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GEOLOGICAL SURVEY OF CANADA RADIOCARBON DATES III

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INTRODUCTION

All C^{14} measurements in this date list were made with the 2 L counter described in our first date list (GSC I). Ages were calculated on a C^{14} half life of 5570 ± 30 yr and 0.95 of the activity of the NBS oxalic-acid standard, and are quoted in years before 1950.

In addition to the counting errors of sample, background, and standard, and the errors in the half life, all age errors starting with sample GSC-120 include an error term to account for the average variation of ± 1.5% in the C^{14} concentration during the past 1300 yr as measured by Willis, Tauber, and Münnich (1960) in sequoia tree rings. Similar results have been obtained by the author in work on an 1100-yr old Douglas fir from Vancouver Island, now nearing completion. The error term inserted to cover this variation makes little difference to the resultant error of older samples but gives a more realistic error for the young samples. For instance, in samples up to 1000 yr old, this correction generally accounts for about 50% of the age error, in a 10,000 yr sample about 30%, and in a 20,000 yr sample about 5%.

No changes were made in the routine chemical pretreatment and CO_2 preparation of organic samples. Sea shells with GSC numbers greater than 149 were treated with HCl to remove the outer 20% before the CO_2 was collected for dating, rather than the outer 10% as in our earlier procedure. Occasionally, more or less of a shell sample was removed depending on the size and condition of the sample. Deviations from the routine procedure are listed under the respective samples. This change in the shell pretreatment was prompted by the results of four samples that were analyzed in two fractions after the usual 10% preleach, and of one sample that was prepared twice. The two fractions and the corresponding dates of these samples are listed in the following table.

Date No.	Fraction, %	Age, years
GSC-61	10-50	10,360 ± 240
	51-100	10,540 ± 210
GSC-111	11-50	30,300 ± 1600
	51-100	36,300 ± 2000
GSC-119	11-70	10,460 ± 160
	71-100	10,740 ± 170
GSC-146	13-55	7620 ± 210
	56-100	8200 ± 220
GSC-134 (1st preparation)	11-100	29,430 ± 680
(2nd preparation)	63-100	29,800 ± 220

* The introductory part of this paper has been prepared by the first author who operates the laboratory. The date list has been compiled by the second author from descriptions of samples and interpretations of dates by the various collectors.

The innermost fraction is consistently older in all five samples suggesting slight contamination, although the differences between the two fractions are smaller than the sum of the absolute errors of the two fractions in all but two samples. While the errors are within statistical limits the differences between the two fractions are not those predicted by chance. If chance alone were operative there should be just as many samples in which the inner fraction is younger.

No measurements like those listed in the table above have been made with samples from which the outer 20% were removed, but it is expected that this procedure will remove most of the remaining contamination. It is not impossible, however, that in very old shells the contaminating C has penetrated the whole thickness of the shell.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Eastern Canada

GSC-160. Tignish Shore, Prince Edward Island — **12,670 ± 340 / 10,720 B.C.**

Marine shell fragments (*Macoma, Astarte, Balanus*) coll. 6 to 20 ft below summit of gravel knoll (alt ca. 25 ft) beside road to North Point, ca. 1 mi N of Tignish Shore, Prince Edward Island (46° 58′ 30″ N Lat, 63° 59′ 45″ W Long). Half shells of *Astarte* from depth 20 ft. Deposit probably is glaciomarine. Coll. 1962 by V. K. Prest.* *Comment* (V.K.P.): the shell-bearing material presumably originated during glacial retreat from NW Prince Edward Island, when the seashore was 80 ft above present sealevel (Prest, 1962). Date agrees with GSC-101: 12,410 ± 170 (GSC-II) for shells 10 mi SW ascribed to a shore at alt 50 ft. Outer 10% of shells discarded. Sample mixed with dead gas for counting. Date based on one 3-day count.

GSC-119. Glennevis, Ontario — **10,740 ± 170 / 8790 B.C.**

Marine shells (*Macoma balthica*) from road cut 1 mi N of Glennevis, Ontario (45° 17.6′ N Lat, 74° 29.8′ W Long), from sand overlapping marine clay on edge of till hill. Sand appears to be a shore or near-shore deposit; thus shells are inferred to relate to a stand of the Champlain Sea at or slightly above the site (alt 258 ft). Coll. 1961 by J. J. L. Tremblay. *Comment*: although slightly older than expected, date agrees approx. with other dates for shells from Ottawa-Montreal region. Outer and inner fractions of sample were dated separately, after removal of outermost 10% of shells:

outer fraction (11-70% leach) 10,460 ± 160
inner fraction (71-100% leach) 10,740 ± 170

Each date is based on a single count. The inner fraction was mixed with dead gas for counting.

GSC-131. Big Swamp, Picton, Ontario — **8460 ± 160 / 6510 B.C.**

Peat coll. with Hiller peat sampler from base of bog overlying lacustrine

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

sediments at alt ca. 300 ft in a depression in limestone bedrock, 4.5 mi NW of Picton, Ontario (44° 02′ N Lat, 77° 14′ W Long). Depth below surface, 265 to 275 cm. Coll. 1962 by J. Terasmae. *Comment* (J.T.): pollen sequence from this locality correlates with that from nearby Rossmore bog at alt 245 ft, and extends below dated level approx. to level of GSC-157 (9480 ± 170, this list) in Rossmore bog. Sample pretreatment did not include usual NaOH-leach.

GSC-156. Roblin Lake, Ontario **7620 ± 170**
5670 B.C.

Gyttja from Roblin Lake ca. 7 mi S of Belleville, Ontario (44° 03′ N Lat, 77° 25′ W Long); coll. in 2-in. Shelby tube from base of dark brown fine-detritus gyttja 45 ft below lake bed and 76 ft below water level (alt 361 ft). Sampled layer is underlain in sequence by inorganic sediments, glacial deposits, and limestone. Coll. 1963 by J. Terasmae and E. Mirynech. *Comment* (J.T.): date marks beginning of rapid deposition of organic sediment, probably resulting from climatic change at beginning of Hypsithermal time. Palynological record in the core extends deeper than dated level. Correlation of this pollen record with those from Rossmore bog (GSC-157, this list) and Victoria Road bog (GSC-132, this list) indicates that recession of the lake in Ontario basin (transition Lake Iroquois to Lake Ontario) below level of Roblin Lake took place considerably earlier than this date, probably prior to 9500 yr ago. Date based on one 3-day count. NaOH-leach omitted from pretreatment of sample.

GSC-157. Rossmore Bog, Ontario **9480 ± 170**
7530 B.C.

Gyttja coll. with piston sampler at 320 to 330 cm depth in bog ca. 3 mi S of Belleville, Ontario (44° 07′ N Lat, 77° 23′ W Long). Sample from base of gyttja overlying inorganic lacustrine and glacial deposits. Surface of bog is at alt of Lake Ontario (ca. 245 ft). Coll. 1962 by J. Terasmae. *Comment* (J.T.): date is minimum for establishment of Lake Ontario at or near its present level, following abandonment of the Iroquois level and short-lived intermediate levels. NaOH-leach was omitted from pretreatment of sample.

GSC-132. Victoria Road Bog, Kirkfield, Ontario **9600 ± 190**
7650 B.C.

Gyttja 565 cm below bog surface at alt ca. 825 ft, 3.6 mi NE of Kirkfield, Ontario (44° 37′ N Lat, 78° 57′ W Long). Coll. with piston sampler from lowest organic layer in bog and lake deposits overlying alluvial sand in an abandoned channel. Coll. 1962 by J. Terasmae. *Comment* (J.T.): date gives minimum age for abandonment of the Kirkfield outlet between the Huron and Ontario Lake basins. Date based on one 3-day count. Sample pretreatment did not include usual NaOH-leach.

GSC-130. Copetown bog, Ontario **9230 ± 180**
7280 B.C.

Peat and gyttja coll. with Hiller peat sampler at 720 to 730 cm depth, ca. 0.5 mi S of Copetown, Ontario (43° 13′ 45″ N Lat, 80° 03′ 15″ W Long). Sample from base of organic deposit overlying inorganic lacustrine sediment at alt ca. 800 ft in a depression in drift. Coll. 1961 by J. M. Stewart, McMaster Univ.; subm. by J. Terasmae. *Comment* (J.T.): pollen record from this bog extends below GSC-130 and has been correlated with sequences from Galt and

Hamilton with basal C^{14} dates of 11,950 ± 350 (I(GSC)-29) and 10,150 ± 450 (I(GSC)-11), respectively (see Isotopes I). C^{14} dates from the three sites support the pollen correlation. NaOH-leach was omitted from pretreatment of sample.

GSC-92. Churchill, Manitoba — **7270 ± 120 / 5320 B.C.**

Marine pelecypod shells (*Hiatella arctica* and *Mya truncata*) from surface of emerged beach, alt ca. 465 ft, probably a few ft to tens of ft below marine limit, 55 mi SW of Churchill, Manitoba (58° 11′ N Lat, 95° 03′ W Long). Coll. 1960 by J. D. Aitken for B. G. Craig. *Comment* (B.G.C.): sample gives minimum date for retreat of Laurentide ice from area and for entry of Tyrrell Sea (Lee, 1960) into SW Hudson Bay.

B. Western Canada

GSC-141. Waldron Ranch, Alberta — **9560 ± 170 / 7610 B.C.**

Small pieces of charcoal scattered through silty clayey alluvium of Oldman River in gully at Waldron Ranch, ca. 16 mi N of Lundbreck, Alberta (SE1/4, Sec. 7, tp. 10, rge. 1, W 5th Mer.: 49° 48′ N Lat, 114° 07′ W Long). Alluvium overlies varved silt and clay which overlies Laurentide till. Sample from 2 to 12 ft below ground level and below a 1/2-in. bed of volcanic ash probably equivalent to ash overlying GSC-161. Coll. 1960 by A. M. Stalker. *Comment*: sample pretreatment did not include usual NaOH-leach. Date based on a single long count. Sample mixed with dead gas for counting.

GSC-161. Blood Indian Reserve, Alberta — **10,620 ± 250 / 8670 B.C.**

Organic matter from N bank St. Mary River in Blood Indian Reserve ca. 10 mi S of Lethbridge, Alberta (NW1/4, Sec. 4, tp. 7, rge. 22, W 4th Mer.: 49° 32′ 30″ N Lat, 112° 56′ 30″ W Long), 2.5 to 3.5 ft below top of 4-ft soil profile forming base of 14 ft of alluvial and eolian deposits overlying varved clay and silt, in turn overlying youngest Laurentide till in vicinity. A 1-in. bed of volcanic ash above sampled soil probably is equivalent to ash layer overlying GSC-141. Coll. 1962 by A. M. Stalker. *Comment*: date based on single count. NaOH-leach omitted from sample pretreatment.

GSC-169. Downie Creek, British Columbia — **3760 ± 140 / 1810 B.C.**

Spruce wood (id. by R. J. Mott) from alt 6900 ft at head of Downie Creek ca. 25 mi N of Revelstoke, British Columbia (51° 18′ N Lat, 118° 01′ W Long). Sample from one of three logs 1 ft in diam and up to 6 ft long partly embedded in outwash 1000 ft beyond glacier snout and 900 ft above tree line. Coll. 1962 by J. O. Wheeler. *Comment*: the wood is probably from a tree that grew within the area covered by the glacier at its 19th-century maximum and at least 900 ft above the present tree line when the climate was more favorable than today.

GSC-168. Fort Langley, British Columbia — **11,930 ± 190 / 9980 B.C.**

Shells (*Macoma calcarea*) from marine clay 25 ft below land surface and

40 ft above sealevel, in excavation for Trans-Canada Highway SE of Fort Langley, Langley Municipality, British Columbia (49° 10′ N Lat, 122° 35′ W Long). Coll. 1963 by J. E. Armstrong. *Comment* (J.E.A.): shells accumulated during post-Vashon marine submergence, and prior to or contemporaneous with Sumas ice advance a few mi E.

GSC-124. Coquitlam, British Columbia **26,450 ± 520**
24,500 B.C.

Peaty silt from Maryhill gravel pit, Coquitlam Municipality, Lower Fraser Valley, British Columbia (49° 14′ N Lat, 122° 47′ W Long), from silty bed near base of ca. 50-ft section of nonglacial sandy alluvium overlain by 100 ft (+) of Vashon drift and underlain by till and clay. Coll. 1962 by J. E. Armstrong. *Comment* (J.E.A.): this is first dated occurrence of Quadra sediments in Fraser Lowland E of Vancouver metropolitan area. Date based on one 3-day count.

Icarus Point series, Vancouver Island, British Columbia

Peat from two levels on wooded sea cliff at Icarus Point, NW of Nanaimo, Vancouver Island, British Columbia (49° 14.5′ N Lat, 124° 00.5′ W Long). Exposed section includes 3 tills separated by 2 series of stratified sediments containing peat.

GSC-98. Icarus Point, upper peat **>36,200**

Peat about 60 ft above beach, from 5-ft section of silt and fine sand with wood fragments and peat partings overlain and underlain by till. The sampled strata comprise the basal part of the upper series of intertill sediments. Coll. 1958 by J. G. Fyles. NaOH-leach omitted from sample pretreatment.

GSC-155. Icarus Point, lower peat **>37,600**

Peat about 28 ft above beach, from prominent 6 to 10 in. peat bed within 10 ft of silt underlain by 15 ft of sand and 10 ft of marine clay. These strata comprise the lower series of intertill sediments and lie beneath the till sheet beneath GSC-98. Coll. 1962 by E. C. Halstead.

General Comment: the upper intertill series was assumed equivalent to Quadra sediments (typical dates 25,000 to 30,000 yr). The infinite date of GSC-98 raises the possibility that unit is older than the Quadra (see GSC-81, 94, 99, GSC-II).

Crofton series, Vancouver, British Columbia

Peat and wood from interglacial or interstadial strata exposed in excavations at British Columbia Forest Products' pulp mill .75 mi N of Crofton, Vancouver Island, British Columbia (48° 52′ 30″ N Lat, 123° 38′ 40″ W Long). Coll. by E. C. Halstead.

GSC-163. Crofton peat **>38,800**

Peat from 4 to 6 in. bed of peaty silt and wood at alt 100 ft on 40 ft face 'behind' the pulp mill. Peat bed lies within 15 ft of silt and clay underlain by sand and overlain by 10 ft of silty sand; this succession is overlain and truncated by the surface (Vashon) till. Coll. 1963. *Comment* (E.C.H.): peat-bear-

ing beds are similar to the Quadra sediments but the infinite date suggests they are older. Date based on a single count.

GSC-153. Crofton wood **>36,500**

Wood fragments from fresh exposure on partly overgrown sea cliff adjacent to railway below pulp mill, associated with layers of sparse fine plant material within silt and fine sand at alt 15 ft. These materials appear to constitute a channel fill truncating laminated silt and clay and younger than the strata enclosing GSC-163. Coll. 1962.

C. Northern Canada, General

GSC-88. Hunker Creek (silt), Yukon **30,800 ± 1600 −1400 28,850 B.C.**

Fine plant detritus from frozen silt beneath a 20-ft bed of woody, silty peat in right bank of Hunker Creek at mouth of Last Chance Creek, Klondike Dist., Yukon (64° 01′ N Lat, 139° 06′ W Long), 2 ft above creek level and 4 ft below top of silt. Coll. 1961 by J. Terasmae and O. L. Hughes. *Comment*: wood from base of peat at depth 20 ft dates 9520 ± 130 (GSC-73: GSC II). Dates confirm existence of a major stratigraphic break between silt and overlying peat. Silt is tentatively correlated (O.L.H.) with similar material, 4.5 mi upstream along Hunker Creek, beneath a bone-bearing gravel that yielded wood dated >35,000 (I(GSC)-181, Isotopes II). NaOH-leach was omitted from sample pretreatment. Date based on single 4-day count.

GSC-121. Porcupine River, Yukon **10,740 ± 180 8790 B.C.**

Peat 4 ft below ground on upper part of S bank of Porcupine River, Yukon (67° 28′ N Lat, 139° 54′ W Long), from base of marly peat with freshwater shells overlying silty clay which overlies a thick section of silt with minor sand and gravel. Coll. 1962 by O. L. Hughes. *Comment* (O.L.H.): silty clay beneath peat possibly accumulated in a lake when meltwater from Laurentide Ice Sheet discharged into Porcupine Basin through McDougall Pass and/or through headwaters of Eagle River, perhaps as recently as late Wisconsin. NaOH-leach omitted from sample pretreatment.

GSC-128. 'Gill' Lake, Yukon **12,550 ± 190 10,600 B.C.**

Silty gyttja from NW side of 'Gill' Lake, Yukon (65° 28′ N Lat, 139° 42′ W Long), coll. with SIPRE coring drill at depth 91 to 93 in. near base of permanently frozen bog in a depression in terminal moraine of a former valley glacier. Coll. 1962 by O. L. Hughes. *Comment* (O.L.H.): date is compatible with view that the moraine relates to a glacial advance distinctly older than the latest advance in the Ogilvie Mtn area (Vernon and Hughes, in press). Minimum date for the latter is GSC-50: 7510 ± 100 (GSC-I) for basal peat on a moraine at North Fork Pass, Yukon. Sample pretreatment did not include usual NaOH-leach.

King Point series, Yukon

Peat and wood from deposits exposed on rapidly eroding sea cliff E of

King Point, Arctic coast, Yukon (69°04.5′ N Lat, 137° 50′ W Long). Coll. 1962 by O. L. Hughes.

GSC-151. King Point, beneath till **>38,200**

Wood and peaty fragments coll. 2 ft above base of sea cliff 3.5 mi E of E end of King Point spit. Sample from organic silt grading up into stony clay with marine shells (thickness 10 to 18 ft) overlain in succession by till (20 to 30 ft), sand and silt (8 to 15 ft), and surface peat (up to 3 ft). The till, representing last glaciation of site, apparently terminates in vicinity of a moraine, ca. 4 mi W, which is assumed to mark maximum (classical?) Wisconsin stand of Laurentide Ice Sheet.

GSC-159. King Point, above till **9510 ± 170**
7560 B.C.

Peat 18 ft below ground level 0.2 mi W of GSC-151, from 2-in. peat bed in silt 4 ft above till in stratigraphic section similar to that at GSC-151. Sample treated with cold (rather than hot) NaOH.

GSC-120. Rat River, Northwest Territories **>38,600**

Wood, in part beaver-chewed, from W side of Rat River, W of Mackenzie River, Northwest Territories (67° 39.5′ N Lat, 135° 28′ W Long); coll. near base of 40-ft section of silt with organic layers, which overlies till over gravel. No till was seen above silt in poorly exposed upper part of section, but evidence from surrounding area suggests that Laurentide ice covered the site and extended several mi W in (classical?) Wisconsin time. Coll. 1962 by O. L. Hughes.

GSC-147. Rat River, Northwest Territories **9970 ± 180**
8020 B.C.

Wood (twigs) 12 ft below ground on back wall of flow slide on N bank of Rat River, W of Mackenzie River, Northwest Terirtories (67° 43.5′ N Lat, 135° 50.5′ W Long). Sample from organic silt 0.4 ft thick beneath clay, silt, and peat, and resting on 1 ft of clay over sand. The dated layer may have originated in pond or floodplain antedating modern valley of Rat River. Coll. 1962 by O. L. Hughes. Sample mixed with dead gas for counting.

MacAlpine Lake series

Pelecypod shells and peat collected in two localities a few mi apart to determine approximate date of ice recession and age of highest marine beaches. Coll. 1962 by W. Blake, Jr.

GSC-110. MacAlpine Lake, shells **8160 ± 140**
6210 B.C.

Whole shells and fragments of *Hiatella arctica* from surface and down to 1 ft depth in silt, alt ca. 600 ft, 18 mi NW of MacAlpine Lake, Northwest Territories (66° 49′ N Lat, 103° 28′ W Long). Date based on one 3-day count.

GSC-116. MacAlpine Lake, peat **1090 ± 100**
A.D. 860

Basal peat 10 to 12 in. below surface of tussock, and underlain by sand and gravel, between beaches on an esker, alt ca. 630 ft, 5 mi N of MacAlpine Lake, Northwest Territories (66° 47′ N Lat, 103° 04′ W Long). Chemical pre-

treatment omitted from sample preparation. Sample mixed with dead gas for counting.

General Comment (W.B., Jr.): because the shells are within 50 ft of highest marine beaches (ca. 650 ft alt) pelecypods are believed to have lived when the highest beaches were being formed immediately after the glacial retreat. Blake (1963) cites evidence that edge of ice-sheet was still at end moraine along N edge of MacAlpine Lake 8160 yr ago. Peat was dated in unsuccessful attempt to obtain independent check on age of highest beaches.

GSC-115. Bathurst Inlet **8370 ± 100**
6420 B.C.

Whole shells of *Hiatella arctica*, and fragments of *Hiatella*, *Mya* sp., and *Macoma balthica* from surface and down to 1 ft depth in silt between ca. 650 and 670 ft alt, 4 mi W of Bathurst Inlet, Northwest Territories (66° 32′ N Lat, 107° 42′ W Long). Coll. 1962 by W. Blake, Jr. *Comment* (W.B., Jr.): shells are the highest found in region, and presumably date highest beaches, at 700 to 750 ft.

GSC-125. Mt. George, Kent Peninsula **9190 ± 210**
7240 B.C.

Shells of *Mya truncata* on surface of beaches on top of Mt. George, the highest point (alt ca. 610 ft) on Kent Peninsula, Northwest Territories (68° 39.5′ N Lat, 107° 01′ W Long). Coll. 1962 by H. H. Bostock for W. Blake, Jr. *Comment* (W.B., Jr.): the dated pelecypods indicate that Kent Peninsula was ice free 9200 yr ago. Higher beaches do not exist on Kent Peninsula, but the marine limit elsewhere along the mainland coast is close to 700 ft. Shells probably date highest beaches. Sample mixed with dead gas for counting.

Gordon Bay series

Plant debris and pelecypod shells coll. in deltaic beds of silt and sand in attempt to determine recent rate of land uplift. The nearly flat-lying deltaic beds are exposed at the head of Gordon Bay on E side of Bathurst Inlet, Northwest Territories (66° 49.5′ N Lat, 107° 05′ W Long). Top surface of delta below surface peat is at alt of 29 ft. Coll. 1962 by W. Blake, Jr.

GSC-138. Gordon Bay, plant debris **2170 ± 140**
220 B.C.

Leaves and twigs of birch, alder, and willow, and fragments of mosses from 19 ft alt. Date based on one 3-day count.

GSC-137. Gordon Bay, shells **1850 ± 140**
A.D. 100

Whole shells and fragments of *Mytilus edulis* at 24 ft alt. Date based on one 3-day count.

General Comment (W.B., Jr.): the changing fauna and increasing coarseness of sediments upward in section indicate imminent approach of shoreline, and eveness of surface of delta suggests that little erosion has occurred since emergence. Thus *Mytilus* and accompanying fragile *Macoma balthica* in living position are believed to have lived when beds now at 29 ft alt were at or close to sealevel. If so, uppermost sediments were being deposited ca. 2000 yr ago,

and, if constant sealevel is assumed, uplift since then has *averaged* 1.5 ft per century (Blake, 1963).

Melville Sound series

Plant debris, pelecypod shells, and peat coll. in and on top of silty and sandy, gently dipping deltaic beds in unnamed bay on S side of Melville Sound, Northwest Territories (68° 11.5′ N Lat, 106° 17′ W Long). Uppermost sand beds in delta are at alt 29 ft. Coll. 1962 by W. Blake, Jr.

GSC-152. Melville Sound, plant debris **3070 ± 140**
1120 B.C.

Twigs, leaves, and moss fragments from bed at ca. 24 ft alt deformed by growth of an ice wedge. Sample pretreatment included *cold* NaOH-leach. Sample mixed with dead gas for counting.

GSC-158. Melville Sound, shells **2510 ± 180**
560 B.C.

Whole shells and fragments of the pelecypods *Macoma balthica, Macoma calcarea*, and *Mya truncata* at 26 to 28 ft alt. Sample mixed with dead gas for counting.

GSC-172. Melville Sound, peat **400 ± 140**
A.D. 1550

Peat at 28 ft on top of ice wedge and at base of peat layer 2 to 3 ft thick that mantles surface of deltaic beds. Date based on single 3-day count.
General Comment (W.B., Jr.): dates on the organic debris and shells are similar to those obtained from Gordon Bay; possible reasons for the slight age differences appear elsewhere (Blake, 1963). Perhaps uplift during last 2500 yr has been slightly slower at Melville Sound, about 100 mi N of Gordon Bay. Age of surface peat, which has accumulated since the delta emerged from the sea, gives no information as to time of passage of shoreline. Shell date indicates that the ice wedge started to develop within last 2500 yr, but because the surface peat mantles the ice wedge as well as the deltaic beds, significant growth of the wedge ceased 400 yr ago, or earlier.

GSC-136. Lang River, Somerset Island **9180 ± 170**
7230 B.C.

Marine pelecypod shells (*Hiatella arctica* and *Mya truncata*) from surface of delta, alt 418 ft, 3 mi W of mouth of unnamed river 6 mi S of Lang River, E side Somerset Island, Northwest Territories (72° 11′ 30″ N Lat, 94° 05′ W Long). Site probably ca. 100 ft below marine limit. Coll. 1962 by B. G. Craig. *Comment*: date is minimum for retreat of Laurentide ice from area (see also Craig, in press, and L571 A, B, Lamont VII).

GSC-150. Cunningham River, Somerset Island **9180 ± 170**
7230 B.C.

Marine pelecypod shells (*Hiatella arctica*), 7 mi inland from mouth of Cunningham River, Somerset Island, Northwest Territories (73° 59′ N Lat, 93° 40′ W Long), from eroded surface of marine silt at alt 204 ft, at least 200 ft below marine limit. Shells abundant; many occur paired in living position. Coll. 1962 by B. G. Craig. *Comment*: date is minimum for retreat of ice from N Somerset Island (Craig, in press).

Cape Alexander series, Boothia Peninsula

Plant detritus and marine shells from bank of stream ca. 2 mi inland from small bay E of Cape Alexander, W side of Boothia Peninsula, Northwest Territories (70° 22′ N Lat, 96° 19′ W Long). The bank, cut below a terrace at alt 72 ft, exposes alternating layers of plant detritus and sand containing marine pelecypod shells. Coll. 1962 by B. G. Craig.

GSC-144. Cape Alexander, shells **6010 ± 160**
4060 B.C.

Shells of *Astarte borealis* coll. 4 ft below ground level. Date based on one 3-day count.

GSC-145. Cape Alexander, plant detritus **2120 ± 180**
170 B.C.

Twigs, leaves, and other plant fragments from layer immediately above GSC-144. Sample pretreatment included *cold* NaOH-leach. Sample mixed with dead gas for counting.

General Comment (B.G.C.): the two samples appeared to represent an estuarine-deltaic environment when seashore stood ca. 75 ft above its present level. In view of other shell dates from the region (particularly Northern Keewatin series, GSC I) and disparity in age of the two samples, it is apparent that shells in this deposit have been redeposited from a higher site. Consequently, the strata may be alluvial rather than deltaic, and the 2120-yr plant material may have been deposited when shoreline was between sample site (alt 72 ft) and present shore.

GSC-146. Makinson Inlet (S arm), Ellesmere Island **8200 ± 220**
6250 B.C.

Marine pelecypod shell fragments from surface of raised beach at head of S arm of Makinson Inlet, Ellesmere Island, Northwest Territories (77° 10′ N Lat, 81° 50′ W Long), at ca. 240 ft, ca. 100 ft below the marine limit. Coll. 1960 by R. L. Christie. *Comment* (J.G.F.): shells probably originated closely following general deglaciation, at a time when sea penetrated to site from Baffin Bay through lower reaches of Makinson Inlet, a region largely glacier-covered today. Outer and inner fractions of sample were dated separately, after removal of outermost 12% of shells:

outer fraction (13-70% leach) 7620 ± 210
inner fraction (71-100% leach) 8200 ± 220

The discrepancy between the two dates is ascribed to contamination of the outer fraction. Each date is based on a single count.

GSC-140. Makinson Inlet (N arm), Ellesmere Island **>36,400**

Peat from upper part of valley wall 5 mi E of head of N arm of Makinson Inlet, Ellesmere Island, Northwest Territories (77° 40′ N Lat, 81° 40′ W Long), from base of 4-ft bed of sandy moss peat exposed in a landslide scar that cuts a meltwater channel. Peat, overlain by boulders in channel bottom and underlain by bouldery gravel on sandstone and shale, probably accumulated on floor of channel. However, the 'old' date reinforces alternative possibility that peat and gravel beneath it comprise remnant of high-terrace deposits

(interglacial or preglacial) across which channel was eroded. Coll. 1961 by J. G. Fyles.

GSC-118. Augusta Bay, Ellesmere Island **6370 ± 100**
4420 B.C.

Marine shells (*Mya truncata, Hiatella arctica*) from silt underlying 15 ft of sand beneath a beach terrace near S shore of Augusta Bay, Bay Fiord, Ellesmere Island, Northwest Territories (78° 51′ N Lat, 81° 48′ W Long). Site, at alt 120 ft, is on seaward face of moraine marking a stand of the terminus of former outlet glacier. An associated ice-contact delta at alt 250 ft is believed to mark the sealevel when the glacier margin stood at the moraine. Coll. 1961 by J. G. Fyles. *Comment*: date is minimum for ice retreat from the moraine, which now lies 10 mi W of the ice cap (see also GSC-170, 175, this list).

GSC-170. Strathcona Fiord (shells), Ellesmere Island **7750 ± 160**
5800 B.C.

Shells of *Mya truncata* a few hundred ft S of Strathcona Fiord opposite mouth of N arm of Fiord, Ellesmere Island, Northwest Territories (78° 42′ N Lat, 82° 51′ W Long). Sample is from a shell-rich zone including paired valves at the top of massive silt beneath 5 ft of beach gravel at alt 245 ft. Site is on seaward face of a valley-side ice-contact deltaic terrace (alt 335 ft) that probably marks sealevel when the glacier terminus in the fiord stood close to this locality. Coll. 1961 by J. G. Fyles. *Comment*: date is minimum for glacial retreat from this part of the fiord valley some 20 mi W of the present ice cap.

GSC-175. Strathcona Fiord (peat), Ellesmere Island **7680 ± 150**
5730 B.C.

Moss peat from base of sandy peat at depth 9 ft in bottom of a small upland gully, alt 1300 ft, at top of valley wall 1 mi SW of the head of Strathcona Fiord, Ellesmere Island, Northwest Territories (78° 33′ N Lat, 82° 20′ W Long). Peat is underlain by till and covered by 1 to 2 ft of colluvium. Coll. 1961 by J. G. Fyles. *Comment*: date is minimum for time since deglaciation of the upland 10 mi W of present ice cap. Compare with dates for early postglacial marine shells from nearby valleys (GSC-118 and 170, this list). Sample held at slightly less than normal pressure during one count; mixed with dead gas during other count.

GSC-129. Borup Fiord, Ellesmere Island **3720 ± 140**
1770 B.C.

Willow wood and moss from deformed alluvium beneath glacier snout at head of Oobloyah Bay, Borup Fiord, Ellesmere Island, Northwest Territories (80° 50′ N Lat, 83° 06′ W Long), from lower part of 80-ft section of sand, silt, and gravel, covered by 10 to 30 ft of coarse gravel and underlain by marine clay. These deposits, tilted and faulted, now stand at alt 50 to 150 ft at E side of glacier terminus and are exposed by gully of ice-margin stream. They comprise an up-thrust part of the modern outwash plain graded to present sealevel. Coll. 1961 by J. G. Fyles. *Comment*: glacier has recently encroached on ground that has been ice-free for more than 3700 yr (compare with GSC-105, GSC II, related to a glacier 9 mi E).

D. Northern Canada, Old Marine Shells

Marine pelecypod shells on or in surface deposits at various localities within the Arctic Archipelago have yielded 'old' C^{14} dates. Some of the 'old' samples comprise thick fragments and rare thick whole shells collected above the postglacial marine limit, from sites that lack deposits or landforms suggesting marine inundation: these shells probably were glacially transported from lower positions (see GSC-111, 135, below; GSC-51, GSC I). Other 'old' shell samples come from sites below or approx. at upper limit of marine submergence and, prior to dating, gave no indication of being other than postglacial (GSC-134, 139, 149, and 154, below). Some may be glacial erratics but some may have come directly from unrecognized remnants of interglacial marine deposits or may have been reworked from such deposits by the postglacial sea or by rivers. Stratigraphically distinct interglacial marine deposits so far are known only on N. Axel Heiberg Island and adjacent parts of Ellesmere Island (see GSC-113, below; GSC-65, GSC II).

GSC-111. Hare Cape Ridge, Ellesmere Island **36,300 ± 2000**
34,350 B.C.

Thick, worn fragments and rare whole shells of *Hiatella arctica*, *Mya truncata*, and *Astarte* sp. from upland extending W from the summit of Hare Cape Ridge, Ellesmere Island, Northwest Territories (79° 55′ N Lat, 86° 22′ W Long); coll. at alt ca. 2050 ft from several acres of ground surface in an area of sandstone and shale rubble and disintegrated outcrop strewn with erratic stones. Emerged beaches and marine sediments have been recognized only below alt 500 ft. The shells at this high locality and at others nearby above 500 ft probably were transported by glacier ice. Outer and inner fractions of sample were dated separately after removal of outermost 10% of the shells:

outer fraction (11-50% leach) 30,300 ± 1600
inner fraction (51-100% leach) 36,300 ± 2000

Coll. 1961 by J. G. Fyles. *Comment*: sample site is at approx. same locality as L-548 (Lamont VII; Sim, 1961) dated as 19,500 ± 1100. GSC-51 (28,700 ± 600) is from a similar site at 630 ft 8 mi SW (see GSC I). The differences in age between GSC-111 and L-548 as well as between the two fractions of GSC-111 are assumed to result from varying degrees of contamination with young C. Thus all the dates are probably minimal.

GSC-134. Swinnerton Peninsula, Ellesmere Island **29,800 ± 220**
27,850 B.C.

Shells and fragments of *Hiatella arctica*, *Mya truncata*, and rare *Astarte* from alt 280 to 300 ft on S side of Swinnerton Peninsula, Ellesmere Island, Northwest Territories (77° 20′ N Lat, 81° 40′ W Long); from sandy ground surface approx. at upper limit of emerged marine beaches and at highest occurrence of shells in any quantity (isolated shell fragments were found up to 350 ft). Coll. 1961 by J. G. Fyles. *Comment*: shells were expected to be early postglacial (see GSC-146, 8200 ± 220, this list, from a nearby site), but apparently belong to an earlier marine episode, probably prior to last glaciation. It is not known whether shells have been redeposited. Dates were determined

for two preparations:

standard preparation (11-100% leach fraction)	29,430 ± 680
inner preparation (63-100% leach fraction, date based on one 3-day count)	29,800 ± 220

Similarity of the two dates suggests absence of major contamination. Hence, they may indicate the approx. absolute age rather than a minimum (contrast with GSC-111 above).

GSC-113. Rens Fiord, Axel Heiberg Island **36,800 $^{+4200}_{-2800}$ 34,850 B.C.**

Marine shells (*Astarte* sp.) from alt 350 to 370 ft, 3 mi SE of Rens Fiord, N Axel Heiberg Island, Northwest Territories (81° 03′ N Lat, 93° 10′ W Long). Shells from ground surface on upper part of bank of small river, and derived from stratified silt, sand, and gravel beneath boulder-strewn, apparently glacial deposits. Site is ca. 200 ft above inferred postglacial marine limit. Coll. 1961 by J. G. Fyles. *Comment*: date agrees with the inference that the deposits are interglacial. The occurrence is similar to GSC-65 (GSC II) coll. 35 mi. E on Ellesmere Island. Sample mixed with dead gas for counting; date probably is minimal.

GSC-139. Rens Plain, Axel Heiberg Island **36,600 $^{+3700}_{-2200}$ 34,650 B.C.**

Marine shells (*Hiatella arctica*) from bank of stream eroded through sandy plain at alt 140 ft on N Axel Heiberg Island, 5 mi W of Nansen Sound, Northwest Territories (81° 05′ N Lat, 92° 25′ W Long). Sample from 20 ft of sand covered by wash of pebbles and underlain by silt. Coll. 1961 by J. G. Fyles. *Comment*: site lies below marine limit (ca. 170 to 200 ft) and shells were expected to date from the postglacial submergence ca. 8000 yr ago. However they must belong to an earlier, possibly interglacial marine interval (see GSC-113, above; GSC-65, GSC II). It is not known whether the inclosing sands were deposited during the same interval or whether they are younger materials containing reworked shells. The freshness and abundance of the shells indicate a nearby primary source. Date is probably minimal.

GSC-149. NW Ellesmere Island **37,200 $^{+4100}_{-2700}$ 35,350 B.C.**

Marine shells (*Hiatella arctica*) from wall of a gully at alt 150 ft, 1 mi inland from Nansen Sound 4 mi S of White Point, Ellesmere Island (81° 10′ N Lat, 90° 15′ W Long). Marine limit is at ca. 230 ft. Shells are abundant, in silt beneath beach gravel and overlying poorly sorted gravel or till. Coll. 1961 by J. G. Fyles. *Comment*: for GSC-139, above, applies to this sample.

GSC-154. Nelson Griffiths Point, Melville Island **34,050 $^{+2650}_{-1990}$ 32,100 B.C.**

Marine shell fragments (incl. *Hiatella arctica*) from surface at Nelson Griffiths Point, Melville Island, Northwest Territories (75° 05′ N Lat, 106° 00′

W Long), at alt 198 ft on highest emerged beach recognized in the vicinity. Coll. 1962 by W. E. S. Henoch, Geog. Branch, Dept. of Mines and Tech. Surveys, Ottawa. *Comment*: shells were expected to be early postglacial but evidently belong to an earlier marine episode, probably prior to the last glaciation. It is not known whether shells have been redeposited. Date is probably minimal.

GSC-123. Fury Beach, Somerset Island **31,860 $^{+2560}_{-1940}$**
29,910 B.C.

Marine pelecypod shell fragments (*Hiatella* sp.) from ground surface 12 mi NW of Fury Beach, Somerset Island, Northwest Territories (72° 45′ N Lat, 92° 25′ W Long), in stony marine clay or till at base of end moraine, alt ca. 744 ft, ca. 250 ft above marine limit. Coll. 1962 by B. G. Craig. *Comment* (B.G.C.): shells antedate last glaciation and were deposited here by glacier ice. Date based on one 3-day count and possibly is minimum.

GSC-135. Port Logan, Boothia Peninsula **>23,300**

Marine pelecypod shells and fragments (*Yoldia arctica, Clinocardium ciliatum, Astarte* sp., and *Hiatella arctica*) from cross-bedded sand 16 mi W of Port Logan, E side of Boothia Peninsula, Northwest Territories (71° 20′ N Lat, 93° 52′ W Long); alt ca. 640 ft, possibly ca. 100 ft above marine limit. Coll. 1962 by B. G. Craig. *Comment* (B.G.C.): sample was small and mixed with dead gas for counting; date is minimum. Shells antedate last glaciation, and may be indigenous or redeposited.

II. ARCHAEOLOGIC SAMPLES

GSC-143. Bennett site, Ontario **690 ± 130**
A.D. 1260

Charcoal from Bennett site, Ontario, in Lot 14, Concession 1, Nelson Tp., Halton Co. (43° 25′ N Lat, 79° 57′ W Long), in Pot Concentration 3 under pottery fragments and 4 to 9 in. below the plough zone. Coll. 1962 by J. V. Wright, Nat. Mus. of Canada, Ottawa. *Comment* (J.V.W.): site is assigned to the late Pickering branch of the Ontario Iroquois Tradition and was occupied just prior to the Uren site. C^{14} date is in excellent agreement with the seriational estimate of 1250 A.D.

GSC-162. Morrison's Island, Quebec **4700 ± 150**
2750 B.C.

Charcoal from Morrison's Island 6-site, Pontiac Co., Quebec (45° 48.5′ N Lat, 77° 02′ W Long), ca. 3 mi down Ottawa River from Pembroke, Ontario. Sample from squares T14X and T14Y of Burial 17 at alt 426 ft; maximum depth of burial 28 in. Coll. 1963 by C. C. Kennedy; subm. by J. V. Wright. *Comment* (J.V.W.): date is slightly older than was expected for this site with its Brewerton Focus (Laurentian Archaic) lithic complex and abundance of native copper artifacts.

GSC-148. McCormick Inlet, Melville Island **1150 ± 160**
A.D. 800

Charred moss from prehistoric dwelling 6 ft above high tide on shore of

McCormick Inlet, Melville Island, Northwest Terirtories (75° 49′ N Lat, 112° 07′ W Long). The moss, mixed with fragments of charred wood and bone, occurred on upper surface of a hearthstone and gave impression of having been placed there as fuel. Coll. 1962 by W. E. S. Henoch, Geog. Branch, Ottawa; subm. by W. E. Taylor, Nat. Mus. of Canada. *Comment* (W.E.T.): date indicates occupation of site less than 1150 yr ago. Dead moss beneath hearth has date of 1740 ± 190, I-840 (Isotopes IV). The few artifacts recovered represent a Dorset Culture occupation and constitute the northwesternmost occurrence of this culture discovered so far. Sample mixed with dead gas for counting; date based on a single 3-day count.

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