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W. BLAKE, Jr.

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Energy, Mines and Resources Canada
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CONTENTS

The present date list, GSC XIV, is the third 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 GSC VII to XI (1968 to 1971) were reprinted with the same pagination.



Tables

# GEOLOGICAL SURVEY OF CANADA RADIOCARBON DATES XIV


## *ABSTRACT*

*Twenty-five radiocarbon age determinations on archeological samples made by the Radiocarbon Dating Laboratory are reported. They are on samples from various areas as follows: Quebec (2); Ontario (5); Alberta (3); British Columbia (7); Yukon Territory (2); Northwest Territories - Mainland (1); Northwest territories - Arctic Archipelago (5). Details of background and standard for the 2-L and 5-L counters during the period from January to December 1973 are summarized in Tables 1 and 2. Table 3 gives statistics on the number of counts used to determine average background and standard counting rates; Table 4 provides data on the amount of sample required of various types of material; and Table 5 compares results obtained from all three counters on a single Douglas fir sample of known age.*

## *RESUME*

*Le rapport présente les résultats de 25 datations effectuées par le Laboratoire de datation au carbone 14 sur des échantillons archéologiques. Ces échantillons proviennent de différentes régions: Québec (2); Ontario (5); Alberta (3); Colombie-Britannique (7); Yukon (2); Territories du Nord-Ouest - continent (1); Territoires du Nord-Ouest - archipel Arctique (5). Les renseignements du bruit de fond et de l'étalonnage des détecteurs 2-L et 5-L pour la période de janvier à décembre 1973 sont résumés aux tableaux 1 et 2. Le tableau 3 donne les statistiques du nombre d'impulsions utilisés pour déterminer la moyenne des taux d'impulsions du bruit de fond et de l'étalonnage; le tableau 4 fournit des données sur le volume de matière requise des divers types de matériaux; et, le tableau 5 compare les résultats obtenus par les trois détecteurs pour le même échantillon de sapin de Douglas d'âge connu.*


## Introduction*

During the 12-month period from January to December 1973, the 2-L counter (Dyck and Fyles, 1962) was operated for approximately 11 months and the 5-L counter (Dyck *et al.*, 1965) for approximately 10 months. The 1-L counter (Lowdon *et al.*, 1971) was not operated during this period. The 2-L counter was routinely operated at 2 atm and the 5-L counter at 1 atm, except for the period July 17 to August 30 when the latter was operated at high pressure (4 atm).

Problems were once again encountered (Lowdon and Blake, 1973, Lowdon *et al.*, 1972) with the counting equipment, and again were directly related to a breakdown in the air-conditioning unit in the counting laboratory. One week's counting time for both counters was lost in June. However, the most serious problem occurred on September 1 when, due to a complete breakdown in the air-conditioning unit, the humidity in the counting laboratory rose to 100%. The electronic components became saturated. Inside the castle (Dyck, 1967), the moisture reacted with the flux used for soldering, formed acid, and reacted with the soldered connections in the guard tubes. The result was that all 22 guard tubes had to be removed from the castle, cleaned, and reassembled using non-acid flux solder. At the same time, two of the guard tubes ceased to function and replacements had to be ordered. Twenty-two days elapsed until optimum counting conditions were again achieved. However, after this down period was over, it was discovered that the 5-L counter had developed a leak and it took 28 additional days before this leak was identified and repaired. The installation of a new air-conditioning unit in the spring of 1974 hopefully has solved the problem.

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

Table 3 lists the statistics on the number of daily counts used to determine the average background and


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*Prepared by the first author, who operates the laboratory. The date list has been compiled by the second and third authors. All persons referred to as collectors or submitters of samples or cited as sources of data are, unless otherwise specified, with the Archeological Survey of Canada, National Museum of Man, Ottawa.

TABLE 1

Background (c/m) for Periods Used,
January 1, 1973 to January 4, 1974

| Period | 2-L Counter (2 atm) | 5-L Counter (1 atm) |
|---|---|---|
| January 2-30, 1973 | 0.978 ± .048 | 2.110 ± .028 |
| January 31 - February 28 | 0.966 ± .033 | 2.173 ± .027 |
| March 1 - April 5 | 0.964 ± .032 | 2.082 ± .026 |
| April 6 - May 2 | 0.929 ± .017 | 2.014 ± .025 |
| May 3 - June 8 | 0.898 ± .020 | 2.013 ± .020 |
| June 13 - July 16 | 0.946 ± .024 | 1.990 ± .023 |
| July 17 - August 30 | 0.913 ± .014 | 2.507 ± .036* |
| September 20 - November 1 | 1.069 ± .016 | - - |
| October 19 - November 21 | - - | 2.074 ± .021 |
| November 2 - December 4 | 1.085 ± .017 | - - |
| November 22 - December 18 | - - | 2.007 ± .029 |
| December 5 - January 4, 1974 | 1.098 ± .021 | - - |

*5-L counter operating at 4 atm

standard counting rates used for age calculations for the periods listed. During the period that the 5-L counter was operated at high pressure (4 atm), one background count was omitted for statistical reasons. The same background and standard $CO_2$ gas preparations were used for all high pressure determinations. During the periods November 2 - December 4 and December 5 - January 4 for the 2-L counter, one and two background were omitted, respectively. No oxalic acid counts had to be omitted for either counter. The number of different background preparations used during the entire period was 13 for the 2-L counter, and 15 for the 5-L counter. With respect to the oxalic acid preparations, four different ones were used for both counters.

Since January 1972, age calculations have been carried out monthly by a C.D.C. 6400 computer. This has replaced the C.D.C. 3100 used previously. Calculations are based on a $C^{14}$ half-life of 5568 ± 30 yrs. and 0.95 of the activity of the NBS oxalic acid standard. Ages are quoted in radiocarbon years before present (B.P.) where "present" is taken to be 1950.

In all previous date lists, age errors reported included: the counting errors of sample, background and standard; the error in the half-life of $C^{14}$; and an error term to account for the average variation of ± 1.5% in the $C^{14}$ concentration of the atmosphere during the past 1100 years. This last error term had been incorporated into the error calculation mainly as a result of the work done on Douglas Fir (*Pseudotsuga menziesii*) tree rings (Dyck, 1965, 1966, 1967) and sequoia (*Sequoia gigantea*) tree rings (Willis *et al.*, 1960). However, more recent work on bristlecone pine (*Pinus aristata*), mainly by the University of Arizona but also by the University of Pennsylvania and other laboratories, has shown that the concentration of $C^{14}$ in the atmosphere has varied by as much as 15% over the past few thousand years. Sufficient data are now available to provide a conversion table from radiocarbon years to tree ring (calendar) years for the last 7500 years, if the user so desires (Olsson, 1970; Damon *et al.*, 1972). This data takes into account the variations in the $C^{14}$ concentration in the atmosphere. For this reason, it was decided to omit the correction for fluctuations in the concentration of atmospheric $C^{14}$ from GSC radiocarbon dates, starting in January 1973. The omission of this error term in no way affects the date produced, but it does reduce the error assigned to a date. In this date list, the error assigned to dates on samples with GSC numbers greater than 1828 does not include the error term discussed above.

Unless otherwise stated in the sample descriptions, all ages are based on two 1-day counts. Finite dates are based on the 2σ criterion (95.5% probability) and "infinite" dates on the 4σ criterion (99.9% probability).

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

Where $C^{13}/C^{12}$ ratios are available, a correction for isotopic fractionation has been applied to the date and the $\delta C^{13}$ value reported. Related to the PDB standard, the "normal" values used for correction are $\delta C^{13} = -25.0‰$ for wood, other terrestrial organic materials, and bones (terrestrial and marine), and 0.0‰ for marine shells. The $C^{13}/C^{12}$ ratios were determined by the GSC Geochronology Section (Head, R.K. Wanless) on aliquots of the same sample gas used for age determination.

As previously reported (Lowdon *et al.*, 1970), archeologic samples, particularly charcoal, often pose more of a problem to the laboratory than any other type of material supplied for dating. Charcoal samples are commonly small and require mixing with "dead gas" for counting purposes. Mixing reduces the accuracy of results and increases the archeologist's problems in correctly interpreting dates. Also, many charcoal samples are contaiminated by modern rootlets.

The submitter of a sample should supply material that is free from visible contamination, and should also supply a sample that is large enough to allow for duplicate analyses. Table 4 shows the minimum amount of sample required to produce sufficient $CO_2$ gas to fill the 2-L counter to 2 atm without the necessity of mixing with dead gas. At least 3 times the minimum amount is desirable.

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

TABLE 2

Standard, $N_O$,* (c/m) for Periods Used,
January 1, 1973 to January 4, 1974

| Period | 2-L Counter (2 atm) | 5-L Counter (1 atm) |
|---|---|---|
| January 2-30, 1973 | 18.313 ± .106 | 28.365 ± .140 |
| January 31 - February 28 | 18.368 ± .159 | 28.376 ± .122 |
| March 1 - April 5 | 18.174 ± .175 | 28.393 ± .236 |
| April 6 - May 2 | 18.173 ± .093 | 28.387 ± .118 |
| May 3 - June 8 | 18.198 ± .092 | 28.207 ± .115 |
| June 13 - July 16 | 18.209 ± .129 | 28.258 ± .114 |
| July 17 - August 30 | 18.357 ± .077 | 109.486 ± .192** |
| September 20 - November 1 | 18.438 ± .107 | - - |
| October 19 - November 21 | - - | 28.264 ± .131 |
| November 2 - December 4 | 18.689 ± .099 | - - |
| November 22 - December 18 | - - | 28.448 ± .206 |
| December 5 - January 4, 1974 | 18.651 ± .112 | - - |

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

**5-L counter operating at 4 atm

TABLE 3

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

| Period | 2-L Background | 5-L Background | 2-L Standard | 5-L Standard |
|---|---|---|---|---|
| January 2 - January 30, 1973 | 4 | 4 | 3 | 3 |
| January 31 - February 28 | 4 | 4 | 3 | 3 |
| March 1 - April 5 | 4 | 5 | 3 | 3 |
| April 6 - May 2 | 4 | 4 | 3 | 3 |
| May 3 - June 8 | 4 | 5 | 3 | 3 |
| June 13 - July 16 | 4 | 4 | 3 | 3 |
| July 17 - August 30 | 5 | 5* | 4 | 4* |
| September 30 - November 1 | 4 | - | 3 | - |
| October 19 - November 21 | - | 5 | - | 3 |
| November 2 - December 4 | 4 | - | 3 | - |
| November 22 - December 18 | - | 4 | - | 3 |
| December 5 - January 4, 1974 | 3 | - | 3 | - |

*5-L counter operating at 4 atm

1950). The agreement between the results obtained from different counters, and with the tree ring age, is most gratifying.


## Acknowledgments

Thanks are extended to I.M. Robertson and S.M. Chartrand for assistance in the preparation and measurement of samples in the laboratory; to K. Santowski for the $C^{13}$ determinations; to R.J. Mott and Mrs. L.D. Wilson for identification of wood and charcoal samples, and to Mrs. G. Mahony and Miss D.J. Lawrence for assistance in compilation. Dr. A.H. Clarke, Jr., National Museum of Natural Sciences, Ottawa, kindly identified the pelecypods in one sample.


TABLE 4

Required Sample Size

| Sample type | Minimum amount of dry sample (g) |
|---|---|
| Wood | 5-10 |
| Charcoal | 5-10 |
| Peat | 10-25 |
| Gyttja | 10-25 |
| Shell | 30 |
| Bone | 500-1000 |

TABLE 5

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

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

## ARCHEOLOGICAL SAMPLES

### Eastern Canada

#### Quebec

GSC-2054. Hynes site — 2870 ± 50 / 920 B.C.

Charcoal (10 g) from Hynes site (BlGf-2) at east end of Ile-aux-Allumettes, Pontiac Co., Quebec (45°53.5'N, 76°56.2'W). Sample is from hearth in squares T5B and T6B at depths ranging from 30 to 45 cm. Relatively small site, 1.8 m above level of Ottawa River, should assist in study aimed at determining "phases" for Initial Woodland in Ottawa Valley. Coll. 1957 by C.C. Kennedy, Ottawa.

Comment (C.C.K.): this date is 430 years earlier than the earliest of previously published dates for Initial Woodland sites in the Ottawa River drainage basin: the Constance Bay site, 490 B.C. (2440 ± 75 yrs.; S-578; Watson, 1972). Changed river flow since construction of dams probably caused extensive erosion at this site, as is the case with other Initial Woodland sites in the Ottawa Valley.

Comment (W.B., Jr.): clean sample with most pieces < 1 cm in diameter. No rootlets seen. Date based on one 3-day count in 5-L counter.

GSC-2065. Morrison's Island-2 site — 130 ± 160 / 1820 A.D.

Charcoal (6.1 g) from Morrison's Island-2 site (BkGg-10), 4.8 km east of Pembroke, Ontario, in Pontiac Co., Quebec (45°48.7N, 77°01.9'W). Sample is from hearth in squares T1-EE and T2-EE at depths ranging from 15 to 23 cm. Small Initial (Middle) Woodland site is ca. 4.6 m above Lower Allumette Lake. Site may be significant due to destruction of many contemporary sites by changes in river flows and hydroelectric development. There are few dates for Initial Woodland sites in eastern Ontario, western Quebec, and northern New York. Coll. 1959 and subm. 1974 by C.C. Kennedy, Ottawa.

Comment (C.C.K.): the charcoal sample clearly was not contemporaneous with the Initial Woodland pottery. Low-elevation, river-sand deposits in the Ottawa Valley have been camped on by various peoples from very late Archaic (ca. 3000 B.P.) to recent times, and the chances for contamination have been considerable.

Comment (W.B., Jr.): clean charcoal sample, mostly chunks 0.5 to 2 cm long. No rootlets seen. Sample mixed with dead gas for counting. Date based on two 1-day counts in 5-L counter.

#### Ontario

GSC-2061. Marshall's Bay-1 site — 1750 ± 60 / 200 A.D.

Charcoal (9.35 g) from Marshall's Bay-1 site (BiGb-1), Lac des Chats, Ottawa River, 3.2 km east of Arnprior, Ontario (45°26'N, 76°18'W). Sample is from hearth in square T5J at depths ranging from 30 to 53 cm. Site is ca. 1.7 m above level of Lac des Chats. Relatively large Initial Woodland site with good-sized sample of pottery and lithics. Estimated age 2000 years. Coll. 1973 and subm. by C.C. Kennedy, Ottawa.

Comment (C.C.K.): this appears to be an acceptable date for a late phase of the Initial Woodland represented at the site. With the charcoal were rocker-stamped sherds and a pseudo scallop shell rim sherd.

Comment (W.B., Jr.): clean sample of charcoal and charred wood; most pieces coated by rusty silt, but no rootlets seen. Individual pieces are up to 2 cm long. Pretreatment included 5 minute cold NaOH-leach. Date based on one 2-day count in 5-L counter.

GSC-1660. Whitson Lake site — 1550 ± 190 / 400 A.D.

Wood charcoal (1.7 g) from site B1Gk-19 in dry sand on slope at western end of Whitson Lake, Petawawa River, Ontario (45°59'26"N, 77°42'25"W), at altitude ca. 161 m, 6 m above present water level. Charcoal pieces (mostly < 0.5 cm in diameter) from 28 to 33 cm below surface of Sq. W2A-Q111, in sand; associated with quartz chips and scraper at 27-cm depth. Coll. 1971 by B.M. Mitchell, Deep River, Ontario.

Comment (B.M.M.): this site was considered Archaic, because it yielded a Brewerton side-notched point, produced no ceramics whatever, and generally exhibited an artifact recovery depth exceeding local Initial Woodland sites. A date of A.D. 400 is thus considered late. Additional age estimates will be made when more artifacts are recovered. Site was mistakenly referred to as B1Gk-17 in Hurley *et al.*, 1972).

Comment (W.B., Jr.): a few tiny rootlets were removed from the sample. NaOH-leach omitted due to small sample size. Date based on two 1-day counts in the 1-L counter.

GSC-1863. Buck Lake No. 2, site BiGu-2 — 4080 ± 60 / 2130 B.C. / $\delta C^{13} = -23.9‰$

Charcoal (7.1 g) from site BiGu-2 located on southeast side of Buck Lake, along a bank fronting onto a natural sand beach. Located within Ilfracombe Park, Stisted Twp., District of Muskoka, Ontario (45°25'13"N, 79°25'36"W), at altitude 305 m. Single large piece of wood charcoal (identified by R.J. Mott as gymnosperm wood; resin ducts indicate *Picea, Larix,* or *Pinus* type) derived from 0.6 to 1.2 m depth within cultural pit No. 1, which also contained a few chert flakes and a few potsherds. Site appears to represent a single component Laurel campsite and should date to within the first few centuries A.D, (Stothers and Stothers, 1973), Coll. 1971 by D.M. Stothers, now of University of Toledo, Toledo, Ohio, for Historical Sites Branch, Ontario Ministry of Natural Resources, Toronto, Ontario.

Comment (D.M.S.): the radiocarbon date indicates an Archaic temporal provenience for which cultural material is totally lacking. A possible explanation is the use of driftwood for fuel; i.e., driftwood representing material which had, for about two millenia, been buried in lake sediments under water. Pretreatment included 10 minute cold NaOH-leach. Date based on two 1-day counts in 5-L counter.

GSC-1962. Selkirk No. 2, site AeGx-2 — 100 ± 60 / 1850 A.D.

Charcoal (ca. 10 g) from site AeGx-2 located along north shore of Lake Erie, west of the mouth of Grand River, on lakeshore edge of Selkirk Provincial Park, just east of mouth of Spring Creek, Ontario (42°48'01"N, 79°57'05"W), at altitude 175 m. Sample consists of small pieces (mostly < 1 cm in diameter) of wood charcoal derived from Pit No. 1, Stratum III, at a depth of 0.75 to 0.9 m (Stothers, 1972). Coll. 1972 by D.M. Stothers for Historical Sites Branch, Ontario Ministry of Natural Resources. Sample should date the earliest phase of the Princess Point Complex in the Grand River region, which should date to about 600 to 700 A.D.

Comment (D.M.S.): the essentially modern date is unacceptable and probably can be accounted for through disturbed state of stratigraphy (due to lake water action) and slumping of bank due to undermining.

Comment (W.B. Jr.): all visible rootlets removed by M. Lanoix. Date based on one 1-day count in 5-L counter.

GSC-1917. Porteous, site AgHb-1, House No. 5/Pit 46 — 900 ± 70 / 1050 A.D.

Charcoal (12.0 g) from site located southeast of Brantford, between Mohawk Lake and Grand River Oxbow, on sandy loam hill ca. 0.4 km from, and overlooking, the Grand River, Brantford Twp., Brant Co., Ontario (43°07'45"N, 80°12'54"W), at altitude 198 m. A small, one quarter acre, pallisaded argicultural village, with incipient longhouses inside pallisades and five discrete garbage middens outside the pallisades. Sample consisted of small pieces (mostly < 2 cm in diameter) of wood charcoal derived from 46 cm depth in cultural pit, which underlay one edge of the main hearth, within House No. 5 (field designation H2). Pit also contained abundant ceramic, lithic, faunal, and charred cultigen material representing the latest phase of the Princess Point Complex (Stothers and Stothers, 1973; Stothers, 1974), which is transitional to early Glen Meyer. Coll. 1971 by D.M. Stothers for Historical Sites Branch, Ontario Ministry of Natural Resources.

Comment (D.M.S.): date is very acceptable, as village is believed to date from 800 to 900 A.D. Other dates received from this site are A.D. 750 $^{+100}_{-90}$ (CWRU-126) from Midden A, square B2 (Stothers, 1974); A.D. 820 ± 100 (I-4972) (Noble and Kenyon, 1972) from House 3, pit 2; A.D. 580 ± 90 (I-5820) (Noble and Kenyon, 1972) from House 4, pit 19; and A.D. 480 $^{+90}_{-100}$ (CWRU-124; Stothers, 1974) from House 5, pit 12. Date based on two 1-day counts in 5-L counter.

## Western Canada

### Alberta

GSC-1744. Windle, site EfPs-1 — 2530 ± 140 / 580 B.C. / $\delta C^{13} = -19.0‰$

Bison bone from Windle site (EfPs-1) on west bank of Kananaskis River about 0.5 km downstream from confluence of Ribbon Creek, in southwest corner one quarter of sec. 12, tp. 23, rge. 9, W. 5th mer., Alberta (50°56'30"N, 115°08'W), at altitude ca. 1525 m. Sample came from bank of Kananaskis River, ca. 3 m below surface and 50 cm above normal river level. It was in alluvial clay deposited by Kananaskis River along its flood plain. Bison bones are abundant at 2 or 3 levels for a distance of 10 m along the bank. The sample came from one of the lower levels. Coll. 1971 by M. Wilson, Calgary; subm. by A. MacS. Stalker, Geological Survey of Canada, Ottawa.

Comment (A.M-S.): site has not been excavated and cultural material has not been found there. However, some of the bones may have been broken during butchering. Date indicates Kananaskis River has not downcut during last 2500 yrs., and may even have raised its bed slightly in this region.

Comment (W.B., Jr.): single bone (404 g) sawed into pieces by R. Richardson. Dry when received; all adhering mud removed with a wire brush. Bone is thin-walled and brownish in colour; no rootlets or vegetation seen. Collagen fraction recovered after treatment with both HCl and NaOH (5 minute leach only). Sample mixed with dead gas for counting. Date based on two 1-day counts in 2-L counter.

GSC-1944. North Saskatchewan River, site FcQa-8 — 8030 ± 200 / 6080 B.C.

Charcoal (2.7 g) from site FcQa-8 on North Saskatchewan River, south of Nordegg, Alberta (4 km west of forestry road bridge) (52°24'N, 116°09'W), at altitude ca. 1220 m. Clean charcoal (largest pieces < 1.5 cm long) from hearth exposed in wall 2.8 m below surface within 3.5 m-thick exposure of eroding loess cap on 30 m high outwash terrace. Sample, collected in situ from old exposure with dry matrix and no roots, is from Ah horizon of buried soil 40 cm below lower volcanic ash, which is presumed to be Mazama or older. Ground surface is characterized by pine-buffalo grass associations. Coll. 1972 by B.O.K. Reeves University of Calgary, Calgary.

Comment (B.R.): provides date for early human occupation in the footshills section of the North Saskatchewan River valley, in accordance with estimate based on artifacts found at other sites nearby. Also provides date on period of soil formation and surface stability in loess deposition sequence (largely a result of wind transport of glacial silts off the North Saskatchewan River flood plain) in the area. Date indicates relatively rapid rate of deposition subsequent to this period of soil formation. Period of stability dates in Pinedale IV times (Reeves and Dormaar, 1972), perhaps reflecting decreased river flow and silt transport during time of maximum ice advance in headwaters. Sample mixed with dead gas for counting. Date based on three 1-day counts in 2-L counter.

GSC-1730. Brule Lake, site FiQ1-1 — 2870 ± 180 / 920 B.C.

Charcoal (3.7 g) from prehistoric hearth, site FiQ1-1, in roadcut on north side of Athabaska River near the outlet of Brule Lake, west of Entrance, Alberta (53°20'N, 117°45'W), at altitude ca. 993 m. Sample was from within section of eolian sand, 1.7 m below surface, 3 m above beach sands of Brule Lake and 5 m above the level of the lake itself (988 m). Hearth is on top of a layer of red, iron oxide-stained, eolian sand; the overlying sand is brown. Coll. 1970 by J. Elliott, University of Calgary, Calgary; subm. by B.O.K. Reeves, University of Calgary, Calgary, and N.W. Rutter, then with Geological Survey of Canada, Calgary (now with National Energy Board, Ottawa).

Comment (W.B., Jr.): as submitters suggested, date provides a minimum age for the underlying Brule Lake Beach, and it indicates a period of dune stability. Due to small sample size, NaOH-leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date based on two 1-day counts in 2-L counter.

British Columbia

GSC-1767. Yuquot village, site DjSp-1 — 3590 ± 190 / 1640 B.C.

Charcoal (1.35 g) from Yuquot village (site DjSp-1), Friendly Cove, Nootka Sound, British Columbia (49°36'N, 126°37'W). Yuquot rests on a large shell midden built on sand and gravel spit (Folan and Dewhirst, 1970). Sample (field number 1A36) collected from maximum depth of excavation (grid square 1A, level 36), 5.7 m above mean sea level and 5.4 m below crest of midden, in matrix of wet sand and pebbles. This matrix, containing waterworn artifacts and faunal remains, continues below the limits of excavation. Bulk of organic midden deposits lies 1.3 m above charcoal sample. Coll. 1966 for W.J. Folan, Carleton University, Ottawa and J.T. Dewhirst; subm. in series by Folan for dating by Gakushuin University, Tokyo, Japan in 1968 (GaK-2180, 3000 ± 100 yrs.); this result did not agree with age of two overlying samples (GaK-2179, 4080 ± 80 yrs., and GaK-2183, 4230 ± 90 yrs). Sample subm. by Dewhirst, then Carleton University, Ottawa, now National Historic Parks and Sites Branch, Indian and Northern Affairs Dept., Ottawa, to GSC for lab check in 1972.

Comment (J.T.D.): despite improved date on GSC cross-check, sample age is still too young as compared with age of overlying samples. This may be partly due to very small amount of sample left for check or to the unknown intrusive nature of the sample.

Comment (W.B., Jr.): only discrete lumps of charcoal (some > 1 cm in diameter) submitted to laboratory. Some were rounded at corners, suggesting possible transport or wear of some sort. NaOH-leach omitted due to small sample size. Sample mixed with dead gas for counting. Date based on one 2-day count in 2-L counter.

GSC-1828. North Calvert Island, site EjRa-10 — 3290 ± 210 / 1340 B.C. / $\delta C^{13} = +1.0‰$

Fragments of marine shells, *Saxidomus giganteus* (identified by A.H. Clarke, Jr., National Museum of Natural Sciences, Ottawa) from soil layer at base of cultural sequence, site EjRa-10, exposed in wave-cut section in coastal dunes (now inactive), North Calvert Island, British Columbia (51°40'N, 128°08'W), at altitude 0.2 m above present average high tide (5 m above tide at time of collection). Ca. 3.7 m of eolian sands and shell midden layers extend above the base of the section. Coll. 1971 and subm. by J.T. Andrews, University of Colorado, Boulder, Colorado.

Comment: (J.T.A.): sample submitted to date initial occupation of site and to provide upper limit on contemporaneous sea level. Date is similar to others from corings in coastal middens in the region which indicate sea level was possibly 2 m lower than present at the time the pelecypods were living (Retherford, 1972).

Comment (W.B., Jr.): *Mytilus californianus* (identified by A.H. Clarke, Jr.) and an unidentified gastropod were present in the sample, although only *Saxidomus giganteus* was used for dating. Shell fragments were very chalky and some had slight incrustations. Due to small sample size (7.0 g), only outer 10% of shell removed in HCl-leach. Sample mixed with dead gas for counting. Date based on two 1-day counts in 2-L counter.

Boardwalk site series

Charcoal samples from Boardwalk site (GbTo-31), northwest side of Elizabeth Point, Digby Island, Prince Rupert Harbour, British Columbia (54°17'20"N, 130°22'46"W), at altitude 0 to 7.6 m. Prehistoric winter village of Gispakloats tribe of Tsimshian. Shell midden containing ca. 310,000 $m^3$ of cultural material. Samples submitted for dating to determine length of occupation of front house platform. Coll. 1969 by G.F. MacDonald.

GSC-1673. Boardwalk site, $C^{14}$ sample No. 7 — 750 ± 130 / 1200 A.D.

Charcoal (NMC-480; 15.0 g) from 99 cm north of south wall, 155 cm east of west wall, and 79 cm depth below datum, in Pit E3. Matrix: burnt shell. Estimated age ca. 2000 yrs.

GSC-1683. Boardwalk site, $C^{14}$ sample No. 16 — 2190 ± 130 / 240 B.C.

Charcoal (NMC-481; 12.5 g) from N 35, E 45, feature 7f. Estimated age ca. 1000 yrs.

GSC-1677. Boardwalk site, $C^{14}$ sample No. 5 — 940 ± 140 / 1010 A.D.

Charcoal (NMC-482; 15.5 g) from S 61 cm, W140 cm, 141 cm depth below datum, in Pit E2. Matrix: dark brown soil and shell fragments. Estimated age ca. 2500 yrs.

GSC-1722. Boardwalk site, $C^{14}$ sample No. 4 — 760 ± 130 / 1190 A.D.

Charcoal (NMC-483; 11.5 g), 36 cm from north wall, 46 cm from west wall, 123 cm depth below datum. Matrix: brown soil and shell fragments near pocket of blue mussels.

GSC-1720. Boardwalk site, $C^{14}$ sample No. 6 — 1060 ± 130 / 890 A.D.

Charcoal (NMC-485; 15.0 g) from E 18 cm, S 76 cm, 152 to 173 cm depth below datum. Matrix: dark brown soil and shell fragments. Several pieces identified as coniferous wood by R.J. Mott, Geological Survey of Canada.

General Comment (G.F.M.): samples GSC-1673 (750 ± 130 yrs.), -1677 (940 ± 140 yrs.), -1720 (1060 ± 130 yrs.) and -1722 (760 ± 130 yrs.) are from an associated stratigraphic sequence, and relate to occupation floors 91 to 168 cm below the surface (MacDonald, 1959). A single sample has been dated which relates to the basal levels of this sequence; S-750 (3625 ± 105 yrs old) is 260 cm below the surface, and 5 cm above the basal clay. The basal 91 cm of the midden between samples GSC-1720 and S-750 appear to have been deposited within a span of 2.5 millenia, when, ca. A.D. 900, the accumulation rate of midden refuse accelerated, resulting in over 152 cm of deposits. Sample GSC-1683 (2190 ± 130 yrs.) provides a middle-date for occupation of the back house platform. It is also associated with the basal levels of the back-ridge shell dump, suggesting an initial date for burials in this area in the late B.C. range.

Comment (W.B., Jr.): all samples were large, well preserved charcoal chunks; individual pieces were up to 2 to 3 cm in length. A few rootlets were picked out of samples GSC-1720 and -1722 by hand. Due to smaller sample size of GSC-1722, pretreatment included only 5 minute cold NaOH-leach and this sample was mixed with dead gas for counting. Each of the five dates is based on two 1-day counts in the 5-L counter.

## Northern Canada, Mainland

### Yukon Territory

Gladstone site series, Kluane Lake

Charcoal and charred wood from the Gladstone site, JhVg-1, on the east shore of Kluane Lake, just west of the mouth of Gladstone Creek, Yukon Territory (61°20'N, 138°40'W), at altitude ca. 790 m. Site is in a bluff 18 m above the present level of Kluane Lake. This stratified site contains: 1) Aishihik complex, very sparse above an ash interpreted as being White River ash; 2) Gladstone phase, well represented just below the ash; and 3) a small Little Arm component at the contact of the red and yellow zones of the Kluane loess. Ca. 1 m of loess overlies the White River ash. Coll. 1973 by R.E. Morlan; subm. by R. Wilmeth.

GSC-2002. Gladstone site, Slims soil — 1890 ± 50 / 60 A.D. / $\delta C^{13} = -23.4‰$

Charcoal (NMC-639; 8.0 g; *Picea* sp., identified by R.J. Mott, Geological Survey of Canada) from just below the major component of the site (the Gladstone phase). From Square 0/E10, level F1, 15 cm below the White River volcanic ash, 10 cm below the cultural material of the Gladstone component, in the middle of the red zone of the Slims Soil, a paleosol in the upper part of Kluane loess. Estimated age 6000 to 7000 yrs.; the sample is ca. midway between Gladstone and Little Arm phase components.

GSC-2028. Gladstone site, White River ash — 780 ± 60 / 1170 A.D.

Charred wood (NMC-640; 10.5 g; *Picea* sp., identified by R.J. Mott) from N1/E12-12.5, Zone C. Sample lay in direct contact with upper surface of White River ash, and removal of tree (ca. 6 cm in diameter) exposed clean white ash and no loess. Submitter believed sample to represent a small spruce tree which was killed by the ash fall and which fell across the surface of the ash prior to resumption of loess deposition. Estimated age 1400 yrs.

Comment (R.E.M.): both age determinations are too recent in view of Neoglacial chronology in area (Denton and Stuiver, 1966), and further field work is necessary to understand the site. The possibility of GSC-2002 being a root cannot be excluded, for some birch roots extend deeply in this area; it is not from a rodent burrow.

Comment (W.B., Jr.): for GSC-2002 only a single piece of charcoal, 5x4x4 cm in size and representing not over 25 annual rings, was submitted to the lab. A few tiny rootlets were removed by hand when the sample was split apart. In view of group of dates close to 1200 yrs old on peat and charcoal underlying eastern lobe of White River ash (Hughes *et al.*, 1972), date GSC-2002 (1890 ± 50 yrs.) on charcoal 15 cm below the ash does not seem unreasonable. For GSC-2028, three pieces of wood (up to 5 cm long) were submitted; most heavily charred parts, containing rootlets, were cut off. Each date based on two 1-day counts in the 5-L counter.

### District of Mackenzie

GSC-1689. Warden's Grove — 810 ± 130 / 1140 A.D.

Wood (NMC-541; 12.25 g; *Picea* sp., identified by L.D. Wilson, Geological Survey of Canada) from heart of 60- to 90-cm diameter stump, south-southeast of Warden's Grove cabin, ca. 7.5 km below (northeast of) the confluence of Hanbury and Thelon Rivers, District of Mackenzie, N.W.T. (63°39'55"N, 104°26'15"W) at altitude ca. 190 m and ca. 27 m above level of Thelon River. Stump found at base of 1.5 to 2.4 m-high bank

containing banded eolian deposits and varves. Plain above bank is continuous to the Clarke River, 2 km to the south. No direct cultural affiliation, as no artifacts found at this site. Original location of stump impossible to determine after trowelling, because its roots may have brought along a large quantity of loose sand.

Comment (B.G.): sample predates period of decline in temperatures at the time of later Chipewayan occupation in the Thelon Valley (Gordon, 1974). The date correlates well with similar temperature decline following Viking occupation in West Greenland. Date based on two 1-day counts in 5-L counter.

## Northern Canada, Arctic Archipelago

### Devon Island

Port Refuge series

Charcoal samples from Port Refuge site, RbJu-1, Grinnell Peninsula, Devon Island, District of Franklin, N.W.T. (76°17'N, 94°48'W). All samples are from surface of gravel beaches, and are partly or completely overgrown by patches of saxifrage. Samples should give maximum age for Independence I occupation. Estimated age 3500 to 4500 yrs B.P. Coll. 1972 by R. McGhee, Memorial University of Newfoundland, St. John's.

GSC-1931. Port Refuge, 1972-2 — 4120 ± 120 / 2170 B.C.

Charcoal (2.6 g) associated with flint flakes in interior of Upper Beach Component structure No. 12, at altitude 24 ± 1 m (hand levelling).

GSC-1940. Port Refuge, 1972-3 — 4360 ± 90 / 2410 B.C.

Charcoal (3.4 g) associated with flint artifacts in interior of Upper Beach Component structure No. 16, at altitude 22 ± 1 m (hand levelling).

GSC-1949. Port Refuge, 1972-1 — 3480 ± 140 / 1530 B.C.

Charcoal (1.4 g) associated with flint artifacts in interior of Upper Beach Component structure No. 21, at altitude 22 ± 1 m (hand levelling).

General comment (R.G.): dates GSC-1931 and 1940 are internally consistent and agree with dates on Independence I material from northern Greenland and Ellesmere Island (Knuth, 1967; cf. also Maxwell, 1960). Since the charcoal appears to be derived from driftwood rather than local willow, dates should give a maximum age for the Independence I occupation. Structure No. 21, from which the charcoal used for GSC-1949 was collected, and the associated artifacts were not typical of others found at the site, and the date may suggest a late variant of Independence I culture in this area.

Comment (W.B. Jr.): visible saxifrage rootlets were picked out by hand by submitter and only a few tiny traces were noticed in the laboratory. Charcoal pieces are up to 1 to 2 cm in diameter. Numerous small charcoal chunks were examined by R.J. Mott, who noted (pers. comm., 1974) that many fragments were gymnosperm wood but they were too small for a specific determination to be made. Each sample mixed with dead gas for counting, and each date based on two 1-day counts in the 2-L counter.

### Ellesmere Island

GSC-1899. Muskox Fiord site, RcHv-1 — 1110 ± 80 / 840 A.D. / $\delta C^{13} = -14.9‰$

Whale bone, probably part of a rib, from middle and main house of several Eskimo house ruins at site RcHv-1 on the east side of the entrance to Muskox Fiord, Ellesmere Island, District of Franklin, N.W.T. (76°24.5'N, 87°08'W), at altitude 3.5 m above high tide level. Coll. 1970 by W. Blake, Jr., Geological Survey of Canada, Ottawa.

Comment (W.B., Jr.): dated bone was one of two small pieces fitted into larger bones forming base and lower wall of house structure. Although its altitude (as determined by levelling) was 3.5 m, sea level at the time the house was occupied could not have been more than 1.5 m above present, relative to the land; otherwise the lowest entrance tunnels to the houses would have flooded at times of high water. If the bones derived from a whale killed by the Eskimo occupants, this age determination reinforces the data from the Cape Storm area, on the west side of the entrance to Muskox Fiord (Blake, 1972), that land uplift during the last few centuries has been negligible. If the bone derived from a whale which died before site RcHv-1 was occupied, then the age determination cannot be used to pin-point the position of sea level, but it does put a limiting date on the time of occupancy of the site. Bone was dry and well preserved. All outside parts, some with algae and lichens, were cut off on a bandsaw to obtain a 734 g sample. Collagen fraction recovered after treatment with both HCl and NaOH for one hour. Date based on two 1-day counts in the 5-L counter.

GSC-1770. Wood River site UcAp-1 — 1070 ± 270 / 880 A.D.

Charcoal (0.6 g) from site UcAp-1 on north side of Wood River and west side of Black Cliffs Bay, Ellesmere Island, District of Franklin, N.W.T. (82°30'N 63°07'W), at altitude ca. 11.5 m (altimeter determination). Site is in gravel, 3 m from the edge of an old river delta terrace and ca. 60 m from the sea. Sample, which consisted mostly of soil, elongate and fractured pebbles, and charred bone, is from the middle of the central hearth. Coll. 1972 by G. Hattersley-Smith, then Defence Research Establishment Ottawa, now British Antarctic Survey.

Comment (G.H-S.): date is later than expected and suggests that the central hearth, a distinctive feature of the Independence culture, persisted to the end of the Dorset period in certain areas. The location suggests that Eskimos crossed the plateau southeast of the Grant Ice Cap from the Lake Hazen area, and followed the valley of the Wood River to its mouth, thus by-passing the Robeson Channel coast (Hattersley-Smith, 1973).

Comment (W.B., Jr.): three pieces of the charcoal were examined by R.J. Mott, who identified all as coniferous wood, with two appearing to be *Larix* sp. Thus the wood used by the Eskimos consisted, at least in part, of far-travelled driftwood. NaOH-leach omitted due to small sample size. Sample mixed with dead gas for counting. Date based on one 3-day count in 2-L counter.

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| | |
|---|---|
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| GSC IV | Dyck, Fyles and Blake, 1965 |
| GSC VIII | Lowdon, Wilmeth and Blake, 1969 |
| GSC IX | Lowdon and Blake, 1970 |
| GSC X | Lowdon, Wilmeth and Blake, 1970 |
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INDEX