with no pitting or secondary precipitates, although the shells were all slightly chalky. Two valves still retained traces of the ligament. All six valves were between 4.4 and 4.8 cm in length, and 2.2 to 2.4 cm in height. The sample received the standard HCl leach to remove the outer 20% of shell material. Date is based on one 3-day count in the 2 L counter.

GSC-2310. Cape Storm, 52-54 m shells 42 500 ± 1900
$\delta^{13}C = +1.6‰$

Marine pelecypod shells (sample BS-75-161; 50.4 g; **Mya truncata**; identified by W. Blake, Jr.) from a freshly dug exposure at an elevation of 52 to 54 m (leveled). Collected August 2, 3, 4 and 6, 1975 by W. Blake, Jr. and R.J. Richardson, then GSC, now Alberta Geological Survey, Edmonton.

Comment (W. Blake, Jr.): The aragonitic shells in this new collection were very well preserved, with many intact valves and numerous paired valves (although the latter were not used for dating). Most valves retained some internal lustre and all retained some periostracum, indicating little or no transport. All whole valves were 4 to 6 cm in length and 1 to 3 mm in thickness, although the largest and thickest valves were not used. This large collection was air dried in Ottawa during the winter of 1975-1976, as with few exceptions the shells were damp to wet at the time of collection. The sample for dating comprised fragments from the same 24 valves (12 right and 12 left, but not pairs) submitted for U-series dating, but the latter technique did not prove to be successful (Ford and Schwarcz, 1977). The sample received the standard HCl leach to

remove the outer 20% of shell material. Date is based on one 3-day count in the 5 L counter.

GSC-2485. Cape Storm, 52-54 m shells — 40 500 ± 740, $\delta^{13}C = +1.3‰$

Marine pelecypod shells (sample BS-75-161; 654 g; **Mya truncata**; identified by W. Blake, Jr.) from a freshly dug exposure at an elevation of 52 to 54 m (leveled). Collected August 2, 3, 4 and 6, 1975 by W. Blake, Jr. and R.J. Richardson.

Comment (W. Blake, Jr.): This age determination was carried out as a follow-up on GSC-2310 (42 500 ± 1900 years, this series), and to further attempt to test the validity of radiocarbon dating on pre-Holocene shells. The sample of aragonitic shells was as described under GSC-2310. Many of the well preserved shells were intact, although fragments were also used; paired valves were not used. Three determinations were made, after the outermost 10% of shell material was removed by HCl leach.

GSC-2485. Outer fraction — 42 400 ± 920, $\delta^{13}C = +1.9‰$

This fraction comprises 11 to 40% of shell material. Date is based on one 5-day count in the 5 L counter at 4 atmospheres.

GSC-2485. Middle fraction — 41 400 ± 820, $\delta^{13}C = +1.7‰$

This fraction comprises 41 to 70% of shell material. Date is based on one 5-day count in the 5 L counter at 4 atmospheres.

GSC-2485. Inner fraction — 40 500 ± 740, $\delta^{13}C = +1.3‰$

This fraction comprises 71 to 100% of shell material. Date is based on one 5-day count in the 5 L counter at 4 atmospheres.

GSC-2486. Cape Storm, 52-54 m, periostracum — 31 700 ± 540, $\delta^{13}C = -17.8‰$

Periostracum from marine pelecypod shells (sample BS-75-161; 12.0 g dry; **Mya truncata**; identified by W. Blake, Jr.) from the same large batch of shells (654 g) used for GSC-2485 (3 determinations, this series.

Comment (W. Blake, Jr.): The age of the periostracum is clearly younger than the best age on the shells from which this outer, organic covering was derived (40 500 ± 740 years, GSC-2485, date on the innermost of three fractions). GSC-2485 is virtually identical with two dates (inner and outer fraction) on **Mya truncata** shells from higher (at 63.0 m) in the same section (Blake, 1980, 1985; GSC XXVI, 1987, p. 26-27), whereas the date on the periostracum (GSC-2486) is slightly younger than the youngest date, GSC-2584-3 (35 800 ± 1080 years), of three determinations on marine algae, also collected at the 63.0 m level. After the periostracum was recovered, following treatment of 654 g of shells, no further pretreatment was carried out; 12.0 g of dry material was burned and then the KOH method was used (cf. Lowdon et al., 1977; Lowdon, 1985). Date is based on one 4-day count in the 2 L counter.

GSC-2527. Cape Storm, 52-54 m shells — >37 000, $\delta^{13}C = +1.3‰$

Marine pelecypod shells (sample BS-75-162; 47.0 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the same site as described for collection BS-75-161 (GSC-2310, -2485, and -2486, this series), at an elevation of 52 to 54 m (leveled). Collected August 2, 3, 4 and 6, 1975 by W. Blake, Jr. and R.J. Richardson.

Comment (W. Blake, Jr.): Details of the site and collection are the same as for the dates listed above. This new sample is entirely made up of parts of 20 right valves from pairs; the corresponding left valves were used for U/Th dating and the remainder of the right valves was retained for determining amino acid ratios. The longest two pairs were each 4.8 cm. All valves were well preserved, and several retained periostracum fragments as well as bits of the ligament. In general the aragonitic shells were somewhat chalky on the exterior surfaces, but the interior surfaces retained their lustre. No pitting was present and only one or two valves may have had slight secondary precipitates on interior surfaces. The sample received the standard HCl leach to remove the outer 20% of shell material. Date is based on one 4-day count in the 5 L counter.

GSC-2800. Cape Storm, 57.5-59 m shells — 40 800 ± 1350, $\delta^{13}C = +1.9‰$

A single pair of marine pelecypod shells (sample BS-77-306; 47.0 g; **Mya truncata**; identified by W. Blake, Jr.) from a freshly dug exposure in sand and silty sand at the same general site where the 1970 and 1975 collections were made. In 1977, for the first time, in situ shells were found in the lower half of the section, at an elevation of 57.5 to 59.0 m (leveled). Collected August 10 and 11, 1977 by W. Blake, Jr.

Comment (W. Blake, Jr.): The sample submitted for dating was the entire right valve of a single intact pair plus part of the left valve. The aragonitic shell was 6.5 cm long, 5.0 cm high, and shell thickness was as much as 7 to 8 mm in places (especially near the hinge). The remainder of the left valve was used for amino acid determinations. The ^{14}C result is virtually identical with two dates (inner and outer fractions) on **Mya truncata** shells and with one of a

series of three dates on marine algae higher (at 63.0 m) in the same section (Blake, 1980, 1985; GSC XXVI, 1987, p. 26-27). The present sample received the standard HCl leach to remove the outer 20% of shell material. Date is based on one 5-day count in the 5 L counter.

Cape Storm series (IX)

A whale rib (sample BS-75-174) on the ground surface at the same site (north side) where the river has cut through the raised marine deposits of Andersrag Beach, 6.5 km north of Cape Storm, Ellesmere Island, Northwest Territories (76°24'N, 87°34'W), at an elevation of 55 m (leveled). This large bone was loose on the ground surface, and it appeared to have slid down the sandy slope to the position where it was found. The bone appeared to be quite dry at the time of collection, but it was thoroughly wetted in a rainstorm at Cape Storm on August 7, 1975. Collected August 5, 1975 by W. Blake, Jr.

GSC-2229.	Cape Storm, 55 m bone (I)	28 700 ± 1110 $\delta^{13}C$ = -20.7‰

A 44.5 cm-long segment (1862 g), in the middle part of the rib, was dried in an electric oven at Ottawa; its weight decreased from 2052 to 1862 g. The bone was cut in cubes on a band saw, then pulverized in a rock crusher. This first date followed pretreatment first with 3N HCl and then, in order to speed up the reaction, 6N HCl was used, followed by distilled water rinses to neutralize the solution. The NaOH leach was omitted. The 7.9 g of collagen was burned and purified using the KOH method (Lowdon et al., 1977; Lowdon, 1985), and 7.4 cm of CO_2 was produced, as measured on a manometer. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2229-2.	Cape Storm, 55 m bone (II)	>37 000

For this second determination a 1746 g sample, representing a 46 cm-long rib segment, was cut and crushed as described for GSC-2229 (this series). The sample was then 'cooked' in distilled water in a pressure cooker for two hours, the resulting solution was filtered through a glass fibre filter, and the filtrate was dried. The resultant collagen, weighing 14.7 g, was burned and purified using the KOH method, and 57.2 cm of CO_2 was produced. Date is based on two 1-day counts in the 5 L counter. No $^{13}C/^{12}C$ ratio was determined.

GSC-2229-3.	Cape Storm, 55 m bone (III)	16 000 ± 200 $\delta^{13}C$ = -20.4‰

For determination GSC-2229-3 and -2229-4 two batches of rib were used, weighing 1151 g and 1230 g, respectively. The bone was cut and crushed as with the earlier samples. Both batches of bone produced a dark brown solution on treatment with 6N HCl. A total of 3.8 g and 8.9 g were burned following the acid leach and distilled water rinses, and 21.6 cm of CO_2 resulted. Date is based on one 1-day count in the 2 L counter.

GSC-2229-4.	Cape Storm, 55 m bone (IV)	20 100 ± 1370 $\delta^{13}C$ = -19.3‰

This determination is based on the liquid used for the pretreatment of GSC-2229-3 (this series). This liquid was precipitated by addition of NaOH; upon burning 43.3 g a total of 3.9 cm of CO_2 was obtained. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Comment (W. Blake, Jr.): The three determinations (after the first date) were carried out to try to test the validity of the 28 700 ± 1110 year-old result (GSC-2229). Obviously the widely divergent results did not do this, and further testing is needed, perhaps AMS dating on separate organic fractions. It is clear that the bone is pre-Holocene in age, but further testing of both shells and bones (see Cape Storm series VIII, this list; series VII in GSC XXVI, 1987, p. 26-27) is required to determine if they relate to the same ice free interval.

Jakeman Glacier series (II)

Plant detritus and marine pelecypods collected from an "island" in the river along the northwest side of Jakeman Glacier, southeastern Ellesmere Island, Northwest Territories (76°30.5'N, 80°55'W). The "island" is protected by an icing from further erosion by the river, at least for a part of each summer. A previous series from this site was reported in GSC XXI, 1981, p. 16. Collected July 3, 1968 by W. Blake, Jr.

GSC-1038.	Jakeman Glacier (III)	8660 ± 180

Plant detritus (sample BS-35-68; 110.0 g dry) from a 1 cm-thick peat band (approximate elevation, 35 m, determined by altimeter) overlying the major part of the shelly marine silt at the site. The well-matted peat band is overlain by a silt more yellow-orange in colour with fewer shells and then by a thin diamicton that may represent a till. NaOH leach omitted from sample pretreatment. After treatment with HCl, distilled water rinses, and drying, 9.0 g was burnt (the detritus contained both calcareous silt and shell fragments). Date is based on one 3-day count in the 2 L counter.

GSC-1208.	Jakeman Glacier (IV)	8210 ± 140 $\delta^{13}C$ = +2.6‰

Fragments and whole marine pelecypod shells (sample BS-36-68; 100.0 g; **Mya truncata**; identified

by W. Blake, Jr.) from a nearly horizontal (extremely gentle NE-dipping) layer on the glacier (southeast) side of the "island", at an elevation of approximately 30 m (altimeter determination). The hillock comprising this part of the "island" has a partial surface covering of recent till composed dominantly of shield rocks. Two determinations were made:

GSC-1208. Outer fraction 8040 ± 150
$\delta^{13}C = +2.5‰$

Date is based on one 2-day count in the 5 L counter.

GSC-1208. Inner fraction 8210 ± 140
$\delta^{13}C = +2.6‰$

Date is based on one 2-day count in the 5 L counter.

GSC-1211. Jakeman Glacier (V) 8590 ± 200
$\delta^{13}C = -16.8‰$

Periostracum and siphon sheaths from the same collection of **Mya truncata** shells (sample 135-36-68; 13.0 g dry) used for GSC-1208. NaOH leach omitted from sample pretreatment. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): The stratigraphic relations between various parts of the "island" are not completely clear, as is evident from the fact that the peat band, which is topographically higher than the shells, is clearly older. The difference is more marked if a correction for the apparent age of sea water is applied to the shells. When marine shells are normalized to 0.0‰ this correction is of the order of 350 years for the Jones Sound region (Blake, 1975, 1987), then the age of the inner fraction of the shells would become 7860 ± 140 years (GSC-1208).

A portion of BS-35-68 was examined by M. Kuc and he reported in some detail on the sample (unpublished GSC Bryological Report No. 41). He described the sample as "moss remains with minor mineral additions". Remains of vascular plants were rare and largely undeterminable.

The difference in age between the carbonate of the shells and the periostracum is not easy to understand. At least in this case it is not, apparently, attributable to miniscule sample size of the periostracum (cf. Blake, 1975).

West-central Ellesmere Island

Makinson Inlet series (III)

Driftwood samples were collected from a flight of raised beaches on the north side of the head of Piliravijuk Bay, westernmost Makinson Inlet, Ellesmere Island, Northwest Territories. Collected August 1977 by W. Blake, Jr. All elevations were determined by instrumental levelling. All samples received the standard treatment with NaOH, HCl, and distilled water rinses.

GSC-3456. Piliravijuk Bay, 19.5 m 4480 ± 60
$\delta^{13}C = -23.8‰$

A driftwood log (sample BS-77-359; 11.3 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 86-1 by H. Jetté) which was somewhat splintered and spread around, lying in its own depression (not a frost crack) in the eastern beach area north of Piliravijuk Bay (77°19'N, 82°10'W), at an elevation of 19.5 m. Collected August 17, 1977.

Comment (W. Blake, Jr.): This well preserved log was 3.75 m long and at least 10 cm in diameter. All outside wood and wood along cracks was cut away or scraped clean. Date is based on two 1-day counts in the 5 L counter.

GSC-3411. Piliravijuk Bay, 21.0 m 4590 ± 90
$\delta^{13}C = -24.3‰$

A driftwood log (sample BS-77-361; 12.5 g dry; **Picea** sp., unpublished GSC Wood Identification Report No. 78-9 by L.D. Farley-Gill) partly imbedded in beach gravel in the eastern beach area north of Piliravijuk Bay (77°19'N, 82°10'W), at an elevation of 21.0 m. Collected August 17, 1977.

Comment (W. Blake, Jr.): Only 15 m of this 135 cm-long log (18 cm in diameter) was buried in beach shingle. A 208 g damp sample was oven-dried; the dry weight was 152 g. All outside wood was cut away. Date is based on three 1-day counts in the 5 L counter.

GSC-2651. Piliravijuk Bay, 21.0 m 4600 ± 60
$\delta^{13}C = -25.6‰$

A driftwood log (sample BS-77-362; 11.8 g dry; **Picea** sp., unpublished GSC Wood Identification Report No. 78-9 by L.D. Farley-Gill) mostly imbedded in shingle beach in the eastern beach area north of Piliravijuk Bay (77°19'N, 82°10'W), at an elevation of 21.0 m. Collected August 17, 1977.

Comment (W. Blake, Jr.): This well preserved log had 35 cm exposed out of a total length of 92 cm. It was 16 cm in diameter just above the fork. On oven-drying the slightly damp wood decreased in weight from 222 to 175 g. All outside wood cut off. Some resin noted in parts of the bulk sample. Date is based on one 3-day count in the 5 L counter.

GSC-2705. Piliravijuk Bay, 23.0 m 4900 ± 60
$\delta^{13}C = -25.3‰$

A driftwood log (sample BS-77-364; 11.7 g dry; **Larix** sp., unpublished GSC Wood Identification Report No. 78-23 by R.J. Mott) partly buried in beach shingle in the eastern beach area north of Piliravijuk Bay (77°19'N, 82°10'W), at an elevation of 23.0 m. Collected August 17, 1977.

Comment (W. Blake, Jr.): This well preserved small log (30 cm exposed, 49 cm total length, 5 cm maximum diameter) was just above the elevation of 21.0 to 22.0 m at which two pieces of pumice were found. On oven-drying the damp wood decreased in weight from 157 to 105 g. All outside wood was cut away. Only 15 rings of this firm and well preserved wood were used for dating. Date is based on one 3-day count in the 5 L counter.

GSC-3703.	Piliravijuk Bay, 30.5 m	5630 ± 70 $\delta^{13}C$ = -23.4‰

A driftwood log (sample BS-77-385; 11.4 g; **Picea** sp., unpublished GSC Wood Identification Report No. 78-9 by L.D. Farley-Gill) lying horizontally in a somewhat steeper slope in the western beach area north of Piliravijuk Bay (77°19'N, 82°11'W), at an elevation of 30.5 m. Collected August 20, 1977.

Comment (W. Blake, Jr.): This large log (a stump?), of which 60 by 27 cm was exposed, was the next to highest log found in innermost Makinson Inlet. Date is based on two 1-day counts in the 5 L counter.

GSC-2713.	Piliravijuk Bay, 32.0 m	5930 ± 60 $\delta^{13}C$ = -24.5‰

A driftwood log (sample BS-77-386; 11.6 g dry; **Picea** sp., unpublished GSC Wood Identification Report No. 78-9 by L.D. Farley-Gill) lying horizontally in shingle in the western beach area north of Piliravijuk Bay (77°19'N, 82°11'W), at an elevation of 32.0 m. Collected August 20, 1987.

Comment (W. Blake, Jr.): This large log, 1.85 m long, but with only the middle covered by a veneer of beach shingle, had a maximum diameter of 12 cm. On oven drying a piece of wet wood decreased in weight from 246 to 56.7 g. Date is based on one 3-day count in the 5 L counter.

Glacier 7A-45 Series (II)

Peat and twigs from sites close to Glacier 7A-45 (designation following the Glacier Atlas of Canada, Department of the Environment; Area 46427A, unpublished), a westward-flowing outlet glacier from the central Ellesmere Island ice cap, Northwest Territories. The site is approximately 16 km north of the head of Makinson Inlet (north arm). Other dates (series I) from near this glacier were reported in GSC XXI (1981, p. 17-18) and another group is in the present list (series III). All elevations are altimeter determinations.

GSC-3591.	Glacier 7A-45 (VI)	4700 ± 60 $\delta^{13}C$ = -28.1‰

Twigs (sample BS-77-340; 9.7 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 83-5 by R.J. Mott) from 35 to 40 cm above the base of a peat deposit, approximately 9 m thick, exposed along a river on the south side of Glacier 7A-45, Ellesmere Island, Northwest Territories (77°49.8'N, 81°45'W), at an elevation of 60 m. Collected August 15, 1977 by W. Blake, Jr.

Comment (W. Blake, Jr.): This sample was collected 35 to 40 cm above the base of the peat deposit. Leaves and stems of **Dryas integrifolia** extracted from the basal 10 cm of peat gave an age of 5180 ± 260 years (GSC-2909), and twigs of **Salix** sp. from the uppermost 10 cm of peat were 2590 ± 150 years old (GSC-3191; both in GSC XXI, 1981, p. 17-18, and Blake, 1981). The particular sample dated here was a group of twigs; a portion of each twig being used for a concurrent amino acid determination was also represented in this sample. The aspartic acid ratio of the twigs was 0.0448 (UA-1336, personal communication from N.W. Rutter, University of Alberta, Edmonton, March 1983). Arctic hare droppings were also present at this level in the peat. Nearly every twig used had some intact bark; some twigs were contorted, maximum length was 25 to 30 cm, and none showed evidence of significant transport (i.e., bark worn off, rounded ends, etc.). Date is based on two 1-day counts in the 5 L counter.

GSC-3389.	Glacier 7A-45 (VII)	5000 ± 100 $\delta^{13}C$ = -27.1‰

Moss peat (sample BS-81-221; 11.0 g dry) from 60 to 70 cm below the ground surface at the east end of a major gully adjacent to the river on the south side of Glacier 7A-45, Ellesmere Island, Northwest Territories (77°49.8'N, 81°45'W), at an elevation of 140 m. The brown, well preserved moss, with individual stems up to 20 cm long, comprised the uppermost unit at the site. Collected July 5, 1981 by W. Blake, Jr.

Comment (W. Blake, Jr.): Organic layers more than 30 000 years old are present lower in the section. This sample was dated to see if the moss peat at the surface was, in fact, of Holocene age. The sample received the standard treatment with NaOH, HCl (no reaction), and distilled water rinses. Date is based on two 1-day counts in the 2 L counter.

GSC-3783.	Glacier 7A-45 (VIII)	6450 ± 70 $\delta^{13}C$ = -29.9‰

Peat (sample 83-BS-115; 52.0 g dry) from a section exposed among a network of lateral drainage channels adjacent to, and on the south side of, Glacier 7A-45, Ellesmere Island, Northwest Territories (77°49.8'N, 81°44.5'W), at an elevation of 215 m. Collected June 20, 1983 by W. Blake, Jr.

Comment (W. Blake, Jr.): The presence of this peat, in an area where none is forming today, suggests that the ice edge was considerably behind its present position some 6500 to 6400 years ago

(cf. Blake, 1981). The damp peat was dried (slightly) in an electric oven. An examination of the sample revealed no fragments of coal (unpublished GSC Plant Macrofossil Report No. 83-55 (preliminary) by J.V. Matthews, Jr.). There is always a danger of coal in this general area, as coal-bearing strata of the Eureka Sound Formation outcrop nearby. The sample received the standard treatment with NaOH, HCl (no reaction), and distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

Glacier 7A-45 series (III)

Several organic layers are exposed along the walls of a large gully which has resulted from a retrogressive flow slide south of the river adjacent to Glacier 7A-45 (77°49.8'N, 81°45'W), at an elevation of 130 to 140 m a.s.l. The site is 16 km north of the head of Makinson Inlet (north arm), Ellesmere Island, Northwest Territories.

GSC-2687.	Glacier 7A-45 (IX)	32 500 ± 1580 $\delta^{13}C$ = -28.0‰

Wood (sample BS-77-324; 2.7 g dry; probably **Salix** sp.; unpublished GSC Wood Identification Report No. 78-22 by R.J. Mott) from silt exposed in a vertical face. The organics were collected from a zone 5 to 6 m below the ground surface, in frozen sediments that may be attributable to a former ice-dammed lake. Collected August 14, 1977 by W. Blake, Jr. and R.J. Richardson.

Comment (W. Blake, Jr.): The three largest twigs, all wet, were utilized for the age determination. All bark, plus any adhering sediment with the bark, was removed as the Quaternary deposits are underlain by folded rocks of the Eureka Sound Formation, in which coal is present. The twigs were 7, 7.5, and 9 cm in length, respectively, and the two larger twigs were 5 to 8 mm in diameter. The sample was oven-dried, after which adhering sand and silt was brushed off. NaOH leach was omitted from the sample pretreatment. The sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3364.	Glacier 7A-45 (X)	31 100 ± 480 $\delta^{13}C$ = -28.5‰

Twigs (sample BS-81-222; 12.3 g dry; most of the twigs were identified as **Salix** sp., but several had features similar to those of **Betula** sp.; unpublished GSC Wood Identification Report No. 83-4 by R.J. Mott) from an exposure at the top west end of the gully. The twigs were extracted from a 5 cm-thick band of organic debris near the top of a unit of waterlaid sediments (sand) and beneath a till-like unit at the surface. Collected July 7, 1981 by W. Blake, Jr., J.A. Baker, and S.C. Blake.

Comment (W. Blake, Jr.): This sample was dated as a check on GSC-2687 (this series), which was a very small sample. The resulting age appeared to provide confirmation of GSC-2687, despite the fact that the presence of **Betula** sp. in interstadial time would be unusual. "Although the organic band was not an in situ buried tundra surface, the well preserved nature of the fragile twigs and of the accompanying seeds and mosses suggests deposition in a pond with minimum transport. Fossils present include fragments of a ground-beetle, **Amara alpina**, and seeds of either **Arctostaphylos alpina** or **A. rubra** (both determined by J.V. Matthews, Jr.), none of which live at this latitude today. The deposit also contains a rich assemblage of luxurious mosses, in which the dominant species is **Tomenthypnum nitens** (determined by J.A. Janssens)." (Blake, 1982a, p. 73). The twigs selected for dating were not the largest ones, nor were they the twigs that showed a great deal of wear (rounded ends). Many were <1 cm in length and <2 mm in diameter; the largest were only 4 mm in diameter. The sample received the normal pretreatment with NaOH, HCl (no reaction), and distilled water rinses. Date is based on one 5-day count in the 5 L counter.

GSC-3364-2.	Glacier 7A-45 (XI)	>40 000 $\delta^{13}C$ = -28.4‰

A second batch of twigs (sample BS-81-222; 9.7 g dry; identification as listed under GSC-3364, this series) from the same collection.

Comment (W. Blake, Jr.): Most of the twigs in this sample were <1 cm long and <2 mm in diameter; in general these were smaller diameter twigs than those used for GSC-3364. Again, every effort was made to exclude twigs with rounded ends (implying transport) or those with flattened cross-sections. Many retained bark, which was removed.

This determination, carried out to confirm the result on GSC-3364, failed to do so. One possible explanation would seem to be that some Holocene-aged material, perhaps a root, was included in the sample used for GSC-3364. This explanation is harder to invoke for GSC-2687 (this series), however, which was collected from deeper in the section. The sample received the normal pretreatment with NaOH, HCl (no reaction), and distilled water rinses. Date is based on two 1-day counts plus one 3-day count in the 5 L counter.

GSC-3828.	Glacier 7A-45 (XII)	>39 000 $\delta^{13}C$ = -28.5‰

Twigs (sample 83-BS-100; 10.8 g dry; **Salix** sp. (the main type) and **Betula** sp. (a much smaller proportion); unpublished GSC Wood Identification Report No. 84-19 by R.J. Mott) from the same horizon from which BS-81-222 was collected two years earlier. Collected June 19, 1983 by W. Blake, Jr. and K.E. Rolko, now Science North, Sudbury, Ontario.

Comment (W. Blake, Jr.): This sample was dated to see if the discrepancy created by GSC-3364 (31 100 ± 480 years) and GSC-3364-2 (>40 000 years) could be resolved. As with the 1981 collection the well preserved twigs selected were not the largest ones, nor were they the ones that showed a great deal of wear (rounded ends). Many pieces were <1 cm in length and <2 mm in diameter; the largest twigs used were 5 mm in diameter and none exceeded 6 cm in length. The twigs were selected individually, 11.6 g washed and oven dried (10.2 g). An additional 0.6 g of twigs, unwashed but carefully examined to make certain that no sediment was adhering, was added, for a total of 10.8 g. The sample received the standard pretreatment with NaOH, HCl (no reaction) and distilled water rinses. Date is based on one 5-day count in the 5 L counter.

The dating situation is further complicated because a single piece of wood (sample 83-BS-100; 0.35 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 85-76 by R.J. Mott), from the same sample, was determined to be 41 910 ±450 years old (TO-190) by accelerator mass spectrometry (AMS). This date was based on a single twig, 3.5 cm long and with a maximum diameter of 1.0 cm; stubs of branches remained as well as some bark. This finite age determination is well below the limit of wood ages attained by the IsoTrace Laboratory (e.g., see Beukens et al., 1986).

GSC-3421.	Glacier 7A-45 (XIII)	>38 000 $\delta^{13}C = -28.6‰$

Twigs (sample BS-81-218 (5.7.81); 11.7 g dry; mostly **Salix** sp.; unpublished GSC Wood Identification Report No. 82-13 by R.J. Mott) from a layer slightly lower in the section at the northeast end of the gully. The sample, from a band rich in organic debris within sand strata, is from approximately 8 to 10 m below the ground surface. Collected July 5, 1981 by W. Blake, Jr. and J.A. Baker.

Comment (W. Blake, Jr.): As with collection BS-81-222 and 83-BS-100 the twigs were in general well preserved. The twigs selected were not the largest ones, nor were they the ones that exhibited a great deal of wear (rounded ends). Many pieces were <1 cm in length and <2 mm in diameter; all were <6 cm long and none exceeded 9 mm in diameter. Twigs with bark were avoided, so as to reduce the chance that coal particles might be trapped between the bark and the wood. The sample was given a pre-wash in distilled water to remove adhering sand grains and coal particles, followed by oven-drying. Pretreatment included NaOH and HCl (no reaction) leaches plus two 1-day counts in the 5 L counter.

Obviously this interesting site warrants further analysis of both plant macrofossils and insects. In addition, radiocarbon dating (by AMS) of constituents other than wood should be carried out to see if the chronological problems can be resolved.

East-central Ellesmere Island

GSC-4310.	Cadogan Inlet	31 600 ± 1120 $\delta^{13}C = +0.2‰$

Marine pelecypod shells (sample 86-BS-107; 27.8 g; **Hiatella arctica**; identified by W. Blake, Jr.) from coarse sand in an excavation along a stream channel through raised beaches on the north side of Cadogan Inlet, Ellesmere Island, Northwest Territories (78°13.5'N, 75°47.0'W), at an elevation of 115 m (altimeter determination). The collection site was approximately 3.5 m below the ground surface. Collected June 21, 1986 by W. Blake, Jr., K.A. Eyvindson, now McMaster University, Hamilton, Ontario, and K.E. Rolko.

Comment (W. Blake, Jr.): An early Holocene age was expected for this sample, which was collected at a slightly higher elevation than the highest shells (108 m) near Rice Strait (cf. GSC-3314, 8470 ± 100 years; GSC XXVI, 1987, p. 34). It is the first time that 'old' shells have been collected in situ along the west side of Smith Sound. The shells were well preserved, with many intact valves. After adhering sediment was removed by washing in distilled water, the shells were air dried in the field. Date is based on two 1-day counts in the 2 L counter.

Baird Inlet series

Marine pelecypod shells (**Hiatella arctica**; identified by W. Blake, Jr.) from sand and mud in a raised beach on the north side of Baird Inlet, Ellesmere Island, Northwest Territories (78°32.0'N, 76°04.0'W), at an elevation of 90 m (altimeter determination). Collected June 7, 1985 by W. Blake, Jr., K.A. Eyvindson, and K.E. Rolko. Two determinations were made:

GSC-4079.	Baird Inlet, thin shells	8440 ± 100 $\delta^{13}C = +0.3‰$

Thin shells (sample 85-BS-194A; 46.5 g) from this collection.

Comment (W. Blake, Jr.): All aragonitic shells in the sample selected had good external ornamentation but no internal lustre. Encrusted shells were excluded for the most part, but a few were pitted and a few had minor encrustations. This sample comprised 9 left valves, 6 right valves, and 27 fragments. The largest measured 4.2 by 1.9 cm. Most valves were less than 2 mm thick. Date is based on three 1-day counts in the 5 L counter.

GSC-4084.	Baird Inlet, thick shells	8400 ± 100 $\delta^{13}C = +1.1‰$

Thick shells (sample 85-BS-194B; 47.0 g) from the same collection.

Comment (W. Blake, Jr.): Thick aragonitic shells were dated from the same collection, to determine if there was an appreciable age difference between thick and thin shells. The sample comprised 17 left valves plus 3 fragments and 6 right valves plus 7 fragments. The largest intact valve was 3.8 by 1.8 cm, but some fragments were from larger valves; maximum thickness, 5 mm. These thicker valves were somewhat chalky, some had worn exterior surfaces, and some had thin encrustations on internal surfaces. Date is based on three 1-day counts in the 5 L counter. Both dates are similar to shells at 108 m at the mouth of Rice Strait (GSC-3314; 8470 ± 100 years; GSC XXVI; 1987, p. 34).

GSC-4000. Cape Herschel plateau 1070 ± 90

Calcareous precipitate (sample BS-81-238; 24.3 g) which occurred as crusts on granitic bedrock on the Cape Herschel plateau, Ellesmere Island, Northwest Territories (78°36.2'N, 74°42.5'W), at an elevation of 215 to 225 m. Collected July 8, 10, 13 and 30, 1981 by W. Blake, Jr., J.A. Baker, and S.C. Blake.

Comment (W. Blake, Jr.): It was thought that these crusts, composed of both calcite and aragonite in ratios varying between 60:40 and 80:20 (unpublished GSC Mineral Identification Report No. 81-42 by A.C. Roberts), might have been deposited subglacially, as they occur, primarily, close to the lee side of sculptured outcrops (rather than on the more highly polished and striated stoss surfaces). The date suggests that the crusts are of more recent origin or, if they are older, that their age has been affected by exchange with atmospheric CO_2. Because of the small sample size only the outer 10% of calcareous material was removed by HCl leach. Date is based on two 1-day counts in the 2 L counter. A $^{13}C/^{12}C$ ratio of +12.0‰ was determined, but no correction was applied.

Camp Pond series

Aquatic moss, wood and sediments from a small pond, informally named 'Camp Pond', near the Cape Herschel station, Ellesmere Island, Northwest Territories (78°37.1'N, 74°41.5'W), at an elevation of 58.0 m (leveled). The aquatic moss was at the pond surface, the other samples were extracted from cores of frozen sediment recovered from the pond on two occasions.

GSC-4205. Camp Pond (I) modern
$\delta^{13}C = -30.1‰$

Aquatic moss (Botanical Collection No. 13-1981; 22.0 g dry) from the pond surface. The sample was collected along the east and southeast sides of the pond, air dried in the field, and stored in plastic bags. Collected July 1, 1981 by W. Blake, Jr.

Comment (W. Blake, Jr.): This moss sample was dated as part of a series to determine: 1) whether living vascular plants, algae and mosses around selected ponds in east-central Ellesmere Island had 'apparent ages' (cf. MacDonald et al., 1987) and 2) the $^{13}C/^{12}C$ ratios, so as to better interpret ratios obtained on various constituents in the lake sediment cores themselves (cf. GSC XXVI, 1987, p. 30-32). Sample received the standard pretreatment with hot NaOH, hot HCl (no reaction) and distilled water rinses to neutral pH. Date is based on two 1-day counts in the 5 L counter.

GSC-2838. Camp Pond (II) 4890 ± 70
$\delta^{13}C = -16.6‰$

Organic pond sediment (sample BS-78-4 (7:100-104 cm); 35.5 g dry) from 100 to 104 cm depth below the sediment/water interface. Collected May 19, 1978 by W. Blake, Jr., J.P. Bridgland (now Cape Breton Highlands National Park, Ingonish Beach, Nova Scotia), R.J. Richardson (now Alberta Geological Survey, Edmonton, Alberta), and P.B. Smith (Shawville, Quebec) using a SIPRE-type motor driven coring device (Blake, 1978).

Comment (W. Blake, Jr.): This date is on the basal sediment (increment 5B, of which only the lowermost 4 cm were used) from the longest core extracted from 'Camp Pond'. The frozen core increment (preserved as collected) weighed 172.7 g. After thawing, removal of excess H_2O and oven drying the weight was reduced to 37.0 g. The basal sediment, at 103 to 104 cm depth, is dominated by **Fragillaria pinnata** (unpublished GSC Diatom Report 79-1 by S. Lichti-Federovich). NaOH leach was omitted from the sample pretreatment. To achieve a slower reaction the sample was treated with H_3PO_4 rather than HCl, followed by distilled water rinses. The CO_2 recovered by the treatment with H_3PO_4 was saved (cf. GSC-2837, this series), whereas the organic residue remaining after pretreatment was burnt to obtain the CO_2 for GSC-2838. Date is based on two 1-day counts in the 5 L counter.

GSC-2837. Camp Pond (III) 3950 ± 120
$\delta^{13}C = +9.3‰$

Carbonate fraction (sample BS-78-4 (7:100-104 cm); 35.5 g dry) from which the CO_2 was recovered by dissolving the 4 cm-long core increment of organic pond sediment in H_3PO_4 (see GSC-2838, this series).

Comment (W. Blake, Jr.): The most likely source for carbonate material was thought to be the veneer of till around the pond, and this carbonate-rich erratic material derives from Proterozoic and Paleozoic bedrock to the north. For this reason an

age significantly older than that obtained on the organic fraction of the core increment was expected. Surprisingly, a younger age was obtained, and at present a ready explanation for this result is not available.

GSC-2990. Camp Pond (IV) 5760 ± 100
$\delta^{13}C = -16.9‰$

Organic pond sediment (sample BS-79-1 (12:131-133 cm); 12.5 g dry) from 131 to 133 cm depth below the sediment/water interface. Collected June 1, 1979 by W. Blake, Jr., H. Hyvärinen (University of Helsinki, Helsinki, Finland), R.N. McNeely (then Water Quality Branch, Environment Canada, now GSC), and R.J. Richardson, using a SIPRE-type motor driven coring device (Blake, 1982b).

Comment (W. Blake, Jr.): This core penetrated deeper into the pond's sediments, presumably in a hole between boulders, but it is still younger than the basal organic sediment in nearby 'Beach Ridge Pond' at an elevation of 34.0 m (GSC XXVI, 1987, p. 32-33). The basal 2 cm-thick increment was removed from the frozen core by cutting with a diamond saw. Total wet weight was 70.4 g; after the excess water was poured off, 40.0 g. After oven drying the weight was reduced to 15.8 g and after dry sieving through a #18 screen (to remove sand grains larger than 1 mm in size) the weight was 13.3 g. Because of the small sample size, NaOH leach was omitted from the pretreatment, which otherwise included an HCl leach and distilled water rinses. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2841. 'Horseshoe Pond' 1740 ± 70
$\delta^{13}C = -15.3‰$

Organic sediment (sample BS-78-26 (20:56-59 cm); 46.2 g dry) from 56 to 59 cm below the sediment/water interface in the outlet arm of the largest lake on the low, northwest peninsula east of Erik Harbour and northwest of Cape Herschel, Ellesmere Island, Northwest Territories (78°37.6'N, 74°43'W), at an elevation (pond surface) of 3.0 m (leveled). Collected May 25, 1978 by W. Blake, Jr., J.P. Bridgland, R.J. Richardson and P.B. Smith using a SIPRE-type motor driven coring device (Blake, 1978).

Comment (W. Blake, Jr.): This sample represents the basal 1 to 3 cm (angular and uneven bottom) of Core 20, Increment 5. The frozen weight of this increment was 111.5 g; after thawing, removal of part of the water, and drying – 86.2 g; and after removal of rock fragments and sand (retained on the #18 sieve, i.e., >1 mm in diameter) – 58.0 g. NaOH leach omitted from sample pretreatment, which otherwise included an HCl leach and distilled water rinses. Date is based on two 1-day counts in the 2 L counter.

GSC-3948. Brackish Water Pond modern
$\delta^{13}C = -13.2‰$

Algal crusts (sample BS-81-246; 85.0 g dry; filaments of the blue-green alga **Oscillatoria** sp.; identified by J.P. Smol, Queen's University, Kingston, Ontario) from shallow water in "Brackish Water Pond" (informal name) at the northwest corner of the Cape Herschel peninsula, Ellesmere Island, Northwest Territories (78°37.8'N, 74°42.6'W), at an elevation of 0 m. This pond receives an influx of marine waters at the highest tides. Collected July 12, 1981 by W. Blake, Jr.

Comment (W. Blake, Jr.): This sample was composed of large sheets of algae, which were air dried after collection. The algae were dated as part of a series to determine whether modern vascular plants, mosses, and algae around Ellesmere Island ponds or lakes had apparent ages or not. The $^{13}C/^{12}C$ ratios in the same series of samples were determined to provide guidance in interpreting the ratios being obtained from lake/pond sediment cores in the area. This sample was pretreated with NaOH and HCl (moderate reaction) plus distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

GSC-3293. Elison Pass 2440 ± 50
$\delta^{13}C = -24.5‰$

A piece of driftwood (sample BS-81-151; 16.9 g; **Picea** sp., identified by L.D. Farley-Gill) imbedded in moss in Elison Pass approximately 0.95 km south of the head of Erik Harbour, Ellesmere Island, Northwest Territories (78°36.6'N, 74°44.5'W), at an elevation of approximately 4 m. Collected June 22, 1981 by W. Blake, Jr.

Comment (W. Blake, Jr.): This piece of wood is one of only a few pieces found so far in the vicinity of Cape Herschel. Most driftwood was apparently used by natives who have been camping and hunting in the area for over 4000 years (cf. GSC-3355, 4410 ± 210 years, this list). The sample, although not imbedded in beach gravel and hence somewhat suspect, provides an approximation for the position of the sea, relative to the land, 2400 to 2500 radiocarbon years ago. Pretreatment included NaOH and HCl (no reaction) leaches, plus distilled water rinses. Date is based on one 3-day count in the 5 L counter.

GSC-3170. Elison Lake 3850 ± 100
$\delta^{13}C = -23.4‰$

Organic sediment (sample BS-78-27 (1:47-50 cm); 90.0 g dry) from 47 to 50 cm below the sediment/water interface near the south end of Elison Lake, Ellesmere Island, Northwest Territories (78°36.3'N, 74°44.5'W), at an elevation of 17.0 m (leveled). Collected May 25, 1978 by W. Blake, Jr., J.B. Bridgland, R.J. Richardson and

P.B. Smith using a SIPRE-type motor driven coring device (Blake, 1978).

Comment (W. Blake, Jr.): This lake proved hard to core; three other attempts in 1978 hit rock or boulders, as did 14 tries in 1979. The basal 3 cm of increment No. 7 was cut off using a diamond saw. Wet sediment weight – 152.0 g; weight after water poured off – 138.8 g; weight after overnight drying in an electric oven – 97.3 g; weight of residue after sieving through a #18 screen (1.00 mm mesh) – 90.6 g. NaOH leach omitted from sample pretreatment, but HCl leach and distilled water rinses were carried out. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-4174. Johan Peninsula 2950 ± 70

Calcareous precipitate (sample 85-BS-84; 24.5 g) from the bottom and sides of a granitic boulder partially imbedded in calcareous till 3.8 km northwest of the northwest corner of Herschel Bay on Johan Peninsula, Ellesmere Island, Northwest Territories (78°37.7'N, 74°52.0'W), at an elevation of 220 m. Collected May 25, 1985 by W. Blake, Jr.

Comment (W. Blake, Jr.): The platy material comprising this sample occurred below ground surface for the most part, but the upper edges of the plates extended up to 1 cm above ground level in places. The largest intact piece measured 7.2 x 4.2 cm. The sample was dated as part of a series (cf. GSC-3692 and -4000, this list) to see if precipitates on bedrock or boulders can be used to contribute to the working out of chronologies. The time of deposition of the enclosing till is probably several thousand years older, when the site is considered in regional context. Because of the small sample size and the presence of significant quantities of silt on and within the sample matrix, only the outer 10% of calcareous material was removed with HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter. A $^{13}C/^{12}C$ ratio of +7.7‰ was determined, but no correction was applied.

GSC-3562. Rosse Bay, wood 90 ± 130
$\delta^{13}C = -27.9‰$

A small piece of wood (sample BS-82-14; 3.5 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 82-48 by R.J. Mott) partially imbedded in till comprising an island in front of an unnamed glacier on the southwest side of Rosse Bay, Ellesmere Island, Northwest Territories (78°39.4'N, 74°47.0'W), at an elevation of 5 m. Collected May 18, 1982 by W. Blake, Jr.

Comment (W. Blake, Jr.): It was hoped that this piece of willow would provide information about the time of formation of this morainic island. The date may indicate that the glacier advanced and then retreated very recently, i.e., sometime within the last 200 ^{14}C years. A second alternative is that the willow grew on the island after the ice had receded. The slightly damp sample was air dried in the office. The bent piece of wood totalled 22.5 cm in length, and the small side branches were still intact, with bark. All adhering mud was scraped off. The sample was pretreated with NaOH and HCl (no reaction) plus distilled water rinses. The sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-4259. Rosse Bay, barnacles 370 ± 80
$\delta^{13}C = +1.5‰$

Cirriped plates and bases (sample 86-BS-81; 52.1 g; **Balanus balanus**; identified by W. Blake, Jr.) from, and adjacent to, a single large boulder in a moraine adjacent to an unnamed glacier on the southwest side of Rosse Bay, Ellesmere Island, Northwest Territories (78°40.0'N, 74°48.5'W), at an elevation of approximately 15 m (altimeter determination). The edge of the glacier is some 3 m below this site and approximately 10 m distant. Collected June 15, 1986 by W. Blake, Jr., K.A. Marentette (now University of Windsor, Windsor), and K.E. Rolko.

Comment (W. Blake, Jr.): It is obvious from the date that the part of this broad moraine ridge nearest the glacier is essentially modern, assuming that the barnacles are typical of the age of other elements of the marine fauna. Barnacles (**Balanus crenatus**) collected alive in Rice Strait in 1898 gave an age of 240 ± 100 years (GSC-2672; GSC XXVI; 1987, p. 34-35). Date is based on two 1-day counts in the 5 L counter.

GSC-3525. Leffert Glacier lateral moraine 190 ± 70
$\delta^{13}C = +0.3‰$

Marine pelecypod shells (sample BS-81-82; 18.0 g; **Astarte borealis**; identified by I. Lubinsky, University of Manitoba, Winnipeg) from clay/silt at the west end of a small morainic island, 1.45 km east of the 1959 position of the snout of Leffert Glacier on the north side of Rosse Bay, Ellesmere Island, Northwest Territories (78°42.0'N, 74°44.5'W), at an elevation of 4 to 6 m. Collected June 15, 1981 by W. Blake, Jr. and J.A. Baker.

Comment (W. Blake, Jr.): This island is part of a lateral moraine system built along the north side of innermost Rosse Bay during the most recent advance of Leffert Glacier. However, the age is much younger than was expected from a series of dates on shells and calcareous algae collected from the lateral moraine along the south side of Leffert Glacier at 'Leffert nunatak' (Blake, 1984a, 1984b). The date is somewhat difficult to understand as shells of the same species collected alive nearby in 1898 by the 'Second Norwegian Arctic Expedition in the "Fram"

1898-1902' gave an age of 380 ± 50 years (GSC-1916; Blake, 1975, 1987). Possibly some even younger shells, i.e., ones which immediately predate or postdate the advent of nuclear bomb testing in the 1950's, together with their enclosing sediment, have been pushed up by the last advance of Leffert Glacier or by recent sea ice action. The well preserved shells were all intact valves (4 right and 7 left) plus one left valve fragment. The largest measured 3.2 x 2.5 cm. All valves were characterized by intact periostracum and good internal lustre. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-4405. Alexandra Fiord 310 ± 80
$\delta^{13}C = -27.1‰$

A wood fragment (sample 86-BS-123; 1.3 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 87-08 by R.J. Mott) from the ground surface 1.0 km northwest of the head of Alexandra Fiord, Ellesmere Island, Northwest Territories (78°51.0'N. 76°25.0'W), at an elevation of 185 m (altimeter determination). Collected June 22, 1986 by W. Blake, Jr.

Comment (W. Blake, Jr.): This single twig was 17.0 cm long, and it had a maximum diameter of 0.8 cm. The wood was clean, about half of the bark was stripped away, and the ends were slightly rounded. The twig was lying on a bedrock surface 220 cm from the ice cliff at the margin of the glacier. The wood probably derives from a willow tree overridden by the glacier and later exposed as the ice receded slightly. Because of the small sample size, pretreatment with HCl and NaOH was omitted. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-4502. Stygge Glacier 90 ± 60
$\delta^{13}C = -24.7‰$

Wood (sample 87-BS-40; 10.6 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 87-34 by R.J. Mott) from the surface of till in a medial moraine on Stygge Glacier, approximately 4.5 km southwest of the head of Jokel Fiord, Ellesmere Island, Northwest Territories (78°45.0'N, 78°24.5'W), at an elevation of 165 m (altimeter determination). Collected August 21, 1987 by W. Blake, Jr.

Comment (W. Blake, Jr.): This piece of wood was the only one found in the thin veneer of till overlying ice, although marine shell fragments were abundant. The wood could well have been considerably older, to judge by the dates obtained earlier on other pieces of **Salix** sp. in moraines around the central Ellesmere Island ice cap (cf. Blake, 1981; GSC XXI, 1981, p. 17-18). However, it would appear to have derived from 'Stygge Nunatak', a short distance up-glacier, in the very recent past. The well preserved, solid wood was slightly damp when collected (but no mold was present); it was air dried in the field. Its maximum dimensions were: 26 cm long (main stem); 15 cm long (secondary stem); 2.5 cm in diameter at base. All of the weathered greyish-coloured wood on the surface was removed by scraping. The sample received the standard treatment with NaOH, HCl, and distilled water rinses. Date is based on one 1-day count in the 5 L counter.

GSC-3692. Bache Peninsula 2010 ± 50

Calcareous precipitate (sample 83-BS-28; 32.0 g) which occurred as crusts on gneissic bedrock on the south coast of Bache Peninsula 11.7 km west-northwest of Cape Camperdown, Ellesmere Island, Northwest Territories (79°01.9'N, 75°06.5'W), at an elevation of 420 m. Collected June 7, 1983 by W. Blake, Jr., J.E. Dale (now Queen's University, Kingston, Ontario) and K.E. Rolko.

Comment (W. Blake, Jr.): Like the crusts on the Cape Herschel plateau (GSC-4000, 1070 ± 90 years, this list) the possibility existed that these crusts were deposited subglacially, hence dating was carried out. There is no other evidence that a glacier covered the area 2000 years ago, although there may have been more extensive snowdrifts at that time. The comments made for GSC-4000 probably apply equally well here. The sample was given no pretreatment. Date is based on one 3-day count in the 5 L counter. A $^{13}C/^{12}C$ ratio of +8.7‰ was determined, but no correction was applied.

GSC-3710. Bache Peninsula 7730 ± 120
$\delta^{13}C = +1.4‰$

Marine pelecypod shells (sample 83-BS-90; 13.0 g; **Mya truncata**; identified by W. Blake, Jr.) from the ground surface and at shallow depth (less than 30 cm) in sand and beach gravel on the south coast of Bache Peninsula approximately 20.6 km west-northwest of Cape Camperdown, Ellesmere Island, Northwest Territories (79°03.5'N, 75°30.0'W), at an elevation of 70 m (altimeter determination). Collected June 18, 1983 by W. Blake, Jr. and K.E. Rolko.

Comment (W. Blake, Jr.): This dated collection is the only one made along the south coast of Bache Peninsula, as much of this coast is cliffed. It is slightly older than shells at 62 m near Cape Henry, eastern Bache Peninsula (GSC-2937, 6920 ± 140 years; GSC XXVI, 1987, p. 35). It is similar in age to a collection from the opposite side of Buchanan Bay at 75 m on Cocked Hat Island (GSC-4320, 7680 ± 90 years, this list). Most shells used for dating were fragments, although the collection contained many intact valves. Because of the small sample size, only the outer 10% of shell material was removed by HCl

leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3789. Bache Peninsula modern
$\delta^{13}C = -26.5‰$

Algal crusts (sample Bot. Coll. No. 7-1983; 86.0 g dry; **Mougeotia** sp.; identified by J.P. Smol, Queen's University, Kingston, Ontario) from water less than 30 cm deep at the south end of an unnamed lake in a basin in Paleozoic bedrock, Bache Peninsula, Ellesmere Island, Northwest Territories (79°04.6'N, 75°33'W), at an elevation of 410 m. Collected July 1, 1983 by W. Blake, Jr.

Comment (W. Blake, Jr.): This sample was dated as one of a series to determine whether modern vascular plants, mosses, and algae around Ellesmere Island ponds and lakes have apparent ages or not. The $^{13}C/^{12}C$ ratios in the same series of samples were determined to provide guidance in interpreting the ratios being obtained from lake/pond sediment cores in the area. This sample was pretreated with NaOH and HCl (strong reaction) plus distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

GSC-3766. Flagler Bay 7270 ± 80
$\delta^{13}C = +1.8‰$

Marine pelecypod shells (sample 83-BS-65; 28.0 g; **Mya truncata**; identified by W. Blake, Jr.) from the ground surface and at shallow depth in sand and mud among boulders (with dimensions in some cases exceeding 1 m) in a gully near the south end of an unnamed island at the mouth of Flagler Bay, Ellesmere Island, Northwest Territories (79°05.8'N, 75°58.0'W), at an elevation of 68 m (altimeter determination). Collected June 14, 1983 by J.E. Dale (now Queen's University, Kingston, Ontario), K.E. Rolko, and W. Blake, Jr.

Comment (W. Blake, Jr.): This sample is similar in age to shells at 65 m at the eastern end of Knud Peninsula, 3.0 km to the west. The shells used for dating were all fragments, but some were from quite large valves (more than 3 cm high). Some fragments were more than 3 mm thick at the posterior end, but most shells are less than 1 mm thick. The dated sample comprised 15 left and 15 right valves (all posterior ends) plus seven miscellaneous pieces (whose size and shape indicated that they were also **Mya truncata**). The shells exhibited no chalkiness, incrustations or pitting. A few fragments retained traces of the periostracum, and all retained internal lustre. Date is based on one 3-day count in the 2 L counter.

GSC-3700. Knud Peninsula, east 7300 ± 140
$\delta^{13}C = 0.0‰$

Marine pelecypod shells (sample 83-BS-42; 9.0 g; **Macoma calcarea**; identified by W. Blake, Jr.) from the ground surface and at shallow depth in silt and fine sand at the eastern end of Knud Peninsula, Ellesmere Island, Northwest Territories (79°05.8'N, 76°04.5'W), at an elevation of 65 m (altimeter determination). Collected June 11 and 14, 1983 by W. Blake, Jr., J.E. Dale, and K.E. Rolko.

Comment (W. Blake, Jr.): This sample is the highest shell collection made at the eastern end of Knud Peninsula. Shells at the heads of Flagler Bay and Beitstad Fiord, on either side of Knud Peninsula, are considerably younger (GSC XXVI, 1987, p. 35). Many of the thin shells in the collection were encrusted with secondary carbonate, but such shells were excluded from the dated sample. Both right and left valves were well represented; the largest valve measured 2.8 by 2.1 cm; the smallest, 1.0 by 0.8 cm. Because of the small sample size, only the outer 10% of shell material was removed with HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count plus one 1-day count in the 2 L counter.

Western Knud Peninsula series

Samples of algae from the lake shore and outlet channel, and samples from a core of the bottom sediments from an unnamed lake on the plateau north of Haa Island and above the junction of Beitstad Fiord and Hayes Fiord, Knud Peninsula, Ellesmere Island, Northwest Territories (79°03.0'N, 77°27.0'W), at an elevation of 665 m.

GSC-3575. Western Knud Peninsula (I) modern
$\delta^{13}C = -8.6‰$

Algal crusts (sample BS-81-71; 25.0 g dry) from the northeastern shore of the lake and from between boulders in the adjacent outlet channel from the lake. Although the algae were difficult to identify because they were so dried-out, a few intact filaments of **Lynbya** sp., a blue-green taxon, and resting cysts of the green flagellated alga, **Haematococcus** sp., were present in the sample (personal communication from J.P. Smol, November 1982). Collected June 11, 1981 by W. Blake, Jr.

Comment (W. Blake, Jr.): Pretreatment included the standard leaches with NaOH and HCl (no reaction) plus distilled water rinses). Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3794. Western Knud Peninsula (II) modern
$\delta^{13}C = -6.9‰$

Algal crusts (Bot. Coll. No. 9-1983; 80.0 g) collected or described for GSC-3575 (this series). This sample was also badly degraded, but it was largely made up of the blue-green genus **Oscillatoria** (personal communication from J.P. Smol, February 1984). Collected July 17, 1983 by W. Blake, Jr. and K.E. Rolko.

Comment (W. Blake, Jr.): Pretreatment included the standard leaches with NaOH and HCl (no reaction) plus distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

GSC-3632.	Western Knud Peninsula (III)	1580 ± 90 $\delta^{13}C$ = -30.5‰

Algae from a concentration of sheaf-like layers (sample BS-82-85 (2: 25.0-27.5 cm); 15.3 g dry) at 25.0 to 27.5 cm below the sediment/water interface in a core collected in 7.55 m of water (of which the top 2.35 m was ice). Collected June 5, 1982 by W. Blake, Jr., T.W. Anderson, and F.M. Nixon.

Comment (W. Blake, Jr.): The organic carbon content was 5.0% at 27.5 to 28.5 cm depth and 11.6% at 25.0 to 26.0 cm depth. This sample was dated to determine when heavy algal growth commenced. NaOH leach was omitted from the sample pretreatment, but the algae received the standard HCl treatment (no reaction) plus distilled water rinses. The sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3602.	Western Knud Peninsula (IV)	6210 ± 70 $\delta^{13}C$ = -29.1‰

Basal organic lake sediment (sample BS-82-85 (2: 60.0-67.5 cm); 318.0 g wet) of 60.0 to 67.5 cm below the sediment/water interface in the same core described under GSC-3632 (this series). Collected June 5, 1982 by W. Blake, Jr., T.W. Anderson, and F.M. Nixon.

Comment (W. Blake, Jr.): This date provides a minimum age for the deglaciation of this plateau area and for the onset of organic sedimentation in the lake (Blake, in press). This determination and the available dates on marine shells from the fiord heads (especially GSC-2897, 5520 ± 90 BP from Beitstad Fiord and GSC-3929, 4990 ± 70 BP from west of the head of Flagler Bay; both in GSC XXVI, 1987, p. 35), plus dates on marine shells from farther east (GSC-3700, 7300 ± 140 BP from the eastern tip of Knud Peninsula; GSC-3766, 7270 ± 80 BP from the mouth of Flagler Bay; and GSC-3710, 7730 ± 120 BP from the southern coast of Bache Peninsula; all in this list) are incompatible with the maps published by Dyke and Prest (1987a, 1987b). These maps depict the entire area from which the six age determinations are derived as being ice free by 9000 years ago.

Two increments were prepared, weighing (wet) 162.0 and 156.0 g, respectively, in order to obtain sufficient material for dating (without the necessity of mixing with dead gas for counting), hence the relatively large increment used in relation to total core length. The organic carbon content ranged between 1.9 and 2.6% for the core increment utilized (3 determinations). NaOH leach omitted from sample pretreatment. Date is based on one 5-day count in the 2 L counter.

Cocked Hat Island

GSC-4320.	Cocked Hat Island	7680 ± 90 $\delta^{13}C$ = +2.5‰

Marine pelecypod shells (sample 86-BS-91; 27.2 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the ground surface and at shallow depth (less than 15 cm) in pockets of sand on the southwest side of Cocked Hat Island, Northwest Territories (78°47.4'N, 74°34.0'W), at an elevation of 75 m (altimeter determination). Collected June 20, 1986.

Comment (W. Blake, Jr.): This sample is the first to be dated between Skraeling Island and the south side of Pim Island. Like a date on shells from the south side of Bache Peninsula (GSC-3710, 7730 ± 120 years, this list) the sample is less than 8000 years old. The dated sample comprised 52 fragments (28 left valves, 24 right), all free of lichens, incrustations, precipitates, etc. All fragments were washed clean of adhering mud in the field and office using distilled water, and they were then air dried. The largest fragment measured 2.6 by 2.0 cm, but some fragments were from much larger shells. All shells had good external ornamentation and at least half retained good internal lustre. Shell thickness was up to 2 mm in the hinge area. Date is based on two 1-day counts in the 2 L counter.

Bathurst Island

GSC-3049.	Goodsir Inlet	38 500 ± 1370

Organic-rich mineral soil (sample DB4; 82.0 g dry) from the Ahy horizon at a depth of 52 cm in a freshly cut trench (dug to expose the soil profile) 5 km south of Goodsir Inlet, Bathurst Island, Northwest Territories (75°40.0'N, 97°41'W), at an elevation of 61 m. The soil sample was collected from perennially frozen material approximately 4 cm below the frost table. Collected July 27, 1975 by C. Tarnocai, Land Resource Research Centre, Agriculture Canada, Ottawa.

Comment (C. Tarnocai): The ^{14}C date relating to the Ahkyz horizon of soil DB4 indicate that this soil horizon developed during an ice-free interstadial period more than 38 000 years ago. The morphology and composition of this Ahkyz horizon, which is cryogenic in origin, indicate that this soil was a Cryosol and, in this interstadial period, the soil was most likely very similar to the present soil. Since the ^{14}C sample was taken only a few centimetres below the present permafrost table and since this Ahkyz horizon generally develops near the permafrost table, this would indicate that the permafrost table of the interstadial Cryosol was located at approximately the same depth as it is situated today.

Thus, it is probable that the cold climate that exists in the area today was also present during this interstadial period.

In the late Wisconsin period, approximately 24 000 BP (Dreimanis et al., 1966) to 9000 years BP (Blake, 1964), glacial ice covered the terrain. This glacial ice was a cold-based type (Sugden, 1977, 1978), that is, the glacier sole was frozen to the substrate. Thus, the movement was not by basal sliding but by plastic flow within the ice that caused little or no disturbance of the soil and produced no till or glacial landforms. Falconer (1966) reported that, when thin glacial ice on Baffin Island retreated in more recent times, undisturbed patterned ground was left behind. A similar phenomenon probably occurred on these Bathurst Island soils since they were frozen throughout the late Wisconsin period and yet little or no disturbance took place as a result of the overlying cold-based glacial ice. According to Blake (1964), some areas of Bathurst Island may have been deglaciated as early as 10 000 years ago but much of the island was ice-free by 9000 BP.

Comment (W. Blake, Jr.): This sample was collected during a survey of soils on Bathurst, Cornwallis, and adjacent smaller islands as one component of a terrain inventory (Tarnocai, 1976). This most interesting age determination, and the comments above (part of an unpublished report by the submitter) form an important addition to our knowledge of late Pleistocene chronology in the northern part of the Arctic Archipelago. Few finite dates on buried organic materials exist (cf. Blake, 1974), although two age determinations on **Salix** sp. wood in the same age range (as well as one older result) have been obtained from a collection from Webber Glacier, Ellesmere Island (GSC-3427, 38 200 + 1240 years; GSC XXVI, 1987, p. 37). The bulk sample was damp on receipt; upon oven drying its weight decreased from 128.5 to 82.0 g. The sample was given the standard leaches with NaOH and HCl plus distilled water rinses. Date is based on one 3-day count in the 5 L counter.

Goodsir Inlet peat series

Peat from different depths in a large, eroding, high centre lowland (peat) polygon, located southwest of Goodsir Inlet, Bathurst Island, Northwest Territories (75°40'N, 97°40'W) at an elevation of 61 m. Collected July 25 and 27, 1975 by C. Tarnocai.

GSC-2355. Goodsir Inlet peat (I) 5830 ± 70

Moderately decomposed moss peat (sample DB3-1; 15.9 g dry) from the permafrost table (25 cm below the surface) in the polygon.

GSC-2317. Goodsir Inlet peat (II) 6160 ± 90

Moderately decomposed moss peat (sample DB3-2; 6.9 g dry) taken from the permafrost layer of the polygon, at a depth of 78 cm.

GSC-2326. Goodsir Inlet peat (III) 5070 ± 60

Moderately decomposed fen peat (sample DB3-3; 11.4 g dry) from the base of the peat in the polygon, at a depth of 130 cm.

Comment (C. Tarnocai): The rate of peat deposition between approximately 6160 years BP and 5830 years BP, based on samples GSC-2317 and -2355, respectively (there was 53 cm difference in depth between them), was 16 cm per 100 years. This rate indicates a very rapid peat accumulation as a result of greater biomass production than exists today. All surfaces of these high centre lowland polygons are strongly eroded and almost completely devoid of peat-forming vegetation. Hence, no active peat development was noted on these peatlands during the survey. The higher peat accumulation (higher biomass production) in the past is attributed to more favourable climatic conditions, as it was probably warmer and wetter during that period than has been the case recently. The peat accumulation in the upper Mackenzie Valley was found to be the greatest in **Sphagnum** peat deposits. The rate of peat accumulation on these **Sphagnum** peat deposits during the last 1500 years, however, was several times lower than the rate found in the Bathurst Island peatland (Tarnocai, 1973).

Sample DB3-3 (GSC-2326) was obtained from the same peat profile as were the other two samples. DB3-1 (GSC-2355, 5830 ± 70 BP) and DB3-2 (GSC-2317, 6160 ± 90 BP). The sample was taken from the basal peat of the deposit, at 130 cm below the surface. The date of this basal peat is, at 5070 ± 60 BP, much more recent than that of the other two samples, both of which were taken at shallower depths (25 cm for DB3-1 and 78 cm for DB3-2). The sample should be rerun to check the date. If the date is still less than the dates of samples DB3-1 and DB3-2 then probably some contamination took place. The estimated date of the basal peat in this deposit, based on the rate of peat accumulation derived from samples DB3-1 and DB3-2, is 6485 years BP.

Comment (W. Blake, Jr.): All three samples were received wet, but were then oven dried. Each sample received the standard treatment with NaOH, HCl, and distilled water rinses. GSC-2317 was mixed with dead gas for counting. GSC-2317 is based on two 1-day counts in the 2 L counter, GSC-2326 is based on one 3-day count in the 2 L counter, and GSC-2355 is based on two 1-day counts in the 5 L counter. See addendum p. 98.

Goodsir River series

Buried fibrous organic material from two sites in central Bathurst Island, Northwest Territories. In each case the peat-like organic matter is at the base of a solifluction slope. Collected July 17 (Bath-1) and 19 (Bath-2), 1974 by G.F. Walton and J.C.F. Tedrow, both of Rutgers University, New Brunswick, New Jersey, from freshly dug trenches in eroded polygons.

GSC-2302. Goodsir River (I) 5660 ± 100

Fibrous organic material (sample Bath-2; 16.0 g dry) at 40 to 48 cm depth 2.0 km northeast of the National Museum of Canada station in Polar Bear Pass and on the east side of Goodsir River, Bathurst Island (75°44.7'N; 98°23.5'W), at an estimated elevation of approximately 30 m.

GSC-2315. Goodsir River (II) 5470 ± 60

Fibrous organic material (sample Bath-1; 23.0 g dry) at 35 cm depth 2.7 km northwest of the NMC station and 1.5 km west of Goodsir River, Bathurst Island (75°45.0'N, 98°27.5'W), at an estimated elevation of approximately 25 m.

Comment (W. Blake, Jr.): Buried organic materials such as these are common on Bathurst Island, especially in the central area where Walton and Tedrow worked; e.g., see the dates listed in GSC V (1966, p. 122-123) and GSC XX (1980, p. 18-19). The sites are discussed in more detail, including data from unpublished GSC Palynological Report No. 76-3 by S. Lichti-Federovich, in Walton and Tedrow (1986). NaOH leach was omitted from the pretreatment of both samples. GSC-2302 was mixed with dead gas for counting, and the date is based on one 2-day count in the 2 L counter. GSC-2315 is based on two 1-day counts in the 5 L counter.

Freemans Cove series

A buried organic layer was located beneath a solifluction apron near Freemans Cove, southeast Bathurst Island, Northwest Territories (75°09'N, 98°13'W), at an elevation of approximately 30 km. The layer was typically 10 cm thick, and overlain by 75 cm of sandy solifluction debris. The solifluction apron is developed on a bouldery gravel stream terrace. The organic layer was frozen at the time of excavation, and is presumed to be within the permafrost. Collected June 28-29, 1981 by J.A. Heginbottom.

GSC-3380. Freemans Cove (I) 640 ± 60

Sedge-moss peat (sample HGA-8114; 15.8 g dry) from a buried organic layer beneath the solifluction lobe, 3.65 m in from the margin of the lobe and 70 to 80 cm below the surface.

GSC-3385. Freemans Cove (II) 440 ± 50

Sedge-moss peat (sample HGA-8106; 30.8 g dry) from a buried organic layer beneath the solifluction lobe, 40 to 45 cm in from the margin of the lobe and 35 to 40 cm below the surface. The dominant moss is cf. **Barbula icmadophila**, but also present are **Drepanocladus lycopodioides** var. **brevifolius** and **Orthothecium chryseum** var. **chryseum** (unpublished Bryological Report No. 480 by J.A. Janssens, University of Minnesota, Minneapolis, Minnesota).

GSC-3739. Freemans Cove (III) 790 ± 50

Peat (sample HGA-8112; 43.3 g dry) from a buried organic layer beneath the solifluction lobe, 2.35 m in from the margin of the lake and 80 cm below the surface.

Comment (W. Blake, Jr.): This series of samples was dated to determine the rate and period of activity of the solifluction apron. After the first two determinations it was clear that the period of activity being dated involved the last few hundred years, but the third date (GSC-3739), between the two others, is older than either. When 'young' radiocarbon dates such as these are being dealt with, it is essential that the ages be converted to calendar years (e.g., see Stuiver and Pearson, 1986). When that is done in this case it is clear that the dates do not overlap. One possible explanation is that in the case of sample HGA-8112 (GSC-3739, 790 ± 50 BP) the buried organic layer was thicker than at the other two points along the trench, and a deeper part of the layer was sampled. The submitter stated that the organic layer was typically 10 cm thick, and quite a lot of time could be represented by that thick an organic accumulation. Another possibility, less likely in my estimation, might be that older organic material, which originated uphill from the site at which sample HGA-8114 (GSC-3380, 640 ± 60 BP) was collected, was dragged along by the advancing apron and deposited where sample HGA-8112 was taken.

Each sample was treated with NaOH, HCl and distilled water rinses. GSC-3385 showed a slight reaction with HCl, GSC-3380 and -3739 a moderate reaction. GSC-3380 was mixed with dead gas for counting. Each date is based on two 1-day counts in the 5 L counter.

Melville Island

GSC-422-2. Barrow Dome >39 000

Moss peat (sample FG-64-102b; 185 g dry; **Calliergon** peat, dominated by **Calliergon giganteum**; unpublished GSC Bryological Report No. 257 by M. Kuc) from 1.8 m below the surface of a

flat-topped hill, elevation approximately 90 m, standing as an erosion remnant 4.8 km north of Barrow Dome, Sabine Peninsula, Melville Island, Northwest Territories (76°41'45"N, 109°00'W; corrected from the original publication). The dated sample was from the upper part of a 0.75 m-thick bed of moss and sand within sand and sandy gravel. Little vegetation grew in the vicinity when the sample was collected in July 24, 1964 by J.G. Fyles; submitted 1973 by W. Blake, Jr.

Comment (W. Blake, Jr.): It was hoped that sufficient material remained after the original determination (GSC-422; >38 600; GSC VI, 1967, p. 192-193) that the sample could be redated at 'high pressure'. As with the original determination (for which the NaOH leach was omitted, and which produced so little CO_2 that the sample was mixed with dead gas for counting), the sample contained so much inorganic material (sand) that insufficient CO_2 was produced for a 'high pressure' date. Counting was done at normal pressure, and GSC-422-2 merely confirms GSC-422 (cf. Blake, 1974). Pretreatment included one hour hot NaOH leach, one hour hot HCl leach, plus distilled water rinses. Date is based on one 4-day count in the 5 L counter.

Other mosses present were **Campylium polygamum** (rare), **Aulacomnium palustre** var. **imbricatum** (rare and introduced), and **Drepanocladus** sp. cf. **latifolius** (rare). Kuc (unpublished GSC Bryological Report No. 257, 1973) stated:

"This is a typical shallow water or permanently submerged boggy tundra bio-product, known also from many recent samples. It is deposited on sand free of plankton and muddy constituents. **Calliergon** and **Campylium**, at least some of their stems, seem to indicate water ecomorphosis (= environmental modifications). **Aulacomnium** and **Drepanocladus** are plants of moss-bog, seasonally submerged, tundra. The past habitat was probably a shallow water body or a flooded sand depression surrounded by moss-bog tundra. In general appearance, the material represents a primitive growth. It is probably of early postglacial age, but its somewhat compressed nature suggests it may be older."

Prince Patrick Island

Mould Bay series

Pelecypods and gastropods collected alive by dredging in Mould Bay, Prince Patrick Island (76°15'N, 119°20'W).

GSC-434. Mould Bay (I) 380 ± 140

Pelecypod shells (sample Mould Bay 'B'; 13.0 g dry; **Musculus** sp.; identifier unknown) from individuals collected alive during the summer of 1964 by R.K. Lee (then National Museum of Natural Sciences, Ottawa) and J.G. Fyles. The shells were washed, brushed clean and dried. Following removal of the outer 20% of shell material (standard treatment) the sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-438. Mould Bay (II) 720 ± 130

Pelecypod 'meat' (sample Mould Bay 'A'; 5.6 g dry) derived from the shells used for GSC-434. The sample was given no pretreatment (after the soft parts were removed from the shells) except for washing in distilled water and oven drying. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-474. Mould Bay (III) 320 ± 150

Gastropod shells (sample Mould Bay 'C'; 5.6 g dry; **Buccinum** sp.; identified by A.H. Clarke, Jr., then of the National Museum of Natural Sciences, Ottawa) from individuals collected alive in 1952 by S.D. MacDonald, National Museum of Natural Sciences, Ottawa. The gastropods were recovered by dredging off the delta of Station Creek, in a water depth of 10 to 24 m (S.D. MacDonald, personal communication, 1988). In the laboratory the shells were picked clean of soft parts, then washed and boiled in distilled water. Because of the sample size, no shell material was removed with HCl prior to dating. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): Determination GSC-474 provides valuable information on the 'reservoir effect' (cf. Olsson, 1980) in the western Queen Elizabeth Islands, and it complements data from the eastern part of the Arctic Archipelago (cf. GSC-XXVI, 1987, p. 24, 27, 28, 34, and 44; also GSC-3671, 280 ± 90 years, this list). The species used for dating was probably **Buccinum hydrophanum**, as that is the only **Buccinum** species listed for the waters near Prince Patrick Island by Macpherson (1971). The particular collection she listed was from Crozier Channel, on the opposite side of the peninsula from the locality at which Station Creek empties into Mould Bay. The age obtained for GSC-434 is difficult to understand, unless the gastropods actually were dead when they were collected, but with the soft parts still intact (which seems unlikely). The lack of agreement between GSC-434 and -438 is also perplexing.

United States of America

Washington

GSC-3130.	Puget Sound	440 ± 40 $\delta^{13}C = +0.3‰$

A single marine pelecypod shell (sample #1278 from the Thomas Burke Memorial Washington State Museum, Seattle, Washington; 45.2 g; **Pecten caurinus**; identified by the Museum) collected from unknown locality in Puget Sound, U.S.A. ca. 1910 (collector unknown); submitted 1980 by J.L. Luternauer.

Comment (W. Blake, Jr.): This shell was dated as part of an attempt to learn more about the reservoir effect in the region near the Fraser Delta. Other dates from the Pacific coast of North America are presented in Robinson and Thompson (1981). The shell has good internal lustre and no internal or external incrustations. Some of the hinge area was retained (not used for ^{14}C sample). Both the inner nacreous layer and the outer surface of the shell are mainly calcite, with some rhodocrosite (minor) and quartz (minor). Date is based on one 3-day count in the 5 L counter.

ARCHEOLOGICAL SAMPLES

Eastern Canada

Newfoundland

GSC-1987.	L'Anse aux Meadows	2500 ± 60

Fragment of a wooden artifact (National Historic Sites provenience number 4A67E3-1; 11.2 g dry; **Abies balsamea**; unpublished GSC Wood Identification Report No. 74-5 by L.D. Wilson) found in an archeological excavation, at the base of a 1 m-thick peat layer containing driftwood, overlying emerged beach gravel, at the foot of a 4 m terrace on which a Norse settlement dating to approximately 1000 BP has been found. The site is at L'Anse aux Meadows village at the extremity of Northern Peninsula, Newfoundland (51°35.75'N, 55°32.10'W), at an elevation of 2.75 m. Collected by B. Schönbäck, then a consultant to Parks Canada.

Comment (D.R. Grant): Unless it was rafted in with the rest of the driftwood, most of which also dates prior to 2000 BP, the artifact strongly suggests habitation at this site at least 1000 years before arrival of Norse settlers. A Dorset or Thule affiliation is supposed. This date and several others on wood and peat covering the emerged beaches (Kuc, 1975; Mott, 1975) indicate that the sea had fallen to its present level before 2500 BP. In contrast, in situ marine shells in raised beaches (Grant, 1972) and the earliest freshwater sediment in isolated marine basins (Henningsmoen, 1977) indicate that shorelevel regression has proceeded regularly, though at decreasing rates, to present level. There is thus a conflict in the sea level history inferred from marine indicators versus that from freshwater indicators. A discrepancy in the position of sea level at time of Norse occupation of up to 4 m has yet to be resolved, and this indication of a pre-Norse culture introduces another complication.

Comment (W. Blake, Jr.): This hard sample was 7 cm long and 2 cm in diameter; it was cut from end of a rod- shaped, worked artifact. All outside wood and wood along cracks was removed. Date is based on two 1-day counts in the 5 L counter.

Labrador

Red Bay series

Two samples of whale bone from Red Bay, Labrador, Newfoundland (51°43'31"N, 56°25'40"W).

GSC-3086.	San Juan Site, Red Bay, whale bone	1490 ± 140 $\delta^{13}C = -21.0‰$

Whale bone (sample 24M12R14-1; 420 g dry; a humerus, possibly from a right whale; identified by S.L. Cumbaa, Zooarchaeological Identification Centre, National Museum of Man, Ottawa) from the underwater excavation of the suspected Basque whaling vessel the **San Juan** (1565), situated 42 m north of the northeast corner of Saddle Island in the harbour at Red Bay, Labrador, at a depth of 9.74 m. The sample was found 25 cm below the sea bed surface in close association with structural pieces from the starboard side of the vessel (excavation unit 24M12R). Although the sample likely resulted from butchering activities at the whaling station on Saddle Island it was thought that the association with the structure of the vessel indicated deposition near the time of the sinking of the **San Juan**. Collected October 1, 1979 by Michel Audy; submitted April 1980 by R.J. Ringer, both of Parks Canada, Environment Canada, Ottawa.

Comment (R.J. Ringer): This age determination is much too early, given the context of the sample, and at this point we can find no explanation for the anomalous date.

Comment (W. Blake, Jr.): The NaOH leach was omitted from the pretreatment of GSC-3086. After a leach with 3N HCl, distilled water rinses, and drying, only 1.1 g of collagen remained. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3283.	San Juan Site, Red Bay, cod vertebrae	700 ± 50 $\delta^{13}C = -21.3‰$

Vertebrae of the Atlantic cod (sample 24M192M9-11; 510.0 g; **Gadus morhua**; identified by S.L. Cumbaa) from a site between the stern of the vessel **San Juan** and Saddle Island (10 m north of the northeast corner of the island), at

a depth of 5.10 m. Whale bones occurred with the cod bones. Collected August 11, 1980 by W. Stevens, Parks Canada, Ottawa; submitted by J. Ringer of the same organization.

Comment (W. Stevens): This date appears to be unacceptable in that it should represent the period ca. 1540 AD. However, in view of other dates received from this site, 460 AD (GSC-3086, this series) for a whale bone and 1680 AD (GSC-3076; GSC XX, 1980, p. 23) for a log, the fish bone date is much more in line with expectations. The date also supports the hypothesis that the fish bone is not an intrusion from a later occupation (19th or 20th centuries) and, in fact, may represent an earlier occupation.

Comment (W. Blake, Jr.): The 542 vertebrae (Catalog No. 80-1751) used for this determination were stored in fresh tap water after collection from the sea bed, then air dried. The uncorrected age was 640 ± 50 years. If a correction is applied for the apparent age of sea water (say, 400 years), and if the radiocarbon years are then converted to calendar years (cf. Stuiver and Pearson, 1986) one of the possible ages for this sample is about 1530 to 1550 AD (the other possibility is about 1640 AD), i.e., very close to the time that the Basques were fishing in the Red Bay area (the **San Juan** is believed to have sunk about 1565). The NaOH leach was omitted; then the sample was treated with cold 3N HCl and distilled water rinses. After drying 27.4 g of collagen was burned. Date is based on two 1-day counts in the 5 L counter.

GSC-3285.	Tracey Beach, Red Bay	modern $\delta^{13}C$ = -22.4‰

Section of a mid-thoracic rib of a large whale (sample TB-80-1; 1206.1 g dry; probably of the family Balaenidae; identified by S.L. Cumbaa) partially imbedded in underlying organic sand and cobble beach at Tracey Beach, along the western shore of the harbour at Red Bay, Labrador, at an elevation of 1.5 m. This bone and others were covered by a 10 to 15 cm-thick sod layer and the material enclosing the bone was wet. The excavated site was in a small depression above and behind the active beach. Collected August 30, 1980 by J.A. Tuck, Memorial University of Newfoundland, St. John's, and S.L. Cumbaa; submitted by J. Ringer.

Comment (W. Blake, Jr.): The sample was dated to determine whether the Tracey Beach whale bone deposit was contemporaneous with the Basque occupation of Red Bay, i.e., the last half of the sixteenth century. This particular bone was thought to be significant because the distal end of the rib has been chopped through. The problem is not answered with this determination. As the NaOH leach was omitted possibly younger organic (humic) materials, derived from the overlying sand, made the whale bone appear younger than it really was. Alternatively, the whale bone deposit is a younger feature of Red Bay. Only a cold 3N HCl leach was applied, and after distilled water rinses and drying 11.0 g of collagen was burned. Date is based on one 3-day count in the 5 L counter.

Nova Scotia

GSC-3218.	Delorey Island Site	810 ± 70

Charcoal (sample BjCj (Area 1 - No. 2); 5.0 g dry) from 20 to 30 cm below the ground surface at the Delorey Island Site (BjCj-9), 0.5 m north of the south bank of Delorey Island at the mouth of Tracadie Harbour, Antigonish County, Nova Scotia (45°40'N, 61°40'W), at an elevation of 3.1 m. The sample was from the bottom of the black soil zone and above the sterile orange clay. Collected July 28-31, 1980 by B. Benoit and R.J. Nash, St. Francis Xavier University, Antigonish, Nova Scotia.

Comment (R.J. Nash): This sample derived from the bottom of level 3 at the bottom of the occupation zone. The age 810 ± 70 BP (1140 AD conflicts with a nearly identical sample (I-11,619) which gave an uncorrected date of 1595 ± 80 BP, or 355 AD). There has been some disturbance at the site, but the disturbance is not ubiquitous. In an effort to resolve the ambiguities of the radiocarbon dates, which should identify the time of initial occupation, a body sherd with cord-wrapped stick decoration was submitted to Alpha Analytic Inc. for thermoluminescence dating in 1983. This sherd (Alpha-554) was also from level 3 of the same pit and was dated to 460 BP (±20%). This is a rather late date for pottery in general in Nova Scotia and cord-wrapped stick decoration in particular.

The absolute dates at least form a sequence – 355 AD, 1140 AD and 1490 AD, and the position taken here is that the site is a Late Woodland component with a considerable time span, beginning as early as 350 AD and containing intermittent occupations lasting into the historic period. Typological analysis also supports the idea of occupation spanning more than a millenium at this prehistoric Micmac village site.

Comment (W. Blake, Jr.): The age of GSC-3218, when the plus error term is applied (880 years = AD 1070) is quite close to the submitter's estimated age of 1000 AD. When converting to AD ages the error term should not be ignored, thus a range of ages should be given, not a single AD age value. Furthermore, the radiocarbon dates should be converted to calendar years BP (see Stuiver, 1982; Stuiver and Pearson, 1986) if they are to be compared to a thermoluminescence age determination, which is not reported in ^{14}C years, nor is it related to 1950. Unless pieces of charcoal were physically split in half there is no reason that the

sample submitted to Isotopes, Inc. should be considered "nearly identical sample", and the problems caused by submitting samples to more than one laboratory are well illustrated by the results reported here!

The charcoal comprising sample GSC-3218 was picked over carefully and all visible rootlets were removed (earlier the submitter had removed the larger rootlets). The dated material, containing lumps up to 1 cm in diameter, was clean in appearance, but some contamination from tiny rootlets or humic material may have remained. The sample was given the standard treatment with NaOH, HCl, and distilled water rinses, after which 3.5 g of dry sample remained for combustion to CO_2. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Ontario

GSC-2799. Wyght Site (BfGa-11) 890 ± 70

Wood charcoal (sample BfGa-11 J15; 4.4 g dry) from a depth of 8 to 12 cm below the ground surface at the Wyght Site (BfGa-11), 7.5 km northeast of Rideau Ferry on the southeastern shoreline of Lower Rideau Lake, Leeds County, Ontario (44°51'00"N, 76°07'08"W), at an elevation of approximately 123 m. The site is 2 to 3 m above present summer water levels. The excavation was made on a cottage property on which a lawn had been developed over the site with minimal surface modification. The enclosed material is a well-drained subsoil. The sample is from a hearth which contained Initial Woodland ceramics and faunal bone and is associated with a stone lined pit. Collected September 12-14, 1978 by G. Watson, Ottawa, Ontario.

Comment (G.D. Watson): This date is confirmed by three other dates from the site: S-1621 (NMC-1034), 940 ± 60 BP (1010 AD); S-1678 (NMC-1031), 935 ± 40 BP (1015 AD); and S-1676 (NMC-1029), 830 ± 70 BP (1120 AD). Dates from other features are S-1680 (NMC-1033), 2460 ± 65 BP (510 BC); S-1627 (NMC-1030), 2300 ± 55 BP (350 BC); S-1755, 1880 ± 110 BP (70 AD single charcoal grain); S-1679 (NMC-1032), 1695 ± 65 BP (255 AD); and S-1675 (NMC-1028), 1645 ± 65 BP (305 AD). The archaeological deposit did not exceed 20 cm and there is significant mixing of the sherds from about 100 vessels. However, there is high correlation (.93) between radiocarbon age and depth-of-recovery of the charcoal sample for the dates between 510 BC and 1120 AD. This relationship has been used to place a series of 28 vessels in temporal sequence to an accuracy of ±250 years using the T-test of difference between means of estimated age with a probability of .05 or less that the difference between the estimated ages could occur by chance alone.

Another charcoal sample from the site yielded the date S-1841 (NMC-1131), 7595 ± 270 BP (5645 BC). This sample was not deeper than the 510 BC date and is associated with Vinette Dentate pottery. However, none of the artifactual evidence can be classified as representative of this date, which may be from a forest fire or from an Archaic occupation which left very limited evidence.

Charcoal from another area of the site, which is separated by a 3 m-high cliff, yielded a date S-1756, 1235 ± 105 BP (715 AD). This date is strongly associated with flint flakes but is a few metres from Initial Woodland Point Peninsula ceramics.

Although only a few ceramic sherds are considered to be representative of the 1060 AD date the other three dates within one standard deviation indicate the validity of the date (Watson, 1980).

Whitson Lake series

Wood charcoal from two sites on Whitson Lake on the Petawawa River in the eastern part of Algonquin Provincial Park, Ontario.

GSC-2181. Whitson Lake, B1Gk-17 4540 ± 70

Charcoal (sample W2A-6 (S100-2); 8.5 g dry) from a site B1Gk-17 on the sloping sandy shore at the west end of Whitson Lake, Ontario (45°59'26"N, 77°42'25"W), at an elevation of 161 m. The site, in clean sand, is 2.4 to 3.0 m higher in elevation than a Middle Woodland site, from which it was also areally separated. The charcoal was collected in Square S-100 from a depth of 26.7 to 38.1 cm in association with quartz chips and near a Brewerton side-notched point (at 30.5 cm depth). Collected September 29, 1968 by B.M. Mitchell, Deep River, Ontario.

Comment (B.M. Mitchell): This date supports the archaeological data which suggested an Archaic age site. It is compatible with Ottawa Valley dates for the 500 foot (152 m) above sea level mark. It is most valuable in substantiating early, heavy usage of quartz in east central Ontario. This is the oldest ^{14}C date of the Petawawa River series and relates to the lowest levels yet discovered, on that system (cf. GSC-1660, 1550 ± 190; GSC XIV, 1974, p. 5); another date on charcoal from the Whitson Lake site is considered too late.

Comment (W. Blake, Jr.): This good charcoal sample contained numerous pieces 1 to 2 cm in diameter. A few rootlets were removed. Pretreatment included a 5-minute leach with cold NaOH, then HCl and distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

GSC-2238. Whitson Lake, B1Gk-15 680 ± 80

Charcoal (sample W1-1; 3.85 g dry) from site B1Gk-15 in yellow, organically-stained sand on a spit extending into Whitson Lake, Ontario from the south side (45°59'05"N, 77°41'44"W), at an elevation of 155 m. The charcoal was recovered from 15 to 20 cm below the ground surface in a hearth feature. Collected September 28, 1974 by B.M. Mitchell.

Comment (B.M. Mitchell): The date is acceptable for occupation of the central eastern Ontario area by groups making pottery which has collars decorated with incising. Another date, GSC-1351 (1240 ± 130 BP; GSC XII, 1972, p. 14) for Algonkian occupation in the Petawawa River Valley refers to cord/fabric malleated pottery makers. The occupation dated by GSC-2238 was expected to be somewhere between 1270 and 1510 AD.

Comment (W. Blake, Jr.): The sample was cleaned of large rootlets. Pretreatment included a 5-minute leach with cold NaOH, then HCl and distilled water rinses. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 5 L counter.

Slack-Caswell Quarry series

Two samples of wood charcoal were collected from freshly exposed hearth features composed of ash, charcoal, and cultural debris encased within the Ae horizon of a grey brown luvisol matrix at the Slack-Caswell Quarry Site (AfHa-1), 1 km southeast of Rockford, Ontario (42°54'45"N, 80°10'0"W), at an elevation of 216.4 m.

GSC-2619. Slack-Caswell (I) 630 ± 60

Charcoal (sample F-14-1; 4.3 g dry; **Quercus** sp.; unpublished GSC Wood Identification Report No. 77-61 by R.J. Mott and L.D. Farley-Gill) from 22 to 29 cm below the ground surface. Collected August 31, 1977 by S.M. Jamieson, then McMaster University, Hamilton; now Erindale College, University of Toronto, Mississauga, Ontario.

Comment (S.M. Jamieson): The charcoal is from a freshly exposed pit hearth feature associated with storage and ash pits containing late Glen Meyer artifactual remains and **Zea** pollen. Floral, faunal and settlement data indicate temporary spring and autumn occupation. Seven additional components are represented at the site (see an unpublished report to the Ontario Heritage Foundation, 1979, "The Slack- Caswell Quarry and Workshops: Some Organizational Implications", by S.M. Jamieson).

Comment (W. Blake, Jr.): Some rootlets were removed in the field by the collector. Sixty pieces of charcoal identified as **Quercus** sp. (Leucobalanus (white oak) group, which includes **Quercus alba**, **Q. macrocarpa**, and **Q. bicolor**) were used for dating. Other species present in the charcoal included 32 pieces identified as **Acer** sp. (soft maple group, which includes **Acer rubrum** and **A. saccharinum**), one piece identified as **Acer** sp. (hard maple group, which includes **A. saccharum** and **A. nigrum**), three pieces identified as **Pinus strobus** (white pine), one piece identified as **Platanus** or **Fagus** (sycamore or beech), one piece identified as **Populus** or **Salix** (poplar or willow), and one piece identified as **Prunus serotina** (black cherry); unpublished GSC Wood Identification Report No. 77-61 by R.J. Mott and L.D. Farley-Gill. Pretreatment included a 5-minute leach with cold NaOH, HCl, and distilled water rinses. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3054. Slack-Caswell (II) 650 ± 70

Charcoal (sample F-20; 3.5 g dry; **Quercus** sp.; unpublished GSC Wood Identification Report No. 80-11 by L.D. Farley-Gill and R.J. Mott) from 18 to 30 cm below the ground surface (below the Ah horizon within the Ae horizon, and extending to the top of the BA horizon). Collected July 11, 1978 by B. Greco for S.M. Jamieson; submitted by S.M. Jamieson.

Comment (S.M. Jamieson): The charcoal is from a freshly exposed longhouse pit hearth feature associated with Prehistoric Neutral (Pound-like) remains.

Comment (W. Blake, Jr.): Visible rootlets were removed in the field and some additional ones, plus adhering dirt, were removed on receipt of the sample. Three pieces identified as **Quercus** sp. (white oak group) were used for dating. Also present were seven pieces identified as **Acer** sp. (soft maple group) and one coniferous fragment which has morphological features similar to those found in **Pinus** sp. After the standard treatment (NaOH and HCl leaches, plus distilled water rinses), the sample was mixed with dead gas for counting. Date is based on two 1-day counts with the 2 L counter.

Northern Canada, Arctic Archipelago

Devon Island

GSC-2178. Cardigan Strait site 3580 ± 150

Charcoal (sample 1974-1(A); 1.05 g; coniferous wood charcoal, probably **Picea** sp.; unpublished GSC Wood Identification Report No. 75-12 by R.J. Mott) from Cardigan Strait archeological site, on a raised beach 4.8 km north of Cape Harrison, Devon Island, Northwest Territories (76°30'N, 90°34'W), at an elevation of 19 ± 1 m (determined by hand leveling). The sample was collected at a depth of 2 to 10 cm below the surface in coarse dry gravel under a very thin lichen cover in and around the hearth of an

Independence I ruin (Ruin 2, Cardigan Strait site, RcJh-3). The site is 300 m inland from the present shore and 450 m south of a major stream cutting through beaches. Collected July 24, 1974 by R. McGhee, then Memorial University of St. John's, St. John's, Newfoundland; now National Museum of Civilization, Ottawa.

Comment (R. McGhee): The date is quite acceptable for a site that produced a sample of Independence I artifacts. It is within the range of eight dates on driftwood charcoal associated with similar cultural material from Port Refuge, Devon Island, and from northern Greenland (3480 ± 140 years (GSC-1949; GSC XIV, 1974, p. 9) to 4540 ± 120 years (K-754)). The sample received the standard pretreatment of NaOH, HCl, and distilled water rinses. Because of the small sample size (0.8 g after pretreatment) the sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Southern Ellesmere Island

GSC-2165. Cape Storm 4360 ± 60
$\delta^{13}C = -25.6‰$

Charcoal pieces, probably from driftwood (sample 1974-7; 11.1 g; **Picea** and/or **Larix** sp. (probably both species present); unpublished GSC Wood Identification Report No. 75-21 by R.J. Mott) from the interior of Ruin 4, Cape Storm site (RcHw-4) on a raised gravel beach, approximately 500 m inland from Muskox Fiord, Ellesmere Island, Northwest Territories (76°22'N, 87°32'W), at an elevation of 20 ± 1 m. The sample was collected at a depth of 0 to 10 cm in coarse gravel with no surface vegetation, from the interior area of an Independence I ruin. Collected by R. McGhee, then Memorial University of Newfoundland, St. John's, Newfoundland, now National Museum of Civilization, Ottawa.

Comment (R. McGhee): The date is quite acceptable. It is within the range of five dates on driftwood charcoal associated with similar material in northern Greenland 3610 ± 120 BP (K-563) to 4540 ± 120 BP (K-754; these and three others are all cited in Knuth, 1967) and slightly older than three driftwood charcoal dates associated with similar material from Port Refuge, Devon Island (3480 ± 140 BP (GSC-1949), 4120 ± 120 BP (GSC-1931), and 4360 ± 90 BP (GSC-1940; all in GSC XIV, 1974, p. 9).

Comment (W. Blake, Jr.): The reader is also referred to dates on charcoal derived from driftwood in the Cape Rutherford-Skraeling Island-Digarmulen Point area of east central Ellesmere Island (this list). It should be noted that whereas Blake (1975) used the level of the ice-foot surface (approximately equal to high-tide level or, perhaps more correctly, at least in the early part of the summer before the surface of the ice foot has ablated, to highest high tide level) as sea level, McGhee (personal communication, 1978) used the surface of the floating sea ice at high tide, and this level is below the surface of the ice foot. The sample received the standard treatment with NaOH and HCl, plus distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

Skraeling Island

GSC-3261. Skraeling Island ASTt #7 4400 ± 110
$\delta^{13}C = -26.2‰$

Charcoal (sample PS-80-2; 2.8 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 81-21 by R.J. Mott), a sample which also contained fragments of **Salix** sp. and **Larix** sp. from the floor area of an isolated central passage dwelling feature on Skraeling Island, in Alexandra Fiord on the east coast of Ellesmere Island, Northwest Territories (78°54'N, 75°37'W). Collected July 29, 1980 by P. Schledermann, Arctic Institute of North America, Calgary, Alberta; now University of Victoria, Victoria, British Columbia.

Comment (P. Schledermann): This relatively small ASTt dwelling feature was located at an elevation between 21 and 22 m on "Little" Skraeling Island. The charred material was located between 5 and 10 cm below the surface. The radiocarbon date is one of the earliest from the study area. This particular driftwood date is, however, probably too old by a number of centuries. Uncorrected age: 4420 ± 110 BP. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3362. Tusk Site 4250 ± 60
$\delta^{13}C = -24.5‰$

Charred material (sample PS-81-1; 22.0 g), interpreted as being driftwood charcoal, was obtained on sand beneath boulders on a beach terrace on Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of approximately 29 m. Collected August 4, 1981 by K. McCullough, Arctic Institute of North America, Calgary, Alberta, and P. Schledermann.

Comment (P. Schledermann): In 1977, a partially buried walrus tusk was dated by Radiocarbon, Ltd., resulting in a date of 5390 ± 380 BP (uncorrected, RL-834; Schledermann, 1978). Because of the questionable cultural association of the tusk, a search for charred materials from the same beach terrace was carried out in 1981. The driftwood date is undoubtedly too old although the associated artifacts suggest an early ASTt occupation. Uncorrected age: 4240 ± 60 BP. Date is based on two 1-day counts in the 5 L counter.

GSC-3406. Oldsquaw Site 980 ± 50
$\delta^{13}C = -22.8‰$

Charred bone (sample PS-81-9; 11.6 g dry) was obtained from a hearth feature near the main site on Skraeling Island, Northwest Territories (78°55'N, 75°36'W), at an elevation of 3 to 4 m. Collected July 27, 1981 by P. Schledermann.

Comment (P. Schledermann): This site represents the latest evidence of Dorset occupation in the study area. The tent ring and hearth feature which yielded the charred bone sample is located 50 m north of the main site. The MASCA Range is 980 to 880 BP (Ralph et al., 1973) and, considering that the probable sea mammal bone material used would produce an older than "true" date, the occupation of this site would have been fairly close in time to the initial Thule Inuit presence in this region. Uncorrected age: 950 ± 50 BP.

Comment (W. Blake, Jr.): The original sample, upon drying in an electric oven, decreased in weight from 109.7 to 92.5 g. Date is based on two 1-day counts in the 5 L counter.

GSC-3007. Sverdrup Site 770 ± 50
House 7 $\delta^{13}C = -27.7‰$

Wood (sample PS-79(14); 11.3 g; **Salix** sp.; unpublished GSC Wood Identification Report No. 80-2 by L.D. Farley- Gill) obtained from the kitchen area floor of winter house ruin no. 7, Sverdrup Site, Skraeling Island, Northwest Territories (78°54'N, 75°39'W), at an elevation of 5.5-6.5 m. Collected July 25, 1979 by P. Schledermann.

Comment (P. Schledermann): This Thule culture winter dwelling is thought to have been occupied about the same time as winter house no. 8 at this site. The latter dwelling was dated at 590 ± 70 BP (GSC-3772; this list) on a sample of arctic heather. The date on willow from house no. 7 again reflects the difference in results between dates on willow (earlier) and dates on heather (later). This date is probably well over 100 years too early. Uncorrected age: 810 ± 50 BP.

Comment (W. Blake, Jr.): The sample dated was a single piece (broken into two parts) of willow; total length was 34 cm and the diameter varied between 1.5 and 2.5 cm. On drying in an oven the weight of the main piece decreased from 38.1 to 31.1 g. Date is based on two 1-day counts in the 5 L counter.

GSC-3772. Sverdrup Site 590 ± 70
House 8 $\delta^{13}C = -26.9‰$

Arctic heather (sample PS-82-5; 5.0 g dry; **Cassiope tetragona**; identified by W. Blake, Jr.), collected from the kitchen floor area, 35 cm below the surface of winter house ruin no. 8, Sverdrup Site, Skraeling Island, Northwest Territories (78°54'N, 75°39'W), at an elevation of approximately 6 m. Collected July 30, 1982 by K. McCullough.

Comment (P. Schledermann): This heather sample was dated in order to determine to what extent this large two-platform Thule winter dwelling post-dated the initial Ruin Island phase in the study area. The ^{13}C corrected result of 590 ± 70 BP is thought to reflect fairly accurately the time of occupation. The dwelling style had evolved into a more rounded exterior wall appearance and a kitchen compartment more directly open to the main dwelling than in earlier Ruin Island type dwellings. Uncorrected age: 620 ± 70 BP.

Comment (W. Blake, Jr.): Some of the **Cassiope** pieces almost certainly have some melted fat or other such material on them, although the worst pieces were not used. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3553. Sverdrup Site 1100 ± 60
House 6 $\delta^{13}C = -25.7‰$

Wood (sample PS-82-2; 10.5 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 82-50 by R.J. Mott) collected from the sleeping area of winter house ruin no. 6, Sverdrup Site, Skraeling Island, Northwest Territories (78°54'N, 75°39'W), at an elevation of 5 to 6 m. Collected August 4, 1982 by P. Schledermann.

Comment (P. Schledermann): After several years of research in the Bache Peninsula region, resulting in numerous radiocarbon assessments, it has become evident that age determinations on willow nearly always result in earlier dates than do dates on **Cassiope** or **Dryas** from the same horizons. This sample from Thule culture winter dwelling no. 6 was obtained 60 cm below the surface in close proximity to the heather sample which gave a date of 590 ± 50 (GSC-3561; this list). Uncorrected age (for GSC-3553): 1110 ± 60 BP.

Comment (W. Blake, Jr.): The determination was carried out on a single stick, 26 cm long and 2.2 cm in maximum diameter. Upon oven drying the weight decreased from 30.5 to 17.8 g. Date is based on two 1-day counts in the 5 L counter.

GSC-3561. Sverdrup Site 590 ± 50
House 6 $\delta^{13}C = -27.0‰$

Arctic heather (sample PS-82-1; 16.0 g dry; **Cassiope tetragona**; identified by W. Blake, Jr.) was obtained from the sleeping area of winter house ruin no. 6, Sverdrup Site, Skraeling Island, Northwest Territories (78°54'N, 75°39'W), at an elevation of 5 to 6 m. Collected August 4, 1982 by W. Blake, Jr.

Comment (P. Schledermann): The heather was collected from the edge of a slightly raised sleeping

area about 60 cm below ground surface in a Ruin Island type Thule culture winter house (McCullough, 1986). The artifact collection included one item of Norse origin, and the date is thought to be reasonably accurate, perhaps slightly late (cf. also GSC-3553, 1110 ± 60 BP, this list, **Salix** sp. from the same horizon). Uncorrected age: 620 ± 50 BP.

Comment (W. Blake, Jr.): This sample also contains moss fragments, hair, sedge fragments, and possibly stems of other ericaceous plants. The slightly damp sample was air dried. Date is based on two 1-day counts in the 5 L counter.

GSC-3003. Skraeling Island 790 ± 50
Site, House 22 $\delta^{13}C = -27.8‰$

Arctic heather (sample PS-79(7); 15.0 g dry; **Cassiope tetragona**; identified by W. Blake, Jr.) was collected from the floor level of house ruin no. 22, Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 9 to 10 m. Collected August 2, 1979 by P. Schledermann.

Comment (P. Schledermann): Thule dwellings no. 21 and 22 appeared to have been constructed as one unit and were probably occupied simultaneously. A heather sample from each floor was dated in order to test this assumption. The two dates (cf. House 21, GSC-3156, 630 ± 60 BP) were quite far apart although the MASCA Range (Ralph et al., 1973) indicates a possible overlap. The date from House no. 22 seems more in line with results from other Ruin Island-type dwellings in the area. Uncorrected age: 830 ± 50 BP.

Comment (W. Blake, Jr.): Both samples were taken from floor level in rich cultural materials. This sample contains slightly more inorganic detritus than **Cassiope** samples dated previously, and some of the detritus consists of magnetic grains. All rootlets and moss fragments were removed from the sample. Date is based on two 1-day counts in the 5 L counter.

GSC-3156. Skraeling Island 630 ± 60
Site, House 21 $\delta^{13}C = -26.8‰$

Arctic heather (sample PS-80-1; 15.5 g dry; **Cassiope tetragona**; identified by W. Blake, Jr.) was collected from the central floor area of winter house ruin no. 21, Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 9 to 10 m. Collected August 1, 1980 by P. Schledermann.

Comment (P. Schledermann): This and the adjoining Thule winter dwelling appear from material evidence to have been occupied at an early stage of the Ruin Island phase (McCullough, 1986). The heather date may be slightly late, compared to other dates from the site. The neighbouring dwelling, House 22, produced a date on heather (GSC-3003; 790 ± 50, corrected and 830 ± 50, uncorrected; this list). The MASCA Range (Ralph et al., 1973) indicates a potential overlap of the two dates. Uncorrected age: 660 ± 60 BP.

Comment (W. Blake, Jr.): The damp material was air dried, and the best **Cassiope** fragments were picked out for dating. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 5 L counter.

GSC-2922. Skraeling Island 780 ± 70
Site, House 9 $\delta^{13}C = -26.8‰$

Wood (sample PS-79(1)A; 15.4 g dry; **Salix** sp., unpublished GSC Wood Identification Report No. 79-40 by R.J. Mott) collected from the kitchen tunnel in winter house ruin no. 9, Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 7 to 8 m. Collected August 6, 1979 by P. Schledermann.

Comment (P. Schledermann): This date appears to be too early by several decades. The kitchen was undoubtedly part of the original house structure and was later sealed off from the main dwelling. Both the kitchen and the main dwelling appeared to have been occupied on at least two occasions, judging by the floor material separation. The main dwelling date on willow was 620 ± 50 uncorrected (600 ± 50, corrected; GSC-3013; this list). The MASCA range of the two dates does not overlap. Uncorrected age: 810 ± 70 BP.

Comment (W. Blake, Jr.): Only the single largest piece of wood was used for dating. Upon oven drying its weight decreased from 64.3 to 15.4 g. Dimensions (dry): 13 cm long, 4 cm maximum diameter. Date is based on two 1-day counts in the 5 L counter.

GSC-3013. Skraeling Island 600 ± 50
Site, House 9 $\delta^{13}C = -26.3‰$

Wood (sample PS-79(8)A + B; 9.4 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 80-3 by L.D. Farley-Gill) collected at floor level in winter house ruin no. 9, Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 5 to 6 m. Collected July 22, 1979 by P. Schledermann.

Comment (P. Schledermann): This Thule culture winter dwelling produced the first example of the early decorated Sicco Type harpoon heads. The dwelling remained somewhat of an enigma with both the original tunnel and kitchen room deliberately sealed off. A sample of willow from the sealed kitchen tunnel yielded a date of 810 ± 70 uncorrected (GSC-2922, 780 ± 70 BP corrected). The kitchen date should be older; however, the time span between the two dates is too great. Both dates are thought to be related to the earlier of two occupation levels. Uncorrected age: 620 ± 50 BP.

Comment (W. Blake, Jr.): Two pieces of wood, both identified as **Salix** sp., were used for this determination. Date is based on two 1-day counts in the 2 L counter.

GSC-3038. Skraeling Island Site, House 15 — 750 ± 50; $\delta^{13}C$ = -22.0‰

Fragment (sample PS-79(18); 10.0 g dry) from a piece of woolen cloth obtained from the floor level of winter house ruin no. 15 on Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 10 to 11 m. Collected August 4, 1979 by P. Schledermann from 20 to 25 cm below the surface. The overlying material was a mixture of sod, soil, twigs, heather, grease, and cultural elements.

Comment (P. Schledermann): The woolen cloth piece, thought to be of Norse origin (Schledermann, 1980), was found on the floor of a relatively large and much used Thule culture winter dwelling of the Ruin Island type. It is not possible to know how old the cloth was prior to its appearance in house 15, although it is probably safe to assume that it pre-dates the occupation of the dwelling. Uncorrected age: 700 ± 50 BP.

Comment (W. Blake, Jr.): The cloth was cleaned in alcohol twice by the submitter to inhibit mold. Date is based on one 3-day count in the 5 L counter.

GSC-2924. Skraeling Island Site, House 15 — 640 ± 70; $\delta^{13}C$ = -28.8‰

Wood (sample PS-79(2); 12.0 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 79-39 by R.J. Mott), collected near floor level of winter house ruin no. 15 on Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 11 to 12 m. Collected August 4, 1979 by P. Schledermann.

Comment (P. Schledermann): This willow sample was obtained near floor level in rich cultural materials including skin pieces, bone, wood, and baleen. The Thule winter house ruin is a large Ruin Island type dwelling which had been completely buried and partially destroyed by more recent superimposed house construction. The willow date is probably too old, but by a smaller margin than has usually been the case with this material. Uncorrected age: 700 ± 70 BP.

Comment (W. Blake, Jr.): This wood sample consisted of several pieces; the largest stem is >1 cm in diameter (wet) and 9+ cm long. Upon oven drying the sample weight decreased from 55.4 to 18.2 g. Most pieces still had the bark attached. Adhering sand and a few rootlets were removed by scraping. Date is based on two 1-day counts in the 5 L counter.

GSC-3059. Skraeling Island Site, House 15 — 550 ± 50; $\delta^{13}C$ = -26.8‰

Arctic heather (sample PS-79(20); 14.5 g dry; **Cassiope tetragona**; identified by W. Blake, Jr.) collected at floor level in winter house ruin no. 15, Skraeling Island site, Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 10 to 11 m. Collected August 6, 1979 by P. Schledermann.

Comment (P. Schledermann): Thule winter house no. 15 yielded two pieces of woven wool originally of Norse origin. The heather sample was dated in order to determine the approximate time of occupation of the house, relative to the age of the cloth (GSC-3038, 750 ± 50 BP). A willow sample from the house floor produced a date of 700 ± 70 BP (GSC-2924, uncorrected; 640 ± 70, corrected). Uncorrected age (for GSC-3059): 580 ± 50 BP.

Comment (W. Blake, Jr.): Two plastic bags of material were submitted, but only material from Bag 1, which was closest to the location of the cloth (GSC-3038) was used for dating. The sample was air dried on receipt. Unlike previous samples of **Cassiope** from this region, the sample used for GSC-3059 contained considerable quantities of fur and hair mixed in; a few feathers were also noted. Also present were sedge fragments, **Dryas integrifolia** leaves, and **Salix** sp. The sample dated was comprised solely of leaves and stems that could be ascribed with certainty to **Cassiope tetragona**. Date is based on two 1-day counts in the 5 L counter.

GSC-3098. Skraeling Island Site, House 3 — 970 ± 100; $\delta^{13}C$ = -27.3‰

Wood (sample PS-79(9); 3.5 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 80-10 by L.D. Farley- Gill) collected from the floor of the kitchen area in winter house ruin no. 3, Skraeling Island, Northwest Territories (78°54'00"N, 75°36'30"W), at an elevation of 15 m. Collected August 3, 1979 by P. Schledermann.

Comment (P. Schledermann): An increasing awareness that willow samples almost consistently produce earlier dates than **Dryas** and **Cassiope** samples led to the dating of this sample from Thule winter dwelling no. 3. The ^{13}C corrected result of 970 ± 100 is deemed too early by two centuries. The dwelling structure and associated artifacts are clearly related to the Ruin Island phase of the early Thule culture (Schledermann and McCullough, 1980; McCullough, 1986). Uncorrected age: 1000 ± 100 BP.

Comment (W. Blake, Jr.): The single piece of wood used was 10 cm long; maximum diameter, 1.5 cm. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3197. Skraeling Island Site, House 6 — 810 ± 50; $\delta^{13}C = -28.4‰$

Twigs (sample PS-80(7); 10.0 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 80-39 by R.J. Mott), was collected from the floor level (50 to 60 cm below the surface) of the kitchen tunnel of house ruin no. 6, Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 9 m. Collected July 30, 1980 by P. Schledermann.

Comment (P. Schledermann): This Thule culture winter dwelling produced several artifacts of Norse origin, including a lump of chain mail, a boat rivet and a piece of iron (Schledermann, 1980, 1981). Charred oak from the kitchen hearth gave a date of 675 ± 110 (GX-6069; $\delta^{13}C = -25.3‰$). The MASCA range of these two dates does overlap and a reasonable estimate of occupation is between 750 and 650 BP. Uncorrected age: 860 ± 50 BP.

Comment (W. Blake, Jr.): Upon oven drying the sample weight decreased from 72.0 to 22.0 g. Nearly all of the twigs in this sample lacked bark. Maximum diameter was 1 cm. Each of the six twigs used for dating was identified as **Salix** sp. Date is based on two 1-day counts in the 5 L counter.

GSC-3174. Skraeling Island Site, House 8 — 550 ± 60; $\delta^{13}C = -27.7‰$

Willow wood (sample PS-80(6); 9.8 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 80-40 by R.J. Mott) was selected from material collected in the central floor area of ceremonial house ruin no. 8, Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 5 to 6 m. Collected July 31, 1980 by K. McCullough.

Comment (P. Schledermann): In physical appearance house ruins no. 8, 9 and 10 first appeared to have been occupied as a single unit. It soon became obvious, however, that House no. 9 had been used on several occasions. This date, from the adjoining ceremonial house no. 8, is very close to the later occupation date (GSC-3013, 600 ± 50 BP) of House no. 9. Considering the vagaries of willow as a dating material, such evidence of possible contemporaneity could be quite coincidental. Uncorrected age: 600 ± 60 BP.

Comment (W. Blake, Jr.): Unlike the twigs used for GSC-3197 this willow had bark on every piece used for ^{14}C dating. Upon oven drying the sample weight decreased from 101.0 to 31.7 g. Of the wood in this sample nothing was used larger than 0.5 cm in diameter and up to 20 cm in length. Date is based on two 1-day counts in the 5 L counter.

GSC-2938. Skraeling Island Site, House 10 — 760 ± 60; $\delta^{13}C = -30.5‰$

Wood (sample PS-79(3)B + C; 11.2 g; **Salix** sp.; unpublished GSC Wood Identification Report No. 79-42 by R.J. Mott) were collected from the floor level of house ruin no. 10, Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 7 to 8 m. Collected August 2, 1979 by P. Schledermann.

Comment (P. Schledermann): House ruin no. 10 was a typical Ruin Island type dwelling, which may have been connected to the "blocked" dwelling no. 9. This latter dwelling gave two dates on willow: GSC-3013, 620 ± 50 BP and GSC-2922, 810 ± 70 (both uncorrected). The second date was obtained on willow derived from the bottom level of the subsequently closed kitchen room. It is difficult to assess the relative importance of these dates because of the problem which has become increasingly obvious regarding the use of willow as dating material. The corrected dates from House no. 10 and the kitchen of House no. 9 are very close and suggest a possible contemporaneity of H. 10 and H. 9, when the latter was first used as a complete dwelling with kitchen and tunnel. Uncorrected age: 840 ± 60 BP.

Comment (W. Blake, Jr.): After oven drying only the two thickest pieces were used for dating; both had a considerable amount of adhering bark. Piece B: 8.0 cm long, 2.0 cm maximum diameter; Piece C: 3.5 cm long, 2.0 cm maximum diameter with side branches out 2 to 3 cm. Date is based on two 1-day counts in the 5 L counter.

GSC-3033. Skraeling Island Site, House 14 — 800 ± 70

Wood (sample PS-79(16); 4.5 g; **Salix** sp.; unpublished GSC Wood Identification Report No. 80-9 by L.D. Farley-Gill) collected at floor level in winter house ruin no. 14 on Skraeling Island, Northwest Territories (78°54'N, 75°37'W), at an elevation of 10 to 11 m. Collected August 6, 1979 by P. Schledermann.

Comment (P. Schledermann): This Thule culture winter dwelling, of the Ruin Island type, had been superimposed on House 15 which yielded a date on willow of 700 ± 70 BP (GSC-2924, uncorrected). The date from House 14 is thought to be too old by at least 100 years. Corrected age not available as the CO_2 sample submitted for determination of $^{13}C/^{12}C$ ratio was lost at the University of Waterloo.

Comment (W. Blake, Jr.): After air drying, the sample used for dating was three of the largest pieces (which fit together). Total length: 13 cm; maximum diameter, 1.5 cm; and the root base is 6.5 cm across. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Haa Island

GSC-2981. Haa Island 270 ± 50
$\delta^{13}C = -25.5‰$

Arctic heather (sample PS-79(6); 15.0 g dry; **Cassiope tetragona**; identified by W. Blake, Jr.) obtained from the platform area of winter house ruin no. 10, Haa Island Thule site, Haa Island, Northwest Territories (79°00'N, 77°37'W), at an elevation of 7 to 8 m. Collected July 22, 1979 by P. Schledermann.

Comment (P. Schledermann): This date on heather confirms the general impression that this Thule culture winter dwelling was occupied very late in the Thule culture period. The large three-platform structure may have been one of the last winter dwellings used during the prehistoric period in this area. Uncorrected age: 270 ± 50 BP.

GSC-3408. Haa Island 500 ± 50
$\delta^{13}C = -27.1‰$

Arctic heather (sample PS-81-12; 16.1 g dry; **Cassiope tetragona**; identified by W. Blake, Jr.) collected between 35 and 40 cm below the surface on the central floor area of winter house ruin no. 24 on Haa Island, Northwest Territories (79°00'N, 77°37'W), at an elevation of 12 to 13 m. Collected July 25, 1981 by D. Lyons for P. Schledermann; submitted by P. Schledermann.

Comment (P. Schledermann): The sample represents cultural debris from a winter house ruin which appears to be one of the few structures pertaining to a relatively early Thule culture occupation of this site. In relation to material finds the date is probably fairly accurate. Uncorrected age: 530 ± 50 BP.

Comment (W. Blake, Jr.): This large sample was well preserved and wet. On oven drying the weight decreased from 343.2 to 186.1 g; 16.1 g of the best material was selected for dating, and other vegetal remains were excluded. Date is based on two 1-day counts in the 5 L counter.

GSC-3447. Haa Island 530 ± 60
$\delta^{13}C = -28.4‰$

Arctic heather (sample PS-81-13; 16.0 g dry; **Cassiope tetragona**; identified by W. Blake, Jr.) from the roof area 25 to 30 cm below the surface of winter house ruin no. 19, Haa Island Thule site, Haa Island, Northwest Territories (79°00'N, 77°37'W), at an elevation of 10 m. Collected July 18, 1981 by K. McCullough.

Comment (P. Schledermann): The Haa Island Thule culture winter site is one of the more important sites for future studies of the Thule culture in the study area. House no. 19 was tested sufficiently to reveal a collapsed roof structure of whale ribs, sod, and heather. Extensive water seepage prevented further work on the dwelling shortly after floor level was reached in one small area. The date may be too early; however, the lack of sufficient data from the test units prevents a more definite assessment of the occupation period. Uncorrected age: 590 ± 60 years.

Comment (W. Blake, Jr.): This well preserved sample, upon oven drying, decreased in weight from 150.8 to 87.4 g. The best material (16.0 g) was selected for dating. Date is based on two 1-day counts in the 5 L counter.

East-central Ellesmere Island

Cape Herschel series

GSC-3064. Cape Herschel (I) 2800 ± 60
$\delta^{13}C = -23.2‰$

Charred bone (sample BS-79-168; 8.0 g dry) from a paleoeskimo hearth (SdFh-2) on a ridge facing Neptune Rock on the northeast side of the Cape Herschel peninsula, Ellesmere Island, Northwest Territories (78°36.6'N, 74°38.5'W), at an elevation of 10.5 m (leveled). Collected July 17, 1979 by W. Blake, Jr. under the supervision of P. Schledermann.

Comment (W. Blake, Jr.): This well preserved charred material was in part on the surface, in part under a thin layer of moss, and in part under the angular rocks making up the hearth. Because of the porous nature of the charred bone (and some melted animal tissue may be included, but no obvious wood was utilized), rootlets had penetrated in places. These were removed with tweezers. Any pieces that had what appeared to be adhering lichens or other bits of vegetation were scraped clean or the contaminated part was broken off. The sample received the standard treatment with NaOH, HCl and distilled water rinses. Date is based on two 1-day counts in the 5 L counter. Uncorrected age: 2770 ± 60 BP.

GSC-3349. Cape Herschel (II) 4110 ± 110
$\delta^{13}C = -20.2‰$

Charred material (sample BS-81-327; 4.0 g dry) from an Arctic Small Tool tradition (ASTt) site on the main area of raised beaches on the north side of the Cape Herschel peninsula, Ellesmere Island, Northwest Territories (78°37.2'N, 74°40.5'W), at an elevation of 14.7 m (leveled above the ice foot, the reference point for all elevation determinations in the vicinity of Cape Herschel). Collected July 31, 1981 by W. Blake, Jr. and J.A. Baker under the supervision of P. Schledermann.

Comment (W. Blake, Jr.): The charred material, probably bone for the most part, was from beneath stones in the hearth of the southern structure at the lower ASTt site (both levels are included within the Blake site, SdFh-4, personal communication from P. Schledermann, November 1987). The dated

material, all well charred, was separated by hand from less burnt bone or unburnt bone, as well as from pieces that were clearly charcoal. The sample received the standard treatment with NaOH, HCl (no reaction) and distilled water rinses. Because of the small sample size (3.3 g dry after pretreatment) the sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter. Uncorrected age: 4030 ± 110 BP.

GSC-3310.	Cape Herschel (III)	4340 ± 80 $\delta^{13}C$ = -19.3‰

Charred material (sample BS-81-328; 5.4 g dry) from an ASTt site on the main area of raised beaches on the north side of the Cape Herschel peninsula, Ellesmere Island, Northwest Territories (78°37.2'N, 74°40.5'W), at an elevation of 20.9 m (leveled). Collected July 31, 1981 by W. Blake, Jr. and J.A. Baker under the supervision of P. Schledermann.

Comment (W. Blake, Jr.): This nondescript charred material was collected from under a single flat sandstone slab (14 by 29 cm, and 1.5 cm in thickness) in a structure within the upper level of sites. The dated sample may have contained some charred bone and charred wood, although every effort was made to separate out obvious pieces of these materials (charred or otherwise) at the same time that rootlets were picked out. The sample may also contain some melted blubber or other animal debris, and the $^{13}C/^{12}C$ ratio is more typical of such materials than it is of wood (cf. GSC-3355, $\delta^{13}C$ = -25.2‰ on charcoal, this series). The sample received the standard pretreatment with NaOH, HCl (no reaction) and distilled water rinses. Date is based on two 1-day counts in the 2 L counter. Uncorrected age: 4240 ± 80 BP.

GSC-3355.	Cape Herschel (IV)	4410 ± 210 $\delta^{13}C$ = -25.2‰

Charcoal (sample BS-81-258; 1.6 g dry; probably **Picea** sp., unpublished GSC Wood Identification Report No. 81-34 by R.J. Mott) from an ASTt site on the main area of raised beaches on the north side of the Cape Herschel peninsula, Ellesmere Island, Northwest Territories (78°37.2'N, 74°40.5'W), at an elevation of 21.5 m (leveled). Collected July 17 and 19, 1981 by W. Blake, Jr. and J.A. Baker under the supervision of P. Schledermann.

Comment (W. Blake, Jr.): This collection of charcoal was made under several cobbles and boulders in the northeast corner of the southernmost structure (upper level) on this area of raised beaches. Most charcoal lumps were collected within 5 cm of the surface. Forty fragments were examined by Mott, who stated, in the unpublished report cited above,

"All were coniferous wood, obviously derived originally from pieces of wood of large diameter and not small twigs or branches. The charcoal was very delicate and easily crushed, which along with the small size of the fragments made identification difficult, and in most cases impossible. Those fragments that showed some features indicated that the charcoal was derived from spruce (**Picea**) wood, although some larch (**Larix**) may be present. Among the remaining smallest fragments, one piece of only partially carbonized wood was recovered. This fragment was part of a small-sized and small diameter twig and was not coniferous wood. However, only the outer portion of the twig remained making identification impossible".

It is also interesting to note the close correspondence in age of a sample (GSC-3310) which probably consisted mainly of materials of marine origin with a sample (GSC-3355) of terrestrial origin. The sample received the standard pretreatment with NaOH, HCl (no reaction) and distilled water rinses. Because of the small sample size (1.2 g dry) following pretreatment, the sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter. Uncorrected age: 4410 ± 210 BP.

GSC-2821.	Cairn Site	4250 ± 80 $\delta^{13}C$ = -26.3‰

A sample of charred wood fragments (sample Cairn Site (SfFi-1), locality 1(A); 3.6 g) from the central hearth of an ASTt dwelling feature located near Cape Rutherford, Ellesmere Island, Northwest Territories (78°50'N, 74°59'W). The wood fragments were identified as **Picea** sp., **Larix** sp., **Salix** sp. and unidentified deciduous (unpublished GSC Wood Identification Report No. 78-43 by R.J. Mott), but only a 3.6 g sample of **Picea** sp. was used for dating. Collected August 5, 1978 by P. Schledermann, then Arctic Institute of North America, Calgary; now University of Victoria, Victoria, British Columbia.

Comment (P. Schledermann): The central passage remains from this feature were located at an elevation of approximately 17 m. The driftwood date appears to be too old by a number of centuries, at least with reference to the site elevation. Only a microblade was located near the hearth, and further cultural identification other than a general ASTt assignment must follow additional work on the site. Uncorrected age: 4270 ± 80 BP. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3596.	Hearth Site (SfFj-20)	3450 ± 90

Charcoal (sample PS-82-3; 3.7 g; probably **Picea** or **Larix** sp.; unpublished GSC Wood Identification Report No. 82-49 by R.J. Mott) beneath boiling stones in a single ASTt hearth feature located

0.30 km inland from the present shore of Johan Peninsula, Ellesmere Island, Northwest Territories (78°52'N, 75°15'W), at an elevation of 27 to 29 m. Collected July 27, 1982 by P. Schledermann.

Comment (P. Schledermann): The ASTt hearth feature is located near a cliff outcrop which would have been accessible to the sea only at a time when the coastline was submerged 20 to 25 m below its present level. The sheltered hearth feature probably reflects summer season activity.

Comment (W. Blake, Jr.): This excellent charcoal sample was picked over by R.J. Mott; all lumps of charcoal (numerous pieces are greater than 1 cm in length) were determined to be coniferous wood. No **Salix** sp. was present. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2576. Digarmulen-1 4390 ± 80
$\delta^{13}C = -25.1‰$

Charcoal (sample PS-77/Digarmulen-1; 2.5 g; **Picea** sp. and **Larix** sp.; unpublished GSC Wood Identification Report No. 77-46 by L.D. Farley-Gill and R.J. Mott) was obtained from an ASTt hearth feature. Only **Picea** sp. (30+ fragments, 2.5 g) was used for dating. The stone-covered hearth feature is located on a gravel terrace near Digarmulen Point, Thorvald Peninsula, Ellesmere Island, Northwest Territories (78°58'N, 75°45'W), at an elevation of 22 m. Collected August 5, 1977 by P. Schledermann.

Comment (P. Schledermann): This hearth feature was the first located evidence of early ASTt activities in the study area. The site elevation and the date on charcoal derived from driftwood is fairly close to the results from Skraeling ASTt #7 (GSC-3261, 4420 ± 110 BP, uncorrected, this list). In order to test the validity of this driftwood charcoal date, suspected of being too old, a sample of charred bone, probably sea-mammal, was also dated. This resulted in an assessment of 3960 ± 90 BP (GSC-2646 uncorrected, this list).

Comment (W. Blake, Jr.): Five grams of damp charcoal were air dried, and most of the rootlets present were removed. Sample was mixed with dead gas for counting. Date is based on one 2-day count in the 2 L counter.

GSC-2646. Digarmulen-2 3970 ± 90
$\delta^{13}C = -23.9‰$

Burned bone (sample PS-77/Digarmulen-2; 22 g) was obtained from an ASTt hearth feature located near Digarmulen Point, Thorvald Peninsula, Ellesmere Island, Northwest Territories (78°58'N, 75°45'W), at an elevation of 22 m. Collected August 5, 1977 by P. Schledermann.

Comment (P. Schledermann): The charred bone sample (uncorrected age: 3960 ± 90 BP) was obtained from the same hearth feature which yielded wood charcoal, dated earlier to 4390 ± 80 BP (GSC-2576, uncorrected, this list). The two assessments clearly show the problems associated with driftwood dates. The date on charred bone is probably also somewhat less than accurate (in terms of giving a precise age for occupation of the site) if, as we suspect, sea mammal bones are involved. The difference between the driftwood date and the actual use of the hearth could be in excess of 1000 years. All visible rootlets, rock chips, and charcoal were removed from the sample. NaOH leach was omitted from sample pretreatment. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3375. Cliff Site 700 ± 70
$\delta^{13}C = -28.0‰$

Wood (sample PS-81-7; 6.9 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 81-39 by R.J. Mott) collected from test unit #1, central floor area of winter house ruin no. 10, Cliff Site, Thorvald Peninsula, Ellesmere Island, Northwest Territories (79°01'N, 76°40'W), at an elevation of 3 to 4 m. Collected July 17, 1981 by I. Robertson for P. Schledermann; submitted by P. Schledermann.

Comment (P. Schledermann): The sample represents cultural debris from the floor of a Thule culture winter house ruin related to a poorly known period of occupation in the Bache Peninsula region. The material cultural association suggest that the date is at least 100 years too old. Uncorrected age: 740 ± 70 BP. Upon oven drying the wet sample decreased in weight from 46.6 to 15.8 g. Only the larger piece of wood was used. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3268. Bight Site 3790 ± 360
$\delta^{13}C = -23.8‰$

Charcoal (sample PS-80-5; 0.6 g; **Picea** and **Larix** sp.; unpublished GSC Wood Identification Report No. 81-20 by R.J. Mott) found in small concentrations on the living floor of dwelling feature #1, situated on a small gravel terrace on Knud Peninsula, Ellesmere Island, Northwest Territories (79°06'N, 76°09'W), at an elevation of 21 m. Collected July 2, 1980 by P. Schledermann.

Comment (P. Schledermann): This single camp unit produced a number of diagnostic artifacts indicating a close relationship with the Sarqaq occupations in Greenland. Any date on driftwood charcoal has a potential error due to the unknown period of sea transport and deposition prior to use. As a general rule, such dates are older than the period of human use. In this particular instance I would estimate that the more recent period of the MASCA

range (3640 to 4630) is reasonably accurate. Uncorrected age: 3770 ± 360 BP. Sample mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2827. Ridge Site 2710 ± 60
$\delta^{13}C = -23.4‰$

Charred bone (sample SgFm-6; 22.0 g) was separated from a mixed sample of charred wood, bone and uncharred bone by W. Blake, Jr. and R.J. Mott (cf. unpublished GSC Wood Identification Report No. 79-11). The sample was collected from several small concentrations within a defined dwelling structure on Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'N, 76°09'W), at an elevation of 20 m. Collected July 17, 1978 by P. Schledermann.

Comment (P. Schledermann): This dwelling feature produced a large number of diagnostic artifacts indicating a late pre-Dorset period of occupation. The charred bone material is probably derived from sea mammals, the principal economic resource in the area. The MASCA range is 2750 to 2850 BP, and although the probable sea mammal material should yield dates that are too early by several centuries, I feel that the MASCA range is a fairly close approximation to the time of occupation of this feature. Uncorrected age: 2690 ± 60 BP.

Comment (W. Blake, Jr.): Rootlets were removed and fragments of bone with lichens were excluded from the dated sample. NaOH leach omitted from sample pretreatment. Date is based on two 1-day counts in the 5 L counter.

GSC-3141. Longhouse Site 1110 ± 70
$\delta^{13}C = -25.7‰$

Charred wood (sample PS-79(10); 2.7 g; probably **Salix** sp.; unpublished GSC Wood Identification Report No. 80-8 by L.D. Farley-Gill) was obtained from a hearth feature in stone row 2, unit #1, on the Longhouse site, Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'N, 76°11'W), at an elevation of 8 to 9 m. The site is on a gentle slope which ends in a lake. Collected July 19, 1979 by P. Schledermann.

Comment (P. Schledermann): A series of joined cooking hearth features, often in rows 30 m to 40 m in length, was located near extensive communal dwellings on the site (Schledermann, 1981). Several samples of charred materials from selected hearths were dated in order to assess the age and cultural association of these features. Hearth row #2 was dated as a check on the dates obtained from Hearth row #1 (GSC-2834 and 2757, this list). Since willow was deemed to be more reliable than either charred bone or driftwood, this material was used for all hearth row dates. Uncorrected age: 1120 ± 70 BP.

Comment (W. Blake, Jr.): Only wood fragments which had morphological features similar to **Salix** sp. (a total of 25 to 30 were examined) were used. One fragment, probably **Picea** sp., was excluded. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3262. Longhouse Site 2850 ± 50
$\delta^{13}C = -30.8‰$

Charred bone (sample PS-80-3; 35.2 g) was collected from a hearth feature on a pronounced ridge west of the main site on Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'N, 76°11'W), at an elevation of 10 to 11 m. A large number of camp and hearth features were located along a raised beach. Collected July 5, 1980 by P. Schledermann.

Comment (P. Schledermann): This component of the site was termed the "Early Dorset Ridge" judging by the many diagnostic artifacts located throughout the ridge area. Although charred bone material must be treated with caution due to obvious problems with differences in terrestrial and sea mammal bone assessments, this sample is assumed to be charred sea mammal bones, and hence the date undoubtedly is too early by two to four centuries. Uncorrected age: 2940 ± 50 BP. Date is based on one 3-day count in the 5 L counter.

GSC-2834. Longhouse Site 1150 ± 60
$\delta^{13}C = -25.4‰$

Charcoal (sample SgFm-3; 5.1 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 79-10 by R.J. Mott) was collected from hearth Row no. 1, Unit #3, Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'N, 76°11'W), at an elevation between 11 and 16 m. Collected July 15, 1978 by P. Schledermann.

Comment (P. Schledermann): Several rows of joined cooking hearths were located on this site (Schledermann, 1981). In order to determine the association with other features, such as large Dorset culture communal dwellings, several samples of charred willow from selected hearths were dated. Three GSC dates and two Geochron dates produced reasonably similar results, indicating a Late Dorset culture association dating to between 1170 and 968 BP according to the MASCA range. Considering the tendency for willow dates to give earlier than "true" results I would estimate a temporal placement closer to the later end of the range, i.e. 1050 to 950 BP. Uncorrected age: 1160 ± 60 BP.

Comment (W. Blake, Jr.): The sample used for dating comprised 60 pieces of charcoal, including all of the largest lumps (maximum size: 2 x 1 cm). Bark was still present on some small cylindrical pieces. Date is based on two 1-day counts in the 2 L counter.

GSC-2757. Longhouse Site 1180 ± 70
$\delta^{13}C = -26.3‰$

Charred wood (sample L.H. site, Row 1, Unit 4 (SgFm-3); 3.9 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 78-44 by R.J. Mott) was collected from Hearth Row #1, Unit #4 on Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'30"N, 76°11'00"W), at an elevation between 11 and 16 m. Collected July 15, 1978 by P. Schledermann.

Comment (P. Schledermann): The dating of willow charcoal from this hearth row unit (Schledermann, 1981) was performed in order to verify the date from unit #3 (GSC-2834, 1160 ± 60, uncorrected, this list). As stated in the comments on the GSC-2834 results, an estimated temporal MASCA range placement with "willow" correction for the use of these hearth rows is between 1050 to 950 BP. Uncorrected age: 1200 ± 70 BP.

Comment (W. Blake, Jr.): Only **Salix** sp. was used for dating. Individual pieces were up to 2.6 x 1.7 cm in size. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3108. Eskimobyen Site, House 1 1200 ± 70
$\delta^{13}C = -22.1‰$

Right femur (sample PS-79(19); 247.8 g) of a subadult walrus (**Odobenus rosmarus**; identified by C.R. Harington, National Museum of Natural Sciences, Ottawa) was obtained from the right-hand front corner of winter house ruin no. 1, Eskimobyen Site, Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'15"N, 76°09'00"W), at an elevation of 8.35 m. Collected July 15, 1979 by P. Schledermann.

Comment (P. Schledermann): This faunal sample was collected in the same area as the willow which dated to 1040 ± 120 (GSC-2796; uncorrected, this list). The collection locality appears to have served as a cooking and/or lamp platform area in the front, right part of the early Thule culture winter dwelling. Sea mammal bones are thought to yield dates which are too old, although no agreement seems possible as to the degree of variability. A study of dates on willow in this region also suggests results which are older than the actual event. A heather sample from the sleeping platform area resulted in a date of 680 ± 50 BP (GSC-2953, uncorrected, this list). The walrus date could be over 450 years too old. Uncorrected age: 1150 ± 70 BP. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2953. Eskimobyen, Site, House 1 610 ± 50
$\delta^{13}C = -29.5‰$

Arctic heather (sample PS-79(5)A; 20.0 g; **Cassiope tetragona**; identified by W. Blake, Jr.) collected from the sleeping platform of winter house ruin no. 1, Eskimobyen Site, Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'15"N, 76°09'00"W), at an elevation of 8 to 9 m. Collected July 15, 1979 by P. Schledermann.

Comment (P. Schledermann): This sample of heather was dated in order to either verify or dispute the early dates obtained on walrus femur (GSC-3108) and willow (GSC-2796, both in this series) from the floor area of this Thule culture winter dwelling. The latter two dates were, based on the artifact assemblage from the dwelling, deemed to be too early by a significant number of years (200 to 450 years). A second rather remote possibility, would be an earlier Dorset occupation of an original structure subsequently rebuilt by later Thule culture inhabitants. The more likely explanation relates to the problems with sea mammal and some willow dates. Uncorrected age: 680 ± 50 BP. Date is based on two 1-day counts in the 5 L counter.

GSC-2796. Eskimobyen Site, House 1 970 ± 120
$\delta^{13}C = -29.2‰$

Wood (sample SgFm-4(A); 1.4 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 78-54 by R.J. Mott) was obtained from the front right-hand corner of winter house ruin no. 1, Eskimobyen Site, Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'15"N, 76°09'00"W), at an elevation of 8.35 m. Collected July 20, 1978 by P. Schledermann.

Comment (P. Schledermann): The sample was obtained from the cooking area of an early Thule culture winter dwelling and was immersed in fatty debris at the time of collection. The age determination was surprisingly early and is suspected of being too old. Subsequent dating of walrus bone and heather samples from the same dwelling produced different results, although the walrus bone date is fairly close (walrus bone, GSC-3108, 1150 ± 70 BP uncorrected; heather, GSC-2953, 680 ± 50 BP uncorrected, both in this list). Sea mammal bones usually produce dates of greater than true age, by several centuries. Uncorrected age (for GSC-2796): 1040 ± 120 BP.

Comment (W. Blake, Jr.): The sample was separated into different wood components by R.J. Mott; the dated sample is entirely **Salix** sp. The largest single piece, 5.8 cm long and 1.1 cm in maximum diameter, had rounded ends, implying transport. Only this single piece of wood (1.4 g) was used for dating. The sample received the standard pretreatment with NaOH, HCl, and distilled water

rinses. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3018. Eskimobyen Site, House 3 510 ± 70

Mountain avens (sample PS-79(17); 8.0 g dry; **Dryas integrifolia**; identified by W. Blake, Jr.), collected from the sleeping platform of winter house ruin no. 3, Eskimobyen Site, Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'15"N, 76°09'00"W), at an elevation of 7 to 8 m.

Comment (P. Schledermann): The sample was obtained from a Thule culture winter dwelling occupied during a middle stage of the Thule period. The dwelling and its contents indicate strong cultural impulses from the Central/Eastern Canadian Arctic at this time, probably related to actual population movements. The sample was dated in order to compare the results obtained on various materials from a single occupation episode. It is suggested that **Dryas** and **Cassiope** dates are more dependable and accurate than **Salix** or certainly than driftwood dates. Corrected age not available as the CO_2 sample submitted for determination of $^{13}C/^{12}C$ ratio was lost at the University of Waterloo.

Comment (W. Blake, Jr.): The sample was allowed to air dry in the office, then only stems and leaves of **Dryas integrifolia** were picked out of the bulk sample. **Cassiope tetragona** is also present in the matted debris. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2950. Eskimobyen Site, House 3 430 ± 70 $\delta^{13}C = -29.6‰$

Mountain avens (sample PS-79(4)A; 30.0 g dry; **Dryas integrifolia**; identified by W. Blake, Jr.) obtained from the floor of winter house ruin no. 3, Eskimobyen Site, Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'15"N, 76°09'00"W), at an elevation of 7 to 8 m. Collected July 20, 1979 by P. Schledermann.

Comment (P. Schledermann): The sample is from a Thule culture winter dwelling occupied during a middle stage of the Thule culture continuum in this region. This date corresponds closely to one on heather (**Cassiope tetragona**) from the sleeping platform of the same dwelling (GSC-3018, 510 ± 70 BP, uncorrected, this series). Uncorrected age (for GSC-2950): 500 ± 70 BP.

Comment (W. Blake, Jr.): Part of this well preserved sample was air-dried, the remaining mixture of damp and dry **Dryas** leaves and stems was oven-dried (weight decreased from 44.3 to 30.0 g). Pebbles, rootlets, and other vegetation were removed by hand. Date is based on two 1-day counts in the 5 L counter.

GSC-3396. Eskimobyen Site, House 25 730 ± 70 $\delta^{13}C = -26.9‰$

Arctic heather (sample PS-81-4; 9.0 g dry; **Cassiope tetragona**; identified by W. Blake, Jr.) collected in the central floor area of winter house ruin no. 25, Eskimobyen site, Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'N, 76°09'W), at an elevation of 9 to 10 m. Collected June 22, 1981 by P. Schledermann.

Comment (P. Schledermann): This date is thought to reflect, fairly accurately, the approximate occupation period of this Thule culture dwelling. The structure is a typical, perhaps slightly later, example of the "Ruin Island" phase winter house. The dwelling was completely buried under 50 to 70 cm of a sand/gravel and sod matrix, and the heather was enclosed in cultural debris which included blubber-saturated dirt, sand, and skin pieces. A **Salix** sample from the floor area produced a date of 920 ± 50 BP (GSC-3379, uncorrected, this series). Uncorrected age (for GSC-3396): 760 ± 70 BP.

Comment (W. Blake, Jr.): On oven drying the sample weight was reduced from 135.8 to 61.6 g. Well preserved stems and leaves were used for dating. Date is based on two 1-day counts in the 2 L counter.

GSC-3379. Eskimobyen Site, House 25 910 ± 50 $\delta^{13}C = -25.8‰$

Wood (sample PS-81-5; 12.0 g; **Salix** sp.; unpublished GSC Wood Identification Report No. 81-35 by R.J. Mott) collected at floor level 52 cm below the present surface, in winter house ruin no. 25, Eskimobyen Site, Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'N, 76°09'W), at an elevation of 9 to 10 m. Collected July 1, 1981 by P. Schledermann.

Comment (P. Schledermann): This sample was obtained from the floor area of one of the few "Ruin Island" type Thule culture dwellings on the site. The dating of **Cassiope** (GSC-3396, this series) from the same house floor provided a good example of the age difference resulting from the dating of two different materials. As expected, the **Cassiope** date (760 ± 70 BP, uncorrected) is considerably later and is thought to be the more accurate assessment. Uncorrected age: 920 ± 50 BP.

Comment (W. Blake, Jr.): The single piece of wood was 12.5 cm long; maximum hole thickness is 5.5 cm. On oven drying its weight was reduced from 77.6 to 47.2 g. Date is based on two 1-day counts in the 5 L counter.

GSC-3267.	Eskimobyen Site	400 ± 50 $\delta^{13}C$ = -27.1‰

Wood (sample PS-79(17); 11.3 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 81-18 by R.J. Mott) collected from the raised sleeping platform of winter house ruin no. 3, Eskimobyen Site, Knud Peninsula, Ellesmere Island, Northwest Territories (79°07'15"N, 76°09'W), at an elevation of 7 to 8 m. Collected July 18, 1979 by P. Schledermann.

Comment (P. Schledermann): The sample was obtained from a Thule culture winter dwelling occupied during a middle stage of the continuum in this region. The sample was used to test the hypothesis that willow samples provide dates believed to be too old. A sample of heather (GSC-3018, this series) obtained from the same platform produced a date of 510 ± 70 BP (uncorrected), and therefore did not confirm the hypothesis. In all other instances comparative samples of willow and heather have resulted in earlier willow dates. The hypothesis is based on the assumption that fresh heather is obtained for the sleeping platform cover in contrast to the use of dead, dry willow for cooking. Uncorrected age: 410 ± 50 BP.

Comment (W. Blake, Jr.): Only the two largest pieces of wood were used for identification and dating. Maximum size was 17 cm long by 1.2 cm diameter. On oven drying the weight decreased from 43.2 to 17.7 g. Some mold was present on some pieces, but not the two used. Date is based on two 1-day counts in the 5 L counter.

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GSC XII	Lowdon, Wilmeth and Blake, 1972
GSC XIII	Lowdon and Blake, 1973
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Addendum (W. Blake, Jr.): With regard to age determinations GSC-2317, -2326, and -2355 (Goodsir Inlet peat series, Bathurst Island; see p. 75) the submitter now states that he believes that the samples were mislabeled in the field, and that therefore "the dates have been assigned to incorrect depths on the lab forms" (personal communication to W. Blake, Jr. from C. Tarnocai, March 1, 1988). The submitter further states "Since this peat deposit resulted from natural deposition of plant materials and no visible contamination was observed, the dates should follow the sequence commonly found in other deposits in the area. The revised sequence of dates, which is presented below, provides the commonly occurring rates of peat deposition for these time periods. This rate of deposition is greatest in the lower part of the deposit and gradually decreases to nearly zero at the surface." The revised sequence is GSC-2326 (25 cm depth), 5070 ± 60 BP; GSC-2355 (78 cm depth), 5830 ± 70 BP; and GSC-2317 (130 cm depth), 6160 ± 90 BP. Revised accumulation rates are: 15.75 cm/100 years between 130 and 78 cm depth, 6.97 cm/100 years between 78 and 25 cm depth (Tarnocai and Zoltai, in press).

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*Same CO_2 counted in two counters.
**Two fractions dated of the same sample.
***Three fractions dated of the same sample.
****Second determination includes CO_2 from first preparation.

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