Lamont Natural Radiocarbon Measurements, I

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THE DISCOVERY OF THE CARBON 14 method of age determination by W. F. Libby and co-workers (*1–4*) has so many potential applications in geology, anthropology, archaeology, oceanography, and meteorology that the development of several laboratories equipped to make the necessary measurements is imperative. About a year ago the construction of the requisite facilities was undertaken at the Lamont Geological Observatory. During the first year considerable time was spent on building, calibrating, and improving existing techniques. The detailed description of the experimental procedures used in this laboratory will appear elsewhere (*5*). Since several institutions are setting up natural radiocarbon programs and will have a succession of papers reporting dates and measurements that will be of interest to scientists in many fields, it seems desirable to develop the titles in such a way that cross references will be unambiguous. To that end

[1] Lamont Geological Observatory Contribution No. 49.

TABLE 1

KNOWN SAMPLES

Sample No.	Description	Date	Net cpm
40	Anthracite	1/ 2/51– 1/ 4/51	+0.15 ±0.12
45	"	3/15/51– 3/16/51	−0.31 ±0.25
46	"	7/ 5/51– 7/ 7/51	−0.04 ±0.10
54	"	9/17/51– 9/21/51	+0.10 ±0.29
54′	"	9/24/51– 9/28/51	+0.013 ±0.093
57	"	10/20/51–10/22/51	−0.08 ±0.30
			Av = −0.01 ±0.06
43	Modern wood (pine)	3/28/51– 3/31/51	6.17 ±0.07
43′	" " (")	5/18/51– 5/20/51	6.05 ±0.11
49	" " (maple)	8/ 3/51– 8/ 5/51	5.89 ±0.13
49′	" " (")	8/14/51– 8/16/51	6.073 ±0.126
52	" " (oak)	9/24/51– 9/28/51	5.986 ±0.081
52′	" " (")	9/19/51– 9/23/51	6.089 ±0.063
			Av = 6.07 ±0.05
30	Modern clamshells	4/19/51– 4/21/51	6.60 ±0.20
30′	" "	4/29/51– 4/29/51	6.63 ±0.25
30″	" "	5/ 3/51– 5/ 4/51	7.08 ±0.20
39	" "	2/23/51– 2/27/51	6.42 ±0.17
39′	" "	2/27/51– 3/ 1/51	6.95 ±0.15
			Av = 6.72 ±0.10

		Net cpm	Expected age (yr)	C^{14} age (yr)
110 Series	Bikini Lagoon samples submitted by K. O. Emery from Core *Bik. 224* from Lat. 11° 35.6′ N, Long. 165° 30.1′ E, 23 fathoms, about 2½ miles into the lagoon from Bikini Island. Material largely Halimeda debris. The rate of deposition was estimated at about 1 cm/yr on geologic evidence.			
110B	2″– 6″ depth	6.68 ±0.13	5–15	< 100
110C	6″–10″ "	6.74 ±0.12	15–25	< 100
110D	10″–15″ "	6.70 ±0.20	25–40	< 100
		Av = 6.70 ±0.10		
108A	Sequoia trunk in Am. Mus. of Nat. Hist., clean borings in growth rings between year A.D. 1057 and A.D. 1087. Submitted by Junius B. Bird.			800 ±600
				900 ±200
				1030 ±200
				900 ±200
			880 ±15 Av	930 ±100
108B	Sequoia trunk as above, rings A.D. 570–A.D. 578.			1520 ±170
				1300 ±200
			1377 ± 4 Av	1430 ±150

we propose that the institutional name occur somewhere in the title.

This paper reports the carbon 14 measurements made on various natural, carbon-bearing materials of geological and archaeological interest. The halflife of carbon 14 used is 5,568 years, and the specific activity for modern wood of 15.1 dpm/g determined by Libby (*6*). The errors reported are standard deviations obtained from the counting data. It will be apparent from the facts given below that the counting error is probably the dominant one.

Table 1 gives the data on the known samples used for calibration. After a contamination problem encountered early in the work, the anthracite specimens have remained "dead" within the experimental error. The modern wood values (av 6.07 ± 0.05 cpm) give the base for any age ratio. The samples from the Bikini Lagoon were taken prior to the atomic explosions. They not only prove the high rate of carbonate sedimentation within such lagoons as compared to the open ocean (1 cm/1,000 yr) but give activities equal to that obtained for modern shells. Assuming 14.70 dpm/g for wood, these data give 16.20 ± 0.15 dpm/g for modern carbonate, in agreement with Libby for several modern shell samples. Agreement between the expected and actual age of the other samples appears satisfactory.

Table 2 lists the dates obtained for various archaeological specimens. Samples 115 and 116B provide interesting interlaboratory calibration, since similar material was run in Libby's laboratory.

TABLE 2

ARCHAEOLOGICAL SAMPLES

Sample No.	Description	Age (yr)
113	*Mayan lintel:* Wood (Zapote) taken from carved Mayan lintel from structure 10, Tekal, Guatemala. Am. Mus. Nat. Hist., submitted by Junius B. Bird. Carved date on lintel: 9.15.10.00 in the Mayan calendar which, according to the Goodman-Thompson correlation, would be June 30, A.D. 741. According to the Spinden correlation, this would be Aug. 30, 481. Wood has about 30 years' growth. Hence expected date is (1210–1240) +, Goodman-Thompson or (1470–1500) +, Spinden. Comment: Looks like Spinden date.	1600 ± 200 1400 ± 150 Av 1470 ± 120
115	*Paracas:* Prehistoric cotton cloth, Mummy 114 (Bundle B 1946-14, Am. Mus. Nat. Hist.) Paracas Necropolis Period, Peru. This specimen is of same cultural level but need not be same age as Libby's No. 271, which gave (2257 ± 200).	1850 ± 250 1550 ± 200
104A	Signal Butte I horizon (levels II and III not represented). Charcoal collected by W. D. Strong and John Champe, Nov. 1950, from lowest level (A) in I; below limited sterile split (B), and upper I occupation zone (C). Lot I—S.B. IA } one sample, Lot II—S.B. IA } two counts,	3420 ± 300 3450 ± 150 Av 3445 ± 120
104B	Signal Butte I horizon, three lots combined, Lot III S.B. IC (above split B) and Lots IV and V—S.B. I in an area where there was no split in strata I. Charcoal from C insufficient for test, hence the combination. Lot III—S.B.I.C. Lot IV—S.B.I. (no split) Lot V—S.B.I. (no split) Comment: Younger than commonly accepted. See Strong (*7*), estimate of *ca* 6065 B.C.; and Strong (*8*), estimate of *ca* 2000 B.C. However, Bliss (*9*) estimates S.B.I.C. *ca* 1050 B.C.	2950 ± 200
114	*Jaketown:* Carbonized plant material collected by J. Ford, field designation 20–0–1, 3 miles north of Belzoni, Miss., prepottery.	2400 ± 150 2300 ± 100 Av 2350 ± 80
112C*	*Shagak Bay:* Wood from Aleut midden, north shore of Shagak Bay. Material in place of basal debris of midden at about 3′ above level of rare storm wave activity of present sea. Land has not been lower with respect to sea level for at least X years where X = age of wood.	660 ± 100
112E*	*Clam Lagoon:* Clamshells from Aleut midden on north part of sand pit enclosing clam lagoon. Comment: Aleut culture appears over longer time interval than anticipated. Libby obtained 3020 on one Aleut site.	4620 ± 100 4610 ± 160 4530 ± 150 Av 4600 ± 80
116B	*Huaca Prieta No. 2.* Charcoal from botton of deposit. Dates from near beginning of occupation of the first agricultural prepottery culture. This should be similar material to Libby's No. 598, which gave 4298 ± 230. The agreement is reasonably satisfactory, since only one determination was made in each laboratory.	3650 ± 400

* Nos. 112C and 112E submitted for geological interpretation; no critical archaeological data available.

Table 3 gives the radiocarbon measurements on several samples taken from deep ocean water and deep-sea cores. In each case the carbon was extracted from the sample as carbon dioxide. The deep ocean water sample suggests that the gross oceanic circulation from the arctic surface along the bottom to the equator may be measurable. Further sampling of ocean water at various depths is in process.

TABLE 3

OCEAN SAMPLES

Sample No.	Description	Activity in cpm/g	Apparent age (yr)
100 AB	CO_2 extracted from ocean water taken at 4,100-m depth near Lat. 38° 30′ N, Long. 68° 10′ W. Comment: This was a much smaller sample than usual and had a higher ash correction, so that the result must be considered tentative.	6.31 ±0.20	200 ± 100
105 series	(Submitted by D. Ericson) Core A-164-#38: $CaCO_3$ extracted from various core depths. This core shows coarse debris and graded bedding, apparently representing recent deposition of older material by mass movement.		
	105A 0–12 cm		17,000 ± 900 16,100 ± 1300 16,600 ± 700 Av 16,600 ± 500
	105B 88–92 cm		> 25,000
	105C Cutting edge shell fragments		> 25,000
107 series	(Submitted by D. Ericson.) $CaCO_3$ from Core A152–118 North Atlantic. The lithologic character of the core from 100–350 cm suggests slumped material from the Mid-Atlantic Ridge.		
	107A 84– 92 cm		14,100 ± 800
	107B 196–204 cm		> 25,000
	107C 396–404 cm		16,700 ± 900 16,400 ± 800 Av 16,500 ± 700
	$CaCO_3$ from Core #C-10-14, flats along Hudson Canyon. Sharp lithologic break at 75 cm. Sediment below probably underwent more rapid deposition.		
			14,400 ± 700 14,100 ± 600
	107D 19– 29 cm		Av 14,200 ± 500
	107E 126–143 cm		20,000 or older
	$CaCO_3$ from Core #C-10-5 Lithologic evidence indicates much more rapid rate of deposition below 10 cm.		
	107F 0– 10 cm		5850 ± 250
	107G 149–160 cm		19,000 ± 2200 21,100 ± 1800 Av 19,600 ± 900

The activity present in the top 12 cm of Core A-164-38 is probably due to the mixing of some fine recent calcium carbonate mud with the older material as the latter moved down the slope. A-152-118 shows the presence of slumped sediment between two normal sedimentation sequences.

Table 4 shows the results for a variety of geological samples. Probably the most important is the cedar log from greater Bermuda 111A, which gives an age for the rise in sea level at the end of the Wisconsin stage. This coincides closely with dates obtained by Libby for the termination of the Wisconsin in North America (Two Creeks formation 11,400) and Europe (Alleröd, 11,050; Irish mud, 11,300; and Godwin, 10,850). The sample of peat (111B) representing a higher water stage indicates that the time for the complete melting of the continental glacier must have been on the order of 6,000 years, in agreement with the findings of DeGeer, which were based on varve counts for the retreat of the continental glacier in Scandinavia.

TABLE 4

GENERAL GEOLOGY SAMPLES

Sample No.	Description	Age (yr)
111A	*Bermuda:* Fossil cedar log dredged from entrance to St. George's Harbor. This is representative of widespread cedar forest of Greater Bermuda, which now lies under 10′–30′ of water and 10′–20′ of mud. Presumably rise in sea level at end of Wisconsin killed this forest. Comment: Consistent with Two Creeks date of Mankato. Samples from Wisconsin, Europe, and now Bermuda concur on end of last glacier period at about 11,000 years ago.	11,500 ± 700
111B	*Bermuda peat:* Peat obtained from dredging noted above, but stratigraphically above cedar forest. Comment: Suggests slow rate of sea level rise equivalent to rate of retreat of Wisconsin continental glacier.	7600 ± 600 6700 ± 200 Av 6900 ± 150
102A	*La Soufriere:* Charred wood under last great eruption of La Soufriere, island of Guadeloupe. Submitted by E. Bruet, Sorbonne. Dr. Bruet had estimated the eruption to have taken place about 900 years ago on stratigraphic grounds. No tradition is available for a precise historical check.	550 ± 150
103B	*Boothbay:* Clamshells from a hole dug in the geographic center of the flat in Sagadahoc Bay, Maine, where they occur in marked concentration in a layer 26″ below present surface. The buried layer represents an interval of widespread erosion that was catastrophic for the clam population. Precommercial clam digging.	1000 ± 500 1260 ± 150 Av 1190 ± 140
112B	*Henry Mountains:* Block of wood from alluvial deposit in Henry Mountains Region, Utah. From a study of tree rings of	< 100

TABLE 4—(*Continued*)

Sample No.	Description	Age (yr)
	trees growing on alluvium, the deposit is assumed older than A.D. 1050. Comment: Wood is either recent or contaminated. It may not have been *in situ*.	
Alaskan Samples		
101A	*Anchorage:* Peat from north end of Anchorage International Airport. Sample from lower foot of an 8′ peat exposure. The peat rests on a blue clay. Submitted by E. B. Eckel. Thought to be old but post-Wisconsin.	5340 ± 300
101B	*Eagle River:* Coaly peat from an exposure along Eagle River north of Anchorage. This peat is about 10″ thick and is interlayered with blue clay. It is overlain by late Wisconsin till, and overlies gravel. Comment: Appears to be Cary-Mankato interstadial.	14,300 ± 600
106C	*Mendenhall:* Large wood sample from beneath gravels and outwash of Mendenhall Glacier, Alaska—represents "inter-fluctuational" forest. Submitted by Maynard Miller.	1790 ± 285
112G	*Etienne:* Basal 3″ of 4′ peat deposit grading up to present vegetation. Behind raised beach ridge in Etienne Valley, at elevation of 60′ above present living seaweed line. Age of sample gives minimum age of aggraded valley floor behind beach ridge, which is now raised above present sea level. Submitted by E. Ingerson.	1750 ± 100

TABLE 4—(*Continued*)

Sample No.	Description	Activity in cpm/g	age (yr)
117J	*Tustemena:* Partially lignitized wood from outwash sands in bluffs on northwest shore of Tustemena Lake, Kenai Peninsula. Submitted by T. N. V. Karlstrom. Comment: Suggests Cary-Mankato interval.		15,800 ± 400

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Columbia University has announced plans for a $22,150,000 Engineering Center. The Engineering Center will combine teaching, research, and practice in engineering and the fundamental sciences, on both undergraduate and graduate levels. Besides the Engineering School, the plans provide for an Institute of Advanced Engineering Science and a Division of Cooperative Research in Engineering which will work with industry on problems having educational value. Of the $22,150,000 required to put the Engineering Center program into effect, $13,650,000 is being sought immediately to provide buildings and equipment, and $8,500,000 will be required subsequently for professorships, fellowships, and scholarships. The Engineering Center will be established at Riverside Drive and 125th St. The first unit, an existing four-story building, has been acquired and is now being remodelled and occupied as it becomes ready. The second unit will be erected as soon as funds are available, the aim being completion no later than 1954, the university's bicentennial anniversary. The center will have a staff of 267 professors, assistants, and research workers, compared with a present staff of 142. Enrollment will be increased as the center develops, from the present 1,061 students to an eventual total of 1,750—750 undergraduates and 1,000 graduate students.

Project Atoll is part of a cooperative program of the Military Geology Branch, U. S. Geological Survey, and the Corps of Engineers, U. S. Army. A field party consisting of F. Stearns MacNeil, F. R. Fosberg, and Theodore Arnow, of the Survey, will conduct a coordinated scientific reconnaissance of a dozen islands in the northern Marshalls. Several of the atolls have never been studied scientifically, and two of them, Taongi and Bikar, are reported to be only slightly altered from their primeval state. The program has been designed to fit into the Atoll Research Program of the Pacific Science Board.