A qualitative picture of the level shift was given by Welton (*19*) in 1948. The fluctuating zero-point electric field of the quantized vacuum acts on an electron bound in a hydrogen atom. As a result, the electron is caused to move about its unperturbed position in a rapid and highly erratic manner. The point electron effectively becomes a sphere of a radius almost 10^{-12} centimeter. Such an electron in a hydrogen atom is not so strongly attracted to the nucleus at short distances as a point electron would be. States of zero orbital angular momentum such as $2^2S_{1/2}$ are therefore raised in energy relative to other states such as 2^2P in which the electron has a smaller probability of being found near the nucleus.

In 1949, a relativistic generalization of Bethe's calculation was given by Kroll and Lamb (*20*), which made his results definite. They confirmed additional small contributions of 27 megacycles per second arising from polarization of the vacuum as calculated in 1935 by Uehling (*21*) on the basis of Dirac's theory of the positron, and of 68 megacycles per second from the anomalous magnetic moment of the electron as suggested by Breit (*22*) in 1947. Other small corrections have been calculated by various authors, of which the largest was about 7 megacycles per second made by Baranger (*23*) who took the binding of the electron more exactly into account. At the present time, there is an unexplained residual discrepancy of 0.5 megacycle per second.

Conclusions

It is very important that this problem should receive further experimental and theoretical attention. When an accuracy of comparison of 0.1 megacycle per second has been reached, it will mean that the energy separations of the $2S$ and $2P$ states of hydrogen agree with theory to a precision of a few parts in 10^9 of their binding energy or that the exponent in Coulomb's law of force is 2 with a comparable accuracy. Another way of putting it is to say that the anomalous magnetic moment of the electron would be determined with an accuracy of 1 part in 680, which would provide a useful check on Kusch's more directly measured result (*24*). Finally, I might mention that the fine structure doublet separation now provides the most accurate and direct determination of the famous dimensionless number called the fine structure constant, whose numerical value of about 1/137 it will be the task of some future theory to explain.

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U. S. Geological Survey Radiocarbon Dates III

Meyer Rubin and Hans E. Suess

The following list (Table 1) covers radiocarbon dates measured at the U.S. Geological Survey radiocarbon laboratory during the period between 15 February and 30 June 1955 (*1*). From 15 October 1954 to 14 February 1955, measurements on modern materials were made, the results of which have appeared in a separate article (*2*). The experimental procedure has remained the same (*3*), and the ages have been computed in the same manner as before (*4*, *5*). Most of the 69 samples in this list have been measured in the two counting sets for a total of 3 days each.

Whereas previous efforts were directed toward the establishment of an absolute chronology for the last glaciation from evidence in midwestern United States, we have now concentrated to a greater extent on samples from other parts of the world and have also included material that dates events in postglacial times.

Two additional deep-sea cores, for which the temperature as determined by oxygen-18 analysis as a function of depth had been measured, were investigated during this period. The results corroborated those previously reported (*5*).

With respect to the archeological samples, one general observation may be made: in three caves investigated thus far (Haua Fteah, Shanidar, and Kara Kamar), no datable culture deposits with an age between 13,000 and 23,000 years have been present. This may perhaps indicate a low human population during the time of the maximum extent of the last glaciation. Evidence from the fourth cave (Bockstein) is inconclusive because the completeness of the stratigraphic sequence is in question.

An attempt was made to date the important Brady horizon of the Great Plains Wisconsin glacial stage sequence, which represents a soil-forming period. The results are inconclusive. Two additional samples relating to the Cochrane readvance in Ontario, Canada, were analyzed. These, and the samples previously run (W-176 and W-136) (*5*, p. 485) imply that the area was under a cover of ice from before 38,000 years ago until somewhat before 6380 years ago.

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Table 1. Radiocarbon dates.

Sample No.	Description	Age (years)
	I. *Samples with oceanic implications*	
	A. *Deep-sea sediments*	
	Seven samples were measured from two additional cores that had been investigated for oxygen-18 temperatures by C. Emiliani of the University of Chicago. Again the paleotemperatures as a function of depth show very good correlation with each other and with the two cores previously reported (*5*). The conclusions from this investigation have been published (*6*). The apparent ages were calculated using modern shells for the contemporary assay. Only the coarse fraction of the core with grain size greater than 74 microns was used. The material was prepared by and obtained from D. Ericson, Lamont Geological Observatory, Columbia University.	
W-236 W-237 W-238 W-239	*Core A 172-6* (Lamont Observatory). Obtained from the Caribbean Sea, lat. 14°59'N, long. 68°51'W, depth 4160 meters. The samples came from the following depths in the core: W-236, 0 to 10 centimeters; W-237, 51 to 61 centimeters; W-238, 114 to 125 centimeters; W-239, 240 to 250 centimeters.	3700 ± 200 17,500 ± 500 36,000 or older > 38,000
W-280 W-278 W-276	*Core A 180-73* (Lamont Observatory). Obtained from the Atlantic Ocean, lat. 0°10'N, long. 23°0'W, depth 3750 meters. The samples came from the following depths in the core: W-280, 0 to 8 centimeters; W-278, 30 to 38 centimeters; W-276, 80 to 88 centimeters.	2960 ± 200 15,300 ± 300 27,000 ± 1500
W-228 W-229	*Gulf of Mexico*. Shells from boring operations in the Gulf of Mexico near Rockport, Tex. These samples were run in connection with an extensive study being made of the history of this part of the gulf by F. P. Shepard, Scripps Institution of Oceanography. W-228: shells from core XSJ56, S-5, at 46- to 46.5-foot level. W-229: shells from core XS386, No. 11, at 73- to 75-foot level.	6050 ± 300 9300 ± 350
	B. *Sea-level changes*	
W-227	*Sagadahoc Bay, Me.* Submerged stump in the tidal flat, imbedded in mud 3 feet below mean sea level. The purpose of the analysis was to determine whether the tree grew in place or, as shown by the date, was floated in and buried. Collected by W. H. Bradley, U.S. Geological Survey, Washington, D.C.	< 300
W-244	*Santa Rosa Island, Calif.* Charcoal from marine beds of Pleistocene age on Santa Rosa Island off the coast of southern California near Santa Barbara. These beds contain remains of a dwarfed fauna, including dwarf mammoths 6 feet tall. The beds outcrop at an elevation of plus 10 feet and therefore represent either a sea stand at that height or crustal movement. Date would represent the last possible time for the island to have been connected with the mainland. When the collector revisited the site, he noticed asphaltic material at the sample horizon. The surplus from the original sample was washed in carbon disulfide and found to contain petroliferous material. Therefore the age given does not necessarily date the horizon. Collected by P. C. Orr, Santa Barbara Museum of Natural History, Santa Barbara, Calif.	> 38,000
W-246	*Capetown, Union of South Africa.* Charcoal from under 35 to 40 feet of sand resting on clay in the Cape Flats. The geologic history of the Cape Flats is uncertain, and the sample has a bearing on whether the Cape Flats was a shallow strait recently or whether the sand was wind blown. Collected by S. S. Amdurer, University of Cape Town.	> 38,000
W-252 W-253	*Wailes Bluff, Md.* Shells and wood from a locality well-known for its Pleistocene fossils near Cornfield Harbor on the eastern bank of the Potomac River about 3 miles above its mouth. The section has been described in detail by S. F. Blake (*7*). W-253: wood from greenish-blue marine clay collected by S. F. Blake, U.S. Department of Agriculture, Beltsville, Md., from base of section near sea level. W-252: shells from oyster bed overlying the clay and underlying 6 to 8 feet of sandy clay and cross-bedded sand and gravel; collected by J. Hack and M. Rubin, U.S. Geological Survey, Washington, D.C.	> 35,000 > 35,000
W-265	*Plantation Key, Fla.* Oolite from Cowpens Cut, just west of Tavernier Creek, between Plantation Key and Key Largo, Bay of Florida. Dredged from depth of about 7 feet below present low tide level. The collector, P. E. Cloud, Jr., U.S. Geological Survey, Washington, D.C., says that the appearance of the rock suggests subaerial lithification.	> 25,000
	II. *Glacial samples*	
	A. *United States*	
W-231 W-233	*Doniphan County, Kan.* Snail shells from Bignell loess exposed near the Missouri River situated in the NE¼SE¼ sec. 6, T2S, R20E. Shells came from 8 to 10 feet above base of a 38-foot-thick unit of the Bignell loess overlying 29 feet of Peorian loess, which was topped by a well-developed soil correlated with the Brady soil of Nebraska. A detailed description of the section has been published by Frye and Leonard (*8*). Because of the uncertainty in the modern assay of land snails, these dates derived from comparison with modern wood could possibly differ from the actual age by 1000 years or more. Living clams from a hard-water lake in Connecticut were found to have spurious "ages" of around 2000 years (*9*). The impossibility of removing all the carbonate matrix from around and inside the delicate snail shells also added to the uncertainty of the age of the sample. Collected by A. B. Leonard, University of Kansas. W-231: *Succinea ovalis*. W-233: *Triodopsis multilineata*.	12,550 ± 400 12,700 ± 300
W-234	*Bignell, Lincoln County, Neb.* Sample from the A horizon of the type Brady soil considered to be a major break in the Wisconsin glacial stage. Taken from the east side of deep road cut through Bignell Hill section, 1.7 miles due south of Bignell. Section described and formations named by Schultz and Stout (*10*, p. 241). The soil sample, containing 0.58 percent organic carbon, was oxidized at the U.S. Department of Agriculture Soil Survey laboratory, Beltsville, Md., in a	9160 ± 250

Sample No.	Description	Age (years)
	large furnace after it had been acidified. The CO_2 formed was converted into $SrCO_3$ and submitted for dating in this form. Contamination of the sample by modern rootlets, making the apparent age too young, cannot be discounted even though the collecting horizon was 11 to 12 feet below the surface. In a recent visit to the locality, one of the authors deemed it almost impossible to obtain a sample not so contaminated. Collected by J. A. Elder, processed by V. J. Kilmer, and submitted by G. D. Smith, U.S. Department of Agriculture, Washington, D.C.	
W-248	*Searles Lake, Calif.* Carbonate material (trona) from near the base of the upper salt body beneath Searles Lake, taken from core of drill hole GS-12, at ¼ sec. marker, sec. 2 and 3, R43E, T26S, Mount Diablo meridian, San Bernardino County. Sample was taken at a depth of 73.3 to 73.4 feet. The parting mud, separating the upper salt from the lower salt body, occurs at a depth of 76.3 to 86.9 feet. Carbon extracted from this mud was analyzed by Libby (samples C-616, C-894, C-895, C-896, and C-897) and gave an orderly progression of ages from the top of the mud at 10,494 ± 560 years to the base at 23,923 ± 1800 years (*11*). These deposits should represent a pluvial stage correlative with the last glaciation, whereas sample W-248 comes from just after the cessation of overflow of waters from the Owens Valley at the close of the last substage. Although the date fits perfectly with the sequence given by Libby, some uncertainty arises because of the possibility of the presence of dead carbonate in any lake (*9*). Collected by W. A. Gale, American Potash and Chemical Corporation, Whittier, Calif., and submitted by R. F. Flint, Yale University.	8550 ± 250
W-255	*Block Island, R.I.* Wood from base of a postglacial kettle fill, exposed in a wave-cut cliff 0.4 mile south southeast of Ocean View Hotel. Twigs were lying flat on a bouldery till about 6 feet above mean sea level and were overlain by 7 feet of layers of peat, mucky silts, and fine sands, representing a kettle fill. The date gives only a minimum age for the till. Collected by C. A. Kaye, U.S. Geological Survey, Spokane, Wash.	12,090 ± 200
W-256	*Danville, Ill.* Wood (*Larix*) from till in strip mine drainage ditch in SE¼NE¼ sec. 2, T19N, R12W, northwest of Danville; designated Illinoian by H. E. Eveland (*12*). Recent erosion along the ditch has modified the section seen by Eveland; as a result a question has been raised about possible early Wisconsin age of this till (*13*). Collected by G. W. White and P. R. Shaffer, University of Illinois.	> 37,000
W-257 W-258 W-259	*Puget Sound Basin, Wash.* Three samples of wood relating to the glaciation of the Puget Sound lowland. Current mapping projects have detailed the stratigraphic sequence, but it was not possible to correlate with the standard Pleistocene section of the midwestern United States. The Vashon was believed to be a correlative of the Cary substage of the Wisconsin glacial stage. The dates, however, are older than those of samples from the type section of the Wisconsin stage. Collected by D. R. Crandell and H. H. Waldron, U.S. Geological Survey, Denver, Colo. W-257: wood taken from strata of peat from interglacial sediments overlain by stratified Vashon drift exposed at the spillway access road, N½NE¼ sec. 17, T19N, R7E, Mud Mountain Dam, King County. W-258: wood from nonglacial lacustrine and bog deposit overlain by Vashon drift exposed in East Tacoma gravel pit, SE¼SW¼ sec. 25, T21N, R3E, Pierce County. W-259: wood from interglacial sediments that separate the youngest pre-Vashon glacial stage from the next oldest pre-Vashon glacial stage exposed in beach cliff in NE¼SW¼ sec. 17, T22N, R4E, King County.	> 37,000 > 37,000 > 37,000
W-263	*Gahanna, Ohio.* Wood from outwash sandwiched between a blue till and a lower gray till. This familiar sequence is noted throughout south-central Ohio. The gravel, which customarily has a buried Fox soil at the top, is considered by the collector to represent the outwash from the lower till, which is of early Wisconsin age. The wood, therefore, should date the closing phases of the earlier Wisconsin glaciation in Ohio (*14*, pp. 651, 652). Review of this site at a recent field conference suggests that it may be Illinoian (*15*). Collected by R. P. Goldthwait, Ohio State University.	> 37,000
	B. *Alaska*	
W-268	*Canwell Glacier, Alaska.* Part of a log from end moraine of Canwell Glacier, Alaska Range. Collected by T. L. Péwé, U.S. Geological Survey, College, Alaska.	< 200
W-294	*Salamatof Creek lake section, Kenai Peninsula, Alaska.* Woody sample from near base of 2- to 3-foot thick contorted organic silt section unconformably overlain by 13 feet of uncontorted organic lake silts and peat and underlain by a 1- to 2-foot thick contorted sand and silt layer resting on highly weathered and contorted gravel. As interpreted from geologic evidence, the lake section rests on drift of the Eklutna advance (Illinoian) and occurs just beyond the boundary of an end morainal complex including drift of both Naptowne (Wisconsin) and Knik (post-Eklutna and pre-Naptowne) advances. As dated, the upper contorted silt section can be considered to have been deformed either during the maximum advance of Knik or Naptowne ice. Other evidence suggests that deformation took place during the maximum Naptowne advance and that the overlying undisturbed lake silts and peat represent deposition from early middle Naptowne to the present. Collected by T. N. V. Karlstrom U.S. Geological Survey, Washington, D.C.	> 37,000
W-295	*Southwestern Copper River Basin.* Peat and woody debris taken from stratified sand that grades downward into interbedded stony and varved silt and upward into coarse gravel that is overlain in turn by thick glacial till. These Pleistocene deposits are separated from modern eolian sand by a thin bed of organic material. The section is located in the north bank of the Nelchina River 5.2 miles above its point of entry into Tazlina Lake (Valdez	> 38,000

Sample No.	Description	Age (years)
	D-7, 1:63,360 quadrangle) in the southwestern Copper River Basin and is only 18 miles north of the present terminus of Tazlina Glacier. Interpretation of the stratigraphy suggests that the silt and the sand, from which the sample was taken, were deposited in a proglacial lake, possibly at the beginning of the Wisconsin stage of glaciation. The gravel is believed to be outwash deposited in front of a glacier advancing into the proglacial lake, and the till probably represents the Wisconsin glaciation, although the dating does not demonstrate conclusively the age of the deposits. Collected by J. R. Williams, U.S. Geological Survey, Washington, D.C.	
W-297	*Central Copper River Basin.* Peat and organic silt taken from a cut on the south bank of the Copper River 5 miles downstream from the mouth of the Chistochina River in the Central Copper River Basin, south-central Alaska. This part of the basin was believed to have been covered with a large interior lake in late Pleistocene time, as shown by deposits of lake silt beneath the dated horizon. The lake was drained and organic deposition took place in depressions on the old lake bottom. The sample gives a minimum age for final drainage of the interior lake from this site. Collected by D. R. Nichols, U.S. Geological Survey, Washington, D.C.	4610 ± 200
W-298	*Denbigh flint layer, Iyatayet archeological site, Cape Denbigh, Alaska.* (Described by Hopkins and Giddings, *16*). Sample made up of bits of charcoal (an old hearth?) in paper-thin Denbigh culture layer collected during course of careful archeological excavation. The culture layer is overlain by sterile silt containing locally one or two buried turf zones and underlain by a thin podzol developed in rocky congeliturbate (*16*, Figs. 4 and 6; plate 2). Sample was collected a few feet within the bank (illustrated in plate 2, *16*) in sharply folded rocky material that is a continuation of the fold illustrated in the plate. Previously analyzed radiocarbon samples from the site include two woody samples run by Libby from the Denbigh culture layer that gave ages of 3509 ± 230 years (C-792) and 4658 ± 220 (C-793) (*17*). The possibility of contamination of the Denbigh flint layer samples by younger material related to the development of the overlying buried turf layer could not be discounted in the previously dated specimens, and the charcoal sample was submited as a check on the dating of the culture layer. The small sample required dilution by dead acetylene for analysis; this accounts for the larger-than-usual error that is quoted. Collected by J. L. Giddings, University of Pennsylvania.	3970 ± 600
W-299	*Girdwood Tidal Bog section, Turnagain Arm, south-central Alaska.* Wood from near base of forest peat unit exposed above low tide level and overlain in turn by 5 to 6 feet of tidal silt, 2 feet of forest and sedge peat, 6 to 8 inches of tidal silt, and 1.5 to 2 feet of peat with three distinct forest layers becoming distinctly silty near top of section. The tidal bog stratigraphy records a sequence of lower and higher sea-level phases in the Cook Inlet. The lower peat is interpreted as representing the eustatic low sea-level phase during the Tustumena glaciation, which has been dated from other evidence between 3000 and 1 B.C. The new date falls within the time boundaries of the Tustumena glaciation, and substantiates the belief that this glaciation was an important climatic event during the Recent epoch. Collected by T. N. V. Karlstrom.	2800 ± 180
	C. *Canada*	
W-241 W-242	*Missinaibi River, Ontario.* Intertill peat and wood from base of till that underlies the peat, exposed on the bank of the Missinaibi River, 6 miles upstream from the mouth of the Soweska River. This is within the area covered by the readvance to the Bell moraine at Cochrane. The section down to second sample layer consists of the following: 7.2 feet of cover, not trenched; 1.5 feet of blue-gray till; 7.1 feet of varved clay; 2.7 feet of dark brown, organic silt; 1.6 feet of sand with streaks of peat; 2.1 feet of peat (sample W-241); 2.9 feet of sandy, black till; 0.9 feet of gravel, limestone pebbles, and wood (sample W-242) at the contact with the till above. Tills and silts make up the remaining 42 feet of the section to the base. Collected by O. L. Hughes and submitted by V. K. Prest, Geological Survey of Canada, Ottawa, Ontario.	> 37,000 > 38,000
	III. *Other geologic samples*	
	A. *Volcanic samples*	
W-201	*Kilauea, Hawaii.* Fern mold from fern forest killed by blanket of hot basaltic pumice; uncovered during excavation for the north wing of Volcano House Hotel on the northeast rim of Kilauea *caldera* on the island of Hawaii. Date of sample fixes the approximate end of a major cycle of vigorous lava output (3-K of Powers, *18*) and the beginning of a cycle of crateral collapse that ended in 1790. The eruption that buried the fern forest probably represents a fountaining of Kilauea lava lake to a height that has rarely been equaled since. Collected by H. A. Powers, U.S. Geological Survey, Denver, Colo.	2500 ± 250
W-250 W-251	*Oahu, Hawaii.* Limestone from tuffs dating from a later eruption of the Coco Head-Coco Crater complex on the south coast of Oahu. Collected by P. E. Cloud, Jr. W-250: coral head from tuffs on the seaward flanks of Coco Crater east of Hanauma Bay. The coral presumably grew along the flanks of the volcano while the volcano was in eruption. W-251: pieces of limestone from nearly contemporaneous tuffs along the shore road west of Highway No. 1 at the Hanauma Bay turnoff. May be from an older limestone that was broken through by eruption and mixed thereby with the pyroclastics.	> 32,000 > 32,000
W-285	*Fuji ash, Japan.* Wood from unconsolidated deposits closely associated with ash derived from eruptions of Fuji-san, exposed in Aonohara-mura, Kanagawaken, Honshu. Ash derived from Fuji-san is extensive and covers a large part of the Kwanto plain. Collected by H. L. Foster,	> 35,000

Sample No.	Description	Age (years)
	U.S. Geological Survey, Tokyo, Japan.	
	B. *Geologic processes*	
W-223	*Pictograph claim, S.D.* Musk-ox bones partly impregnated with carnotite from a sand-filled crack on the Pictograph claim in Craven Canyon, Fall River. The sample was considered important because it indicates a movement of uranium. The bones were processed by I. May of the U.S. Geological Survey to extract the carbon; the method used has been described by May (*19*). Collected by L. R. Page, U.S. Geological Survey, Washington, D.C.	9700 ± 600
W-235	*Gully fill, cut 39, Pottawattamie County, Iowa.* Carbon extracted by combustion from soil in gully fill exposed in cut 39 of Chicago, Rock Island and Pacific Railroad relocation, S line, sec. 13, T76N, R41W. Gully fill truncates progressively downward a late Wisconsin gleyed zone, Iowan and Tazewell loess undifferentiated, Farmdale loess of Leighton and Willman (*20*), and Sangamon soil in Loveland loess. Considered post late Wisconsin by collector, R. V. Ruhe, U.S. Department of Agriculture, Iowa State College.	6800 ± 300
W-230 W-243 W-292	*American Bottoms, Ill.* Samples of wood obtained from wells along the Mississippi River near the junction with the Missouri River; part of an investigation into the stratigraphy and history of the Mississippi River Valley undertaken by the Illinois State Geological Survey. Depth of recent scour and correlation of terraces with glacial substages are some of the goals of the investigation conducted by R. Bergstrom and M. M. Leighton, Urbana. These samples were collected by R. Bergstrom. W-230: wood obtained from 79-foot depth below flood plain in a Ranney collector well that was dug near the river at Monsanto, St. Clair County. Location: 1790 feet west and 1000 feet south of the northeast corner of sec. T1N, R10W; surface elevation, 413 feet above mean sea level; elevation of wood sample, 334 feet above mean sea level. Deposits reported at this depth in nearby wells are fine-to-coarse sand, with fine gravel. These deposits are considered to be Recent alluvium. W-243: species of ash wood obtained from 100 to 110 feet below flood plain in a Ranney collector well that was dug 80 feet from the river at Hartford, Madison County. Location: NE¼NE¼SW¼ sec. 33, T5N, R9W; surface elevation is 424 feet above mean sea level; elevation of wood sample, 325 feet above mean sea level. Dated as "older than 24,000 years" (sample C-937) by Libby (*21*). The deposit containing the wood is fine-to-medium, gravelly sand. This deposit, because of its mineralogic similarity to nearby terrace deposits and its difference from shallower alluvium, is believed to be of glacial valley train origin. W-292: wood obtained from 85-foot depth during construction of an irrigation well by Thorpe Concrete Well Company west of Nameoki, Madison County. Location: 1950 feet north and 1800 feet west of the southeast corner of sec. 6, T3N, R9W; surface elevation 425 feet above mean sea level; elevation of sample, 340 feet above mean sea level. Surface is somewhat above Recent flood plain. Deposits at 85-foot depth are believed to be glacial valley train.	< 200 > 38,000 25,000 ± 800
W-254 W-270	*Ohio River, Indiana and Kentucky.* Wood from banks of the Ohio River taken from beds forming a Quaternary succession filling the Ohio Valley. Collected by L. L. Ray, U.S. Geological Survey, Washington, D.C. W-254: wood from laminated clay beds underlying approximately 21 feet of alluvium exposed in the Indiana bank of the Ohio River, approximately 1000 feet west of the boundary between Warrick and Spencer counties. W-270: crushed wood from silty clay underlying 30 feet of alluvium and slump material exposed in the Kentucky bank of the Ohio River approximately 1.6 miles upstream from the bridge at Owensboro.	6410 ± 160 23,150 ± 500
W-287 W-290 W-289 W-288 W-273 W-272	*Kassler quadrangle, Colo.* A series of samples selected to determine the ages of various cycles of alluviation and soil formation, from deposits recognized throughout the Great Plains, Rocky Mountains, and the Great Basin. Collected by Glenn R. Scott, U.S. Geological Survey, Denver. W-287: charcoal from unconformity between Piney Creek alluvium and post-Piney Creek alluvium exposed in arroyo in SW¼SW¼ sec. 7, T7S, R68W. From the date, it would seem that the charcoal was contaminated by modern rootlets. W-290: charcoal from Woodland site, recovered from inside of pottery jar in late Recent windblown sand in the SE¼NW¼SW¼ sec. 30, T7S, R68W. W-289: charcoal from arroyo cut in post-Piney Creek alluvium exposing a Woodland culture in the SE¼SE¼ sec. 11, T7S, R69W. W-288: twigs underlying a bone of a wooly mammoth in a pond deposit in loess of early Wisconsin age in the NW¼NE¼ sec. 36, T6S, R69W. The twigs may have been forced under the bone at a later date, for animals congregated at a spring flowing from the Laramie formation at this site from Kansan time to A.D. 1900. W-273: charcoal from Anathermal alluvium exposed in an arroyo at the foot of the mountains in SW¼SW¼ sec. 24, T7S, R69W. Alluvium of Anathermal and late Recent age separated by the Altithermal soil. W-272: charcoal from Anathermal colluvium exposing an Archaic culture (about 6000 years ±) exposed in Lykins shale in the SE¼SE¼ sec. 11, T7S, R69W. Here the Altithermal soil is developed on the Anathermal colluvium and is overlain by late Recent colluvium on which the late Recent soil is developed.	< 200 1360 ± 200 1490 ± 160 4885 ± 160 5450 ± 160 5780 ± 160
IV. *Archeology*		
	A. *America*	
W-247	*Rockway Point, N.Y.* Charcoal from hearth at depth of 37 inches in trench 1, Clark site, Rockway Point, Waddington Township, St. Lawrence County. Found in course of New York State Science Service excavations in July 1954. Site produced burials of three periods of culture, ranging from late Archaic to late	920 ± 150

Sample No.	Description	Age (years)
	Woodland. Hearth apparently pertained to the latest of these cultures. Collected by W. A. Ritchie, New York State Museum, Albany; submitted by Paul MacClintock, Princeton University.	
W-291	*Isle Royale National Park, Mich.* Charred log found at 13-foot depth in a prehistoric copper mine. The miners used wood fire to heat the rock, then caused spalling by throwing water on the heated surface. The native copper was then liberated by crushing the vein material with stone hammers. Represents the connecting link between the Stone age and the Metal age in this part of the world. Pit elevation, 790 feet above mean sea level. Submitted by R. W. Drier and U. J. Noblet, Michigan College of Mining and Technology, Houghton.	3310 ± 200
	B. *Europe*	
	German reindeer antlers. A. Rust and H. Schwabedissen made available a series of reindeer antlers from various German Paleolithic sites; these represent the only samples on hand pertaining to the glacial history of Europe. Deer antlers seemed extremely promising as reliable material for dating, for they are much richer in organic matter than ordinary bone, and exchange or intrusion of foreign carbon did not seem probable. The possibility of isotope fractionation was checked by two carbon-13 determinations made through the courtesy of H. Craig, University of Chicago, giving a δC^{13} relative to the Chicago standard equal to -22.02 per mil and -19.60 per mil for samples W-264 and W-266, respectively. Compared with the average for modern wood of -25.0 per mil, this indicates a carbon-14 concentration higher in the antlers by 1 percent. In order to correct for this, 120 years was added to the measured age of each sample. Some of these carbon-14 measurements were the most accurate ones ever made in this age range (with the possible exception of the wood from Two Creeks) because of the long counting times of 2 days in each of 2 counters, the perfect stability of the counters, and the supplementary information on carbon-13 concentrations. Some of the samples were completely dissolved in HCl; others were only washed superficially with HCl leaving a trace of carbonate in the antler. However, all the antler samples gave dates younger than those that were anticipated from their stratigraphic positions. The dates on the Upper Magdalenian samples (W-266, W-267, and W-269) according to H. Schwabedissen, are too young for archeologic correlation. Possible sources of contamination in reindeer antlers will have to be investigated further. The antlers may have sunk down, providing dates younger than the enclosing soft sediments.	
W-264 W-281	*Meiendorf, Holstein, Germany.* Antlers from the Meiendorf type locality of Hamburgian Paleolithic from deposits in the Meiendorf kettle (about 13 kilometers northeast of Hamburg). The date is slightly more than 3000 years younger than had been expected from the generally accepted European archeological chronology and from a previous date of the gyttja from the same horizon (sample W-172, 15,750 ± 800 yr) (*5*, p. 487). One must assume that either the gyttja contained a considerable fraction of older washed-in organic matter or that the zone suffered postdepositional contamination. Collected by A. Rust, Ahrensburg, Holstein. W-264: antlers washed only superficially in HCl. W-281: antlers completely dissolved in HCl.	11,790 ± 200 11,870 ± 200
W-271	*Poggenwisch, Holstein, Germany.* Antlers dating the same Hamburgian archeological culture, but from another kettle located near Meiendorf. A previous gyttja date from this kettle (W-93, 15,150 ± 350 yr) (*4*, p. 473) shows a discrepancy similar to that shown in the dates from Meiendorf. Collected by A. Rust.	11,750 ± 200
W-262 W-261	*Stellmoor, Holstein, Germany.* Two antlers from a third kettle in the same vicinity; the upper layer dates the Ahrensburg stage of a Mesolithic culture, the lower the same Hamburgian Paleolithic as that found in the other two kettles. Pollen analyses show that the two stages were separated by the Allerød fluctuation. Collected by A. Rust. W-262: Ahrensburg horizon; expected to be of younger Dryas age; W-261: Hamburgian horizon, same as the afore-mentioned Meiendorf and Poggenwisch kettles.	9500 ± 200 12,450 ± 200
W-266	*Munzingen, near Freiburg, Germany.* Antler from a Magdalenian open site, buried under 4 meters of loess. Believed to date middle or younger Magdalenian. Collected in 1915 by A. Podtberg; submitted by H. Schwabedissen, Schleswig, Schloss Gottorp, Germany.	10,100 ± 250
W-269	*Kneigrotte, near Dobritz, Thuringen, Germany.* Antler from a cave rich in Magdalenian implements. Should date from late Magdalenian time. Collected by M. Richter, submitted by H. Schwabedissen.	8800 ± 200
W-267	*Petersfels, near Enge (Hegan) Baden-Wurttemberg, Germany.* Antler from Magdalenian cave site, correlated with late Magdalenian. Collected by E. Peters; submitted by H. Schwabedissen.	8200 ± 200
W-275 W-279 W-277	*Bockstein-Höhle, Lonetel, Baden-Wurttemberg, Germany.* Three antler samples coming from different layers in the cave, all supposedly associated with Aurignacian implements. The samples were too small for preparation of regular amounts of C_2H_2 and the gases prepared had to be diluted by twice the amount of dead C_2H_2 to make determinations possible. Hence, the errors are about 3 times the normal ones. Collected by R. Wetzel, submitted by H. Schwabedissen. W-275: upper horizon. W-279: middle horizon, well dated archeologically. W-277: lower horizon, transitional to Mousterian.	13,400 ± 800 24,000 ± 3000 > 25,000
	C. *Asia*	
W-224 W-225 W-226	*Kara Kamar, Afghanistan.* Kara Kamar is a Paleolithic rock shelter 8 miles north of Haibak on the north flank of the Hindu Kush Mountains. A 4.5-meter section in the excavation trench, below a surficial dung layer, consisted of a chalky dust bed containing sherds of wheel-made pottery underlain by a layer of brown earth containing a Paleolithic	33,000 ± 3000 or possibly older > 32,000 34,000 ± 3000 or possibly older

Sample No.	Description	Age (years)
	blade assemblage (Culture I). The brown earth was underlain by a thick loess section containing two distinct occupation horizons (Cultures II and III). A second brown earth containing scattered implements (Culture IV) was found beneath the loess directly overlying the bedrock floor. No evidence of Neolithic occupation was found. Collected by C. S. Coon and H. W. Coulter, University of Pennsylvania. W-224: A-5 immediately beneath the upper brown earth; remarkably, the next younger sample from this site, but from a different trench, dated by E. Ralph (*22*) showed an age of only 10,580 ± 720 years (sample P-53). W-225: C-11 from culture layer III in the loess section. W-226: B-9 from culture layer III in the loess section.	
W-245	*Beersheba, Palestine.* Charcoal from excavations on the site of an agricultural settlement in the Negev area on the outskirts of Beersheba, (Khirbet Beytar) southern Palestine. The charcoal was found in silo No. 50 in the lowest level, undisturbed and uncontaminated. Three levels of settlement were discovered; the upper level contained mostly rectangular buildings, the second, the foundations of a large round building, and the lowest level, mostly subterranean dwellings and silos. The material remains point to a close relationship with the so-called "Ghassulian" culture, generally dated in the fourth millenium B.C., and represents the passage from the Stone Age to the Bronze Age. Collected by M. Dothan and submitted by I. Ben-Dor, both from the Department of Antiquities, State of Israel.	5280 ± 150
	D. *Africa*	
W-283 W-284	*Lake Edward, Belgian Congo.* Shells from the Ishango terrace on the north shore of Lake Edward, from a horizon containing a unique Mesolithic (?) culture of human remains, mammals, and fish bones; stone artifacts; bone points and bone harpoons; pestles and grindstones. Overlain by tuffs from volcanos situated at Katwe. From climatic considerations, sample was thought to be of Mankato age. Collected by J. DeHeinzelin, Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium. W-283: shells from culture horizon. A possible explanation for this very unusual age for a Mesolithic culture might be that Lake Edwards received an addition from CO_2-carrying water from mineral springs connected with the nearby volcanos, which were active at the time the shells grew. W-284: modern shells collected from present beach. This age also indicates an addition of old carbon. On this basis, we can conclude only that sample W-283 has a maximum age of 18,000 years.	21,000 ± 500 3000 ± 200

References and Notes

1. Publication authorized by the director, U.S. Geological Survey. Corrine Alexander continued to assist in the preparation of samples. Elizabeth K. Ralph of the University of Pennsylvania radiocarbon laboratory was a guest at this laboratory during the preparation of the Kara Kamar samples.
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The whole of modern thought is steeped in science; it has made its way into the works of our best poets, and even the mere man of letters, who affects to ignore and despise science, is unconsciously impregnated with her spirit, and indebted for his best products to her methods. I believe that the greatest intellectual revolution mankind has yet seen is now slowly taking place by her agency. She is teaching the world that the ultimate court of appeal is observation and experiment, and not authority; she is teaching it to estimate the value of evidence; she is creating a firm and living faith in the existence of immutable moral and physical laws, perfect obedience to which is the highest possible aim of an intelligent being.—T. H. Huxley (*Collected Essays*, VIII, "Discourses, biological and geological," London, 1893–94, p. 226)