complex condensation products of the simple precursors are supplied. While the first layer will be formed in this manner, further building up will take place by covalent and hydrogen bond formation. This can proceed rather easily since both these bonds are relatively unspecific and consequently may have greater freedom with respect to the nature and sequence of the units. This is because the entropy of adsorption onto a specific surface is very large (and negative), whereas the entropy of hydrogen and covalent bonding is much smaller.

While adsorption is a spontaneous process, the building up of the main bulk of the structure requires the supply of free energy mainly for covalent bonding. If we assume that this is effected by coupling with free energy-yielding reactions, duplication may be triggered by conditions determining these reactions which may also be rate determining.

Once the process has started at one point, wherever that point may be, it may continue along the interface in a zipper-like fashion since the building up of the material will always result in an "open" portion just in front. The supply of the complementary precursors need not be strictly synchronous. It is seen that eventually two structures are obtained, one containing "old" protein and "new" nucleic acid, and other "new" protein and "old" nucleic acid, provided that no sister strand crossing over takes place. However, the two structures are identical as far as internal surface structure is concerned. The building up of the paracrystalline "carrier" will terminate when, for example, the surface volume ratio reaches a critical value, possibly determined by such factors as surface energy or charge density or when the supply of some critical material is exhausted. This final size, however, will be influenced by factors of the environment such as temperature, concentration, hydration, *p*H, and so forth. It is also possible that the composition of the bulk material could vary within limits since strict specificity requirements are operating only in the surface layer. The supply of precursors, controlled by the system as a whole, may, however, be considerably buffered, tending to produce identical structures.

We thus have a mechanism whereby a solid structure is duplicated and at the same time a replication and preservation of a specific interface takes place. We may identify this structure with the chromosome, but the diagrammatic view of Fig. 1 is not meant to imply that the interface necessarily runs along the chromosome axis, nor that it is dimensionally correct, nor, indeed, that this is the only way adsorption complexes can be organized into one structure. Variations of the model could, for example, account for "discreteness" of the genetic material in the chromosome. (Chromomeres? see also, Mazia, *15*).

The special conditions described here in some detail do not necessarily apply to all structures containing genetic material nor to all variations of a changing system of which it forms a part. Thus, for instance, the evidence that in certain systems (phage, transforming principle) the nucleic acid only is transferred is not incompatible with the idea that the participation of this material in the host's cell economy results in the same *type* of structure as discussed here. Neither is the principle of the duplicating mechanism restricted to desoxyribose nucleic acid as one of the participants. The evidence that the plant viruses contain ribose nucleic acid only (where one definitely does not find base pairs) should serve as a reminder that genetic mechanisms should not be looked for in the properties of particular substances but in the way the whole system is organized (*16, 17*).

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16. A discussion of these aspects and the problems connected with meiosis, mutations, and differentiation is in preparation.

17. My thanks are due to my colleagues for helpful criticism. The basic ideas underlying the present approach were developed in discussions with Per Oftedal during his stay in this department in 1952.

Lamont Natural Radiocarbon Measurements III

W. S. Broecker, J. L. Kulp, C. S. Tucek

The previously published radiocarbon measurements from this laboratory (*1, 2*) were made in 1950–1952 with the black-carbon method (*3, 4*). Subsequent to this period, the increasing frequency of atomic tests and, later, the larger shots which produced continuous long-term fallout, caused sufficient air contamination to render the black-carbon method unreliable unless elaborate precautions were taken and multiple runs were employed. By the end of 1953, the pioneer work of de Vries and Barendsen (*5, 6*) with carbon dioxide and Suess (*7*) with acetylene had shown that proportional gas-counting methods have some distinct advantages. A gas proportional-counting system was then designed and constructed at Lamont Observatory (*8*). This paper (*9*) reports the results obtained by the black-carbon method during 1953 which are considered reliable and those obtained by the new carbon dioxide proportional-counting method.

Techniques, Assumptions, and Errors

The carbon dioxide proportional-counting system is superior to the black-carbon method for several reasons: (i) it has virtually 100-percent counting efficiency compared to 6-percent; (ii) it is free from air-borne fission product contamination; and (iii) it can be readily adapted to samples containing as little as 0.1 gram of carbon. The use of carbon dioxide is preferred over acetylene because of the absence of explosion hazards, the possibility of going to higher pressures with a consequent increase in sample/

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background ratio, the absence of fractionation during preparation, and the ease of preserving the sample after counting. The carbon dioxide proportional system was selected for routine assay over the liquid scintillation technique because of the simplicity in sample preparation, the absence of fractionation, and the ease of reproducibility of background and counting efficiency.

The new technique involves the conversion of the carbon in the sample to very pure carbon dioxide, which is then placed in a large-volume (5-liter) proportional counter at a pressure of 1 to 2 atmospheres. Three counters have been in routine operation; the characteristics of each are given in Table 1. The small counter is used for samples containing less than 1 gram of carbon.

The ages given in this paper are given in carbon-14 years on the basis of a half-life of 5568 ± 40 years. If the integrated cosmic ray flux has been constant over the past 50,000 years (*10*), if the samples have not been subject to field contamination, and if the proper contemporary value for each sample type is selected, the carbon-14 ages will be in actual years. There was negligible isotopic fractionation in the preparation of these samples. Fractionation in nature appears quite limited (*11*) and would only produce detectable effects on near-modern samples. The relative sequence of ages is independent of the half-life used and very insensitive to changes in the cosmic ray flux.

The error quoted for the ages is a combination of errors from three sources: statistical uncertainty, background fluctuations, and variations in efficiency. In most cases, the background fluctuations were no larger than those expected from statistical fluctuation alone, but during certain periods they exceeded this, introducing somewhat larger error in the determination. These variations can be correlated with extreme atmospheric pressure changes. The variations in efficiency are for the most part much less than 1 percent. This can be checked by the use of an external gamma-ray source. Two or more measurements were made on the majority of samples reported. In a few cases where only limited accuracy was necessary, the age quoted is based on only one determination.

The errors on a given measurement are calculated as follows:

$$E_{R_i} = R_i \sqrt{\left(\frac{E_{S_i}}{S}\right)^2 + \left(\frac{E_{\overline{M}}}{\overline{M}}\right)^2}$$

where E_{R_i} is the error in the individual ratios of sample count rate to control count rate; E_{S_i} is the error in the sample count rate; $E_{\overline{M}}$ is the error in modern control count rate; S_i is the sample count rate; $\overline{M}$ is the average modern control count rate; and R_i equals $S_i/\overline{M}$ (age computed directly from this ratio)

$$E_{S_i} = \sqrt{E_{T_i}^2 + E_{B_i}^2}$$

where E_{T_i} is the error in the total count rate and E_{B_i} is the error in the background count rate.

$$E_{\overline{M}} = \sqrt{\frac{(\overline{M}_i - \overline{M})^2}{n(n-1)}}$$

where $\overline{M}$ is control count rate.

$$E_{T_i} = \sqrt{s_T^2 + e_{S_i}^2}$$

where s_T is the statistical error in total count (1 σ) and e_{S_i} is the error due to uncertainty in efficiency.

The error in the background count rate (E_{B_i}) is estimated from the scatter of background values around the mean for a given period. Rarely does it exceed a factor of 2 times the statistical error for a given background measurement.

Minimum ages are given if the average net count lies within twice the error of zero activity. Therefore, only four or five in 100 given minimum ages should fall below the stated limit.

Table 1. Comparison of counter characteristics (counts per minute for background and modern wood). Counters 1 and 2 have an active volume of 4.9 liters; counter 3 has an active volume of 0.5 liter.

Counter No.	1 atm		2 atm	
	Background	Modern wood	Background	Modern wood
1	15.0	29.0	17.5	58.0
2	12.0	30.2	14.5	60.5
3			3.0	5.6

Results

The natural radiocarbon measurements are arranged in five tables (Tables 2 to 6) for convenience. The samples are grouped according to the primary field of interest—that is, geology or archeology—and by the method used in the assay. The data for the separate study on deep-sea cores are shown in Table 6.

Some comparison and calibration data should be noted. First, in most cases the ages obtained both by the carbon dioxide method and black-carbon method agree within the experimental error (see Table 4, samples L-219, L-125, and L-214; and Table 5, samples L-115 and L-116A). Evidence for fission-product contamination has been detected in some cases [Table 5, sample L-195; and Suess (*12*), samples W-76 and W-77, which were reruns by the acetylene method of samples L-117A and L-117S (*1, 2*), which had been measured earlier by the black-carbon method].

The relative accuracy of the carbon-14 dates is shown again in the detailed stratigraphic suite of samples from Nazca, Peru, shown in Table 5. Several interlaboratory calibrations are available—see samples L-167A in Table 2, L-214 in Table 4, L-182 in Table 5, Suess's sample W-40 (acetylene) (*7*) and Lamont's sample 103B (*1*). Other laboratories have concurred on the Two Creeks, Wis., date at about 11,500 years before the present, and several of the European laboratories have agreed on the Gröningen Church wood standard at about 1000 years before the present (*13*). Some of the early Chicago black-carbon dates appear to be too high—for example, the Gröningen Church was reported to date about 2200 years before the present (*14*). An additional instance of this can be seen in the comparison of sample L-214 (Table 4) for which three laboratories using two different techniques agreed on a date of 5200 years before the present, while Chicago obtained 6440 years before the present (*14*) (see also the discussion in Table 5 on samples L-115 and L-116A).

These new data also give several comparisons of different sample materials from the same site—that is, charcoal and shell (samples L-188C, L-201A, L-188A, and L-188D in Table 3), charcoal and wood (samples L-188B and L-188E in Table 3), and fresh and decayed wood (samples L-223A and L-223B in Table 2). The agreement in all cases is within the experimental error.

It is concluded that the errors stated are a reasonable index of the reproducibility of a measurement, that with the new techniques agreement between laboratories is excellent, and that there is no evidence of contamination in any of the measurements obtained by the gas-counting methods.

Studies of ocean-sediment cores made at the Core Laboratory of the Lamont Geological Observatory indicate that the transition from the Wisconsin glacial period to post-glacial time was marked by a rather sharp climatic change throughout the Atlantic Ocean and Caribbean Sea about 11,000 years ago. The lithologic and paleontologic data and a discussion of the implication of these results will be published separately (*15*). The carbon-14 dates on some of these cores are given in Table 6. All measurements were made on bulk core material. A value close to that of modern wood was used as an estimate of the initial carbon-14 activity of the carbonate in the sediments. Recent measurements on ocean water samples indicate that this assumption should introduce an error of no larger than 300 years.

Table 2. Radiocarbon dates obtained on geologic samples by the black-carbon method. All ages are given in radiocarbon years before the present.

Description	Sample No.	Age
I. *North America*		
A. *Alaska*		
1. *Cook Inlet area*		
Kasilof, Kenai Peninsula. Decomposed wood and bark from culture layer overlain by 3 in. of loess covering floor of house pit. On the basis of dendrochronology and the radiocarbon date, it is estimated that the site was last occupied between 250 and 350 yr ago. Other lines of evidence, both botanical and geologic, suggest that the radiocarbon date may be too young. It is not unlikely that the sample was contaminated by younger carbon, for it was collected well within the root zone of the present vegetation mat. Collected by T. N. V. Karlstrom, U.S. Geological Survey, Washington, D.C., in 1951.	L-137E	450 ± 200
Boulder Point, Kenai Peninsula. Samples from base of 18-ft-thick organic silt deposit. L-117O was taken 2 ft below L-163B. Collected by T. N. V. Karlstrom.		
Wood fragments.	L-163B	8650 ± 450
Peat.	L-117O	8200 ± 900
Boulder Point, Kenai Peninsula. Buried log from basal outwash exposed in sea cliffs north of Boulder Point. Collected by T. N. V. Karlstrom.	L-117M	> 25,000
Homer. Log fragments under 6 ft of slope wash and landslide debris and 8 ft above a buried till near Homer. Indicates that lower Kachemak Bay was ice-free long before 2250 yr ago. Collected by D. B. Krinsley, Alaska Division, U.S. Geological Survey, Washington, D.C., in 1950.	L-137K	2250 ± 300
Ninilchik, Kenai Peninsula. Wood from base of 10-ft peat section overlying 20 ft of stratified sand and gravel resting on gray till. The underlying gravel is interpreted as channel gravel deposited on old till and related to the Naptowne end moraines near Tustumena Lake. Dates the beginning of peat accumulation in late- or post-Naptowne time. Collected by D. B. Krinsley in 1951.	L-137L	9600 ± 650
Point Possession, Kenai Peninsula. Two samples were collected from separate localities outside the boundaries of the last major glaciation (Naptowne) as described from the Cook Inlet area (Karlstrom, in Péwé *et al., 16*) and from apparently similar stratigraphic zones. The close agreement in age is striking and bears on the validity of the radiocarbon method in dating geologic events. Both samples were collected from buried organic deposits separated from underlying drift by a stratified-to-massive blue-gray silt with scattered pebbles and cobbles considered to be a glaciolacustrine deposit related to the Naptowne advance. Collected by T. N. V. Karlstrom in 1951.		
Compressed and deformed peat at top of organic silt overlain by 15 ft of stratified sand and silt in cliff on south shore of Turnagain Arm.	L-137C	9500 ± 650
Organic silt under 30 ft of stratified sand and silt in exposure 3 mi east of collecting site of sample L-137C.	L-163D	9200 ± 600
Hope Junction, Kenai Peninsula. Basal wood from 5-ft section of alternating sequence of peat and organic silt overlying glacial lake silts exposed in road cut of Anchorage Highway near Hope Junction. Collected by T. N. V. Karlstrom in 1953.	L-237F	6800 ± 550
Ingram Creek, Kenai Peninsula. Woody peat from base of alternating peat and silt section 5 ft thick overlying till and bedrock exposed in road cut of Anchorage Highway near head of Ingram Creek. Collected by T. N. V. Karlstrom in 1953.	L-237G	4500 ± 450
Kenai, Kenai Peninsula. Lignitized log at base of 50-ft section of iron-stained and flexured gravel overlying glaciolacustrine or -estuarine deposits, 3 mi north of Kenai in sea bluff.	L-137D	> 24,000
2. *Seward Peninsula*		
Throughout the Seward Peninsula, organic material can be obtained from muck deposits that fill valleys of minor streams which are commonly underlain by blue-gray silt or by an older muck that contains fossil remains such as elephant, horse, and bison, which are conspicuously absent in the dated muck. Locally, the dated muck overlies thin gravel containing remains of extinct mammals. Until recently it has not been possible to correlate these deposits with any known chronology, and their origin and climatic significance have been obscure. These dates, coupled with previously published dates for samples L-117C and L-117D (*2*), demonstrate that the muck has been accumulating more or less steadily from more than 10,200 yr ago to less than 450 yr ago. The contained plant remains suggest that the muck has accumulated during periods when open forests of birch and poplar were present in the valleys as well as during periods, such as the present, when trees were lacking. Samples from zones containing remains of large birch and poplar trees not present in the area today suggest warmer periods, or at least periods with warmer summers, centered about 3600 yr ago and from 8300 to 9500 yr ago. Buried beaver dams indicate beaver activity about 3600, 8350, and 9500 yr ago in an area which is from 50 to 100 mi beyond the range of modern beavers. Finally, the fossil fauna of the Pleistocene appears to have become extinct on Seward Peninsula much more than 10,000 yr ago.		
Peat overlain by 8 ft of muck; upper Coffee Creek, Bendeleben B-6 Quadrangle. Collected by R. S. Sigafoos, Alaska Division, U.S. Geological Survey, Washington, D.C., in 1950.	L-137F	2750 ± 350
Wood overlain by 10 ft of frozen muck; lower Coffee Creek, Bendeleben B-6 Quadrangle. Collected by R. S. Sigafoos in 1950.	L-137G	10,200 ± 800

Description	Sample No.	Age
Wood overlain by 15 ft of muck; Candle Creek, Bendeleben D-1 Quadrangle. Collected by D. M. Hopkins, Alaska Division, U.S. Geological Survey, Washington, D.C., in 1949.	L-137N	9400 ± 750
Wood from muck at head of Black Gulch, Bendeleben C-5 Quadrangle. Collected by D. M. Hopkins in 1948.	L-117E	8800 ± 1000
Wood from buried beaver dam on Mud Creek, Candle D-6 Quadrangle. Collected by D. M. Hopkins in 1949.	L-117E	3600 ± 500
3. *Bristol Bay area*		
Nushagak Bay. Peat toward base of 6-ft organic section over stratified fine sand, at mouth of abandoned slough west of Dillingham. Places a ceiling on a level of the sea several feet higher than at present, tentatively correlated with the "postglacial climatic optimum." Collected by E. H. Muller, Alaska Division, U.S. Geological Survey, Washington, D.C., in 1951.	L-137J	3600 ± 400
Naknek, Alaska Peninsula. Peat in poorly stratified blue-gray silt overlain by 35 ft of stratified sand and silt. Below the peat, stratified silt contains striated cobbles and overlies till exposed at Cape Suworof, ½ mi to the east. Places a ceiling on till at Cape Suworof, implying a pre-Wisconsin age. Collected by E. H. Muller in 1951.	L-137I	> 30,000
Cape Greig, Alaska Peninsula. Peat over till and underlying 35 ft of lacustrine sand and silt. Dates an interval of peat accumulation shortly after glaciation of Cape Greig. Coarse sand and gravel immediately above may be related to a moraine 8 mi to the east at Pilot Point, which is considered to be of Brooks Lake equivalence (Muller, in Péwé *et al., 16*). Collected by E. H. Muller in 1951.	L-137H	12,750 ± 1100
4. *Other localities*		
Chena River. Wood from 4- to 12-in. peat bed overlain by 5 ft of gray-brown silt and 1 ft of surface peat from bluff on south bank of abandoned channel of Chena River, ¼ mi from river, at long. 146°43.3′W, lat. 64°52.3′N. Collected by J. R. Williams, Alaska Division, U.S. Geological Survey, Washington, D.C., in 1950.	L-237A	8450 ± 700
Kobuk River. Samples collected by A. T. Fernald and D. R. Nichols, Alaska Division, U.S. Geological Survey, Washington, D.C., in 1952.		
Tree trunk from organic zone overlying till and overlain by 35 ft of stratified silt and sand.	L-237C	24,400 ± 4000
Silty peat from 35-ft section of sand and intermixed organic material overlain by 75 ft of dune sand.	L-237D	> 24,000
Log from 15-ft depth in terrace sand and gravel in bluff near Shungnak.	L-237E	2500 ± 300
Fairbanks. Wood from stump in forest bed buried under approximately 50 ft of muck in Dawson cut, 8 mi north of Fairbanks. The stump lies at the base of the muck formation that is tentatively thought by the submitter to be Wisconsin in age and correlates well with samples from other localities in stratigraphically similar horizons—that is, L157A and L158A. Submitted by T. L. Péwé, Alaska Geology Branch, U.S. Geological Survey, College, Alaska.	L-137P	> 24,000
Dome Creek. Series of samples in perennially frozen organic silt (muck) along Dome Creek, 10 mi north of Fairbanks. The stump (L-158A, in place) and muck (L-158B) were closely associated; the wood (L-157B) and bison hide (L-127) (*2*) were slightly higher stratigraphically; and sample L-163H was still higher in the section but well within the permafrost zone. Submitted by T. L. Péwé.		
Wood from upright stump at bottom of section.	L-158A	> 30,000
Muck closely associated with L-158A.	L-158B	> 30,000
Wood 2 ft stratigraphically higher than L-158A but nearby. Total exposed permafrost section, 40 to 50 ft.	L-157B	> 25,000
Wood occurring 40 ft below surface in muck stratigraphically 10 ft above L-158B.	L-163H	> 30,000
Eva Creek. Series of samples in a vertical 100-ft section along Eva Creek, 10 mi west of Fairbanks. Sample L-117H (3750 ± 200 yr) (*2*) was taken in the permafrost zone in the same vertical section at a depth of about 8 ft. Submitted by T. L. Péwé.		
Wood taken 30 ft below surface in frozen muck.	L-163J	> 30,000
Wood from 60 ft below surface in frozen muck.	L-157A	> 23,000
Wood from stump at bottom of section (100-ft depth) in frozen silt.	L-137X	> 28,000
Eva Bench. Fragments of wood in permafrost 9 ft below surface in tan silt, 10 mi west of Fairbanks adjacent to Eva Creek. Submitted by T. L. Péwé.	L-137S	10,500 ± 500
B. *Canada*		
Fraser Valley, British Columbia. Material was taken from base of Sumas till, which is believed to represent the last advance of the ice in the lower Fraser Valley. Submitted by J. E. Armstrong and V. K. Prest, Geological Survey of Canada.		
Small stems and rootlets from Richmix Quarry, Sumas Mountain.	L-221D	11,500 ± 1100
Wood from station 252A, Mount Lehman Road.	L-221E	11,000 ± 900
Vancouver Island, British Columbia. Samples taken from 40-in. peat bed in Quadra group which lies beneath 50 ft of Vashon till. This sequence has been traced from intermittent exposures for a 3-mi length of the sea cliff bordering Georgia Strait. The peat-bearing beds are believed to correlate with similar deposits found throughout the Georgia Basin. Submitted by J. G. Fyles, Geological Survey of Canada.		
Wood.	L-221A	> 26,000
Peat.	L-221B	> 24,000
Lethbridge, Alberta. Sample consists of wood (black spruce) contained in 4 ft of limonitic sand and gravel that is underlain by 78 ft of till. Horberg included these materials in his "Lower Till" which he tentatively assigned to the Tazewell or Cary substage of Wis-	L-221C	> 26,000

Description	Sample No.	Age
consin glaciation. Submitted by A. M. Stalker, Geological Survey of Canada.		
C. *United States*		
1. *West*		
White River, Wash. Logs imbedded in volcanic mudflow deposit originating from the northeast side of Mount Rainier, then flowing down the valley of the White River some 40 mi to the west front of the Cascade range, then some 20 mi farther west into the Puget Sound lowland. Both hard fresh wood and badly decayed wood were run to check the possible alteration in the isotopic composition. Submitted by D. R. Crandell, U.S. Geological Survey, Washington, D.C.		
Fresh wood.	L-223A	4800 ± 450
Decayed wood.	L-223B	4950 ± 450
North Fork Newaukum River, Wash. Fossil wood (fir) in stream bed of river in SW 1/4 NW 1/4 sec. 35, T14N, R1W, W. M. Abundant, well-preserved limbs and trunks of fossil trees interbedded in sandstone and conglomerate beds of the Astoria formation of Miocene age.	L-228	> 27,000
San Francisco, Calif. Limb of juniper or red cedar, probably *Juniperus californica,* obtained from the west flank of Russian Hill during the excavation of Broadway Tunnel in a crossbedded, silty to clayey sand immediately above a bed of dark gray, sandy clay. This stratigraphic unit is probably part of an unnamed sand formation that underlies the widespread dune sands of the city and the recent muds and clays deposited in San Francisco Bay and that is extensively developed in the Lake Merced-Merced Valley area. It may be correlative with the Temescal formation and Merritt sand of Pleistocene age. Submitted by M. G. Bonilla and J. Schlocker, Engineering Geology Branch, U.S. Geological Survey, Washington, D.C.	L-227	> 27,000
Rozel Point, Box Elder County, Utah. Sample of asphalt that is believed to be one of the youngest natural oils in existence. Submitted by J. M. Hunt, Carter Oil Company, Tulsa, Okla.	L-155	> 30,000
Grand County Utah. Juniper roots penetrating the McCoy group of the Thompson district. Two separate samples. Collected by Helen Cannon, U.S. Geological Survey.		
Juniper roots.	L-150A	< 200
Juniper roots.	L-150B	< 200
Unaweep Canyon, Colo. Charcoal obtained from a hearth in alluvium along East Creek, Unaweep Canyon. The hearth is 6 ft below the top of the alluvium, which is believed to be correlative with the Tsegi-Calamity-Piney Creek alluvial series. Estimated age: 2500 to 3500 yr before the present. Submitted by C. B. Hunt, U.S. Geological Survey.	L-167B	1350 ± 200
2. *Midwest*		
Stump Lake, N.D. Sample from tree stump along shore in SW1/4 sec. 32, T151N, R60W, Nelson County. Collected by S. Aronow, University of Wisconsin, Water Resources Division, U.S. Geological Survey.	L-239B	500 ± 400
Curtis, Neb. Charcoal from terrace on Dry Creek, NW1/4 sec. 1, T7N, R26W. Collected by J. C. Brice, Washington University, for Water Resources Division, U.S. Geological Survey.	L-239C	2200 ± 300
White Pine, Mich. Log buried beneath 35 ft of clay, north of center of sec. 4, T50N, R42W. Collected by W. S. White, Mineral Deposits Branch, U.S. Geological Survey.	L-239A	12,600 ± 1200
3. *Mississippi Delta*		
Mississippi Delta. Dated samples from the late Quaternary deltaic deposits of the Mississippi can be used to interpret elevations of the sea at the time of sample deposition. The analyses of these samples provide information concerning elevations of the sea following the lowering of sea level in the late Wisconsin maximum. The detailed geology has been covered in a comprehensive report (*17*). The analysis of these dated samples indicates that 10,000 yr ago, the sea was about 100 ft lower than it is at present and that sea level was very nearly at its present level 5300 yr ago. Other geologic information (*17*) indicates that sea level has maintained its stand during the last 5000 yr. Samples L-175D and L-175G, dated 1400 and 350 yr respectively, were laid down in depositional environments associated with standing sea level. In determining the elevation of the sea at the time each sample is deposited, it is necessary to consider the amount of postdepositional downwarping and the elevation of the environment with respect to the level of the sea at the time the sample was buried. The environments of deposition of late Quaternary sediments from which these samples were taken and the amount of structural downwarping have been discussed by Fisk and McFarlan (*18*). Submitted by H. N. Fisk, Humble Oil and Refining Company, Houston, Tex.		
Marine pelecypod shells, surface, mouth of Mississippi River, Plaquemines Parish, La. Surface of mudlump 2000 ft off North Pass.	L-175G	350 ± 250
Large shells from 13-ft depth, Belle Chasse area, Plaquemines Parish Pumping Station, T14S, R24E, sec. 89.	L-175D	1400 ± 200
Marine pelecypod shells from 69-ft depth, same location as sample L-175D.	L-175E	5350 ± 500
Wood from 35- to 45-ft depth, Lake Felicity area, Terrebonne Parish, La., T20S, R20E, sec. 5.	L-175F	6000 ± 550
Wood from 120- to 135-ft depth, Duck Lake area, St. Martins Parish, La., T15S, R11E, sec. 2.	L-175B	9750 ± 550
Wood from 80- to 120-ft depth, North Thibodaux area, Lafourche Parish, La., T14S, R16E, sec. 84.	L-175C	10,900 ± 100
Marine pelecypod shells from 79- to 85-ft depth, University Place and Common Street, Orleans Parish, La.	L-175A	> 30,000
4. *East*		
Damariscotta, Me. Oyster shells		

Description	Sample No.	Age
taken 1 ft above base in one of the largest shell heaps on the west bank of the Damariscotta River. Oysters are no longer abundant in this estuary, possibly suggesting a significant change in climate. This material also afforded a test of the effects of surface contamination. The results suggest slight additions of old carbon to the bulk material, but the results are within stated errors. Collected by W. H. Bradley, U.S. Geological Survey.		
Selected, cleaned shells.	L-160A	1600 ± 250
Bulk material.	L-160B	1900 ± 250
McDowell County, N.C. Well-preserved wood from North Muddy Creek at a point on the stream about 5.2 mi east of Marion, N.C., and 1.3 mi south of Nebo. This specimen is a fragment from a buried log that lies near the base of a peaty blue-gray sandy clay at a total depth of 7 ft beneath the present surface of the flood plain. The log lies immediately above a monazite-bearing gravel that forms the basal aggregate of the fluvial sediments on North Muddy Creek. The clay is overlain by 2 ft of brown sandy silt, which is overlain by 3 ft of red-brown sandy silt. The log appears to have been deposited at the same time as the clay. The upper 3 ft of red-brown sandy silt probably has been deposited since farming began in McDowell County about 150 yr ago. [This sample (W-7) was also dated by Suess at 2270 ± 200 yr (*12*).] Submitted by W. C. Overstreet, U.S. Geological Survey.	L-167A	2680 ± 300
Brantley County, Ga. Organic material from soil samples from the Leon sand. Collected by R. S. Dyal and submitted by L. Alexander, U.S. Department of Agriculture.		
Material from a depth of 17 to 20 in.	L-204A	1150 ± 350
Material from a depth of 88 to 133 in.	L-204B	23,000 ± 8000
South Florida. Mangrove peat from borings at the mouth of Shark River on the southwest coast. At this locality, the surface of which is covered by high tide, as much as 15 ft of autochthonous mangrove peat overlies a submerged rock surface. Because mangroves do not grow in water depths greater than a few feet, this occurrence of peat indicates rapid relative subsidence, and together with the evidence of still sand or uplift on the southeast coast, suggests a tilting of the Florida peninsula and submarine plateau. The ages also suggest that tropical peats can accumulate very rapidly during subsidence—as much as 1 in. per 20 yr. Submitted by Robert N. Ginsburg, University of Miami.		
Peat at 35- to 50-in. depth.	L-162C	1500 ± 350
Peat at 84- to 94-in. depth.	L-162E	1700 ± 400
II. *Pacific Ocean*		
Rapa Island, South Pacific Ocean. Lignite sample from Rapa Island in the Australian group, Polynesia, assigned a late Tertiary age. The isolation of this lignite and its possible young age were the reasons for the analysis. Submitted by J. M. Schopf, U.S. Geological Survey.	L-150C	> 26,000

Table 3. Radiocarbon dates obtained on archeological samples by the black-carbon method. All ages are given in radiocarbon years before the present.

Description	Sample No.	Age
I. *North America*		
San Francisco Bay, Calif. Samples from burials and midden at University Village site (14-S Ma-77). On the basis of cross-dating with the Early horizon of the Sacramento-Delta region, this site is judged to be the earliest known evidence of human occupation in the San Francisco Bay region. Estimated date 1000 to 2000 B.C. Submitted by B. Gerow, Stanford University.		
Charcoal from burials with major cultural association.	L-187A	2700 ± 350
Charcoal from both burials and midden.	L-187B	3150 ± 300
II. *Asia*		
Saudi Arabia. Three samples of charcoal from an ancient mining site in southwestern Saudi Arabia near the northwestern corner of the Rub al Khali. The ages indicate that the veins were mined for gold during at least two periods and will doubtless be of value for studies of desiccation in the Arabian desert. Samples submitted by W. D. Johnston, Jr., Foreign Geology Branch, U.S. Geological Survey.		
Charcoal.	L-159A	1400 ± 250
Charcoal.	L-159B	550 ± 200
Charcoal.	L-159C	500 ± 250
Baluchistan (Pakistan). The dating of prehistoric Indian and Baluchi chronologies is still in a very early stage because there has been so little evidence for gaging a time datum. It is known that the Harappan cultures of the Indus Valley were flourishing after 2200 B.C. because evidence in Mesopotamian sites of that period has been recovered. The assumption that can then be made is that the pre-Harappan Amri ware can probably be dated in the period between 2800 and 2500 B.C. In Baluchistan the evidence is very scanty, and dating can be made only on the basis of comparison with the Harappan period. The Baluchi sites stand midway between the Indus Valley and Iran, and their dating would be indicative of the period when the Near East was influencing India. A basis for comparison with known Mesopotamian sites is necessary; C^{14} dating of the Quetta sequence makes this possible. The Quetta Valley sequence has been		

Description	Sample No.	Age
worked out by stratigraphic excavation, and five assemblages have been defined, running from a preceramic horizon (Neolithic?) to an elaborate ceremonial and agricultural society. Each of these assemblages contains elements directly comparable to other assemblages known in Baluchistan and the Indus Valley. The preceramic culture (KGM) is of maximum importance because its dating will go far in demonstrating whether the Indian area was so peripheral to Near Eastern culture centers that it has been an area of considerable lag, or whether contacts were more frequent and development was more immediately responsive to the West. On the basis of present-day evidence, the following approximate dates have been postulated for the Indus-Quetta cultures:		

Indus Valley	*Quetta Valley*	*Date* (B.C)
Harappan	Damb Sadaat III	2000
	Damb Sadaat II	2300
Amri	Damb Sadaat I	2500–2800
	KGM IV	
	KGM III	3000
	KGM II	
	KGM I	4000

Description	Sample No.	Age
The samples were selected from the stratigraphic levels in the order of sequence from preceramic to the elaborate Quetta culture in order to present a series of sequential dates. The assumption was made that if any sample was contaminated, its date would be out of line with the archeological data. The series of dates resulting is, however, valid in terms of the archeology. If this series of dates can be taken as a reliable indication of the chronology of the Indus River-Baluchistan area, it is clear that, unless considerable cultural lag is postulated, the dates determined by other means for the prehistoric village cultures of both Iran and Iraq to which there is frequent close stylistic comparison with the Baluchistan cultures particularly, must be revised down and in some cases quite considerably.		
Charcoal from Kili Ghul Mohammad I site in Quetta Valley, in the base of Room I in the mound. There is no previous date for a preceramic level in the Indian area. The nearest area in which such comparable levels have been dated with reasonable accuracy is in Iraq (Jarmo). In comparison, there appears to be at least a 1000-yr lag in the Quetta area. However, since this sample is taken from the upper levels of the preceramic horizon, it is entirely possible that a date from the lowest levels (3.5 m below) may close the time gap.	L-180A	5300 ± 500
Charcoal from Mian Ghundai (Damb Sadaat I) Quetta Valley, in rubble fill. The relationships of these levels to the Amri assemblages of Sind are very strong. In view of this fact and of the evidence for dating the Amri of Sind to the period prior to 2300 B.C., and more exactly to 2500 B.C., it appears that the date of 2150 B.C. is too late. In view, however, of the range allowance, it is likely that a date of 2400–2300 B.C. for the Amri of the Quetta Valley (Kechi Beg) is more fitting.	L-180B	4150 ± 350
Charcoal from Mian Ghundai (Damb Sadaat II) in a hearth from wall C of Room 2. The archeological evidence for contemporaneity of the Quetta culture with the Harappan civilization indicates that this date falls well within the time expectancy of that culture.	L-180C	4050 ± 400
Charcoal from Mian Ghundai (Damb Sadaat II) from Room 3, north wall complex. This sample belongs to the Quetta culture, as does L-180C. However, it was collected 3 m below L-180C and was separated from it by at least two floor levels. This sample is, therefore, somewhat earlier than L-180C. It is favorable to that of L-180C in stressing the date of 2000 B.C. for the Quetta culture.	L-180E	4050 ± 350
Hoifung, South China. Charcoal from TAS site in Hong Kong area. This site is believed to belong to the very end of the Neolithic, which is characterized by the first appearance of "glaze" pottery and dark stoneware. The site is thought to be not older than 2000 B.C. or younger than 500 B.C. Submitted by H. L. Movius, Jr., Harvard University; collected by the late Father Maglioni, Catholic Mission, Hong Kong.	L-188C	2950 ± 400
Hoifung, South China. Shells from coastal Neolithic site in the SOS locality. Sample seems to mark the beginning of "net" decoration, and its typical adzes seem to be ancestors of the rectangular type. Predicted age: between 2500 and 500 B.C. Conch shells growing at present in the area were used as a control. Their activity was 2 percent higher than the average value for modern wood. Collected by the late Father Maglioni and submitted by H. L. Movius, Jr.	L-201A	3100 ± 150
III. *Europe*		
Cave of La Madeleine, near Montpellier (Herault) southern France. Carbonized wheat and shells found between two stratified late Neolithic hearths associated with typical pottery of West European or Chasseyian type. The age was estimated as 2500 to 200 B.C. Collected by J. Arnal, submitted by H. L. Movius, Jr.		
Carbonized wheat.	L-188A	4200 ± 500
Shells (average modern wood value assumed for control).	L-188D	4700 ± 400
Cave of Suquet-Coucoliere, near Montpellier (Herault), southern France. Samples associated with pottery and artifacts of early Bronze Age type found in level 3 of this site. The overlying horizon yielded materials of the early Middle Bronze Age and late Neolithic material occurred immediately below. The date was estimated as 1900 B.C. The fact that the two C^{14} dates agree indicates that the difference between the predicted and the C^{14} ages is not due to contamination either in the laboratory or in the field. Collected by P. Ponnaux and C. Ponnaux. Submitted by H. L. Movius, Jr.		
Charcoal.	L-188B	1700 ± 300
Wood.	L-188E	1750 ± 300

Table 4. Radiocarbon dates obtained on geologic samples by the carbon dioxide method. All ages are given in radiocarbon years before the present.

Description	Sample No.	Age
I. *North America*		
A. *Alaska and Canada*		
Umiat, Alaska. Core containing peat and woody material taken in small valley, lat. 69°23′N, long. 152°10′W, 3 mi north of Umiat. Pollen analyses have been correlated with peat from the Chandler Lake area 90 mi to south. Submitted by Boston University Physical Research Laboratories.		
Material 4.2 to 4.6 ft from surface, in layer at top of birch pollen zone.	L-277D	5890 ± 170
Material 20.0 to 21.5 ft from surface, near bottom of birch pollen zone.	L-277C	7530 ± 150
Material 24.0 to 25.0 ft from surface; lies in zone of herbaceous pollen below main peat zone.	L-277B	8300 ± 270
James Bay, Quebec. Peat from bottom level of a bog near Smoky Hills Rapids north of James Bay, 175 ft above sea level. This sample dates the beginning of the upland occupation by forests in this area after recession of the sea. It was previously dated at this laboratory by the black carbon method at 2350 ± 200 yr. Submitted by J. E. Potzger, Butler University, and A. Courtemanche, University of Montreal.	L-219	2430 ± 100
B. *United States*		
Moss Lake, Wash. Samples of sedimentary peat from bog located in S36, T26N, R7E about 3.5 mi east of Stillwater. Submitted by G. B. Rigg and H. R. Gould, University of Washington.		
Peat immediately below layer of white volcanic ash at depth of 14 ft from bog surface.	L-269B	7000 ± 200
Peat immediately overlying blue clay (rock flour) at depth of 21.75 ft below surface.	L-269A	11,900 ± 360
Covington, Wash. Samples of sedimentary peat from bog located about 2 mi east of Covington in S32, T22N, R6E. Submitted by G. B. Rigg and H. R. Gould.		
Peat immediately below layer of brown volcanic ash at a depth of 13.75 ft below bog surface. *Comment*: layer of volcanic ash is presumably correlative with that associated with L-269B.	L-269C	6500 ± 200
Peat immediately above Pleistocene sand and gravel at a depth of 54.5 ft below the bog surface. This sand and gravel is at the bottom of a kettle through which melt water from the Vashon ice sheet passed; it is believed to have been deposited when the front of ice was only a few mi away. If so, the age of this peat should indicate the time that the Vashon ice receded from this area.	L-269D	10,200 ± 500
Santa Rosa Island, Calif. Partially charred and badly decomposed wood sample from base of dwarf mammoth-bearing alluvium in Tecolote Canyon 1 mi inland. This is a minimum date for the 25-ft high sea stand which is probably pre-Wisconsin. Submitted by P. C. Orr, Santa Barbara Museum of Natural History, Santa Barbara, Calif.	L-244	15,820 ± 280
Central California Coast. Rock-boring mollusks that once lived in the surface of a wave-cut platform; this platform, now part of a marine terrace, has an old sea level line which is now approximately 100 ft above sea level at Santa Cruz. Submitted by W. C. Bradley, University of Colorado.	L-285	> 37,000
Mississippi Delta. Wood sample taken from a core at 273-ft depth. Wood from stump of tree that apparently grew on weathered surface which divides Wisconsin and pre-Wisconsin sediments. If this tree grew in place, it must have lived after the sea level was lowered to at least this extent during the onset of the Wisconsin glaciation. This sample was dated earlier (*2*) by the black-carbon method as older than 30,000 yr. Submitted by H. N. Fisk.	L-125I	> 39,000
Wisconsin Lakes. These samples are hydrocarbon extracts from recent sediments in two Wisconsin Lakes. The problem was to define whether these extracts were modern in origin or merely contamination by old hydrocarbons. Sample 243B is the smallest sample which has been subjected to the dating procedure in this laboratory. The total weight of carbon in sample 243B was 0.025 g. Despite the large error, the samples are judged to be composed at least in part of recently formed hydrocarbons. Submitted by S. Judson, Princeton University.		
Lake Mendota bottom sediment 0 to 27 in. depth. Hydrocarbon content about 200 parts per million. Sample run was hydrocarbon extract.	L-243A	5250 ± 1600
Trout Lake bottom sediment 0 to 27 in. depth. Hydrocarbon content about 275 parts per million. Sample run was hydrocarbon extract.	L-243B	1800 ± 1600
South Haven, Mich. Intercalibration samples submitted to various laboratories by J. H. Zumberge of the University of Michigan. The sample consists of a white pine log taken from a peat layer located on the eastern shore of Lake Michigan. Results obtained by the various other laboratories are as follows: Chicago (C-848) 6440 ± 230 yr (*14*); Michigan (M-290) 5090 ± 300 yr (*19*); Yale (Y-169) 5300 ± 250 yr (black carbon) (*19*).	L-214	5130 ± 110
St. Petersburg, Fla. Charcoal (burned long-needle pine) from newly exposed canal cuts near Joe's Creek bridge. Associated with extinct Seminole Field mammals, an "archaic" spear point, flint chips, and burned bone. These materials lie in unconsolidated strata which uncomformably overlie the Pamlico Terrace and therefore are much younger geologically. Nevertheless, the date seems anomalously low in view of the extinct fauna.	L-211	2040 ± 90
II. *Europe*		
Lake Massaciuccoli, Italy. Pebble of compressed peat, perforated by pholads, contained in the purpura haemastoma, s. sp. Consul Beach, at from − 12 to − 26 m of Torre Del Lago. Peat contains the remains of a forest of *Pinus* dominating on *Abies, Picea,* and *Betula,* the highest	L-246	18,350 ± 400

Description	Sample No.	Age
forest formation of the present Alps. Presumably Epi-Wurm II or Epi-Wurm III stage of the last glaciation (*20*). Collected and submitted by A. C. Blanc, Istituto Italiano Di Paleontologia Umana, Rome, Italy.		
III. *Pacific Ocean*		
Raroia Atoll. Samples bearing on eustatic or local fluctuation in the South Pacific Ocean. It is concluded that Raroia coral atoll had attained roughly the present form and dimensions by a date 2500 yr ago. Subsequently, elevation of 15 to 20 cm or eustatic drop in sea level by this amount resulted in onset of considerable erosion of the reef margin by storms and upgrowth of islands by deposition of the coarse rubble of corals. These changes seem to have occurred about 2000 yr ago. Collected by N. Newell, Columbia University.		
Fragment of reef thrown up on erosion remnant of old reef flat, presumably by a hurricane. The date of the limestone of this block provides a rough maximum date by which the atoll had reached its present form and a maximum date for the elevated reef platform on which the block rests.	L-258A	2680 ± 90
Humic soil from a depth of 4 to 5 ft which corresponds closely to the time of change from fine to coarse sedimentation. The sample is thought to be indicative of the maximum age of the principal island of the atoll. This horizon overlies coarse gravel probably equivalent in age to the reef block of sample L-258A.	L-258B	900 ± 130
Pieces of coral separated from the humic soil of sample 258B.	L-258C	1740 ± 230
IV. *Soil studies*		
This group of samples was submitted by the Soil Survey, Soil Conservation Service, U.S. Department of Agriculture, Beltsville, Md. (*21*)		
Podzol from Bennekom, Netherlands (B_{21} horizon, 15 to 20 cm)	L-251A	940 ± 20
Cresco-Kenyon intergrade from Howard County, Iowa, 300 ft west and 150 ft north of SE corner NE1/4 sec. 33, T100N, R13W (A_{11} horizon, 0 to 4 in.).	L-251B	210 ± 130
Cresco-Kenyon intergrade from Howard County, Iowa, 300 ft west and 150 ft north of SE corner NE1/4 sec. 33, T100 N, R13W (A_{12} horizon, 4 to 8 in.).	L-251C	< 100
Edina silt loam, near NW corner, SW1/4 sec. 10, T68N, R21W, Wayne County, Iowa (A_1 horizon, 0 to 6 in.)	L-251D	410 ± 100
Edina silt loam, near NW corner, SW1/4sec. 10, T68N, R21W (A_2 horizon, 8 to 12 in.).	L-251E	840 ± 200
Clarion, A_{11}, 0 to 6 in., Pocahontas County, Iowa.	L-256A	440 ± 120
Webster, A_{11}, 0 to 6 in., Pocahontas County, Iowa.	L-256B	270 ± 120
Barnes loan, 0 to 4 in., Cavalier County, N. D.	L-256D	350 ± 120
Humic Glei, Wayne County, Ind.	L-256C	30,000 ± 8000
V. *Arctic studies*		
Ellesmere Island. Wood samples from shore areas which yield climatological information bearing on the origin and history of arctic ice shelves. The lack of any source area within several hundred miles indicates that the wood probably drifted to its present location on the shore. Samples numbered 254 may indicate times when the shelf was absent; however, a moat between the shelf and the shore has been reported (*22*) that might allow access even during the presence of a shelf. The L-266 series was submitted by Hattersley-Smith; the L-261, L-254, L-248, and L-284 series were submitted by A. P. Crary, Air Force Cambridge Research Center, Cambridge, Mass.		
Wood from hill immediately east of Sanding Lake, Prince Patrick Island. Collected by E. T. Tozer.	L-266A	> 25,000
Wood from 6 mi north of Salmon Point, Intrepid Inlet, Prince Patrick Island. Collected by E. T. Tozer.	L-266B	> 33,000
Wood from top of gravelly ridge about 10 mi inland from Canyon Fiord. Collected by P. F. Bruggeman.	L-266C	> 33,000
Large fragment of spruce believed to be drift wood found near Richardson Depot Point. Collected by A. P. Crary.	L-261A	980 ± 100
Small fragment of spruce from Depot Island in Markham Inlet. Collected by A. P. Crary.	L-261B	2190 ± 150
Small fragments of tamarack from Sheridan River terrace. Collected by A. P. Crary.	L-261C	6050 ± 200
Samples of driftwood from the northern shore of Ellesmere Island behind the present ice shelf. Collected by A. P. Crary.	L-254A L-254B L-254C L-254D L-248A	3400 ± 150 5740 ± 200 6120 ± 150 3000 ± 200 7200 ± 200
Ward Hunt Island. Shells from raised beach (140 ft) on Ward Hunt Island, a small piece of land projecting through the ice shelf on the northern shore of Ellesmere Island.		
McClintock Bay. Shells from raised beach near glacier face.	L-248B	7200 ± 200
Ward Hunt Island. Sponges on the surface of ice shelf near west end of island. May have been trapped by sea ice below shelf and subsequently have been brought to surface through melting. Collected by A. P. Crary.	L-284	400 ± 150
T-3 Ice Island. Samples were chosen in order to determine the origins of an 11- by 5-mi ice island floating in the Arctic Ocean. The significance of the dates obtained has been discussed in a separate publication (*22*). Submitted by A. P. Crary.		
Surface dirt in bottom of drainage lake. Represents a combination of all dirt layers with possibility that much of the top material had been washed away.	L-192B	5730 ± 300
Surface grass and debris. Represents top layer in area of much floral material but may not be representative of organic matter in top dirt layer.	L-192E	450 ± 200
Bottom layer of dirt near outcrop. Uncontaminated by surface layer and not subject to drainge loss as was sample L-192B.	L-213D	3050 ± 200

Table 5. Radiocarbon dates obtained on archeological samples by the carbon dioxide method. All ages are given in radiocarbon years before the present.

Description	Sample No.	Age
I. *North America*		
Apponaug, R.I. Oyster shells used as a roof to protect grave food offering by early Indians. Possibly marks the transition between first- and second-period pottery making in New England. Submitted by W. S. Fowler, Narragansett Archeological Society of Rhode Island.	L-270	800 ± 90
Poverty Point, La. This site (NE1/4 of NE1/4 sec. 19, T19N, R10E, West Carrol Parish) represents the end of the Eastern Archaic Stage and the beginning of the Burial Mound Building Stage. It is the same cultural complex as the Jaketown site in Mississippi (*23*) dated by the black-carbon method (*1*) as 2350 ± 200 yr. These archeological sites provide an excellent opportunity for checking the chronology of stream channel positions in the alluvial valley of the Mississippi River which was worked out by H. N. Fisk (*24*). The cultural deposits at Jaketown were made on an island in the active channel of the Ohio River of Fisk's C-1 stage. The Poverty Point village appears to have been established beside the Mississippi River Channel of C-1 stage and the site partially destroyed by an Arkansas River Channel of stage H. Submitted by J. A. Ford, American Museum of Natural History.		
Charcoal from fireplace 18 in below surface in Midden Area, trench A.	L-195	2860 ± 90
Charcoal from extensive layer exposed beneath southern portion of mound B antedating the construction of this part of the mound.	L-272	2660 ± 80
Winnemucca Lake, Nev. Juniper roots and stalks taken from lowest occupation level in wave-cut Fishbone cave 250 ft above the floor of dry Lake Winnemucca, which was once a part of pluvial Lake Lahonton. The climatic conditions in this desert region permitted the preservation of perishable materials not ordinarily found in such old archeological sites. Excellent specimens of basketry, netting, wooden tools, along with bones of horse, camel, and man are found in the lower levels of the cave. Clear evidence of human occupation occurs in the lowest level, which was dated by this sample. The site was occupied by man very shortly after the lake waters fell below the cave floor. Submitted by P. C. Orr, Western Speleological Institute.	L-245	11,200 ± 250
Santa Rosa Island, Calif. Abalone shells taken from upper part of truncated alluvial fan on coast of Santa Rosa Island. Their presence in this type deposit 50 ft above the present sea level indicates that man occupied this alluvial fan during at least the late stages of its formation. Submitted by P. C. Orr, Santa Barbara Museum of Natural History, Santa Barbara, Calif.	L-257	6820 ± 160
II. *South America*		
Nazca, Peru. Key horizons from ancient Nazca sites collected in 1952–53 (*25*). Submitted by W. D. Strong, Columbia University.		
Site N-1 (Estaqueria)—Strata Cut I (catalog No. 134) from burned end of stake at 0.65-m level; charcoal. Huaca del Loro phase, Fusional Epoch.	L-268E	900 ± 70
Site NTu-8 (Huaca del Loro); Temple Fill from first floor of round temple structure (catalog No. 104); charcoal. Huaca del Loro phase, Fusional Epoch.	L-268F	970 ± 70
Site NTu-8 (Huaca del Loro); Whale Bone Room (catalog No. 103); charcoal. Huaca del Loro phase, Fusional Epoch.	L-268G	1200 ± 80
Section of post removed from small mound at the intersection of lines in the San Jose Pampa; wood. Middle Nazca phase, Florescent Epoch.	L-268H	1430 ± 80
Site N-4 (Cahuachi); Strata Cut I-SW, 3.00- to 3.25-m level (catalog No. 192) from fireplace in southwest face of cut); charcoal. Proto-Nazca phase, Formative Epoch 1.	L-268C	1460 ± 80
Site N-4 (Cahuachi); Strata Cut 7, 4.00- to 4.25-m level (catalog No. 311); charcoal. Proto-Nazca phase, Formative Epoch.	L-268D	1630 ± 80
Site N-4 (Cahuachi); Strata Cut I, 3.50- to 3.75-m level (catalog No. 139); charcoal. Late Paracas phase, Formative Epoch.	L-268A	1710 ± 80
Site N-4 (Cahuachi); Strata Cut I, 3.75- to 4.00-m level (catalog No. 140); charcoal. Late Paracas phase, Formative Epoch.	L-268B	1840 ± 80
Paracas, Peru. Prehistoric cotton cloth, mummy 114 (Bundle B 1946–14, American Museum of Natural History) Paracas Necropolis Period, Peru. This specimen is of the same age as Libby's sample 271 (*14*) which gave 2257 ± 200 yr. Previously dated at Lamont by black-carbon method as 1700 ± 200 yr. (*1*). This figure would place the Necropolis phase of Paracas as contemporary with such important ceramic types as W. D. Strong's incised, slip-painted early Nazca and the Cavernas negative ware. Neither of these has been reported from Necropolis graves. Although perplexing, this observation does not rule out the acceptance of the 1750 ± 100 yr figure, and by some would be taken as supporting evidence. Submitted by Junius Bird, American Museum of Natural History.	L-115	1750 ± 90
Huaca Prieta, Chicama Valley, Peru. Charcoal from two separate samples of firepit at bottom of Test 2, the oldest surviving portion of this midden. Its age should indicate the start of the preceramic, agricultural culture which ultimately produced this midden. Previously dated by the black-carbon method at the Lamont Observatory at 3650 ± 400 yr and by the University of Chicago (sample C-598, at 4298 ± 230 yr (*14*). Collected by C. Larco; submitted by Junius Bird.		
Charcoal.	L-116A	3780 ± 100
Charcoal.	L-116B	3860 ± 100

Description	Sample No.	Age
Amazon Basin. These samples represent an attempt to date pottery from the small organic content which is present in the binding material. The prehistoric ceramics in the Amazon basin were made with the aid of burned bark of the Caraipe tree and/or fresh water sponges as tempering agent. The samples were gathered in two sites of so-called "black earth" on the floodplain at the confluence of Negro and Solimoes (Amazon) rivers in the upper layer (30-cm depth). In addition to defining an age for the ceramics, the samples would date the minimum time since the alluvial deposits were layed down by the Parana do Careiro as it shifted to its present course. This knowledge is of practical value in assessing the degree of permanency of the alluvial stream pattern downstream from Manaus. The dates were calculated on the basis of the assumption that the organic matter was dominantly plant matter, probably caraipe bark, although there was evidence of sponge spicules. The organic matter from living sponges in the same area give a specific activity only 70 percent of that of normal modern wood. Thus the ages are maximal and would be lowered in proportion to the ratio of sponge-plant contribution to the tempering material. The samples were collected by H. O'Reilly Sternberg, Centro de Pesquisas de Geografia do Brasil, who, in the course of his investigation of the geomorphology of this area, conceived the idea of using the tempering agent of the sherds as a carbon source. The project was supported by a grant from the Conselho Nacional de Pesquisas, of Brazil.		
Rims and decorated sherds from Fazenda "Bom Successo."	L-198A	2050 ± 120
Sherds from Fazenda "Alencorne."	L-198C	1100 ± 130
III. *Asia*		
Hotu Man, Iran. Charcoal from hearth under and associated with Hotu skeletons No. 2 and No. 3. The University of Pennsylvania laboratory obtained an age of 9190 ± 590 yr on same material by black-carbon method (*26*). Submitted by C. S. Coon, University of Pennsylvania.	L-182	9500 ± 200
IV. *Africa*		
Khanguet-el-Mouhaad (Department of Constantine), Algeria. This site is important in that it is the first Upper Capsian site in which human remains have been found to be dated by the C^{14} method. The burial is being studied by L. Cabot Briggs at the Bardo Museum in Algiers. Charcoal was found associated with the skeleton at depth of 90 to 100 cm below the surface of midden deposit. Collected by M. Jean Morel of Bone. Submitted by H. L. Movius, Jr.	L-240B	7200 ± 230
Kalambo Falls, Northern Rhodesia. Wood from tree trunk found in Lower Paleolithic site. Presumably this horizon belongs to the very end of the third Interpluvial (Kanjeran-Gamblian) or the very beginning of the Gamblian Pluvial Period—that is, of third interglacial or early fourth glacial age. Excavated by J. D. Clark, Rhodes-Livingstone Museum, Livingstone, Northern Rhodesia. Submitted by H. L. Movius, Jr.	L-271A	> 35,000
Florisbad, near Bloemfontein, Orange Free State. The Florisbad Skull (*Homo* or *Africanthropus helmei*) was discovered in association with many stone implements and fossil bones of numerous extinct species of animals in the lowest of three peat layers at this site. Samples from the three layers were measured by Libby (*14*), who obtained the following ages: (i) sample C-850, Peat layer No. I, older than 41,000 yr; sample C-851 Peat layer No. II, 9104 ± 420 yr; sample C-852 Peat layer No. III, 6700 ± 500 yr. A. C. Hoffman, director of the National Museum in Bloemfontein, who collected these samples, felt that the date for the middle peat (Peat II; sample L-271-C) was definitely too low, since remains of extinct animals were found in association with it. Further investigation revealed that this layer had been penetrated by the roots of gum trees, and, accordingly, a whole new set of carefully collected and cleaned specimens was chosen. Submitted by H. L. Movius, Jr.		
Peat layer No. I	L-271B	> 35,000
Peat layer No. II	L-271C	28,450 ± 2200
Peat layer No. III	L-271D	19,530 ± 650
V. *Pacific Ocean*		
Masbate Island, Philippines. Charcoal from depth of 12 to 18 in. in a "late Neolithic" dry cave site. Date tests H. O. Beyer's prehistoric sequence for Northern Malaysia. Collected by W. G. Solheim, II, University of Arizona. Submitted by H. C. Conklin, Columbia University.	L-274	2710 ± 100
Murray Valley, South Australia. These two samples provide the basis for the archeological sequence in all of Australia. Shells of living mollusks collected in the Tartanga Lagoon on the Murray River were used as modern control for these samples and were found to be approximately 1 percent greater than our modern wood standard. Collected by N. B. Tindale, South Australian Museum, Adelaide. Submitted by H. L. Movius, Jr.		
Large *Unio protovittatus* shells from Layer C at the Tartanga site referred to as Mid-Recent and believed to have been occupied prior to the deposition of the 10-ft terrace of the River Murray. Possibly as old as 9000 yr. Layer C represents approximately the midpoint in the sequence at this site. Tindale estimates that the earliest occupation (Layer A) may go back as a minimum to 8000 years before the present.	L-271E	6030 ± 120
Shells from Layer IX at Devon Downs which provide a figure for the middle stage in the development of the Pirrian culture, of which Devon Downs is the type site. There is no geologic basis for dating this horizon, although it is believed to be younger than the time of formation of the 10-ft terrace of the Murray and hence as old as 4500 years before the present. In any case, at the time Devon Downs was occupied, the climate in South Australia was definitely more moist than it is at present.	L-271G	4290 ± 140

Table 6. Radiocarbon dates obtained on Atlantic deep-sea cores by the carbon dioxide method. All ages are given in radiocarbon years before the present.

Description	Sample No.	Age
Core A-180-74. Collected from 3330-m depth at lat. 0°03′S; long. 24°10′W. Core consisted of uniform foraminiferal lutite with no obvious evidence of turbidity currents, erosion, slumping, or reworked older sediments. The excellent agreement in lithology between this core and three others taken on a 400-km traverse across the mid-Atlantic ridge in the equatorial region indicates that this core represents an undisturbed and uninterrupted record of sedimentation.		
Depth 0 to 5 cm	L-295A	3630 ± 170
Depth 18 to 21 cm	L-295B	11,260 ± 460
Depth 38 to 41 cm	L-295C	15,000 ± 500
Depth 57 to 64 cm	L-295D	18,910 ± 680
Depth 77 to 83 cm	L-295E	23,000 ± 1100
Depth 97 to 103 cm	L-295F	26,700 ± 1800
Depth 114 to 125 cm	L-295G	37,500 ± 4000
Core R10-10. Collected from 4755-m depth at lat. 41°24′N, long. 40°06′W. Core consisted of lutite taken from basin east of the Mid-Ocean Canyon in Newfoundland Basin. The lower part of the core contains some glacial marine deposits. The date of the material in the first 7 cm in the core is somewhat older than expected. Whether this is due to mixing of the top of the core in collection, inclusion of carbonate from preexisting sediments, or loss of the top of the core in collection is not clear.		
Depth 0 to 7 cm	L-212G	4160 ± 190
Depth 35 to 39 cm	L-212H	4360 ± 200
Depth 60 to 70 cm	L-202	8100 ± 120
Depth 90 to 100 cm	L-212A	10,680 ± 180
Depth 112 to 120 cm	L-212C	10,550 ± 420
Depth 120 to 125 cm	L-212D	11,800 ± 480
Depth 165 to 175 cm	L-212F	15,820 ± 600
Depth 255 to 275 cm	L-212E	20,300 ± 900
Core A179-8. Taken at 4060-m depth at lat. 20°28′N, long. 72°49′W, northwest of the Island of Hispaniola on the Caicos-Hispaniola abyssal plain. The core contains numerous layers of calcareous sand probably due to slumping or turbidity currents. The normal sediment consists of lutite.		
Depth 218 to 228 cm	L-279A	10,860 ± 180
Core A179-15. Taken at 3110-m depth at lat. 24°48′N, long. 75°55′W off Eleuthera Island, Bahamas, from a steep slope. Core consisted mainly of calcilutite with a layer of calcareous silt near the base of the section.		
Depth 94 to 99 cm	L-279B	7600 ± 130
Depth 110 to 113 cm	L-279E	10,700 ± 480
Core A180-48. Taken from Fosse de Cayar submarine canyon in the continental shelf near Dakar, French West Africa, at a depth of 1450 m at lat. 15°19′N, long. 18°06′W. The core was taken from canyon wall 100 fathoms above the canyon floor. Material consists of dark green clay very uniform throughout except for silt partings and lenses.		
Depth 190 to 210 cm	L-294B	10,480 ± 380
Depth 440 to 455 cm	L-279D	11,380 ± 390
Depth 490 to 510 cm	L-294C	15,300 ± 550
Core A164-62. Taken at lat. 39°45′N, long. 68°53′W at 2270-m depth. The upper 250 cm of the core consists of graded micaceous glauconitic gray sand. Below the sand, the deposition appears to be normal and the purpose of the measurement was to determine the extent of erosion at the time of sand deposition. The date indicates that at most, only a small amount of post-Wisconsin sediment was removed.		
Depth 468 to 488 cm	L-279C	6990 ± 140
Core A180-1. Taken at 5120-m depth at lat. 39°07′N, long. 54°32′W. The upper 130 cm of the core consists of sands that were probably deposited by the Grand Bank's earthquake turbidity current of 1929 (*27, 28*). The age of 5200 yr indicates that there was only limited erosion at the time of the sand deposition and confirms recency of the event.		
Depth 140 to 170 cm	L-212B	5130 ± 130

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A man who has committed a mistake and doesn't correct it is committing another mistake.—CONFUCIUS.