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DALHOUSIE UNIVERSITY NATURAL RADIOCARBON MEASUREMENTS I

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The Dalhousie University Radiocarbon Dating Laboratory was established in 1972, utilizing equipment and procedures formerly in use at Ohio Wesleyan University, Delaware, Ohio. The laboratory is located on the third floor of the 8-story Life Sciences Center at Dalhousie University. Sample preparation includes leaching with dilute alkali and acid, followed by pyrolysis in a stream of N_2 at 500°C. Operating procedures remain essentially the same, utilizing reduction of acid or combustion generated CO_2 to the counting gas, methane, over Ruthenium catalyst at 500°C. The flow reactor formerly used has been replaced by an in-line static reactor. Following gas purification and one month product gas storage to permit decay of Radon, samples are counted at 50 to 152cm pressure in either of 2 500ml detectors, or a 2L detector.

Shielding includes 20cm of lead, 5cm of iron, 3cm of mercury, and a 16 anode anticoincidence counter operated at 96cm of "dead" methane. Age determinations are based on at least 2 counter fillings for a total of 3000 minutes and are compared with 5000 minute determinations of contemporary and background activity, which are updated by alternate counter fillings on weekends. Sample counts are printed each 100 minutes to monitor system operations. Age calculations are based on the Libby half-life of 5570 ± 30 yr and include 1σ statistical uncertainties of sample, modern, and background activity. Reference age is AD 1950 and is determined from .95 NBS oxalic acid activity or age-corrected 1850 wood.

Background at 1 and 2 atmospheres filling pressure is 1.33 to 1.76cpm for the 2 500ml counters. NBS oxalic acid activity at these pressures is 4.29 and 7.65cpm, respectively.

Table 1 lists check determinations made during initial operation of the Dalhousie Radiocarbon Laboratory.

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I. GEOCHEMICAL SAMPLES—ATMOSPHERIC CO_2

Halifax series

As part of a research program on atmospheric inputs of major nutrients in urban, suburban, and coastal precipitation (Hart, unpub),

a series of atmospheric CO_2 measurements were undertaken to define the effect of industrial CO_2 on ^{14}C level in the Halifax area.

1L of 1N KOH was prepared using deionized distilled (millipore Super Q) water and exposed in 500cm² trays for 1 week. Controls were checked for carbonate contamination in sealed vessels during the exposure period by titration. Sample CO_2 was generated by hydrolysis with 5% H_3PO_4. Results are summarized in Table 2. Coll and subm by W C Hart. *Comment* (WCH): data of Table 2, plus sulfate and chloride precipitation chemistry in the Halifax area indicate that prevailing coastal winds and sea breeze effect preclude recognition of an industrial effect in the Halifax area.

II. GEOLOGIC SAMPLES

Basin Head, Prince Edward Island series

900 ± 105

DAL-27A. Basin Head Harbor wood, P E I AD 1050

Spruce (*Picea*) wood from stump in growth position in sand on side of tidal channel at Basin Head Harbor, PEI (45° 23′ N, 62° 6′ W). Root crown .41 to .98m below Geobotanical Datum (HHW) after Grant (1970). Acid and alkali pretreatment to remove humates and $CaCO_3$ from marine wood-boring mollusks in outer rings. Coll and subm by A Palmer (Lands Directorate, Environment Canada).

TABLE 1
Check Samples—DAL/OWU

Sample	DAL no.	DAL age	OWU no.	OWU age	OWU V, p —
Spruce wood	3	2460 ± 120	489	2520 ± 90	354
Unid. wood	4	14,400 ± 430	487	10,890 ± 275*	353
Unid. wood	65	13,300 ± 310	487	10,890 ± 275*	353
Spruce wood	5	25,100 ± 1600	490	19,535 ± 655*	354
Gyttja	6	5070 ± 200	502	4905 ± 225	362
Gyttja	7	4060 ± 210	477	4800 ± 200	360
Gyttja	8	6920 ± 200	495	5220 ± 145*	—
Gyttja	9	2380 ± 120	497	2370 ± 165	362
Spruce wood	10A	21,400 ± 700	8	19,900 ± 690	
Spruce wood	10B	21,700 ± 1200	8		
Wood charcoal	14	20,700 ± 1000	488	19,300 ± 1080	354
Gyttja	15	5450 ± 150	499	5730 ± 220	362
Gyttja	16	7030 ± 220	503	6230 ± 235	362
Spruce wood	77	19,500 ± 500	452	19,850 ± 765	353

* Difference significant at 2σ. DAL-4, -65, and -5 considered more reliable on geologic grounds.

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1050 ± 90

DAL-27B. Basin Head Harbor wood **AD 900**

Duplicate sample preparation of DAL-27A. *Comment* (AP): date is youngest possible for sand substrate correlated with adjacent sand ridge system, and oldest possible for salt marsh peat at sampling site. Field relations indicate that submergence of the stump records local rise in sea level during the past millennium.

3370 ± 135

DAL-95. Basin Head Harbor sediments **1420 BC**

Sediment sample from 10.4m below HHW Datum in core from estuarine deposit. *Comment* (AP): sample is slightly below, and therefore predates microfossil evidence of marine transgression. Date indicates that local marine transgression was both recent and rapid.

4185 ± 85

DAL-182. Basin Head Harbor sediments **2235 BC**

Basal sediments at 11.4m below HHW in same core as DAL-95. *Comment* (AP): paleoenvironmental reconstruction based on preserved microflora indicates that fresh water sediments were deposited at this time. Date substantiates 2 interpretations based on field relations; 1) cored sediments are all postglacial in age, and 2), relatively high rate of regional rise in sea level is applicable to the E end of Prince Edward I. Additional details reported in Palmer (1974).

TABLE 2

Atmospheric $\delta^{14}C$ in the Halifax, Nova Scotia Area, ‰

Sample dates	Sample no.	Coastal*	Sample no.	Urban**	Sample no.	Suburban†
10-16 April, 1972	56	138 ± 8.8	55‡	142 ± 8.2	—	—
			57	134 ± 9.0		
			64§	140 ± 8.9		
16-23 April, 1972	60	137 ± 9.1	62	146 ± 9.0	92	146 ± 8.5
5-12 Nov, 1972	117	146 ± 6.8	118	143 ± 7.9	119	147 ± 8.2
12-19 Nov, 1972	134	148 ± 9.0	135	144 ± 8.9	136	146 ± 7.5

* Coastal Sta—Natl Research Council Seaweed Research Lab, Sandy Cove NS (44° 28′ N, 63° 33′ W), alt 20m, 120m W of shoreline.

** Urban Sta—Atmospheric Environment Service Meteorol Sta, Citadel Hill, Halifax, NS (44° 38.7′ N, 63° 35′ W), alt 70 m, 1km W Halifax Harbor.

† Suburban Sta—Dartmouth City Water Supply reservoir, Dartmouth, NS (44° 41′ N, 63° 30.5′ W), alt 350m, 4.8km E Halifax Harbor.

‡ DAL-55 exposed at Dalhousie Univ Radiocarbon Dating Lab (44° 38.2′ N, 63° 35.9′ W) alt 60m, 2.1km W Halifax Harbor.

§ DAL-64—alternate preparation of DAL-57.

East Pennant series, Nova Scotia

DAL-32. Buried Forest, E Pennant, N S **1060 ± 130**

Mean of 2 determinations (1045 ± 65 and 1080 ± 115) of Spruce (*Picea*) wood from one of numerous stumps rooted in fresh water peat overlain by *Spartina* marsh peat in salt marsh at E Pennant, N S (44° 27.6′ N, 63° 38.2′ W). Alt of root crown −.41m, Geobotanical Datum (HHW). Alkali and acid pretreatment. Similar sample dated by Geological Survey of Canada GSC-1597 gave 540 ± 130 yr BP. Coll and subm by J G Ogden, W C Hart, and J K Underwood. *Comment* (JGO): discrepancy in dates is greater than expected from field relations. Further studies of growth patterns and flooding levels of coastal trees is in progress. See DAL-33.

315 ± 85

DAL-33. E Pennant Forest Peat **AD 1635**

Fresh water woody peat from level of root crown (DAL-32) at transition to *Spartina* peat. *Comment* (JGO): although possibly contaminated by younger *Spartina* rootlets, indicates that marsh remained essentially fresh until recent times.

8650 ± 230

DAL-69. Steidtman Woods, Ohio **6705 BC**

Unid. wood fragments 10cm above till in 80cm deposit of organic bands alternating with sand and silt layers in Steidtman Woods (41° 18′ N, 83° 40′ W). Spruce cones (*Picea glauca*) with needles and gastropod shells included in deposit. Alkali and acid pretreatment. Coll and subm by C Brady. *Comment* (CB): date younger than anticipated, possibly younger root contamination due to shallowness of deposit.

III. GEOLOGIC SAMPLES—LAKE AND BOG SEDIMENTATION

Lawrence Lake series

Sediment core from central depression of Lawrence Lake, Barry Co, Michigan (44° 26′ N, 85° 21′ W). Intensive investigations include sedimentary history, pollen analysis, contemporary geochemistry, and cultural eutrophication. 9.45m core raised from 12.5m of water was sampled for marl and organic carbon ages. Dating program also undertaken to determine if slumping or turbidites (see Fayetteville Green Lake series (R, 1973, v 15, p 356) occur in stratigraphy. Dates are listed in Table 3 without correction for marl carbonate or isotopic fractionation. Suface sample age indicates possible correction of −1460 yr (DAL-52). Mean age difference between A and B samples (marl-organic age) is 520 yr. Marl samples prepared by phosphoric acid generation (5%), organic carbon ages determined by combustion of residue. Coll by R G Wetzell and R O Kapp. Subm by R G W and R E Bailey. *Comment* (RGW): samples DAL-46, -48, -49, -50 indicate slumping from steep walls of central basin and are consistent with evidence from pollen and diatom stratigraphy to be reported elsewhere.

TABLE 3

Marl and Organic Carbon Ages for Lawrence Lake, Michigan

Depth cm	DAL no.	Marl* age (A)	Organic age (B)	Difference** (A-B)
0-2	52	1460 ± 90	—	—
46-50	40	3050 ± 210	2790 ± 295	260
101.5-104.5	41	4110 ± 170	3640 ± 195	465
201.5-204.5	42	5790 ± 190	4730 ± 400	1055
282-284	43	7830 ± 230	—	—
397-399.5	44	9430 ± 190	9000 ± 390	430
496.5-499.0	45	11,600 ± 250	11,360 ± 405	240
590.0-592.0	46	10,150 ± 250	9480 ± 285	670
701.5-704.5	47	13,520 ± 270	—	—
796.5-800.0	48	9850 ± 190	—	—
856.0-859.0	49	9500 ± 170	—	—
876.0-880.0	50	10,480 ± 200	—	—
931.0-934.5	51	16,650 ± 900	—	—

* Sample number identification; DAL-xxA is marl date, DAL-xxB is organic date from same sample.

** Mean difference or marl and organic dates = 520 yr.

IV. GEOLOGIC SAMPLES—OCEAN SEDIMENTATION

Mid-Atlantic Ridge series

22,050 ± 1230

DAL-67. East Crestal Mts **20,100 BC**

Globigerina ooze from 80cm level in Piston Core DD-401, recovered from 2000m water depth (45° 40.1′ N, 27° 35′ W). Coll and subm by C Stehman. *Comment* (CS): sample from youngest warm-cold transition in Core DD401, based on planktonic Foraminifera. DAL-113 and -114 indicate possible fractionation of +3000 yr.

25,800 ± 1150

DAL-68. East Crestal Mts **23,850 BC**

Globigerina ooze from 160cm level in Piston Core DD401. *Comment* (CS): sample from important faunal transition to be discussed in Stehman thesis. Age may be 3000 yr greater as indicated for DAL-67.

5605 ± 200

DAL-113. E Crestal Mts **3655 BC**

Globigerina ooze > 63μ fraction from 1 to 5cm in Core DD401.

2615 ± 70

DAL-114. East Crestal Mts **665 BC**

Globigerina ooze < 63μ fraction from 1 to 5cm in Core DD401. *Comment* (CS): size fractions sampled from top of core to investigate possible error due to sedimentary effects or granulometry of sediments.

Difference in fine and coarse fractions indicate possible increase in real date of +3000 yr.

36,000 ± 3600

DAL-143. Confederation Peak limestone **34,050 BC**

Limestone from Core 138, water depth 1042m, sample depth 4.5 to 6cm on crest of Confederation Peak, Mid-Atlantic Ridge (45° 24.5′ N, 28° 10.1′ W). Coll and subm by C T Schafer. See DAL-146 for comment.

34,900 ± 3200

DAL-144. Confederation Peak limestone **32,950 BC**

Limestone from Core 140, water depth 987m, sample depth 26 to 29cm on crest of Confederation Peak, MAR (45° 22.9′ N, 28° 10.2′ W). Coll and subm by C T Schafer. See DAL-146 for comment.

21,150 ± 700

DAL-145. Citadel Peak limestone **19,560 BC**

Limestone from Core 145, water depth 1243m, sample depth 1.5 to 2.5cm on crest of Citadel Peak, MAR (45° 26′ N, 28° 34.8′ W). Coll and subm by C T Schafer. See DAL-146 for comment.

34,200 ± 3500

DAL-146. Wegener Mt limestone **32,250 BC**

Limestone from Core 157, water depth 1360m, sample depth 6 to 8.5cm on crest of Wegener Mt, MAR (45° 31.2′ N, 28° 20.4′ W). Coll and subm by C T Schafer. *Comment* (CTS): cores were obtained using a self-contained hydrostatic pressure driven corer developed at the Atlantic Oceanographic Lab (Schafer and Brooke, 1970). These dates, in addition to others reported in Schafer (1974) indicate that deposition and cementation of the limestone occurred prior to last major Wisconsin ice advance.

V. ARCHAEOLOGIC SAMPLES

Kramer site series

720 ± 85

DAL-34. Square C-2, Feature 7 **AD 1230**

Wood charcoal (probably hickory) id by G W Burns, assoc with antlers and deer bone (*Odocoileus*). Pretreatment by hand removal of large root fragments and cellulose reduction. Coll and subm by O Pi-Sunyer.

850 ± 85

DAL-35. Square D-1, Feature 13 **AD 1100**

Wood charcoal (fragments of hickory and ash) id by G W Burns. Coll and subm by O Pi-Sunyer. *Comment* (JGO): serious contamination by contemporary rootlets affected prior determinations (OWU-448A: R, 1973, v 15, p 365). These dates are considered more reliable geochemically.

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