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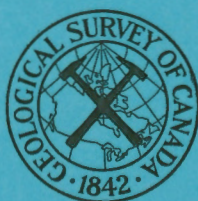
CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA
TOPICAL REPORT NO. 77

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REPORT ON THE VISIT TO RADIOCARBON
DATING LABORATORIES IN THE EASTERN
UNITED STATES

BY
WILLY DYCK



OTTAWA
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Report on the Visit to Radiocarbon Dating Laboratories
in the Eastern United States

Seven Radiocarbon Dating Laboratories in the Eastern United States were visited in the period from August 12th to August 21st, 1963. The respective laboratories and the persons conferred with are listed in the following table:

<u>Name</u>	<u>Laboratory</u>	<u>Place</u>
H.W. Krueger	Geochron Laboratories	Cambridge, Mass.
Minze Stuiver	Yale University	New Haven, Conn.
Miss E.K. Ralph	Univ. of Pennsylvania	Philadelphia, Penna.
M.A. Trautman	Isotopes Incorporated	Westwood, N.J.
Meyer Rubin	U.S.G.S.	Washington, D.C.
Sigalove and Long	Smithsonian Institute	Washington, D.C.
H.G. Ostlund	Marine Laboratory	Miami, Florida.

Laboratory technique trends were found to be toward SHARP transistorized radiation detection equipment, methane gas counting, and gas flow systems and proportional counters for cosmic ray guard rings.

Of the seven laboratories visited all but one either used Sharp Low-Beta electronics or had units on hand waiting to be installed. Fluke high voltage units were used in most laboratories.

One of the laboratories converted samples to acetylene for the C-14 measurements. Although the preparation and handling of C₂H₂ was somewhat hazardous no sample preparation changes were contemplated. Two laboratories used the Lewis Sample converter sold by Sharp for the conversion of samples to methane. These laboratories found the methane conversion process satisfactory, however, the vacuum line needed modifications such as: additional storage of gaseous samples, a second vacuum pump, a larger combustion tube, etc. Four laboratories were

using CO₂ for the C-14 measurements, however, two of these were experimenting with home-made methane converters to be used for high pressure (greater sensitivity) methane counting and increased sample output.

Counter materials most commonly used were copper, quartz, and araldite (epoxy resin) cement. One and 2 litre counters were most common; however, counters from 0.5 litres to 10 litres were also used by some.

Counter shields consisted of 8" to 10" of iron, 2" to 4" of paraffin with boric acid, and 1" of mercury or low activity lead. A summary of the counter parameters, operating conditions, and sample preparation and purification techniques is listed in the table below. Also included in this table is the University of Saskatchewan laboratory which was visited earlier in the year while on annual leave. Our own laboratory is included in the list for comparison purposes.

A growing concern about the fluctuations of the C-14 production rate with time has lead several laboratories into investigations of the C-14 concentration of tree rings and historically dated samples. Miss Ralph showed me a plot of historical age of samples vs. measured C-14 concentrations corrected to zero age, which deviated about +8 per cent from the standard at 5,000 yrs. B.P. using a 5570 yrs. half life for C-14.

About 3/4 of the samples processed in the visited laboratories were of historic or geologic interest, and 1/4 of geochemical interest, labelling 'geochemical' samples such as ocean-and lake-waters and sediments, tree rings, contemporary samples of plants and animals, atmospheric CO₂, etc.

The C¹²/C¹³ ratios of most geochemical samples were also measured so that corrections for possible isotope effects could be applied.

Sample output varied from about 50 to 150 determinations per counter per year depending upon the reliability desired and the kind of shift work employed. Routine sample preparation and counting (with a total of 13 counters) was carried out by 8 full time technicians. In addition, 4 students (2 - Univ. of Pennsylvania; 1 - Miami; 1 - Smithsonian Institute) who were in the process of obtaining a higher degree were using the laboratory facilities for thesis projects. Eight professionals were directly involved in some aspect of the operation of the laboratory in addition to direction and supervision. Several laboratories also called outside help in case of counting equipment troubles.

The laboratories were all air conditioned and equipped with mechanical air filters. Only the Isotopes Inc. laboratory had experienced an increase in the background counting rate, presumably due to radioactive fallout.

In conclusion may I say that the various Radiocarbon Dating Laboratories studies offered no striking improvement over the present set-up of the Geological Survey of Canada laboratory. However, the apparent ease of preparing large quantities of CH_4 makes the gas an attractive alternative to CO_2 , in view of the difficulties encountered in our, as well as in other laboratories in the purification of CO_2 for high pressure counting. Also, the success achieved in the operation of guard counters in the proportional region using CH_4 or in the G.- M. region using a gas flow system, make such guard rings a desirable feature of a C-14 dating system.

Sample Preparation and Counter Performance Details

Laboratory	No. of counters and volume	Counting Gas	Final gas purification step	Operating pressure atm.	Backg. count cpm	Standard count cpm	Type of Guard ring	Remarks
Geochron	2 L	CH ₄	Charcoal	1 2	5.0 6.5	13.0 26.0	CH ₄ - proportional	Complete SHAPP Radio-carbon Dating Station - is experimenting with CH ₄ preparation system - plans conversion of guard tubes to flow system.
Yale	2 L 2 L 0.5 L	CO ₂	CaO furnace	3 3 3	2.7 5.0 0.9	39.0 39.0 10.0	G.M. tubes	- trouble with gas purification and guard tubes
University of Pennsylvania	8 L 10 L	CO ₂	CaO furnace	1 1	8.5 10.0	32.3 40.0	G.M. tubes	- is experimenting with CH ₄ preparation system
Isotopes Inc.	2 L 2 L 0.4 L	CO ₂	CaO furnace	2 2 1	9.2 9.4 2.0	23.2 26.1 3.5	G.M. tubes flow gas system	- is setting up a H ³ counter
University of Miami	1 L	CO ₂	hot Cu	3	2.1	18.3	G.M. tubes	- no changes in method contemplated
U. S. G. S.	1 L 1 L	C ₂ H ₂	charcoal	1 1	2.0 2.0	13 13	G.M. tubes	SHAPP Dating Station except shielding which is a Hg barrel
Smithsonian Institute	2 L	CH ₄	charcoal	2	5.5	26	CH ₄ - proportional	trouble with guard tubes and background stability
University of Saskatchewan	1 L	C ₂ H ₂	charcoal	1	4.5	13	G.M. tubes flow gas system	
G. S. C.	2 L	CO ₂	hot Cu	2	1.5	20.2	G.M. tubes	