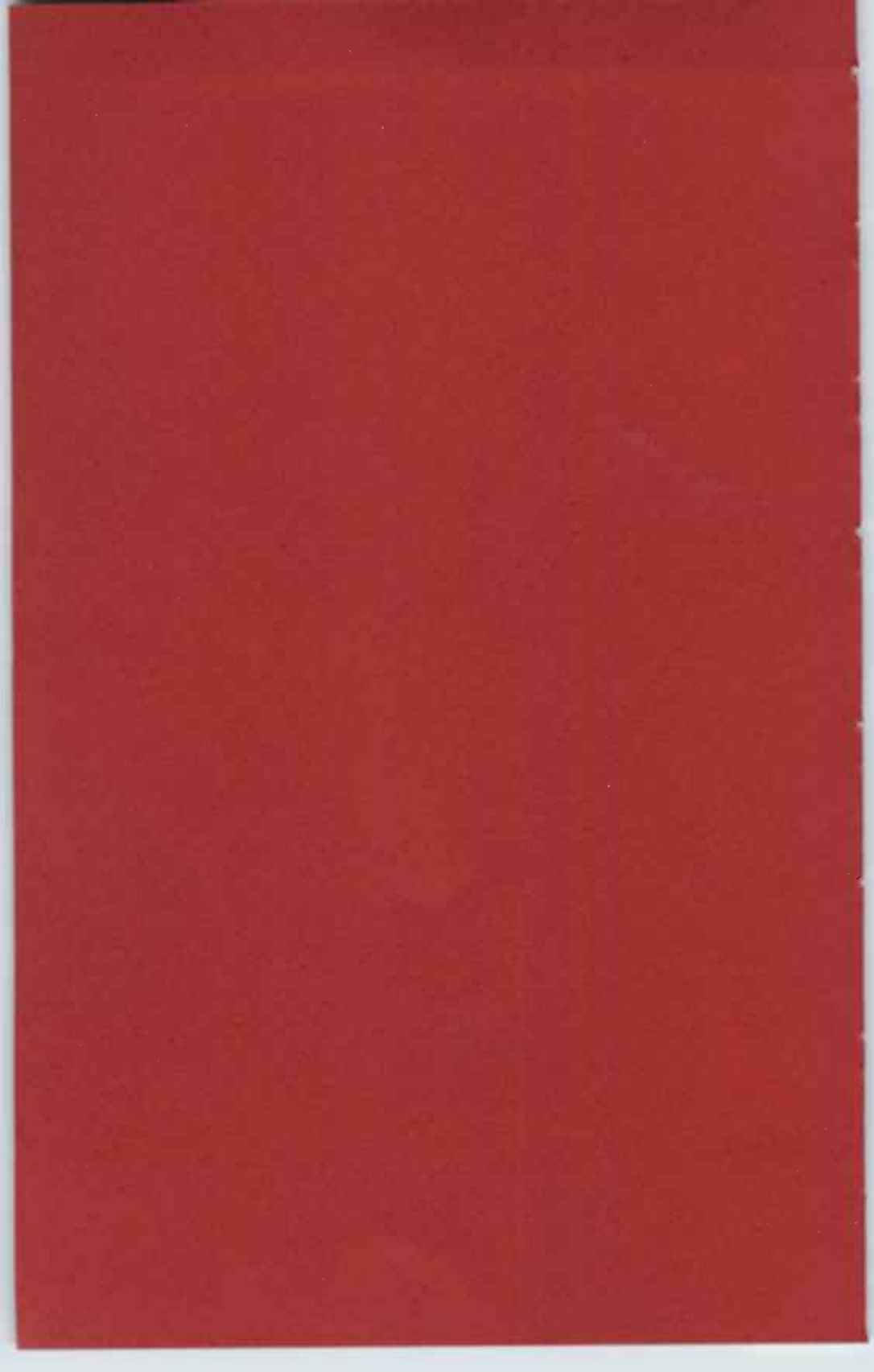
Volume 15, Number 1 - 1973

RADIOCARBON

Published by

THE AMERICAN JOURNAL OF SCIENCE

YALE UNIVERSITY
NEW HAVEN, CONNECTICUT



RADIOCARBON

Editors: RICHARD FOSTER FLINT—J. GORDON OGDEN, III—IRVING ROUSE—MINZE STUIVER
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THE AMERICAN JOURNAL OF SCIENCE

Editors: JOHN RODGERS, JOHN H. OSTROM, AND PHILIP M. ORVILLE

Published tri-annually, in Winter, Spring, and Summer, at Yale University, New Haven, Connecticut.

Subscription rate $45.00 (for institutions), $30.00 (for individuals), available only in whole volumes.

All correspondence and manuscripts should be addressed to the Managing Editor, RADIOCARBON, Box 2161, Yale Station, New Haven, Connecticut 06520.

INSTRUCTIONS TO CONTRIBUTORS

Manuscripts of radiocarbon papers should follow the recommendations in *Suggestions to Authors*, 5th ed.* All copy must be typewritten in *double space* (including the bibliography); manuscripts for vol. 15, no. 3 must be submitted in *duplicate* by February 1, 1973. Vol. 15, no. 2 has already been filled.

Description of samples, in date lists, should follow as closely as possible the style shown in this volume. Each separate entry (date or series) in a date list should be considered an *abstract*, prepared in such a way that descriptive material is distinguished from geologic or archaeologic interpretation, but description and interpretation must be both brief and informative, emphasis placed on significant comments. Date lists should therefore not be preceded by abstracts, but abstracts of the more usual form should accompany all papers (e.g. geochemical contributions) that are directed to specific problems.

Each description should include the following data, if possible in the order given:

1. Laboratory number, descriptive name (ordinarily that of the locality of collection), and the date expressed in years B.P. (before present, *i.e.*, before A.D. 1950) and, for finite dates, in years A.D./B.C. The standard error following the date should express, within limits of $\pm 1\sigma$, the laboratory's estimate of the accuracy of the radiocarbon measurement, *as judged on physicochemical (not geologic or archaeologic) grounds.*

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen.

3. Precise geographic location, *including latitude-longitude coordinates.*

4. Occurrence and stratigraphic position in precise terms; use of metric system exclusively. Stratigraphic sequences should *not* be included. However, references that contain them can be cited.

5. Reference to relevant publications. Citations within a description should be to author and year, with specific pages wherever appropriate. References to published date lists should cite the sample no., journal (R. for Radiocarbon), year, vol., and specific page (e.g., M-1832, R., 1968, v. 10, p. 97). Full bibliographic references are listed alphabetically at the end of the manuscript, in the form recommended in *Suggestions to Authors.*

6. Date of collection and name of collector.

7. Name of person submitting the sample to the laboratory, and name and address of institution or organization with which submitter is affiliated.

8. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted, as prescribed above. Interpretive material, summarizing the significance and implicity showing that the radiocarbon measurement was worth making, belongs here, as do technical matters, e.g., chemical pretreatment, special laboratory difficulties, etc.

Illustrations should not be included unless absolutely essential. They should be original drawings, although photographic reproductions of line drawings are sometimes acceptable, and should accompany the manuscript in any case, if the originals exceed 9 to 12 inches in size.

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* Suggestions to authors of the reports of the United States Geological Survey, 5th ed., Washington, D. C., 1958 (Government Printing Office, $1.75).

NOTICE TO READERS

Half life of C^{14}. In accordance with the decision of the Fifth Radiocarbon Dating Conference, Cambridge, 1962, **all dates published in this volume (as in previous volumes) are based on the Libby value, 5570 ± 30 yr,** for the half life. This decision was reaffirmed at the H^3 and C^{14} Conference, Pullman, Washington, 1965. Because of various uncertainties, when C^{14} measurements are expressed as dates in years B.P. the dates are arbitrary, and refinements that take some but not all uncertainties into account may be misleading. As stated in Professor Harry Godwin's letter to **Nature** (v. 195, no. 4845, p. 984, September 8, 1962), the mean of three new determinations of the half life, 5730 ± 40 yr, is regarded as the best value now obtainable. Published dates can be converted to this basis by multiplying them by 1.03.

A.D./B.C. dates. As agreed at the Cambridge Conference in 1962, A.D. 1950 is accepted as the standard year of reference for all dates, whether B.P. or in the A.D./B.C. system.

Meaning of δC^{14}. In Volume 3, 1961, we indorsed the notation Δ (Lamont VIII, 1961) for geochemically interesting measurements of C^{14} activity, corrected for isotopic fractionation in samples and in the NBS oxalic-acid standard. The value of δC^{14} that entered the calculation of Δ was defined by reference to Lamont VI, 1959, and **was corrected for age.** This fact has been lost sight of, by the editors as well as by authors, and recent papers have used δC^{14} as the **observed** deviation from the standard. This is of course the more logical and self-explanatory meaning, and cannot be abandoned now without confusion; moreover, except in tree-ring-dated material, it is rarely possible to make an age correction that is independent of the C^{14} age. In the rare instances where Δ or δC^{14} are used for samples whose age is both appreciable and known, we assume that authors will take special care to make their meaning clear; reference merely to "Δ as defined by Broecker and Olson (Lamont VIII)" is not adequate.

Radiocarbon Measurements: Comprehensive Index, 1950-1965. This index, covering all published C^{14} measurements through Volume 7 of RADIOCARBON, and incorporating revisions made by all laboratories, has been published. It is available to all subscribers to RADIOCARBON at ten dollars U.S. per copy.

Publication schedule. Beginning with Volume 15, RADIOCARBON will be published in three numbers: Winter, Spring, and Summer. The next deadline is February 1, 1973. Contributors who meet our deadlines will be given priority but not guaranteed publication in the following issue.

List of laboratories. The comprehensive list of laboratories at the end of each volume will now appear in the third number of each volume.

Index. All dated samples appear in index form at the end of the third number of each volume.

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We regret to announce to our readers the withdrawal of the Geological Survey of Canada from our list of contributing laboratories, in order to publish its date lists independently. We are sorry that RADIOCARBON's nearly complete coverage will be diminished thereby.

We shall, of course, continue to include GSC in our list of active laboratories.

The Editors

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Radiocarbon

1973

BIRMINGHAM UNIVERSITY RADIOCARBON DATES VI

F. W. SHOTTON and R. E. G. WILLIAMS
The University of Birmingham, Birmingham, England

The following list comprises results obtained during 1971 from both the 1 L and 6 L proportional gas counters at pressures of 1 to 3 atm of methane. Age calculations are based on 95% activity of NBS oxalic acid standard and computed from the Libby half-life of 5570 ± 30 yr. Background samples are synthesized from Welsh anthracite. Errors quoted refer only to the standard deviation (1σ) calculated from a statistical analysis of sample, background, and standard count rates. Recently a Micromass 6 mass spectrometer was installed in the Radiocarbon Dating Laboratory which will enable C^{13} measurements on future samples. Pretreatment is continued as described previously (R., 1969, v. 11, p. 263) but in cases where sample size was insufficient for full pretreatment, details are described.

ACKNOWLEDGMENTS

We thank Mrs. L. Salvini for continued sample preparation and welcome the assistance of A. C. Johnson in place of Mrs. J. Clarke, who until recently, did the routine counting.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. British Isles

Foulness Island/Dengie peninsula series, Essex

Peat and shells from Foulness I./Dengie peninsula, Essex. Coll. 1969 and subm. by J. T. Greensmith, Dept. Geol., Queen Mary College, London.

Birm-244. **(a) 1265 ± 200 A.D. 685**
(b) 1434 ± 110 A.D. 516

Inner (a) and outer (b) fraction of shells (*Cardium edule*) from inland chernier overlain by ca. ½ m thick soil at Court Farm, Dengie Peninsula, Essex (51° 39′ 10″ N Lat, 0° 54′ 08″ E Long, Grid Ref. TM016994). *Comment*: faunal content of shell body similar to present day. Dates agree with earlier of 2 postulated chernier formation periods viz. 1650 to 1350 and 1150 to 950 B.P. (Greensmith and Tucker, 1969b).

Birm-243.

(a) 3580 ± 175
1630 B.C.
(b) 3936 ± 110
1986 B.C.
(c) 3912 ± 114
1962 B.C.

Innter (a), middle (b), and outer (c) fraction of shells (*Cardium edule*) from 6.86 to 9.75 m depth in Borehole R.11 at Foulness I., Essex (51° 36′ 35″ N Lat, 0° 54′ 30″ E Long, Grid Ref. TM020941). *Comment*: shell bodies highly porous; circulating water thought to be saline.

Birm-242. **7516 ± 250**
5566 B.C.

Plant material washed from silt at 20.0 to 20.2 m depth in Borehole R.10 at Foulness I., Essex (51° 36′ 29″ N Lat, 0° 55′ 35″ E Long, Grid Ref. TM029940). *Comment*: sample size precluded alkali pretreatment. *General Comment*: dates help establish sedimentation pattern assoc. with Flandrian transgression and age deduction of assoc. channel fill deposits (Greensmith and Tucker, 1968; 1969a).

Birm-245. Scandal Beck, Westmorland **>42,000**

Wood from upper of 2 organic horizons in sandy silt overlain by 1.5 m till ca. 5.8 m deep on W bank Scandal Beck, 64 m SSW Brunt Hill Farm, Ravenstonedale, Westmorland (54° 25′ N Lat, 2° 24′ W Long, Grid Ref. SE743024). Coll. 1970 and subm. by G. A. L. Johnson, Dept. Geol., Univ. Durham. *Comment*: earlier measurement on peat sample (Birm-161: $36{,}300\ ^{+2160}_{-1700}$; R., 1970, v. 12, p. 386) suggested interstadial of last glaciation, but new determination on wood conforms with interpretation of pollen as interglacial. First measurement on this wood also appeared inactive (Birm-234: >32,500; R., 1971, v. 13, p. 148) but sample was insufficient for highest age value of 4σ.

Birm-247. Pilgrim Lock, Bidford on Avon, Warwickshire **3010 ± 120**
1060 B.C.

Plant debris washed from black silt with many shells from 4.57 to 4.67 m depth at Pilgrim Lock, Bidford on Avon, Warwickshire (52° 09′ N Lat, 1° 50′ W Long, Grid Ref. SP119516). Coll. 1970 and subm. by P. J. Osborne, Dept. Geol., Univ. Birmingham. *Comment* (P.J.O): insect fauna indicates predominantly open conditions, probably pasture land. Plant macro-fossils include several agricultural weed seeds. Evidence accords well with date.

Kirkby on Bain series, Lincolnshire

Gravel with included lens of organic silt overlying an interglacial sequence which, in turn, overlies Boulder Clay at Bain Aggregates Pit,

Kirkby on Bain, Lincolnshire (53° 08′ N Lat, 0° 10′ W Long, Grid Ref. TF532605). Coll. 1971 and subm. by G. R. Coope, Dept. Geol., Univ. Birmingham.

Birm-250. **(a) 34,800 ± 1000 (32,850 B.C.)** **(b) 28,000 ± 650 (26,050 B.C.)**

Fine plant debris with moss from top 5 cm of organic bed at 3.0 m depth in gravel. Sample contained an arctic insect fauna. Sample (a) after alkali pretreatment, (b) humate extract.

Birm-251. **>45,000**

Wood from ca. 4.0 m depth in gravel contained in interglacial deposit immediately overlying boulder clay. *Comment* (G.R.C.): date consistent with interglacial interpretation.

Birm-252. Lea Marston Pit, Coton, Warwickshire **9700 ± 130 (7750 B.C.)**

Small broken twigs from ca. 5 cm band at 2.46 to 2.51 m depth, washed from brown clayey peat at Lea Marston Pit, Coton, Warwickshire (52° 32′ 40″ N Lat, 1° 41′ 20″ W Long, Grid Ref. SO212942). Coll. 1970 and subm. by P. J. Osborne. *Comment* (P.J.O.): insect fauna very similar to thermophilous assemblage of Birm-215: 9510 ± 235; R., 1971, v. 13, p. 146.

Birm-256. Battlehill, Annan, Scotland **6800 ± 250 (4850 B.C.)**

Sample from top of 5 cm of organic mud at ca. +3.89 m alt. overlain by carse deposit 4.04 m thick on N shore of Solway Firth at Battlehill, Annan, Scotland (54° 58′ N Lat, 3° 14′ W Long, Grid Ref. NY21576494). Coll. 1970 and subm. by W. G. Jardine, Dept. Geol., Univ. Glasgow. *Comment*: date is maximum for local invasion by Carse sea (cf. GU-64: 7254 ± 101; R., 1969, v. 11, p. 50).

Birm-258. Horseholm, Dumfriesshire, Scotland **5410 ± 160 (3460 B.C.)**

Peat from bottom 5 cm of massive organic bed, ca. 3.0 m thick, immediately overlying carse deposit at ca. +6.0 m alt. at Horseholm, Dumfriesshire, Scotland (55° 01′ N Lat, 3° 31′ W Long, Grid Ref. NY03137062). Coll. 1970 and subm. by W. G. Jardine. *Comment*: date is minimum for local end of carse deposition (cf. Q-638: 6645 ± 120; R., 1962, v. 4, p. 59).

Birm-259. Stone Point, Hampshire **>34,000**

Peat from 12 to 15 cm depth at Stone Point, Hampshire (50° 47′ N Lat, 1° 21′ W Long, Grid Ref. SZ458984). Coll. 1971 and subm. by F. Hodson, Dept. Geol., Univ. Southampton. *Comment*: reinterpretation of this sec. indicated Holocene peat, but date supports Ipswichian Interglacial age of West and Sparks (1960).

Birm-260. Tattershall Castle, Lincolnshire **>42,000**

Fragments of wood, cones, and seeds washed from woody peat at 5.74 to 5.84 m depth near base of supposed Ipswichian interglacial deposit at Tattershall Castle gravel pit, Lincolnshire (53° 05′ 45″ N Lat, 0° 11′ 30″ W Long, Grid Ref. TF208569). Coll. 1971 and subm. by F. W. Shotton. *Comment*: deposit may be interglacial.

Birm-270. Glen Ballyre, Isle of Man

(a) 18,700 ± 500
16,750 B.C.
(b) 18,550 ± 185
16,600 B.C.
(c) 18,400 ± 500
16,450 B.C.

Moss (*Drepanocladus revolvens*) washed from clay at 2.93 to 2.97 m below cliff top at Glen Ballyre near Kirkmichael, Isle of Man (54° 19′ 45″ N Lat, 4° 36′ 00″ W Long, Grid Ref. SC315915). Coll. 1971 and subm. by F. W. Shotton. *Comment*: (a) and (c) are same sample measured in different counters; (b) is a separate sample. As previous date, 18,900 ± 330 (Birm-213: R., 1971, v. 13, p. 147) was much earlier than any deposit at base of a continuous late Devensian sequence, a 2nd measurement on moss from same layer was made. Possibility of hardwater effect, as moss can flourish submerged (Mitchell, 1965; Dickson *et al.*, 1970).

Birm-273. Arkle, NW Scotland

(a) 4940 ± 125
2990 B.C.
(b) 5145 ± 135
3195 B.C.

Peat from below solifluction lobe ca. 1.0 m deep in stream gulley beneath summit plateau of Arkle, NW Scotland (58° 22′ 15″ N Lat, 4° 52′ 45″ W Long, Grid Ref. NC312452). Coll. 1970 and subm. by D. N. Mottershead, Dept. Geog., Portsmouth Polytechnic. Sample partially soluble in 5% HCl, precipitated, washed, dried, and dated as acid-soluble fraction (a), remainder filtered, dried, and dated as sample (b). Insufficient material for alkali pretreatment. *Comment*: closely agrees with age of peat from identical position in the Cairngorms, 4880 ± 135 (Sugden, 1971) and similar sites in Colorado Mts. (Benedict, 1966).

Birm-276. Glanllynau, Caernavonshire

12,560 ± 230
10,610 B.C.

Terrestrial seeds hand-picked from Late Glacial detritus mud at Glanllynau, Caernavonshire, N Wales (52° 54′ 45″ N Lat, 2° 22′ 45″ W Long, Grid Ref. SH449373). Coll. 1970 and subm. by G. R. Coope. Sample treated to remove possible humate contamination, and selected to eliminate hard water error and risk of rootlet contamination. Previous date of bulk sample GaK-1603: 12,050 ± 250 (unpub.). *Comment* (G.R.C.): deposit contained rich thermophilous insect assemblage assoc. with low arboreal pollen frequency.

27,650 ± 250

Birm-293. Beckford, Worcestershire **25,700 B.C.**

Organic debris (ca. 25 g) washed from ca. 68 kg of gray organic silt at 2.0 to 2.6 m depth at Beckford Quarry, Beckford, Worcestershire (52° 01′ N Lat, 2° 02′ W Long, Grid Ref. SP98353620). Coll. 1971 and subm. by D. J. Briggs, Dept. Geog., Univ. Bristol. *Comment*: date at end of Middle Devensian, consistent with occurrence in terrace gravel grading to Avon No. 2. Included insect fauna is arctic.

Grimston Hall series, East Yorkshire

Moss peat from coastal cliff sec. 21 km ENE of Hull at Grimston Hall, E Yorkshire (53° 47′ 46″ N Lat, 0° 02′ 36″ W Long, Grid Ref. TA289352). Coll. 1971 and subm. by L. F. Penny, Dept. Geol., Univ. Hull. Dominant moss is *Helodium blandowii* with subordinate *Aulacomnium palustre* and *Acrocladium giganteum*, id. by J. H. Dickson. Samples from slipped block at foot of cliff. Block clearly fell from near top of cliff. Overlying laminated clay contains plant remains (*Salix* and *Betula nana*). Peat, 10 cm thick, and underlying pale gray clay, 5 cm thick lie on Purple Till (late Devensian) weathered to ca. 60 cm depth.

12,230 ± 120

Birm-298. **10,280 B.C.**

Leaves (mostly *Phragmites*) from 2 cm thick layer at base of specimen ca. 10 cm thick.

11,250 ± 170

Birm-301. **9300 B.C.**

Sample from top 2 cm of same specimen, *i.e.*, ca. 6 cm above Birm-298.

General Comment: dates encompass lower half Pollen Zone II. Deposit lies on triple succession of Hessle, Purple, and Drab Tills, with the Hessle eroded away. Dimlington moss bed with dates of 18,500 ± 400 (I-3372, unpub.) and 18,240 ± 240 (Birm-108, R., 1969, v. 11, p. 265), underlies this succession.

>42,300

Birm-299. Cromer, Norfolk **$\delta C^{14}‰ = -999.52 \pm 1.29$**

Wood from clay at unknown depth beneath Cromer Till, from cliff sec. near Cromer, Norfolk (ca. 52° 56′ N Lat, 1° 20′ E Long). Coll. 1970 and subm. by N. R. Page, Hendon Coll. Techn., London. *Comment*: part of same sample given finite age by another lab. (T-1119; Page, 1972). Our limiting determination based on 4σ, but $\delta C^{14}‰$ shows inactivity of sample.

10,040 ± 210

Birm-304. Holderness, Yorkshire **8090 B.C.**

Feebly organic silt 1.1 m deep from lowest of 3 organic beds in gray-brown sandy clay with few pebbles, filling hollow 9 m wide and 1.2 m deep in pale gray leached till ca. ½ km N 2° E of Ellerby Grange,

Holderness, Yorkshire (53° 50′ 00″ N Lat, 0° 13′ 52″ W Long, Grid Ref. TA16403894). Coll. 1970 and subm. by G. D. Gaunt, Inst. Geol. Sci., Leeds. *Comment*: organic content insufficient for alkali treatment. Date is minimum for clearance of late Devensian ice. Cf. dates at Grimston Hall, only 13 km to ESE (Birm-298 and Birm-301, above).

B. Miscellaneous Geologic Samples

Savukoski series, Finland

Plant material washed from silt core samples at Sokli, Savukoski, Finland (67° 49′ N Lat, 29° 24′ E Long). Coll. 1971 and subm. by E. Ilvonen, Inst. Quat. Geol., Univ. Turku, Finland.

Birm-278. **>39,400**

Sample from ca. 26.0 m depth in Borehole 1, immediately overlying till resting on limestone and underlying sand, gravel, and silt.

Birm-279. **32,830 $^{+1460}_{-1240}$ B.C.**

Sample from ca. 22.5 m depth in Borehole 2 overlying sand and underlying silt, sand, and gravel.

General Comment: base of Quaternary deposits not found. First occurrence in Finland of organic deposit as old as mid-Weichselian, overlying an earlier till.

Kuwait Bay series, Persian Gulf

Shells (*Ostrea* sp.), id. by Rev. H. E. J. Biggs, from emerged beaches on N coast of Kuwait Bay, Persian Gulf. Coll. 1971 and subm. by T. A. Al-Asfour, Dept. Geog., Univ. Durham.

Birm 283. **(a) >41,000**
(b) 35,000 ± 1000
33,050 B.C.

Inner (a) and outer (b) fraction of shells from surface of terrace at +46.0 to +51.0 m alt. (29° 28′ N Lat, 47° 47′ E Long).

Birm-285. **(a) >34,500**
(b) >31,500
(c) 32,000 $^{+2300}_{-1800}$
30,050 B.C.

Inner (a), middle (b) and outer (c) fraction of shells from surface of terrace at +40.0 to +42.0 m alt. (29° 31′ N Lat, 47° 52′ E Long).

General Comment: evidence of some degree of isotopic replacement on outside of shells. Birm-283(a) and Birm-285(a) indicate minimum age of the beaches.

Birm-249. Karuküla, SW Estonia >48,750

Inter-morainic wood from 1.65 m depth at Karuküla, SW Estonia. Coll. 1969 and subm. by J. M. Punning, Inst. Geol. Acad. Sci., Estonia, SSR. *Comment* (F.W.S.): Karuküla deposit regarded as a type sec. mid-Würm interstadial, true date therefore critical. Organic beds from 1.50 to 2.55 m dated mainly by Tartu on peat and wood. Peat figures consistent (1.5 to 1.7 m, TA-100, 48,100 ± 1700; 1.95 to 2.15 m, TA-101, 48,100 ± 1650; 2.05 m, TA-276, 47,800 ± 1100; 2.3 m, TA-277, 48,800 ± 1200; 2.35 to 2.55 m, TA-106, >45,000). Wood figures very different, TA-99, 1.5 to 1.7 m, 33,450 ± 800 and TA-275, 1.65 m, 40,500 ± 700. Birm-249 was from same sample as TA-275; date agrees with TA peat series. The limit of age quotation is based on a count value exceeding 4σ and the recorded value in this case was 3.45σ.

Norre Lyngby series, Denmark

Samples from cleared cliff sec. at Norre Lyngby on Jutland coast (57° 24′ 55″ N Lat, 9° 45′ 55″ E Long). Coll. and subm. by F. W. Shotton, P. J. Osborne, and G. R. Coope.

Birm-294. 11,800 ± 260 / 9850 B.C.

Birm-288. 12,875 ± 235 / 10,925 B.C.

Birm-281. 11,330 ± 150 / 9380 B.C.

Birm-274. 13,120 ± 210 / 11,170 B.C.

Birm-287. 12,500 ± 170 / 10,550 B.C.

Birm-282. 12,050 ± 160 / 10,100 B.C.

Birm-286. 13,910 ± 425 / 11,960 B.C.

Birm-300. 12,790 ± 360 / 10,840 B.C.

General Comment: sec. extends one described by J. Iversen (1942) which includes the Allerød and possibly higher and lower beds. It is currently being restudied. Above dates are in descending stratigraphic order, but Birm-281 and Birm-274 are on same horizon. Inconsistencies in figures are explained by differences in nature of sample vegetation: only Birm-281 and -282 are composed of twigs, the others have a possible hard-water error (Shotton, 1972). Probably same bed as Birm-282 previously dated 11,680 ± 140 B.P., K-962, and 11,780 ± 180 B.P., K-963 (R., 1966, v. 8, p. 214).

II. ARCHAEOLOGIC SAMPLES

A. British Isles

Birm-246. Brean Down, Somerset **(a) >24,000 (b) 1300 ± 80 A.D. 650**

Collagen (b) from human bone from ca. 1.0 m depth in Brean sand cliff cemetery adjacent to Brean Down, Somerset (51° 19′ N Lat, 3° 01′ W Long, Grid Ref. ST295588). Coll. 1959 by A. M. ApSimon, Weston-Super-Mare Mus.; subm. by P. A. Rahtz, School Hist., Univ. Birmingham. *Comment*: preservative fraction (a) extracted by refluxing in alcohol; infinite date suggests it is petro-chemical derived. Mus. was using polyvinyl acetate in toluene for consolidation of such material well before sample was coll.

Birm-248. King's School, Worcester **1365 ± 102 A.D. 585**

Collagen from human bones of uncoffined burial (Grave 1) below foundations of wall built in 17th century A.D. at Undercroft College Hall, King's School, Worcester (52° 11′ 20″ N Lat, 2° 13′ 15″ W Long, Grid Ref. SO850545). Coll. 1970 and subm. by P. A. Barker, Dept. Extramural Studies, Univ. Birmingham. *Comment*: confirms previous date (Birm-198: 1414 ± 107; R., 1971, v. 13, p. 154) on separate sample from same grave.

East Goscote series, Leicestershire

Plant material from organic mud with thin sand lenses at 1.25 to 1.65 m depth in Beedle's Quarry, Broom Lodge, E Goscote, Leicestershire (52° 43′ 00″ N Lat, 1° 03′ 30″ W Long, Grid Ref. SK637139). Coll. 1970 and subm. by A. Saville, Dept. Ancient Hist. and Archaeol., Univ. Birmingham. *Comment*: separate samples from same horizon in 2 adjacent secs.

Birm-253. **3970 ± 85 2020 B.C.**

Wood washed from organic mud.

Birm-257. **4054 ± 122 2104 B.C.**

Fine plant debris washed from organic mud.

General Comment: level contained scattered flint industry of Mesolithic aspect. Neolithic dates indicate redeposited industry.

Birm-255. Hatton Rock, Warwickshire **1044 ± 88 A.D. 906**

Charcoal from possible Saxon palace at Hatton Rock, Warwickshire (52° 13′ N Lat, 1° 39′ W Long, Grid Ref. SP237577). Coll. 1970 and subm. by P. A. Rahtz, School Hist., Univ. Birmingham. *Comment*: dates impressive structure previously without age context (Rahtz, 1970).

950 ± 90

Birm-269. Warrington, Lancashire A.D. 1000

Wood (*Ulmus*) from dug-out canoe at ca. 3.4 m depth, ca. +2.0 m alt., in coarse sand 275 m N of R. Mersey at Gate Warth Farm, Warrington, Lancashire (53° 22′ 45″ N Lat, 2° 38′ 00″ W Long, Grid Ref. SJ583871). Coll. 1971 by A. Leigh; subm. by J. R. Rimmer, Warrington Mus. *Comment*: younger than expected (Dunlop, 1932).

1880 ± 150

Birm-271. Perwick Bay, Isle of Man A.D. 70

Charcoal from midden deposit overlying emerged beach material in cave at Traie Coonan, Perwick Bay, Isle of Man (54° 04′ N Lat, 4° 45′ W Long, Grid Ref. SC204673). Coll. 1970 and subm. by L. S. Garrad, Manx Mus., Isle of Man. *Comment*: cave occupation using domestic animals (pig, small ox, Soay type sheep), wild mammals (Red and Roe Deer), sea birds (Razorbill, Guillemot, Chough, and Great Auk) and limpets as food. No artifacts except pointed bone limpet scoops.

940 ± 100

Birm-272. Coventry, Warwickshire A.D. 1010

Wood (*Quercus* sp.) id. by Forest Prod. Res. Lab., Princes Risborough, Buckinghamshire. From newest tree rings at base of large wooden vat-shaped object from construction trench at building site between Bishop and Silver Sts., Coventry, Warwickshire (52° 24′ 38″ N Lat, 1° 30′ 34″ W Long, Grid Ref. SP33387936). Coll. 1971 by B. Hobley; subm. by W. M. Elliott, Herbert Mus., Coventry. *Comment*: possibly a steeping vat, impossible to date except by C^{14}.

2440 ± 100

Birm-277. Les Huguettes, Alderney, Channel Islands 490 B.C.

Charcoal of oak, hazel, hawthorn, and holly, id. by J. F. Hughes, Dept. Forestry, Univ. Oxford, assoc. with pottery in undisturbed layer of wood ash, 0.1 to 0.2 m thick, overlain by wind blown sand, 0.5 m thick, underlying top soil and humus, ca. 0.25 to 0.5 m thick, at bonfire firing site, Les Huguettes, Alderney, Channel Is. (49° 43′ 24″ N Lat, 2° 10′ 50″ W Long, Grid Ref. WA592083). Coll. 1970 and subm. by K. Wilson, Alderney Soc. *Comment*: confirms Iron age date of assoc. pottery (Wilson, 1968).

1430 ± 170

Birm-280. Hinksford, Staffordshire A.D. 520

Collagen from red deer antler (*Cervus elaphus*) from base of gray clay, ca. 3.3 m depth, at Holbeche Brook, Hinksford, Staffordshire (52° 30′ 22″ N Lat, 2° 11′ 41″ W Long, Grid Ref. SO867898). Coll. 1969 by A. V. Morgan; subm. by F. W. Shotton. *Comment*: assoc. with antler, shaped by a cutting tool, which is not prehistoric, according to date.

Tamworth series, Staffordshire

Wood (*Quercus* sp.), id. by J. T. Williams, Dept. Botany, Univ.

Birmingham, from remains of Saxon water-mill, 1.4 m depth overlying Red Triassic Clay at Tamworth, Staffordshire (52° 38′ N Lat, 2° 42′ W Long, Grid Ref. SK210040). Coll. 1971 and subm. by P. A. Rahtz.

Birm-289. **1220 ± 100**
A.D. 730

Wood from band of primary leet fill (ca. 10 cm thick) overlying Red Triassic Clay.

Birm-290. **1162 ± 100**
A.D. 788

Part of branch in silt and sand of earlier mill immediately below thick wooden plank floor.

Birm-291. **1240 ± 110**
A.D. 710

Outer edge of massive timber of mill at ca. 1.3 m depth.

Birm-292. **1195 ± 90**
A.D. 755

Branch from silt layer, ca. 30 cm thick, overlying primary leet fill. *General Comment*: agrees within the standard deviation, indicates a mid-8th century A.D. date.

B. Miscellaneous Archaeologic Samples

Split series, Yugoslavia

Wood and bone assoc. with Diocletian's palace at Split, Yugoslavia. Coll. 1970 and subm. by J. J. Wilkes, Dept. Latin, Univ. Birmingham.

Birm-240. **(a) 286 ± 90**
A.D. 1664
(b) $\delta C^{14}‰ = -3.9 \pm 7.9$
Modern

Bark from piles of medieval street levels. *Comment*: sample (a) after alkali pretreatment, (b) humate extract. Dates confirm modern sewage contamination seeping through wet levels.

Birm-254. **1032 ± 55**
A.D. 918

Collagen from human bones (*Femur* and *Tibia*) from burial site in Diocletian's palace (43° 31′ N Lat, 16° 28′ E Long). In level known to be between 4th and 13th centuries A.D.

Birm-303. **640 ± 160**
A.D. 1310

Bone (*Pullus*) from cooking pot in material above Roman Mosaic (43° 05′ N Lat, 16° 04′ E Long). *Comment*: dates gap in excavation chronology between end of Roman period and arrival of Italian imported pottery.

Molino Casarotto series, Italy

Charcoal and wood from sites of early Neolithic occupation at Molino Casarotto, Arcugnano, Vicenza, Italy (45° 28′ N Lat, 11° 30′ E Long). Coll. 1970 and subm. by L. H. Barfield, Dept. Ancient Hist. and Archaeol., Univ. Birmingham.

Birm-261. **5780 ± 135** **3830 B.C.**

Charcoal from Site 4.

Birm-262. **5820 ± 135** **3870 B.C.**

Charcoal from lowest level of main hearth at Site 4.

Birm-263. **5525 ± 200** **3575 B.C.**

Charcoal from level assoc. with lowest level of main hearth at Site 4.

Birm-264. **5750 ± 135** **3800 B.C.**

Charcoal from lowest level of main midden at Site 4.

Birm-265. **5930 ± 130** **3980 B.C.**

Charcoal in upper level of main midden at Site 4.

Birm-266. **5555 ± 130** **3605 B.C.**

Charcoal from 2nd hearth at Site 4.

Birm-267. **5700 ± 130** **3750 B.C.**

Charcoal from 2nd settlement area at Site 4.

Birm-268. **4890 ± 130** **2940 B.C.**

Part of wooden pile from Site 7.

General Comment (L.H.B.): Birm-261-267 from 1970 excavation of single settlement unit (Loc. 4) of the early square-mouthed pottery culture (Quinzano-Finale phase). They are a consistent group between 3575 and 3980 B.C. Final sample, Birm-268, from another settlement area (Loc. 7) where only piles and no cultural material were preserved; substantially later date suggests this site may be assoc. with a later stage of Neolithic. These dates from Loc. 4 do not correspond with the 6 consistent dates obtained from the same settlement complex in 1969, Birm-172-177 between 4175 ± 150 and 4520 ± 150 B.C. (R., 1970, v. 12, p. 397). It is disturbing that Birm-261-263, were from the lower levels of the main central hearth whose upper levels had produced some of the dated samples in 1969, e.g., Birm-177, 4175 ± 150 B.C. (R., 1970, v. 12, p. 397). The 1969 dates appear early by comparison with dates from the same phase of the square-mouthed culture in Italy (Arene Candide Layers

16 to 19, R-103: 3515 ± 50 B.C., R., 1966, v. 8, p. 402; Grotta Aisone R-95: 3875 ± 75 B.C., R., 1965, v. 7, p. 213). The 1970 dates compare favorably with dates from other sites and are therefore regarded as more acceptable series.

References

Benedict, J. B., 1966, Radiocarbon dates from a stone-banked terrace in the Colorado Mountains, U.S.A.: Geog. Annaler, v. 48A, p. 24-31.

Dickson, C. A., Dickson, J. H., and Mitchell, G. F., 1970, The Late Glacial Flora of the Isle of Man: Royal Soc. [London] Philos. Trans., v. 259, p. 31-79.

Dunlop, G. A., 1932, Three dug-out canoes found at Warrington, Lancashire: Lancashire and Cheshire Antiquarian Soc. Trans., v. XLVII, p. 16-26.

Greensmith, J. T. and Tucker, E. V., 1968, Foulness: some geological implications: Civil Eng. and Pub. Wks. Rev., v. 63, p. 525-529.

———— 1969a, Coastline evolution and reclamation in east Essex: Geol. Soc. London Proc., v. 1569, p. 313-315.

———— 1969b, The origin of Holocene shell deposits in the chernier plain facies of Essex, Great Britain: Marine Geol. Geochem. and Geophys. Internatl. Jour., v. 7, p. 403-425.

Iversen, J., 1942, En pollenanalytisk Tidsfoestelse of Ferskvandslagene ved Norre Lyngby: Dansk. Geol. Foren. Medd., v. 10, pt. 2, p. 130-151.

Mitchell, G. F., 1965, The Late Quaternary of the Ballaugh and Kirkmichael districts, Isle of Man: Geol. Soc. London Quart. Jour., v. 121, p. 359-381.

Page, N. R., 1972, On the age of the Hoxnian interglacial: Geol. Jour., v. 8, p. 129-142.

Rahtz, P. A., 1970, A possible Saxon Palace near Stratford-upon-Avon: Antiquity, no. 174 p. 137-143.

Shotton, F. W., 1972, The hard water effect in radiocarbon dating: Nature, in press.

Sugden, D. E., 1971, The significance of periglacial activity on some Scottish Mountains: Geog. Jour., v. 137, pt. 3, p. 388-392.

West, R. G. and Sparks, B. W., 1960, Coastal interglacial deposits of the English Channel: Roy. Soc. [London] Philos. Trans., v. 243, p. 95-133.

Wilson, K., 1968, Excavating Alderney's Iron age site: Alderney Soc. Bull., v. 3, no. 3.

[RADIOCARBON, VOL. 15, NO. 1, P. 13-41]

UNIVERSITY OF BONN
NATURAL RADIOCARBON MEASUREMENTS V

H. W. SCHARPENSEEL and F. PIETIG
Institut für Bodenkunde, Universität Bonn
Bonn, Bundesrepublik Deutschland

Radiocarbon measurements, mainly on soil and water samples are being continued. Benzene samples are prepared as described earlier (Scharpenseel and Pietig, 1969). By adding another counting unit, the lab. now uses 3 liquid scintillation spectrometers and 4 benzene synthesis lines.

ACKNOWLEDGMENTS

The authors are indebted to E. Kruse, H. Tapp, Chr. Haupenthal, and H. Schiffmann for their technical help in sample preparation. An improved computer program was provided by H. Schiffmann. The Gesellschaft für Mathematik und Datenverarbeitung GmbH Bonn lent us their facilities for computer calculation of C^{14} ages. This work was supported by grants from the German Federal Department of Education and Science. Preparation of carbonate samples from aquifers in Tunisia was financed by the German Federal Department of Economic Cooperation. Travel funds for procurement of soil samples from outside Germany were provided by the German Foundation of Research (Deutsche Forschungsgemeinschaft).

SAMPLE DESCRIPTIONS

I. GROUND WATER SAMPLES

A. Tunisia series

Reported here are results of a 3rd yr of ground water dating in Tunisia; 47 carbonate samples from different wells were coll. C^{14} ages are indicated uncorrected and corrected for dead carbonate-C contribution (Tamers, 1967). Tritium concentrations were also measured. Samples coll. 1970 and subm. by H. W. Scharpenseel, F. Pietig, and Chr. Haupenthal, Inst. f. Bodenkunde, Bonn Univ., J. Ohling, HER-Econ. Coop. Proj., Tunis. This series is continuation of R., 1970, v. 12, p. 22-26 and R., 1971, v. 13, p. 190-193.

Sample	Measured C^{14} age	Corrected C^{14} age
	10,730 ± 130	8220 ± 840
BONN-580. Sidi Naji 10135/4 (36° 2′ N Lat, 10° 4′ E Long)	8780 B.C.	6270 B.C.
	5420 ± 60	3430 ± 660
BONN-581. Q. Khrioua 12620/4 (36° 4′ N Lat, 10° 4′ E Long)	3470 B.C.	1480 B.C.
	7190 ± 90	5310 ± 630
BONN-582. Q. El Ketam 9938/4 (36° 3′ N Lat, 10° 8′ E Long)	5240 B.C.	3360 B.C.
	2400 ± 70	580 ± 600
BONN-583. Tazoghrane 8 (36° 54′ N Lat, 10° 48′ E Long)	450 B.C.	A.D. 1370
	2960 ± 60	
BONN-584. Kherba 369/1 (36° 57′ N Lat, 9° 39′ E Long)	A.D. 1010	Modern
	4880 ± 90	1280 ± 1200
BONN-585. Ain Recoub 364/1 (37° 3′ N Lat, 9° 28′ E Long)	2930 B.C.	A.D. 670
	5830 ± 70	4510 ± 440
BONN-586. Al Kadrah 10933 (35° 29′ N Lat, 10° 8′ E Long)	3880 B.C.	2560 B.C.
	103.6 ± 0.2%	
BONN-587. Tazoghrane 9 (36° 54′ N Lat, 10° 47′ E Long)	Modern	Modern
	14,860 ± 200	10,360 ± 1500
BONN-588. M 'Halhal 5840/5 (33° 24′ N Lat, 9° 0′ E Long)	12,910 B.C.	8410 B.C.
	20,420 ± 460	18,320 ± 700
BONN-589. Fatnassa 2051/5 (33° 47′ N Lat, 8° 45′ E Long)	18,470 B.C.	16,370 B.C.
	21,020 ± 370	18,590 ± 810
BONN-590. Ksar Rhilane 7810/5 (32° 59′ N Lat, 9° 38′ E Long)	19,070 B.C.	16,640 B.C.
	2730 ± 70	840 ± 640
BONN-591. Grombalia 8955/2 (36° 35′ N Lat, 10° 30′ E Long)	780 B.C.	A.D. 1110
	16,510 ± 240	14,470 ± 680
BONN-592. O. Sohil 8464/2 (36° 29′ N Lat, 10° 42′ E Long)	14,560 B.C.	12,520 B.C.
	16,640 ± 180	14,690 ± 650
BONN-593. Sge. Belli 8979/2 (36° 34′ N Lat, 10° 34′ E Long)	14,690 B.C.	12,740 B.C.

Sample	Measured C^{14} age	Corrected C^{14} age
	7300 ± 70	5080 ± 740
BONN-594. O. Sohil 7804/2 (36° 29′ N Lat, 10° 42′ E Long)	5350 B.C.	3130 B.C.
	8580 ± 80	6180 ± 300
BONN-595. O. Sohil 7384/2 (36° 28′ N Lat, 10° 42′ E Long)	6630 B.C.	4230 B.C.
	6200 ± 90	4640 ± 520
BONN-596. Mll. Mateur 5695/1 (37° 4′ N Lat, 9° 39′ E Long)	4250 B.C.	2690 B.C.
	400 ± 50	
BONN-597. Cge A. Koceine 1787/1 (37° 5′ N Lat, 9° 49′ E Long)	A.D. 1550	Modern
	3840 ± 60	
BONN-598. SGR 4$_b$ Elle Azib 5271/1 (37° 11′ N Lat, 9° 59′ E Long)	1890 B.C.	Modern
	5150 ± 80	3170 ± 660
BONN-599. SFR 1 M Bourguiba 5488/1 (37° 7′ N Lat, 9° 49′ E Long)	3200 B.C.	1220 B.C.
	2100 ± 60	630 ± 490
BONN-600. SGR 1 El Azib 5527/1 (37° 10′ N Lat, 9° 57′ E Long)	150 B.C.	A.D. 1320
	13,480 ± 150	10,980 ± 830
BONN-1201. Haffouz 3 (35° 38′ N Lat, 9° 40′ E Long)	11,530 B.C.	9030 B.C.
	2800 ± 60	1000 ± 600
BONN-1202. Cherichira 4 (35° 39′ N Lat, 9° 46′ E Long)	850 B.C.	A.D. 950
	3200 ± 80	1010 ± 730
BONN-1203. Bou Haffna 5 11564 (35° 39′ N Lat, 9° 38′ E Long)	1250 B.C.	A.D. 940
	5400 ± 80	3780 ± 540
BONN-1204. Bou Haffna 3 10927 (35° 41′ N Lat, 9° 39′ E Long)	3450 B.C.	1830 B.C.
	12,100 ± 110	9460 ± 880
BONN-1205. Haffouz 6 12215 (35° 38′ N Lat, 9° 40′ E Long)	10,150 B.C.	7510 B.C.
	160 ± 60	
BONN-1206. Ain Rhezala 1816 (35° 42′ N Lat, 9° 40′ E Long)	A.D. 1790	Modern
	860 ± 60	
BONN-1207. A. Cherichira 18/4 (35° 38′ N Lat, 9° 48′ E Long)	A.D. 1090	Modern

Sample	Measured C^{14} age	Corrected C^{14} age
BONN-1208. A. Bou Morra 41/4 (35° 54′ N Lat, 9° 53′ E Long)	860 ± 60 A.D. 1090	Modern
BONN-1209. Q. Mofrine 10653 (35° 57′ N Lat, 9° 54′ E Long)	1700 ± 50 A.D. 250	200 ± 500 A.D. 1750
BONN-1210. Sbiba 4 7133/4 (35° 31′ N Lat, 9° 2′ E Long)	2700 ± 70 750 B.C.	1080 ± 540 A.D. 870
BONN-1211. Sbiba 3 6821/4 (35° 29′ N Lat, 9° 0′ E Long)	3680 ± 60 1730 B.C.	2030 ± 550 80 B.C.
BONN-1212. A. Saboun 936/4 (35° 33′ N Lat, 9° 6′ E Long)	1800 ± 60 A.D. 150	Modern
BONN-1213. A. Kseiba 1229/3 (35° 45′ N Lat, 8° 52′ E Long)	3050 ± 70 1100 B.C.	1220 ± 610 A.D. 730
BONN-1214. A. Tsabet 1794/3 (36° 4′ N Lat, 9° 30′ E Long)	3000 ± 60 1050 B.C.	460 ± 880 A.D. 1490
BONN-1215. A. El Gharbi 4254/4 (35° 30′ N Lat, 9° 0′ E Long)	2250 ± 60 300 B.C.	120 ± 710 A.D. 1830
BONN-1216. A. El Abair 1426/3 (35° 52′ N Lat, 8° 47′ E Long)	2080 ± 70 130 B.C.	550 ± 510 A.D. 1400
BONN-1217. A. Hadia 933/4 (35° 36′ N Lat, 9° 17′ E Long)	3460 ± 50 1510 B.C.	1900 ± 520 A.D. 50
BONN-1218. A. Adjmi 1425/3 (35° 51′ N Lat, 8° 48′ E Long)	1640 ± 60 A.D. 310	Modern
BONN-1219. A. Afia (35° 52′ N Lat, 8° 53′ E Long)	4360 ± 60 2410 B.C.	2250 ± 750 300 B.C.
BONN-1220. Darchichou 8304/2 (37° 0′ N Lat, 10° 56′ E Long)	10,120 ± 110 8170 B.C.	7620 ± 860 5670 B.C.
BONN-1221. Mornag No. 1 9391/1 (36° 41′ N Lat, 10° 17′ E Long)	13,100 ± 150 11,150 B.C.	10,400 ± 900 8450 B.C.

Sample	Measured C^{14} age	Corrected C^{14} age
	18,630 ± 260	14,910 ± 1240
BONN-1222. A. Gmatine 8072/2 (36° 56′ N Lat, 10° 58′ E Long)	16,680 B.C.	12,960 B.C.
	13,640 ±130	11,870 ± 590
BONN-1223. Darchichou 8305/2 (36° 58′ N Lat, 11° 0′ E Long)	11,690 B.C.	9920 B.C.
	3340 ± 60	1720 ± 540
BONN-1224. El Ala 9739 (35° 38′ N Lat, 9° 34′ E Long)	1390 B.C.	A.D. 230
	750 ± 60	
BONN-1225. O. Hallouf 11548 (35° 56′ N Lat, 9° 54′ E Long)	A.D. 1200	Modern
	11,100 ± 100	9420 ± 560
BONN-1226. Cherichira 1 9276 (35° 38′ N Lat, 9° 48′ E Long)	9150 B.C.	7470 B.C.

Comment: locations of above samples and those of already pub. samples (R., 1970, v. 12, p. 22-26 and R., 1971, v. 13, p. 190-193) are indicated in Fig. 1. They belong to 29 ground water regions; detailed evaluation is pub. elsewhere (Scharpenseel *et al.*, in press). The plain of Kairouan and the region of Chott el Djerid were intensively studied, and isochrones sufficiently concordant with the flow direction could be drawn. In the Kairouan plain and the region N of the Djerid, comparisons of radiocarbon ages with calculations based on water permeability (k_f) and slope values, obtained from pumping trials, as well as on estimated distance from the recharge area, were made and confirmed. Sample El Djazira (Bonn-290) could be compared with the estimated decay age due to natural chlorine-36 measurement (Tamers, Ronzani, and Scharpenseel, 1969), which with 19,400 yr, agreed well.

The oldest ground water samples approaching 30,000 B.P. are in the Kairouan plain (Draa Chouk, BONN-247), embedded in Quaternary sediments, and in ground water exits, such as Seftimi 1 a (BONN-552), C.F. 1 (BONN-558) or Dehibat (BONN-562), belonging to the reservoir of the "Continental Intercalaire", stored in the Neokom-Barrême of lower Cretaceous. Some samples from oases of the Algerian Sahara (BONN-564-567) compare well with the adjacent Tunisian lower Cretaceous samples of the "Continental Intercalaire".

II. SOIL SAMPLES

Pretreatment of soil samples follow the same procedures described (Scharpenseel and Pietig, 1969; Scharpenseel, 1971). Carbon analysis was performed according to Rauterberg and Kremkus (1951).

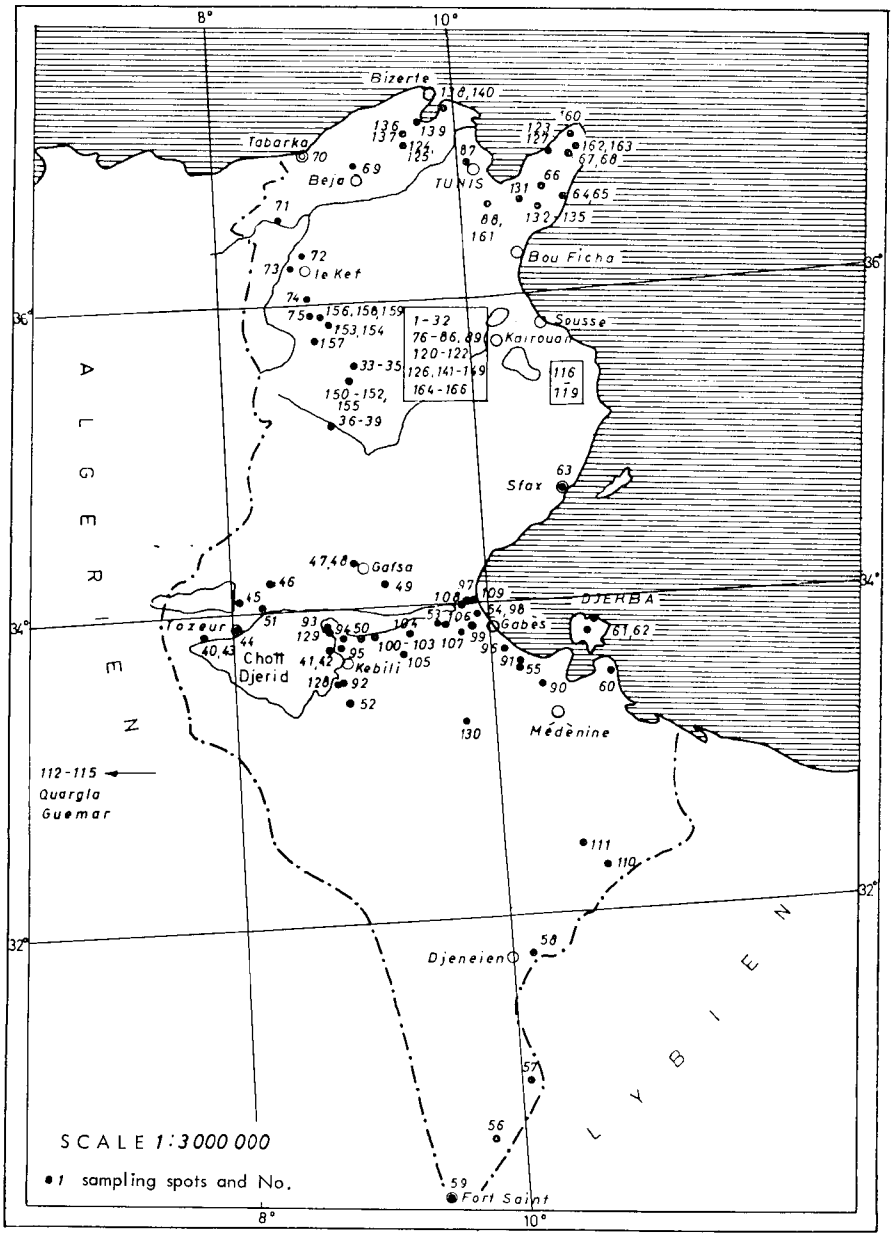

Fig. 1. Distribution of sampling spots in Tunisia.

A. Israel series

These dates are part of study of natural radiocarbon concentration in vertisol profiles in various regions of the world. Vertisols and other soil formations were coll. in Israel with the cooperation of local pedologists.

Buried hydromorphic Hamra soil (red Mediterranean soil, Luvisol) under eolic dune material. It is a relic soil of an old land surface, emerging slowly ca. 25 m from sampling pit. Highway crossing N Tel Aviv, towards Haifa, corner Riohlon St. (32° 7′ N Lat, 34° 48′ E Long).

BONN-688. Soil under dune cover, 1.9% C, 180 to 200 cm — 14,740 ± 200 / 12,790 B.C.

BONN-689. Same location, 2.3% C, 200 to 220 cm — 10,130 ± 140 / 8180 B.C.

BONN-690. Same location, 0.7% C, 220 to 240 cm — 11,170 ± 100 / 9220 B.C.

BONN-691. Same location, 1.0% C, 240 to 260 cm — 12,700 ± 100 / 10,750 B.C.

BONN-692. Hamra in foot of slope, partially within root zone, 5.1% C, 10 to 30 cm — 8490 ± 110 / 6540 B.C.

BONN-693. Same location, 1.0% C, 30 to 50 cm — 7890 ± 110 / 5940 B.C.

BONN-694. Same location, 1.5% C, 50 to 70 cm — 7330 ± 150 / 5380 B.C.

BONN-695. Same location, 1.9% C, 70 to 90 cm — 10,470 ± 130 / 8520 B.C.

BONN-696. Hamra emerges in A horizon of recent profile. Surfacial erosion probable since already in 20 to 30 cm depth lime mycelia, 2.3% C, 10 to 30 cm. — 8340 ± 110 / 6390 B.C.

BONN-697. Same location, 1.0% C, 30 to 50 cm — 8590 ± 100 / 6640 B.C.

BONN-698. Same location, 2.0% C, 50 to 70 cm — 8550 ± 90 / 6600 B.C.

BONN-699. Same location, 0.5% C, 70 to 90 cm — 11,860 ± 150 / 9910 B.C.

BONN-700. Same location, 0.5% C, 90 to 100 cm. Very small sample of benzene only. — 23,030 ± 810 / 21,080 B.C.

Hamra in 3 different positions: 1) covered and outside root zone, 2) just emerging into root zone, 3) within root zone. Coll. 1969 and subm. by H. W. Scharpenseel and H. Gewehr, Inst. Soil Sci., Bonn Univ., and G. Yaari Cohen, Div. Pedol. Dept. of Agric., Haifa. *Comment*: rejuvenation of carbon in root zone here in semi-arid climate not as strong as observed in more humid climate soils (Scharpenseel, 1971). This is only valid, if dune cover is rather old, compared with measured radiocarbon ages. Very high age of BONN-700 is doubtful. Sample was very small due to lack of carbon, which could be derived from some chance inclusion of charcoal instead of humus carbon.

Hamra soil embedded in dune material with lime concretions (Curcar), also particularly around roots as thick coatings, Wingate Inst. of Athletics near coastal hwy from Tel Aviv to Haifa (32° 24′ N Lat, 34° 53′ E Long).

BONN-701. Lime concretions in upper Curcar (not yet fully developed Curcar), on top of Hamra, 300 cm — 13,440 ± 160 / 11,490 B.C.

BONN-702. Lime concretion around root, upper Curcar, 300 to 350 cm — 13,640 ± 170 / 11,690 B.C.

BONN-704. Lime concretions in Hamra around root, 400 to 500 cm — 13,240 ± 140 / 11,290 B.C.

BONN-705. Lime concretions in lower Curcar, 500 to 750 cm — 15,410 ± 210 / 13,460 B.C.

BONN-706. Lime concretions around root in lower Curcar, 500 to 750 cm — 17,920 ± 180 / 15,970 B.C.

Hamra and Curcar in alternation, street to Ekron, (31° 51′ N Lat, 34° 48′ E Long).

BONN-709. Calcinated root in C-horizon of Hamra (II ?) — 16,930 ± 240 / 14,980 B.C.

Curcar-Hamra sequence, Rehovot, corner Main St. and Batia Markov (31° 53.5′ N Lat, 34° 49′ E Long).

BONN-711. Hamra (I ?), red color, 0.2% C, 180 to 200 cm — 14,920 ± 230 / 12,970 B.C.

Jashresh, Pseudogley from Hamra (Nazas), (31° 54.5′ N Lat, 34° 51′ E Long).

BONN-712. S_w-horizon, 0.2% C, 100 to 130 cm — 550 ± 50 / A.D. 1400

BONN-713. fAS_d-horizon, 0.3% C, 200 to 230 cm — 2960 ± 220 / 1010 B.C.

Samples coll. 1969 by H. W. Scharpenseel, H. Gewehr, and G. Yaari Cohen. *Comment*: unfortunately, C^{14} measurement of organic carbon of

some Hamra samples was impossible due to extremely low carbon content after HCl-treatment. Lime concretions in Hamra and Curcar horizons indicate ages between 13,000 and 18,000 yr. The Nazas (Pseudogley) could be contaminated by bomb carbon.

Soil assoc. on limestone (rendsina on soft limestone, calcareous brown earth on harder limestone, Terra rossa on very hard limestone).

Rendsina, Mitzpe Mesua, (31° 40′ N Lat, 34° 35′ E Long).

BONN-742. Rendsina on soft limestone, 1.1% C, A_h 30 to 45 cm — 580 ± 40 A.D. 1370

BONN-743. Same location, 0.5% C, AC 45 to 60 cm — 1500 ± 50 A.D. 450

Calcareous brown earth on harder limestone, only 150 m from Mitzpe Mesua (BONN-742); soil sometimes shows moderate B_v-horizon, (31° 40′ N Lat, 34° 35′ E Long).

BONN-744. Calcareous brown earth, 0.8 % C, A_h 50 to 60 cm — 2040 ± 60 90 B.C.

Terra rossa, Mattah on hard limestone (31° 43′ N Lat, 35° 03′ E Long).

BONN-745. Terra rossa on hard limestone, 0.2% C, B_t 100 to 120 cm — 2420 ± 70 470 B.C.

Samples coll. 1969 by H .W. Scharpenseel, H. Gewehr, and A. Singer, Fac. Agric., Univ. Jerusalem. *Comment*: although rejuvenation due to intrusion of roots exists to a certain extent, rather low residence times of humus-C are in accord with erosion-influenced sloping sampling site.

Husmas soils (Hamra soils with recalcification) and soils with petrocalcic horizon. Holocene Husmas soil, covered by Curcar-debris, 1 km W Argic. School Kanot, along street from Gedera to Ashdod (31° 48.5′ N Lat, 34° 45′ E Long).

BONN-748. Husmas W Kanot Agric. School, 0.3% C, B 80 to 100 cm — 830 ± 160 A.D. 1120

BONN-749. Same location, Hamra with $CaCO_3$-concretions, 0.2% C, 400 cm — 5050 ± 160 3100 B.C.

Dark brown loessic Burozem overlying Husmas with Ca-concretions, K Kibbutz Ruchama, (31° 30′ N Lat, 34° 42′ E Long).

BONN-751. Burozem Ruchama, traces of C, A_c 70 to 90 cm

BONN-752. Burozem Ruchama, traces of A_cB 190 to 210 cm

9000 ± 200 7050 B.C.

BONN-753. Underlaying Husmas, traces of C, B_1 250 to 260 cm

BONN-754. Underlaying Husmas, traces of C, B_2 320 to 340 cm — 13,400 ± 190 / 11,450 B.C.

BONN-755. Underlaying Husmas, traces of C, C 470 to 500 cm

Husmas without loess cover, surfacial, Dorot 1, 8 km NW profile Ruchama (BONN-751), (31° 30.5′ N Lat, 34° 38′ E Long).

BONN-756. Husmas Dorot 1, traces of C, 70 to 80 cm — 90 ± 150 / A.D. 1860

Husmas overlaying fossil gray-green clay, Dorot 2, 9 km NW profile Ruchama (BONN-751), (31° 31′ N Lat, 34° 37′ E Long).

BONN-757. Fossil clay, bordering Husmas, traces of C, 300 to 320 cm — 19,920 ± 340 / 17,970 B.C.

Dark brown soil formed in calcareous dune sand, arid version of chestnut soil. Mafkiim, S Ashkalon, (31° 37′ N Lat, 34° 35′ E Long).

BONN-750. Calcareous B-horizon arid chestnut soil, 130 to 140 cm — 4760 ± 80 / 2810 B.C.

Burozem from Loess with caliche, near Shuval, Beer Shewa street for Tel Aviv, (31° 25′ N Lat, 34° 45′ E Long).

BONN-760. Burozem, near Shuval, 0.4% C, A_h 20 to 40 cm — 1090 ± 200 / A.D. 860

BONN-761. Same location, Caliche, 0.2% C, 100 to 120 cm — 6400 ± 130 / 4450 B.C.

BONN-762. Same location 0.2% C, BC 190 to 220 cm — 15,470 ± 230 / 13,520 B.C.

Sierozem from loess with caliche on top of petrified dune material, Eshel Hanassi, 14 km before Beer Shewa (31° 20′ N Lat, 34° 41.5′ E Long).

BONN-758. Sierozem Eshel Hanassi, 0.5% C, A 15 to 25 cm — 1410 ± 70 / A.D. 540

BONN-759. Same location, caliche, 0.2% C, 80 to 100 cm — 4020 ± 220 / 2070 B.C.

BONN-748-762 coll. and subm. 1969 by H. W. Scharpenseel, H. Gewehr, and H. Koyumdjisky, Volcani Inst. Agric. Res., Bet Dagan, Israel. *Comment*: soils with partly very low content of organic C besides high carbonate-C concentrations required very laborious sample preparation. Apparent mean residence time of organic carbon fraction in upper

100 cm of soil is rather low despite restricted conditions of rejuvenation due to root growth and percolation under prevailing semi-arid and arid climate conditions. Transport and reworking of top surface material is possible.

Vertisols with swelling and cracking clay, slickensides and self-mulching. Vertisol transition Zone E of Hamra-zone still under influence of colic fine sand transport from the W dunes. Plain of Barkai Afula St. to Hedera (32° 29′ N Lat, 35° 1′ E Long).

BONN-715. Vertisol plain of Barkai, 2.9% C, 20 to 40 cm — 960 ± 60 A.D. 990

BONN-716. Same location, 2.2% C, 40 to 60 cm — 1080 ± 80 A.D. 870

BONN-717. Same location, 0.7% C, 60 to 80 cm — 1600 ± 60 A.D. 350

BONN-718. Same location, 0.6% C, 80 to 100 cm — 1850 ± 70 A.D. 100

Vertisol Valley of Jesrael, W fringe, (32° 35′ N Lat, 35° 14′ E Long).

BONN-719. Vertisol, W Valley of Jesrael, 1.0% C, 30 to 50 cm — 960 ± 70 A.D. 990

BONN-720. Same location, 0.8% C, 50 to 70 cm — 1570 ± 70 A.D. 380

BONN-721. Same location, 2.3% C, 70 to 90 cm — 2640 ± 70 690 B.C.

BONN-722. Same location, 0.9% C, 90 to 110 cm — 2550 ± 80 600 B.C.

BONN-723. Same location, 0.6% C, 110 to 130 cm — 2760 ± 80 810 B.C.

Vertisol Valley of Jesrael, drain ditch, (32° 36′ N Lat, 35° 14′ E Long).

BONN-724. Vertisol, drainage ditch, 0.6% C, 80 to 100 cm — 4060 ± 80 2110 B.C.

BONN-725. Same location, 0.8% C, 100 to 120 cm — 3810 ± 50 1860 B.C.

BONN-726. Same location, 0.9% C, 120 to 140 cm — 6460 ± 60 4510 B.C.

BONN-727. Same location, 0.7% C, 140 to 160 cm — 7320 ± 120 5370 B.C.

BONN-728.	Same location, 0.4% C, 160 to 180 cm	7440 ± 80 5490 B.C.

Vertisol, El Hamma, high terrace with brown Vertisol under shallow young cover, (32° 42′ N Lat, 35° 40′ E Long).

BONN-729.	Vertisol El Hamma, 0.7% C, 100 cm	3240 ± 80 1290 B.C.
BONN-730.	Same location, 0.6% C, 200 cm	15,140 ± 120 13,190 B.C.
BONN-731.	Same location, 0.7% C, 300 cm	18,710 ± 230 16,760 B.C.
BONN-732.	Same location, 0.5% C, 400 cm	17,360 ± 580 15,410 B.C.
BONN-733.	Same location, 0.6% C, 500 cm	18,600 ± 120 16,650 B.C.
BONN-734.	Same location, 0.5% C, 600 cm	19,430 ± 350 17,480 B.C.

Vertisol near Kibbutz Kefar Menachem, old alluvium (32° 50′ N Lat, 35° 45′ E Long).

BONN-735.	Vertisol Kefar Menachem, 0.5% C 40 to 60 cm.	3810 ± 70 1860 B.C.
BONN-736.	Same location, 0.2% C, 60 to 80 cm. Sample too small to date.	
BONN-737.	Same location, 0.5% C, 80 to 100 cm	4350 ± 220 2400 B.C.
BONN-738.	Same location, 0.3% C, 100 to 120 cm	7140 ± 210 5190 B.C.
BONN-739.	Same location, 1.1% C, 120 to 140 cm	8250 ± 170 6300 B.C.
BONN-740.	Same location, 0.9% C, 140 to 160 cm	15,490 ± 280 13,540 B.C.
BONN-741.	Same location, 0.9% C, 160 to 180 cm	16,100 ± 270 14,150 B.C.

Vertisol along st. to Syrian Quarantine Sta. and Jordan flow into Lake Genesareth (32° 55′ N Lat, 35° 39′ E Long).

BONN-773.	Vertisol, st. to Quarantine Sta., 1.1% C, 20 to 40 cm	1000 ± 70 A.D. 950

BONN-774. Same location, 1.0% C, 40 to 65 cm — 1970 ± 70 / 20 B.C.

BONN-775. Same location, 0.8% C, 65 to 90 cm — 2280 ± 60 / 330 B.C.

BONN-776. Same location, 1.0% C, 90 to 120 cm — 2670 ± 100 / 720 B.C.

Samples coll. and subm. 1969 by H. W. Scharpenseel, H. Gewehr, and G. Yaari Cohen. *Comment*: below maximum depth of dry season cracks the rejuvenation in Vertisols is low due to high clay content, restrained root growth and low permeation (kf-value). In this range measured apparent mean residence time may approach true age of soil formation. But, theoretically it must be expected, that within range of dry season cracks and self-mulching dynamics, approx. equilibration of carbon residence time due to perfect mixing prevails. From above results it appears that only the profiles "Valley of Jesrael, drain ditch", (beginning at 120 cm), "El Hamma" (beginning at 200 cm), and "Kefar Menachem", (beginning at 100 till 140 cm) reach below crack boundaries. Thus, radiocarbon measurements in Vertisol profiles reveal soil genetic principles and profile dynamics.

B. Bulgaria series

At a guided tour of soil correlation among European classification systems, USA 7th Approximation and FAO–Soil Map of the World, systematic, soil profile samples were taken in *locus typicus* throughout Bulgaria.

Light gray, forest (pseudopodzolic) surface waterlogged soil, Eutric Planosol, Vertic Albaqualf (according to J. D. Rourke, U.S. Dept. Agr., Soil Conservation Service), Glavatsi, Danube valley, heavy loamy river deposits (43° 12′ N Lat, 23° 10′ E Long).

BONN-1071. Vertic Albaqualf, Glavatsi, 1.1% C, Sd1, 35 to 40 cm — 1170 ± 70 / A.D. 780

BONN-1072. Same location, 0.4% C, Sd2/BS, 55 to 65 cm — 3310 ± 70 / 1360 B.C.

BONN-1073. Same location, 0.3% C, SB 85 to 95 cm — 5210 ± 90 / 3260 B.C.

BONN-1074. Same location, 0.5% C, BC 115 to 125 cm — 8050 ± 80 / 6110 B.C.

Leached Chernozem, Luvic Phaeozem, Udic Haplustoll, near village of Gorni Dubnik, loessic material (43° 27′ N Lat, 24° 13′ E Long).

BONN-1075. Leached Chernozem, 2.6% C, Ah2 36 to 47 cm — 940 ± 70 / A.D. 1010

BONN-1076.	Same location, 1.2% C, BAh2 55 to 65 cm	2340 ± 70 390 B.C.
BONN-1077.	Same location, 0.9% C, AhB 85 to 95 cm	4130 ± 90 2180 B.C.
BONN-1078.	Same location, 0.5% C, Cl 120 to 130 cm	7040 ± 80 5090 B.C.
BONN-1079.	Same location, 1.1% C, ClfA 200 to 210 cm	11,100 ± 90 9150 B.C.

Calcareous Chernozem, Calcareous Phaeozem, Typic Calciustoll, NW Pleven, loessic material (43° 29′ N Lat, 24° 11′ E Long).

BONN-1080.	Calcareous Chernozem, 2.5% C, Al 28 to 32 cm	1480 ± 70 A.D. 470
BONN-1081.	Same location, 1.4% C, A2 37 to 43 cm	1480 ± 70 A.D. 470
BONN-1082.	Same location, 0.8% C, A3 66 to 73 cm	3140 ± 80 1190 B.C.
BONN-1083.	Same location, 0.3% C, A4 102 to 108 cm	4130 ± 70 2180 B.C.
BONN-1084.	Same location, 0.5% C, AC 145 to 155 cm	5760 ± 90 3810 B.C.
BONN-1085.	Same location, material of crotovines, 1.0%C, 100 to 150 cm	3460 ± 80 1510 B.C.

Gray Forest soil, Luvic Phaeozem, Udic or Udertic Paleustalf, 12 km S Pleven on reddish brown loess-like clay, (43° 22′ N Lat, 24° 35′ E Long).

BONN-1086.	Gray Forest soil, 1.3% C, Al 7 to 30 cm	470 ± 60 A.D. 1480
BONN-1087.	Same location, 1.0% C, A1B 30 to 37 cm	1980 ± 70 30 B.C.
BONN-1088.	Same location, 1.0% C, BtBv1 70 to 80 cm	4060 ± 100 2110 B.C.
BONN-1089.	Same location, 0.6% C, Bv 135 to 145 cm	4340 ± 120 2390 B.C.
BONN-1090.	Same location, 0.5% C, IIAh1 170 to 180 cm	6520 ± 110 4570 B.C.
BONN-1091.	Same location, 1.5% C, IIAh2 210 to 220 cm	11,140 ± 170 9190 B.C.

BONN-1092.	Same location, 0.8% C, HSB 250 to 265 cm	18,920 ± 340 16,970 B.C.

Gray Forest soil, Luvic Phaeozem, Udic Haplustalf, N Kozlevo village, dist. of Shoumen on loess-like clays, (43° 32′ N Lat, 27° 17.5′ E Long).

BONN-1093.	Gray Forest soil, 0.7% C, BA1 16 to 28 cm	1380 ± 70 A.D. 570
BONN-1094.	Same location, 0.3% C, Bt 35 to 44 cm	1510 ± 80 A.D. 440
BONN-1095.	Same location, 0.2% C, CBt, 60 to 70 cm	2180 ± 70 230 B.C.
BONN-1096.	Same location, 0.6% C, BC 80 to 90 cm	3370 ± 100 1420 B.C.
BONN-1097.	Same location, 0.6% C, BshC 98 to 106 cm	3010 ± 120 1060 B.C.

Strongly degraded Cinnamonic Forest soil, Planosol, Udertic Paleustalf, Karnobat, near Bourgas, Pliocene sandy clay (42° 36′ N Lat, 26° 58′ E Long).

BONN-1098.	Cinnamon Podzolic soil, 0.9% C, Bs1 30 to 40 cm	1780 ± 70 A.D. 170
BONN-1099.	Same location, 0.9%C, Bs2 50 to 60 cm	3340 ± 70 1390 B.C.
BONN-1100.	Same location, 0.5% C, Bsh? 74 to 82 cm	4950 ± 100 3000 B.C.
BONN-1101.	Same location, 0.6% C, fA 85 to 95 cm	10,730 ± 130 8780 B.C.
BONN-1102.	Same location, 0.6% C, ACca 105 to 115 cm	12,380 ± 280 10,430 B.C.
BONN-1103.	Same location, 0.8% C, SACca 155 to 168 cm	14,150 ± 240 12,200 B.C.
BONN-1104.	Same location, 0.5% C, BC 190 to 200 cm	14,140 ± 280 12,190 B.C.

Cinnamonic–Podzolized–Gleyey soil, Planosol, Vertic Albaqualf, Badeshte, Thracian plain on Pliocene sandy clay (42° 16′ N Lat, 25° 44′ E Long).

BONN-1105.	Cinnamonic soil, 1.2% C, Ah 25 to 35 cm	1840 ± 60 A.D. 110

BONN-1106. Same location, 0.7% C, ABS1 40 to 50 cm — 2940 ± 70 (990 B.C.)

BONN-1107. Same location, 0.5% C, S2 60 to 70 cm — 6970 ± 200 (5020 B.C.)

BONN-1108. Same location, 0.3% C, SC 160 to 170 cm — 9850 ± 240 (7900 B.C.)

Smonitsa-Vertisol, Vertisol, Typic Pellustert, Sredets, Thracian Plain on Pliocene redeposited clay (42° 10′ N Lat, 25° 40′ E Long).

BONN-1108. Smonitsa-Vertisol, 3.0% S, Ah1 20 to 30 cm — 990 ± 50 (A.D. 960)

BONN-1109. Same location, 2.3% S, Ah2 40 to 50 cm — 2050 ± 70 (100 B.C.)

BONN-1110. Same location, 7.5% C, Ah3 75 to 85 cm — 2940 ± 70 (990 B.C.)

BONN-1111. Same location, 1.0% C, BtAh 115 to 125 cm — 3890 ± 80 (1940 B.C.)

BONN-1112. Same location, 0.3% C, CB 140 to 150 cm — 4590 ± 90 (2640 B.C.)

BONN-1113. Same location, 0.4% C, BC 170 to 180 cm — 11,110 ± 200 (9160 B.C.)

BONN-1114. Same location, 0.7% C, C 240 to 250 cm — 16,140 ± 460 (14,190 B.C.)

Cinnamonic Forest soil, Chromic Luvisol, Udic Rhodustalf, Koren, alluvium upon orthogneiss (41° 47′ N Lat, 25° 50′ E Long).

BONN-1115. Cinnamon soil, 1.1% C, Ah 15 to 20 cm — 101.0 ± 0.4% Modern

BONN-1116. Same location, 0.4% C, AlBt 30 to 40 cm — 940 ± 60 (A.D. 1010)

BONN-1117. Same location, 1.1% C, Bt1 55 to 65 cm — 1550 ± 80 (A.D. 400)

BONN-1118. Same location, 0.7% C, Bt2 85 to 95 cm — 6620 ± 240 (4670 B.C.)

BONN-1119. Same location, 0.4% C, BC 140 to 170 cm — 8480 ± 140 (6530 B.C.)

Samples coll. and subm. 1970 by H. W. Scharpenseel and W. Kerpen, Inst. Bodenkunde, Bonn. *Comment*: contrary to N European conditions, where soils in equilibrium with present-day environmental conditions are mainly formed during Holocene on glacially or periglacially in-

fluenced parent material, most soils of Bulgaria are older and pre-Holocene in origin. The Smonitsa-Vertisol shows rather uniform C-residence time values within main zone of summer cracks till 85 cm, an older, but also rather uniform age level from 85 to 150 cm, zone of occasional cracks and self mulching during extended periods of extreme draught. Below 150 cm lack of cracks avoids influx of surface material. In consequence, age is rising sharply. (Cf. Vertisols of Israel, BONN-724 to 741 above). Descriptive terms of 7th Approximation were provided for all tested profiles by J. D. Rourke.

C. Sardinia series

Samples of Vertisol profiles in typical locations of Sardinia coll. with local pedologists. Vertisol, formed in phreatic milieu, Aquert, rather shallow, rich in montmorillonite, Plane de Cuga, Ittiri, 20 km SW Sassari (40° 34′ N Lat, 3° 26′ W Long).

BONN-1154.	Vertisol Ittiri, 2.2% C, Ah1 10 to 25 cm	410 ± 90 A.D. 1540
BONN-1155.	Same location, 1.9% C, Ah2 25 to 40 cm	420 ± 90 A.D. 1530
BONN-1156.	Same location, 1.3% C, Ah3 40 to 60 cm	460 ± 70 A.D. 1490
BONN-1157.	Same location, 1.2% C, AhC 60 to 80 cm	570 ± 50 A.D. 1380

Shallow Vertisol, Ustert, Campo Mela, 20 km S Sassari (40° 40′ N Lat, 3° 48.5′ W Long).

BONN-1158.	Vertisol, Campo Mela, 4.5% C, Ah1 10 to 25 cm	220 ± 60 A.D. 1730
BONN-1159.	Same location, 1.8% C, Ah2 25 to 40 cm	1520 ± 70 A.D. 430
BONN-1160.	Same location, 1.3% C, Ah3 40 to 60 cm	1700 ± 70 A.D. 250

Vertisol, Chromoxerert in recent alluvium of Basalt decomposition, typical slickensides, developed on river terrace of Rio Mannu di S. Vero. Below 90 cm buried horizon, St. Vero Milis, Molino Meloni (40° 2′ N Lat, 3° 52′ W Long).

BONN-1161.	Vertisol St. Vero Milis, 0.3% C, Ah1 10 to 30 cm	280 ± 70 A.D. 1670
BONN-1162.	Same location, 0.5% C, SwAh2 30 to 50 cm	3240 ± 110 1290 B.C.
BONN-1163.	Same location, 0.3% C, SwAh3 50 to 70 cm	3370 ± 110 1420 B.C.

BONN-1164.	Same location, 0.8% C, SdAh4 70 to 90 cm	3870 ± 130 1920 B.C.

Vertisol, Pelloxerert, black clay plain of marl, underneath Miocene sandstone, Arziadas, Arenadas, Tuvoi (39° 18′ N Lat, 3° 33′ W Long).

BONN-1167.	Vertisol Arziadas, 1.5% C, Ah1 40 to 60 cm	730 ± 60 A.D. 1220
BONN-1168.	Same location, 0.8% C, Ah2 60 to 80 cm	1490 ± 60 A.D. 460
BONN-1169.	Same location, 1.3% C, Ah3 80 to 100 cm	1770 ± 70 A.D. 180
BONN-1170.	Same location, 0.9% C, Ah4 100 to 120 cm	2060 ± 90 110 B.C.
BONN-1171.	Same location, 0.4% C, Ah5 120 to 140 cm	3470 ± 80 1520 B.C.
BONN-1172.	Same location, 0.5% C, Ah6 140 to 160 cm	4740 ± 80 2790 B.C.
BONN-1173.	Same location, 0.4% C, Ah7 160 to 180 cm	4990 ± 90 3040 B.C.
BONN-1174.	Same location, 0.3% C, AC 180 to 200 cm	5430 ± 100 3480 B.C.

Vertisol, Chromoxerert, formed in weathered trachyt/andesit-tuff of Oligocene volcanism, Monastir, along hwy. 20 km N Cagliari (39° 23′ N Lat, 3° 24.5′ W Long).

BONN-1175.	Vertisol Monastir, 6.2% C, Ah1 20 to 40 cm	107.7 ± 0.5% Modern
BONN-1176.	Same location, 4.9% C, Ah2 40 to 60 cm	670 ± 60 A.D. 1280
BONN-1177.	Same location, 0.6% C, Ah3 60 to 80 cm	2270 ± 70 320 B.C.
BONN-1178.	Same location, 0.3% C, Ah4 80 to 100 cm	1920 ± 100 A.D. 30

Vertisol, Pellustert, formed on weathered calcareous marne, Nurallao (39° 47′ N Lat, 3° 23′ W Long).

BONN-1180.	Vertisol Nurallao, 1.9%, Ah1 0 to 20 cm	40 ± 70 A.D. 1910
BONN-1181.	Same location, 2.6% C, Ah2 20 to 40 cm	410 ± 70 A.D. 1540

BONN-1182.	Same location, 1.5% C, Ah3 40 to 60 cm	1490 ± 60 A.D. 460
BONN-1183.	Same location, 1.3% C, Ah4 60 to 80 cm	1490 ± 80 A.D. 460
BONN-1184.	Same location, 1.3% C, Ah5 80 to 100 cm	1900 ± 80 A.D. 50
BONN-1185.	Same location, 2.1% C, Ah6 100 to 120 cm	2410 ± 70 560 B.C.
BONN-1186.	Same location, 0.8% C, Ah7 120 to 140 cm	3090 ± 80 1140 B.C.
BONN-1187.	Same location, 0.5% C, AC 140 to 160 cm	3220 ± 80 1270 B.C.

Samples coll. and subm. 1970 by H. W. Scharpenseel with local pedologists, A. Pietracaprina and P. Baldaccini. *Comment*: residence times of humus-C measured are partly rather young, although most vertisols are expected to be Holocene in origin. Except for Arziadas (BONN-1167 to 1174) and Nurallao (BONN-1180 to 1187), shallow pedon and fact that sampling horizons were still in self-mulching zone of crack depth are probably responsible. Continuous age increase in deeper profiles of Arziadas and Nurallao supports view that even throughout these deeper profiles younger surface material was transported downwards until the AC-horizon.

D. Sicily series

Typical Vertisol profiles of W Sicily were studied with assistance of local pedologists. Vertisol, typical Chromoxerert, Scalilli, formed in colluvium upon an old terrace, near Corleone (37° 48.5′ N Lat, 1° 8′ W Long).

BONN-1326.	Vertisol Scalilli, 1.9% C, Ah1 0 to 20 cm	860 ± 70 A.D. 1090
BONN-1327.	Same location, 2.3% C, Ah2 20 to 40 cm	1340 ± 70 A.D. 610
BONN-1328.	Same location, 1.1% C, Ah3 40 to 60 cm	1560 ± 70 A.D. 390
BONN-1329.	Same location, 1.9% C, Ah4 60 to 80 cm	2000 ± 80 50 B.C.
BONN-1330.	Same location, 1.9% C, Ah5 80 to 100 cm	2970 ± 70 1020 B.C.
BONN-1331.	Same location, 1.9% C, IIA 100 to 110 cm	3030 ± 90 1080 B.C.

Vertisol, Pelloxerert, mainly colluvial on terrace gravel, below 100 cm depth transition into fossil horizon, Plana di Scala, Corleone (37° 49′ N Lat, 1° 7′ W Long).

BONN-1332.	Vertisol Plane di Scala, 2.4% C, Ah1 0 to 20 cm	530 ± 70 A.D. 1420
BONN-1333.	Same location, 1.5% C, Ah2 20 to 40 cm	1800 ± 60 A.D. 150
BONN-1334.	Same location, 1.5% C, Ah3 40 to 60 cm	1650 ± 70 A.D. 300
BONN-1335.	Same location, 0.9% C, Ah4 60 to 80 cm	2160 ± 60 210 B.C.
BONN-1336.	Same location, 0.6% C, Ah5 80 to 100 cm	2430 ± 70 480 B.C.
BONN-1337.	Same location, 0.6% C, fAh1 100 to 120 cm	3670 ± 100 1720 B.C.
BONN-1338.	Same location, 0.5% C, fAh2C 120 to 140 cm	16,210 ± 360 14,260 B.C.

Vertisol, Pelloxerert, formed in Pliocene clay, underground sandy, *Aziena Sporacia*, experimental farm, Univ. Palermo, Inst. Agronomy (cammarata), Profile 1, (37° 49′ N Lat, 1° 7′ W Long).

BONN-1339.	Vertisol *Az. Sporacia* (1), 1.3% C, Ah1 0 to 20 cm	890 ± 70 A.D. 1060
BONN-1340.	Same location, 1.9% C, Ah2 20 to 40 cm	890 ± 70 A.D. 1060
BONN-1341.	Same location, 1.3% C, Ah3 40 to 60 cm	1080 ± 70 A.D. 870
BONN-1342.	Same location, 1.1% C, Ah4 60 to 80 cm	1460 ± 70 A.D. 490
BONN-1343.	Same location, 1.1% C, Ah5 80 to 100 cm	2160 ± 90 210 B.C.
BONN-1344.	Same location, 1.9% C, Ah6 100 to 120 cm	1430 ± 60 A.D. 520
BONN-1345.	Same location, 0.6% C, Ah7 120 to 140 cm	1700 ± 60 A.D. 250
BONN-1346.	Same location, 0.9% C, Ah8 140 to 160 cm	2910 ± 90 960 B.C.
BONN-1347.	Same location, 0.8% C, Ah9 160 to 180 cm	3990 ± 90 2040 B.C.

BONN-1348.	Same location, 0.7% C, Ah10 180 to 200 cm	4040 ± 120 2090 B.C.
BONN-1349.	Same location, 0.7% C, Ah11 200 to 220 cm	4360 ± 140 2410 B.C.
BONN-1350.	Same location, 0.7% C, AC1 220 to 240 cm	4950 ± 110 3000 B.C.
BONN-1351.	Same location, 0.4% C, AC2 240 to 260 cm	5470 ± 120 3520 B.C.

Vertisol, Chromoxerert, (ca. 10% Na^+ on base exchange complex), *Aziena Sporacia*, experimental farm, Univ. Palermo, Profile 2, (37° 49′ N Lat, 1° 7′ W Long).

BONN-1352.	Vertisol, *Az. Sporacia* (2), 1.2% C, Ah1 0 to 25 cm	113.3 ± 0.4% Modern
BONN-1353.	Same location, 1.1% C, Ah2 25 to 45 cm	990 ± 80 A.D. 960
BONN-1354.	Same location, 0.9% C, Ah3 45 to 65 cm	910 ± 70 A.D. 1040
BONN-1355.	Same location, 0.8% C, Ah4 65 to 85 cm	1600 ± 70 A.D. 350
BONN-1356.	Same location, 0.6% C, Ah5 85 to 105 cm	1970 ± 70 20 B.C.
BONN-1357.	Same location, 0.8% C, Ah6 105 to 125 cm	4990 ± 140 3040 B.C.
BONN-1358.	Same location, 0.3% C, Ah7 125 to 145 cm	9890 ± 240 7940 B.C.
BONN-1359.	Same location, 0.2% C, AC1 145 to 165 cm	9790 ± 160 7840 B.C.
BONN-1360.	Same location, 0.1% C, C2 165 to 185 cm	11,510 ± 310 9560 B.C.
BONN-1361.	Same location, 0.5% C, C3 185 to 205 cm	15,160 ± 370 13,210 B.C.
BONN-1362.	Same location, 0.7% C, C4 205 to 225 cm	12,830 ± 330 10,880 B.C.
BONN-1363.	Same location, 0.3% C, C5 225 to 245 cm	14,720 ± 330 12,770 B.C.

Samples coll. and subm. 1970 by H. W. Scharpenseel with local pedologist, G. Fierotti. *Comment*: in 1st profile, Scalilli, apparent depth limit of summer cracks is ca. 80 cm. Below, no rejuvenation due to sur-

face material occurs, and mean carbon residence time becomes markedly higher. In 2nd profile, Plame di Scala, age break is noticeable between 100 to 120 cm and deeper. A fossil A-horizon produces a sharp increase of carbon mean residence time. Above 100 cm natural radiocarbon values are rather uniform, indicating, that due to summer cracks of about this depth there is a constant rejuvenation within upper 100 cm blanket, caused by droppings of surface material.

Among the 2 profiles within boundaries of the experimental farm, Univ. Palermo, the deeper, darker Profile 1 reveals lower mean residence time values of humus carbon, than the shallower, browner, less humus containing and more sodic Profile 2. The latter lies across a creak, several 100 m apart, but is different in color as in base inventory.

E. Romania series

Soil samples with humus from underneath Danube alluvium in karstic landscape with annual overflooding (winter, spring), when Danube River rises (44° 40′ N Lat, 22° 20′ E Long).

BONN-1379.	Sample 4, 0.9% C, 90 cm	5830 ± 120 3880 B.C.
BONN-1383.	Sample 3, 0.7% C, 120 cm	7660 ± 110 5710 B.C.
BONN-1381.	Sample 2, 0.6% C, 160 cm	8070 ± 130 6060 B.C.
BONN-1385.	Sample 1, 0.6% C, 200 cm	8070 ± 130 6120 B.C.

Samples coll. and subm. 1970 by A. Conea, Inst. Geol. Bucharest. *Comment*: samples from epipaleolithic period, proven by flintstone tools and art objects in same strata. Simple plant cultivation indicated. Estimated age: Atlantic to Boreal time. Results confirm expected age.

E. Local (German) series

Pseudogley–Humus–Iron–Podzol, Aqualfic Fragiorthod formed in sand layer on top of basal moraine of Drenthe-Saale glaciation, Amelsbüren (51° 51′ N Lat, 7° 38′ E Long).

BONN-1364.	Podzol Amelsbüren, 30.3% C, OH1 5 to 0 cm	700 ± 60 A.D. 1250
BONN-1365.	Same location, 31.1% C, OH2 0 to 25 cm	1450 ± 60 A.D. 500
BONN-1367.	Same location, 3.8% C, Aeh 45 to 70 cm	1910 ± 60 A.D. 40
BONN-1368.	Same location, 1.5% C, Bh 70 to 100 cm	1980 ± 80 30 B.C.
BONN-1369.	Same location, 2.0% C, Bsh 100 to 120 cm	1900 ± 70 A.D. 50

BONN-1663. Dark transition zone to Drenthe-Saale basal moraine below 160 cm, 0.5% C — 15,170 ± 230 / 13,220 B.C.

Samples coll. and subm. 1970 and 1971 by H. Butzke, Geol. Landesamt NRW, Krefeld and H. W. Scharpenseel Inst. Bodenkunde, Bonn. *Comment*: deep and strong podzolization was expected to be among oldest of this type, so far, showing apparent carbon residence times of ca. 3000 yr. (BONN-90, R., 1968, v. 10, p. 20). Because of extreme percolation, measurements in humus-podzols are not closely related to age of soil formation. Measured age is minimum. Transition zone to moraine represents fossil A-horizon, now superimposed by Holocene podzol formation.

Bändchenpodzol of Black Forest, Placorthod, Grindenschwarzwald, Gemsbach (48° 14′ N Lat, 8° 35′ E Long).

BONN-1371. Bändchenpodzol 1, 1.9% C, Ahe 25 cm — 720 ± 60 / A.D. 1230

BONN-1372. Same location, 0.3% C, Bb 70 cm — 1790 ± 60 / A.D. 160

BONN-1373. Bändchenpodzol 2, 3.7% C, AhAeg 35 cm — 1670 ± 60 / A.D. 280

BONN-1374. Same location, 1.6% C, Bb 85 cm — 2550 ± 70 / 600 B.C.

BONN-1375. Bändchenpodzol 3, 1.4% C, AhAe 35 cm — 1600 ± 60 / A.D. 350

BONN-1377. Bändchenpodzol 4, 1.4% C, AhAe 38 cm — 2000 ± 60 / 50 B.C.

BONN-1378. Same location, 0.9% C, Bb 85 cm — 2090 ± 70 / 140 B.C.

Samples coll. and subm. 1970 by K. Stahr, Inst. Pedol. Stuttgart-Hohenheim. *Comment*: results resemble previous measurements at nearby Schliffkopfhaus (BONN-859 to 861, R., 1971, v. 13, p. 197/198). Results, prove, that soil was not formed by medieval deforestation as was previously contended.

III. ARCHAEOLOGIC SAMPLES

A. West Germany

BONN-1120. — **8420 ± 160** / **6470 B.C.**

Humus containing layer of possibly Neolithic settlement, Mayen/Eifel (50° 20′ N Lat, 7° 16′ E Long), 0.2% C, 180 to 195 cm.

BONN-1121. — **2060 ± 50** / **110 B.C.**

Humus containing layer, St. Stephanus church Kornelimünster, La

Tène period, directly below pavement, (50° 44′ N Lat, 6° 11′ E Long), 0.7% C.

BONN-1152. **1840 ± 50** **A.D. 110**

Incineration grave, Xanten, estim. Roman, 1st century (51° 40′ N Lat, 6° 28′ E Long), 2.6% C, 150 cm.

Samples coll. and subm. 1970 by G. Strunck-Lichtenberg, Inst. f. Bodenkunde, Bonn. *Comment*: BONN-1120 and 1121 elucidate prehistoric chronology of settlements. BONN-1120 is older than expected. BONN-1152, dated by Roman ceramics to ca. 2000 B.P. Result agrees fairly well; 160 yr-gap probably due to humus percolation from above.

BONN-1556. **520 ±60** **A.D. 1430**

Piece of log, used as support in mines. Sample 1, Müsen, Siegerland, 5.60 m (51° N Lat, 8° E Long).

BONN-1557. **800 ± 60** **A.D. 1150**

Same location, upright standing wooden board in house wall, 60 m.

BONN-1654. **1060 ± 70** **A.D. 890**

Same location, piece of log, 28 m.

BONN-1655. **1230 ± 70** **A.D. 720**

Same location, piece of wood, ore processing site, 28 m.

BONN-1656. **970 ± 70** **A.D. 980**

Same location, frame-wood of cellar basement, 28 m.

Samples coll. and subm. 1971 by Mining Museum Bochum. *Comment*: dates assess early mining in Siegerland; 200 to 300 yr older than expected.

B. Israel

BONN-746. **4200 ± 70** **2250 B.C.**

Ancient Jericho ruins (oldest, deepest ruins assessed at ca. 9000 B.P.), charcoal samples taken from 1/3 to 1/2 of total depth of pit, 250 cm, prehistoric, Sumeric, Akkadic, Caldeic period expected represented. (31° 52′ N Lat, 34° 35′ E Long).

BONN-747. **5110 ± 110** **3160 B.C.**

Same location, charcoal, 350 cm.

Samples coll. and subm. 1969 by H. W. Scharpenseel and H. Gewehr, Inst. f. Bodenkunde, Bonn. *Comment*: unfortunately no continuity of charcoal samples down to bottom of pit. Availability of organic C and charcoal at various depth levels makes site potentially important for humus-C versus charcoal age comparison.

C. Ecuador

2630 ± 80

BONN-1550. **680 B.C.**

High Andes Mts., Ambato, S Quito, on carstic hill, charcoal in soil, pit 80 to 100 cm deep. Few relics of Puruhá-style, dating of pre-Inca settlement (1° 14′ S Lat, 78° 42′ W Long).

990 ± 60

BONN-1551. **A.D. 960**

W part of house in Cashaloma style, hill of E Cordillera, some Inca ceramics, coal 10 to 100 cm, scattered in house. Dates fixation of Inca occupation of Ecuador (2° 32′ S Lat, 78° 53′ W Long).

1510 ± 80

BONN-1552. **A.D. 440**

Same location, coal, 20 to 60 cm.

690 ± 60

BONN-1553. **A.D. 1260**

High Andes, rock precipice E Cordillera W layer, 160 cm, coal in bits and pieces. Locally average Cashaloma ceramics. Attempts chronologic assessment of last pre-Inca as well as Inca cultural horizons (2° 32′ S Lat, 78° 53′ W Long).

750 ± 70

BONN-1554. **A.D. 1200**

Same location, charcoal, 135 cm.

700 ± 60

BONN-1555. **A.D. 1250**

Same location, charcoal, 150 cm.

Samples coll. and subm. 1971 by A. Meyers, Inst. Anthropol., Bonn Univ. *Comment*: results are slightly higher than expected. Age of wood, before conversion into charcoal, could be partly responsible.

D. Peru

Peru samples are part of current large scale study on pre-Spanish settlements and relics.

730 ± 60

BONN-1139. **A.D. 1220**

Wood, Huaycan, Lurín valley; to date pre-Spanish settlement (12° 5′ S Lat, 76° 10′ W Long).

420 ± 80

BONN-1140. **A.D. 1530**

Charcoal, Huaycan, same location; to date pre-Spanish settlement.

660 ± 60

BONN-1141. **A.D. 1290**

Wood, Túcume, Lambayeque; to date pre-Inca pyramid El Mirador (6° 30′ S Lat, 79° 40′ W Long).

BONN-1142. **680 ± 50** **A.D. 1270**

Charcoal, Túcume, same location; to date pre-Inca pyramid El Mirador, NW-platform, 55 to 60 cm under surface.

BONN-1143. **940 ± 50** **A.D. 1010**

Wood, Túcume, same location; to date pre-Inca pyramid de las Estacas, E part, 40 to 55 cm, 4. layer of wooden logs.

BONN-1144. **690 ± 50** **A.D. 1260**

Wood, Túcume, same location; to date pre-Inca pyramid Huaca Alagarda. E wall 45 to 60 cm below top.

BONN-1145. **1430 ± 50** **A.D. 520**

Charcoal, Apurlec, Lambayeque; to date pre-Spanish buildings (6° 20′ S Lat, 79° 40′ W Long).

BONN-1146. **420 ± 50** **A.D. 1530**

Root wood, Aymara, Mala valley; 70 to 80 cm in house wall; to date pre-Spanish settlement (12° 35′ S Lat, 76° 30′ W Long).

BONN-1147. **660 ± 50** **A.D. 1290**

Charcoal, Puyenca, S Chala, 85 cm below garbage pile; to date pre-Spanish settlement (16° 10′ S Lat, 73° 50′ W Long).

BONN-1148. **13,950 ± 130** **12,000 B.C.**

Charcoal, Puyenca, in street lining, same location; to date pre-Spanish settlement.

BONN-1149. **2280 ± 80** **330 B.C.**

Bamboo sticks, Amapaya, Sama valley, part of vertical house wall remnants; to date age of pre-Spanish buildings (18° 10′ S Lat, 70° 40′ W Long).

BONN-1150. **130 ± 50** **A.D. 1820**

Wood, Fundus la Vitúna, Sama valley, Tacna, sowed hard wood, vertical position, 30 cm; to date age of pre-Spanish buildings (18° 12′ S Lat, 70° 40′ W Long).

BONN-1151. **710 ± 60** **A.D. 1240**

Charcoal, Tocuco Alto, Tacna, fireplace 10 to 25 cm below terrace surface; to date pre-Spanish settlement (17° 45′ S Lat, 70° 15′ W Long).

6160 ± 120

BONN-1558. **4210 B.C.**

Charcoal, Sumbay, Arequipa, cave, 20 to 30 cm below surface; to date prehistoric settlement (16° 15′ S Lat, 71° 30′ W Long).

5350 ± 90

BONN-1559. **3400 B.C.**

Charcoal, Sumbay, cave bottom 30 to 40 cm below surface; to date prehistoric settlement, same location.

730 ± 60

BONN-1560. **A.D. 1230**

Llama dung, Alto Tocuco, Pachia, in bottom of inhabited terrace; to date pre-Spanish settlement (17° 45′ S Lat, 70° 15′ W Long).

900 ± 100

BONN-1561. **A.D. 1050**

Charcoal, Alto Tocuco, in bottom of inhabited terrace; to date pre-Spanish settlement, same location.

3260 ± 120

BONN-1562. **1310 B.C.**

Charcoal, hut in Pizacoma, Chucuito; Mesolithic ceramics exists; to date prehistoric settlement (16° 30′ S Lat, 70° 0′ W Long).

1500 ± 70

BONN-1563. **A.D. 450**

Cotton cloth, Chavina-valley, Acari, on bottom of garbage pile; to date layer of Nasca culture (15° 30′ S Lat, 74° 50′ W Long).

280 ± 70

BONN-1564. **A.D. 1670**

Relic of corn cob, Lluta, Pachia, in bottom of house relic, 30 to 40 cm below surface; to date pre-Spanish settlement (17° 45′ S Lat, 70° 15′ W Long).

770 ± 70

BONN-1565. **A.D. 1180**

Corn straw and fiber fabric from desert soil, La Vituna, Las Yaras, 40 cm below surface; to date pre-Spanish settlement (17° 45′ S Lat, 70° 45′ W Long).

390 ± 70

BONN-1566. **A.D. 1560**

Piece of wooden pole of house entrance, Lluta, Pachia, in bottom of former house; to date pre-Spanish settlement (17° 45′ S Lat, 70° 15′ W Long).

270 ± 70

BONN-1567. **A.D. 1680**

Piece of wooden pole of house entrance, in house bottom, 20 to 30 cm below surface; to date pre-Spanish settlement, same location.

BONN-1568. **290 ± 70**
A.D. 1660

Twigs and branches in basement of former house, Lluta, 20 cm below surface; to date pre-Spanish settlement, same location.

BONN-1569. **100.8 ± 0.8%**
Modern

Unknown plant grains, in basement of pre-Spanish storage house, Quebrada de la Vaca, Chala; to date pre-Spanish settlement (15° 48′ S Lat, 74° 24′ W Long).

BONN-1570. **1560 ± 70**
A.D. 390

Lower Part of wooden pole, in base of artificial hill, Cahuachi, Nazca valley 40 cm below surface; to date phase of Nazca culture (15° S Lat, 75′ W Long).

BONN-1664. **570 ± 80**
A.D. 1380

Remnant of wooden pole in bottom of former house (2), Lluta, Pachia, Tacna; to date pre-Spanish settlement (17° 45′ S Lat, 70° 15′ W Long).

BONN-1665. **260 ± 70**
A.D. 1690

Remnant of wooden pole in bottom of former house (1), Lluta; to date pre-Spanish settlement, same location.

BONN-1813. **1110 ± 70**
A.D. 840

Charcoal No. 5 and 6, ruin complex Apurlec, Motupe, Lambayeque, in wall material 20 to 45 cm below surface; to date pre-Spanish ruin complex (16° 20′ S Lat, 79° 40′ W Long).

Samples coll. and subm. 1970 to 1972 by H. Trimborn, Inst. Anthropol., Bonn Univ. *Comment*: project still pending, dates help validate assumptions based on stratigraphic estimates and fossil evaluation.

IV. MODERN SAMPLE

BONN-1387. Grass, Röttgen near Bonn, Oct. 1971 **145.8 ± 0.5%**
Modern

Sample coll. and subm. 1971 by H. W. Scharpenseel. Continues study of bomb carbon level since 1957 (R., 1969, v. 11, p. 13).

REFERENCES

Rauterberg, E. and Kremkus, F., 1951, Bestimmung von Gesamt- und alkalilöslichen Huminstoffen im Boden: Z. Pflanzenernähr., Düng., Bodenkunde, v. 54, p. 240.

Scharpenseel, H. W., 1971, Radiocarbon dating of soils—problems, troubles, hopes, Paleopedology—Origin, Nature and Dating of Paleosols, ed. D. H. Yaalon, Int. Soil Sci. Soc., p. 77 to 88.

Scharpenseel, H. W., *et al.*, Analyses des eaux souterraines en Tunisie, par mesure des concentrations naturelles de radiocarbone et de tritium: Report to the Tunisian Government. (in German: Fortschr. Geol. in Nordrhein-Westfalen, in press).

Scharpenseel, H. W. and Pietig, F., 1968/69, Einfache Boden- und Wasserdatierung durch Messung der C^{14}-oder Tritiumkonzentration: Geoderma, v. 2, p. 273-289.

———— 1970, University of Bonn natural radiocarbon measurements III, v. 12, p. 19-39.

———— 1971, University of Bonn natural radiocarbon measurements IV, v. 13, p. 189-213.

Scharpenseel, H. W., Pietig, F., and Tamers, M. A., 1968, Bonn radiocarbon measurements I, v. 10, p. 8-28.

———— 1969, University of Bonn natural radiocarbon measurements II, v. 11, p. 3-14.

Tamers, M. A., 1967, Radiocarbon ages of ground water in arid zone unconfined aquifer: Am. Geophys. Union Mon., v. 11, p. 143.

Tamers, M. A., Ronzani, C., and Scharpenseel, H. W., 1969, Observation of naturally occurring chlorine Cl-36: Atompraxis, v. 15, p. 1-5.

[RADIOCARBON, VOL. 15, NO. 1, 1973, P. 42-67]

GAKUSHUIN NATURAL RADIOCARBON MEASUREMENTS VIII

KUNIHIKO KIGOSHI, NOBUKO SUZUKI, and HIROKO FUKATSU
Faculty of Science, Gakushuin University, Mejiro, Toshimaku,
Tokyo, Japan

This list continues Gakushuin VII (R., 1969, v. 11, p. 295-362); the same instruments and techniques were employed. Age calculations are based on the Libby half-life of C^{14}, 5570 ± 30 years, and the modern activity given by 95% of the activity of NBS oxalic acid standard. Errors quoted are the standard deviation obtained from the number of counts only. When observed activity is less than 2σ above background, infinite date is given with a limit corresponding to the activity of 3σ. For shell samples, dates are computed without any correction for environmental and biological isotopic fractionation. The description and comments are essentially those of the submitters.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Japan

Yoko-oji series, Kyoto

Samples from alluvium at Yoko-oji, Fushimiku, Kyoto City (34° 55′ N Lat, 135° 44′ 38″ E Long), S of Kyoto City, alt. 10.5 m. Coll. and subm. 1967 by Shiro Ishida, Kyoto Univ., for study of sedimentation rate at Kyoto basin and ages of tephra in the sediment.

GaK-1453. Kyoto, 1 — **12,340 ± 220** / **10,390 B.C.**

Wood (*Quercus*) from gravel 12.5 m below surface of alluvium.

GaK-1454. Kyoto, 2 — **8520 ± 170** / **6570 B.C.**

Roots of reed from sand 9 m below surface of alluvium. *Comment* (S.I.): dates period of swamp formation.

GaK-1455. Kyoto, 3 — **6720 ± 150** / **4770 B.C.**

Twigs and leaves from clay 7.25 m below surface of alluvium, 20 cm above volcanic ash. *Comment* (S.I.): dates volcanic ash.

GaK-1456. Kyoto, 4 — **4910 ± 90** / **2960 B.C.**

Wood from peaty clay 6.5 m below surface of alluvium.

GaK-1457. Kyoto, 5 — **6220 ± 90** / **4270 B.C.**

Drift wood from fine sand 5.7 m below surface of alluvium. *Comment* (K.K.): drift wood date may show age of sedimentation of fine sand.

3200 ± 100

GaK-1458. Kyoto, 6 **1250 B.C.**

Leaves (*Quercus*) from sand, 4.8 m below surface of alluvium.

4190 ± 130

GaK-1459. Kyoto, 7 **2240 B.C.**

Driftwood in clay, 4.3 m below surface of alluvium. *Comment* (K.K.): see GaK-1457.

7050 ± 140

GaK-1460. Kyoto, 8 **5100 B.C.**

Peaty clay 7.5 m below surface of alluvium, underlying volcanic ash. *Comment* (K.K.): date does not confirm that volcanic ash is same as Akahoya (GaK-1241, R., v. 11, p. 296) at S Kyushu.

4500 ± 80

GaK-1461. Matta-moroguchicho **2550 B.C.**

Wood from sandy clay marine deposit, Umeda layer, at Matta-moroguchicho, Jotoku Osaka (34° 42.3′ N Lat, 135° 35′ E Long), 4.7 to 4.8 m below ground surface. Coll. 1967 by S. Ishida and subm. by M. Senchi, Osaka City Mus. Nat. Sci.

Shinhama series

Boring samples from Shinhama, Kusatsu City, Shiga Pref. (34° 59′ 55″ N Lat, 135° 55′ 35″ E Long). Coll. 1966 and subm. by Akira Unozawa, Geol. Survey of Japan.

GaK-1584. Shinhama, 1 **>33,600**

Peat from 16.7 to 17.0 m below ground surface, in granitic sand and gravel overlain by terrace deposit.

29,000 ± 1700

GaK-1585. Shinhama, 2 **27,050 B.C.**

Peat from 5.5 to 5.7 m below ground surface. *Comment* (A.U.): dates peat (Sukumo) just above terrace deposit.

6460 ± 110

GaK-1393. Kashiwazaki **4510 B.C.**

Wood from Kamiwa, Kashiwazaki City, Niigata Pref. (37° 19′ N Lat, 138° 28′ E Long), in lower terrace, Kashiwazaki Layer, with large pebble. Coll. 1966 and subm. by Tsutomu Utashiro, Niigata Univ.

28,050 ± 1550

GaK-1451. Shinchi, Fukushima **26,100 B.C.**

Wood from peat layer at Shinchi-mura, Soma-gun, Fukushima Pref. (37° 51′ 53″ N Lat, 140° 15′ 40″ E Long), underlying sand and gravel, 3 m below surface of lowest terrace. Coll. 1966 and subm. by Keiji Suzuki, Fukushima Univ.

18,750 ± 500

GaK-1452. Negishi, Kukushima **16,800 B.C.**

Wood from fujita fan deposit at Negishi, Kori-machi, Fukushima

Pref. (37° 50′ 47.5″ N Lat, 140° 32′ 20.1″ E Long), 3.2 m below surface. Coll. and subm. 1967 by K. Suzuki. *Comment* (K.S.): dates last stage of Fujita fan deposit (Koriyama Research Group, 1966); see GaK-209 (R., 1963, v. 5, p. 114).

15,000 ± 400

GaK-2370. Hiroshima, Hokkaido **13,050 B.C.**

Wood from Hiroshima-cho, Sapporo-gun, Hokkaido (42° 56′ 22″ N Lat, 141° 32′ 10″ E Long), alt. 53.2 m, 4.5 m below surface of lower terrace deposit which consists of secondary deposit including Shikotsu pumice flow. Coll. and subm. 1968 by Makoto Kashiwabara, Sapporo Daiichi High School.

B. Australia

32,200 ± 400

GaK-1908. Fremantle **30,250 B.C.**

Shells of marine gastropod *Turbo (Ninella) whitleyi* from coarse calcarenite exposed in a quarry (32° 5′ S Lat, 115° 45′ E Long) near Fremantle, W Australia. Coll. and subm. by D. Merrilees and G. W. Kendrick, W Australian Mus. *Comment* (D.M. and G.W.K.): from exposure up to 1 m above modern mean sea level, and probably represents a stand of the sea about this level. Assoc. marine mollusca and coral indicate water temperatures similar to those of today.

GaK-2542. Reef Beach **>32,000**

Charcoal from low cliffs at Reef Beach in Bremer Bay dist., W Australia (34° 29′ S Lat, 119° 9′ E Long). Coll. and subm. 1969 by D. Merrilees. *Comment* (D.M.): from immediate vicinity of mandible (W Aust. Mus. Specimen 69.4.37) of large extinct diprotodontid marsupial (*Zygomaturus trilobus*). Date suggests accumulation of calcareous dunes near Bremer Bay was slower than at Fremantle (cf. GaK-875, R., 1969, v. 11, p. 303, and GaK-1908). Preliminary note on occurrence in Merrilees (1970).

19,400 ± 1200

GaK-2417. Deepdene Cave **17,450 B.C.**

Bone (mainly juvenile *Petrogale*, a marsupial) from lower half of a rimstone pool floor deposit (now dry) in Deepdene Cave, Augusta dist., W Australia (34° 16′ S Lat, 115° 3′ E Long). Coll. 1968 and subm. by D. Merrilees. *Comments* (D.M.): peculiar nature of deposit not yet explained. (K.K.): dated on collagen.

6660 ± 120

GaK-2874. Guildford, Western Australia **4710 B.C.**

Shells of marine bivalve (*Paphia callistotapes* sp.), dredged from sediments in Swan Estuary bed near Guildford, W Australia (31° 54′ S Lat, 115° 58′ E Long). Coll. by G. W. Kendrick and subm. 1970 by D. Merrilees. *Comment* (D.M.): dredged from unrecorded depth from 2.7 to 4.8 m below low-water mark, Fremantle. Other mollusks with same matrix were also marine, and significantly different from living

mollusk fauna of Estuary, but similar to some marine mollusks at Fremantle, 30 km downstream. A marked environmental change seems evident within Swan Estuary since mid-Holocene.

C. England

Bishop Middleham series

Peat from Bishop Middleham, Durham, England (54° 40′ 3″ N Lat, 1° 29′ 49″ W Long). Deposit, 150 cm deep, lies in channel forming part of system, seemingly connected with Ferryhill Gap. Pollen analysis indicates peat growth began during Boreal period. Coll. 1967 and subm. by D. D. Bartley, Univ. Leeds.

6760 ± 120

GaK-2070. Bishop Middleham, 100 cm **4810 B.C.**

Peat, 100 cm below surface. *Comment* (D.D.B.): suggests rapid growth for 1st 40 cm of peat if Boreal-Atlantic transition is placed at ca. 140 cm. Date was required due to marked rise in pollen of *Quercus* and Tilia, beginning at 100 cm depth.

5180 ± 110

GaK-2071. Bishop Middleham, 80 cm **3230 B.C.**

Peat, 80 cm below surface. Pollen (*Plantago lanceolata*) makes its 1st appearance in pollen diagram, presumably indicating beginning of Neolithic agriculture. *Comment* (D.D.B.): supposed elm decline (ca. 3300 B.C.) at 90 cm falls midway between levels giving these 2 dates; thus, a very slow growth of deposit between 100 and 90 cm and a greatly accelerated rate between 90 and 80 cm is presumed. Climatic changes may be assoc., since part of pollen diagram between 100 and 90 cm shows high values of pollen of *Quercus* and *Tilia* and markedly low values for *Alnus*, indicating drier conditions for much of Atlantic period.

3660 ± 80

GaK-2072. Bishop Middleham, 60 cm **1710 B.C.**

Peat, 60 cm below surface.

3360 ± 80

GaK-2073. Bishop Middleham, 40 cm **1410 B.C.**

Peat, 40 cm below surface. *Comment* (D.D.B.): together with Gak-2072, shows that major phase of agriculture, indicated by rise in pollen values of Gramineae, Cyperaceae, *Plantago lanceolata, P. Major,* etc., can be dated to Bronze age. Separation of the 2 dates by only 300 yr suggests rapid deposition of detrital material at that time.

N Derbyshire series

Three peat bogs on a ridge of upland composed of gritstone and shale, at Leash Fen, N Derbyshire, England (53° 15′ 40″ N Lat, 1° 33′ 30″ W Long), alt. 285 m, Totley Moss, N Derbyshire, England (53° 18′ N Lat, 1° 34′ 30″ W Long) alt. 360 m, and Hipper Sick, N Derbyshire, England (53° 12′ 40″ N Lat, 1° 32′ 40″ W Long), alt. 315 m.

Leash Fen samples are taken in sequence from one boring using Hiller Type peat borer. Monoliths were cut for Totley Moss and Hipper Sick peat. Samples coll. 1968 by S. P. Phillips and subm. by Bartley.

GaK-2284. Leash Fen, base **6250 ± 150**
4300 B.C.

Dates beginning of peat growth at Leash Fen. Sample from base of peat bog. Peat growth began in Pollen Zone VIIa some time after Boreal/Atlantic Transition. *Comment* (S.P.P.): agrees with pollen evidence but is later than expected, according to other upland peats. Yet, 285 m is low alt. for upland peat and might explain later growth.

GaK-2285. Leash Fen, 502 cm depth **4070 ± 100**
2120 B.C.

Dates 1st clearance phase; small clearance of fairly short duration assoc. with pastoral rather than arable farming. *Comment* (S.P.P.): accords well with archaeologic evidence of Neolithic activity in area. Neolithic stone axes of 2 different petrologic groups were recovered from gritstone upland and both groups are placed in mid/late 3rd millennium B.C.

GaK-2286. Leash Fen, 460 cm depth **3740 ± 100**
1790 B.C.

GaK-2287. Leash Fen, 410 cm depth **3450 ± 110**
1500 B.C.

Gak-2286 and Gak-2287 date 2 clearance phases on Leash Fen Diagram which, like the 1st (GaK-2285), are fairly small and of short duration although the one at 410 cm is of slightly greater magnitude. *Comment* (S.P.P.): correlating archaeologic and palynologic evidence with radiocarbon dates suggests clearance phase dated at 1790 B.C. could be assoc. with Late Neolithic Beakers although assoc. with Food Vessels is more likely. Later phase dated at 1500 B.C. must correlate with Collared Urns.

GaK-2288. Leash Fen, 340 cm depth **2290 ± 100**
340 B.C.

GaK-2289. Leash Fen, 270 cm depth **2090 ± 100**
140 B.C.

Gak-2288 and GaK-2289 date beginning and end of major clearance phase on Leash Fen diagram. *Comment* (S.P.P.): from 340 cm to 270 cm depth percentage of tree pollen falls dramatically, Gramineae pollen rises, *P. lanceolata* pollen increases and cereal pollen grains are present for 1st time. Dates 340 B.C. to 140 B.C. for duration of phase place it as Iron age. Abundant Iron age remains accord well with magnitude of clearance.

2110 ± 100

GaK-2290. Leash Fen, 180 cm depth **160 B.C.**

Dates minor clearance phase though result is somewhat anomalous, but considering quoted errors, dates GaK-2289 and GaK-2290 are virtually the same. Possibly, peat bog was growing very rapidly, a theory supported by stratigraphic evidence: above 270 cm (depth of GaK-2289) peat is obviously less humified and contains higher proportion of *Sphagnum*. Apparent separate clearance phase at 180 cm may therefore be part of Iron age phase.

1910 ± 100

GaK-2291. Leash Fen, 130 cm depth **A.D. 40**

1530 ± 90

GaK-2292. Leash Fen, 70 cm depth **A.D. 420**

GaK-2292 and GaK-2291 date beginning and end of penultimate clearance phase, which, from pollen evidence is assoc. with both pastoral and arable farming. *Comment* (S.P.P.): dates A.D. 40 to A.D. 420 correspond well with Roman occupation. First stage of Roman road system in Derbyshire, Foss Way, is dated at A.D. 47.

4490 ± 140

GaK-2293. Totley Moss **2540 B.C.**

Dates 1st occurrence of pollen (*Plantago lanceolata*) at Totley Moss.

4770 ± 110

GaK-2294. Hipper Sick **2820 B.C.**

Dates 1st occurrence of pollen (*Plantago lanceolata*) at Hipper Sick.

General Comment (D.D.B. and S.P.P.): pollen diagrams from a number of deposits on gritstone uplands of S. Derbyshire revealed series of phases of agricultural interference with vegetation. Diagram from Leash Fen, lowest peat deposit (285 m), was taken as reference for region and series of clearance phases were dated. In pollen diagram, clearance phases are shown by fall in percentage of tree pollen with rise in values of Gramineae, and presence of agricultural indicators, *Plantago lanceolata, Rumex acetosa,* and *Pteridium aquilinum*. Pollen diagrams at Totley Moss and Hipper Sick show agricultural activity predates 1st clearance phase at Leash Fen, supported by C^{14} dates, 3040 B.C. and 2820 B.C., which indicate a Neolithic phase although there is no archaeologic evidence of Neolithic in early 3rd millennium B.C.

II. ARCHAEOLOGIC SAMPLES

A. Canada

3100 ± 80

GaK-1272. Kajewski site, Alberta **1150 B.C.**

Charred bone from Kajewski site (49° 35′ N Lat, 110° 20′ W Long), Cypress Hills, Alberta. Scattered bone from Sq. 49D.0, from surface of buried slump block in area of dense occupation. Probably 3 components.

Material recovered is largely artifacts made from quartzite cobbles and flakes. Charred bone is from lowest culture-bearing level, assoc. with cobble choppers, a projectile point with basally-thinned stemmed, and a triangular projectile point. Lowest level is dense living floor of occupation debris. Will date the number of dominant cobble and flake tools found throughout Cypress Hills. Est. age 4000 B.C. Coll. 1966 by N. Deemer and subm. for R. Bonnichsen, Univ. Alberta, by R. Wilmeth, Natl. Mus. Canada. *Comments* (R.B.): date overestimated by ca. 3000 yr, a tremendous margin of error even if bone sample gave slightly incorrect date. For lack of diagnostic artifacts at Kajewski, date must be accepted at face value. (K.K.): dated on residues after dissolution of charred bone by nitric acid.

Head-Smashed-In Buffalo Jump series, Alberta

Bone from Head-Smashed-In Buffalo Jump, DkPj-1 (49° 43′ N Lat, 113° 40′ W Long), Porcupine Hills, 16 km W of Fort MacLeod, Alberta. Largest known buffalo jump in NW Plains, 244 m long by 60 m wide. Average depth 6 m, max. depth 12 m. Upper deposits contain typical late prehistoric side-notched points. Lower levels contain Besant, Pelican Lake, and Hanna points. Lowest levels contain wide assortment of stone and bone tools, but no projectile points. Age of deposits is unknown but could predate last glaciation at 12,000 yr ago. Coll. 1966 by Reeves, and subm. for R. G. Forbis, Univ. Calgary, by R. Wilmeth.

GaK-1474. Head-Smashed-In Buffalo Jump, Test Y — **3040 ± 120 / 1090 B.C.**

Bone (NMC-170) from Test Y, cultural Horizon 5, soil Horizon 19 (Ah), depth 3.0 to 3.2 m. First drive of Late Prehistoric. Point assoc. is Avonlea and another unnamed type. Est. age A.D. 300 to 400.

GaK-1475. Head-Smashed-In Buffalo Jump, N test pit — **1860 ± 120 / A.D. 90**

Bone (NMC-171) from N test pit, Layer 8, depth 1.8 to 2.0 m. Earliest horizon with identifiable projectile points, Hanna and Pelican Lake. Will date appearance of these points, and allow for termination date of semi-sterile interval separating bottom horizons. Est. age 800 to 600 B.C.

GaK-1476. Head-Smashed-In Buffalo Jump, Test X — **4050 ± 100 / 2100 B.C.**

Bone (NMC-172) from Test X, 15 cm below bottom of Pelican Lake. In Test Y, this is cultural Horizon 8, soil Horizon 31 (Ah), depth 5.1 to 5.7 m. Will date termination of early occupation of jump. Assemblage at this depth contained no projectile points. Est. age greater than 800 B.C., possibly earlier than 10,500 B.C.

General Comments (R.G.F. and B.R.): dates on GaK-1474 and GaK-1475

are opposite of expected results. Additional date on Late Prehistoric Avonlea level is A.D. 305 ± 130 (GX-1252). (K.K.): dated on collagen.

Nanook site series, Northwest Territories

Charred fat and sod from Nanook site, KdDq-9 (62° 39′ N Lat, 69° 37′ W Long), Cape Tanfield, Baffin I., N.W.T., Canada. Two-component site probably occupied in winter when sea level was almost 8 m higher than at present. Typology fits into 12-site continuum for Tanfield Valley. Coll. 1966 by M. S. Maxwell, Michigan State Univ. and subm. by R. Wilmeth.

GaK-1493. Nanook site, Sq. SL15 **2010 ± 80 60 B.C.**

Charred fat (seal?) (NMC-132) from Sq. SL15, surface depth 2.7 m, in permafrost. Scraped from encrusted cooking rock on floor of earliest level of upper (more recent) of 2 components. Should date beginning of component. Should be more recent than M-1535 (2410 ± 120) (Crane and Griffin, 1966) and older than P-704 (1916 ± 61 (Stuckenrath *et al.,* 1966).

GaK-1494. Nanook site, Sq. OL15 **1870 ± 110 A.D. 80**

Sod (NMC-129) from Sq. OL15, surface depth 30 cm, underlying GaK-1284, in permafrost. Should date most recent part of lower of 2 components. Was expected to be equivalent to GaK-1284 (2380 ± 80) and was subm. as a check using sample of different organic composition. Should be slightly more recent than M-1535.

General Comments (M.S.M.): NMC-132 (GaK-1493): date seems too recent by ca. 180 yr. A series of carbon dates from a stratigraphic column in this site, and archaeologic evidence including comparative typology indicates 3 major uses of this settlement locale; one centering ca. 410 B.C. ± 30 yr; the 2nd centering around 240 B.C. ± 30 yr, and the 3rd centering ca. A.D. 60 ± 30 yr. Sample should date to early point in 2nd occupation. Contamination with melt water is suspected.

NMC-129 (GaK-1494): date, A.D. 80, is unacceptable in light of other carbon dates from site and archaeologic analysis. Other evidence suggests that at 30 cm depth in this permafrost midden samples are contaminated by organisms in standing melt water, unless taken as soon after thawing as possible. Probably future samples should be chopped out before thawing. Caribou skin overlying sample was dated to 430 B.C. (GaK-1284), consistent with M-1535 (460 B.C.) and GaK-1286 (420 B.C.). Note, however, that GaK-1288 from same midden depth of 30 cm, and GaK-1285 from 9 cm lower, date from A.D. 1370 and A.D. 550, respectively. These 2 samples and GaK-1494 may have been exposed to melt water for a longer period than the 3 "good" samples.

Elk Island site series, Manitoba

Charcoal from Elk Island site (GdKn-1), S shore of Elk I., God's

Lake, Manitoba (54° 38′ N Lat, 94° 14′ W Long). Stratified site with Shield Archaic below Selkirk focus (Cree). Coll. 1967 by J. V. Wright, Natl. Mus. Canada. Subm. for Wright by R. Wilmeth.

2760 ± 240

GaK-1860. Elk Island site, 10-14 cm depth **810 B.C.**

Charcoal (NMC-226) from test Trench 2, Level 2, from beneath Hearth 1, at 10 to 14 cm depth. Represents 1st radiocarbon date on Shield Archaic. Est. age: <700 B.C.

2830 ± 210

GaK-1861. Elk Island site, 30 cm depth **880 B.C.**

Charcoal (NMC-227) from test Trench 2, under edge of boulder at 37 cm N and 1.4 m W, 30 cm depth. Will date Shield Archaic component and check GaK-1860 relative to time depth within deposit. Est. age: <700 B.C.

General Comment (J.V.W.): both dates indicate Elk Island site component is late example of Shield Archaic. Time between the 2 readings also suggests that Archaic occupation of site was of limited duration.

1140 ± 80

GaK-1862. God's Lake site, Manitoba **A.D. 810**

Charcoal (NMC-228) from God's Lake site (GdKn-3), at NE end of bay leading to Chataway Lake, God's Lake, Manitoba (54° 37′ 30″ N Lat, 94° 15′ 10″ W Long). From test Trench 1, Sec. 3, E edge of Feature 1, 1 m E, 15 cm S, depth 13 cm. Stratified, with Selkirk focus and Laurel tradition in superposition above a Shield Archaic component. Sample should date Shield Archaic component, but being from upper portion of deposit, it may pertain to Laurel tradition or Selkirk-focus occupations. Est. age: <700 B.C. Coll. 1967 by J. V. Wright and subm. by R. Wilmeth. *Comment* (J.V.W.): reading obviously pertains to Late Woodland Selkirk focus and equates with readings for early portion of this complex from Southern Indian Lake (Wright, 1968).

140 ± 60

GaK-1864. Kitchen site, New Brunswick **A.D. 1810**

Charcoal (NMC-235) from Kitchen site (CaDu-7), upper terrace on left bank of St. John R., opposite mouth of Eel R. and village of Meductic, New Brunswick (45° 0′ N Lat, 67° 29′ 30″ W Long). From W sec., Pit I, 38 to 40 cm depth from surface. Site on old river terrace beside unnamed creek. Matrix is river-deposited silty sand; probably late Archaic. This is 1st Archaic site in Maritime Provinces to be radiocarbon dated and is oldest known site in Mactaquac Reservoir area. Est. age: 3000 or more yr. Coll. 1967 by D. Laverie and D. Sanger, Natl. Mus. Canada and subm. by R. Wilmeth. *Comment* (D.S.): date is obviously wrong. More charcoal needed for dating.

GaK-1865. Frank Channel site, Northwest Territories **670 ± 70 A.D. 1280**

Charcoal (NMC-239) from Frank Channel site (KePl-1), N arm of Great Slave Lake, 3 m above present lake level, N.W.T. (62° 47′ 30″ N Lat, 115° 57′ W Long). From excavated hearth in Unit D, depth 21 cm, assoc. with fish bone. Late component of Taltheilei Shale complex, developmentally ancestral to Yellowknife Indians. Sample should date Lockhart horizon. Est. age: A.D. 1400 to 1700. Coll. 1967 by W. C. Noble, Univ. Calgary and subm. for Noble by R. Wilmeth. *Comment* (W.C.N.): date is acceptable, only about a century older than estimate. Frank Channel materials are similar to Lockhart (MacNeish, 1951).

GaK-1866. Windy Point site, Northwest Territories **1230 ± 180 A.D. 720**

Carbon from burned log (NMC-240) from Windy Point site (LcPc-7), S shore of Winter Lake in Snare R. system, 4.5 m above high water lake level, on esker, N.W.T. (64° 28′ N Lat, 112° 57′ 30″ W Long). From log lying horizontally in Unit C, of middle terrace excavation, assoc. with artifacts including stemmed projectile point. Max. depth of log, 15 cm below surface. Cultural materials from 5 to 8 cm deep black sandy humus, overlain by 2.5 cm cover of gray-black moss and underlain by orange-brown B soil horizon 18 cm deep with no artifacts. Fine gray clay gumbo till and boulders are below B soil horizon. Est. age: 1000 to 500 B.C. Coll. 1967 by W. C. Noble and subm. by R. Wilmeth. *Comment* (W.C.N.): original estimate of 1000 to 500 B.C. was based on presence of Arctic Small Tool points and scrapers as surface finds on lowest terrace of Windy Point esker. Apparently, increasing age is not directly correlated with higher terrace elev. Date is acceptable on typologic or contextual grounds.

GaK-1867. Blackfly Creek site, Northwest Territories **2360 ± 140 410 B.C.**

Carbon (NMC-241) from Blackfly Creek site, S side of Blackfly Creek, draining into Winter Lake in Snare R. system, N.W.T. (64° 28′ 15″ N Lat, 113° 6′ W Long). From exposed buried burned soil horizon of black humus and charred spruce wood 4 to 5 cm thick and ca. 3.6 m above water level. Horizon overlain by 88 cm of wind-blown sands, capped by present stable vegetation. Weak podsol development under buried burned horizon. No cultural materials assoc. Sample is important in dating forest penetration, burning, and establishment of soil horizon in Winter Lake area. Currently, lake lies in forest-tundra transition zone, and Blackfly Creek is within a gallery forest extension. Coll. 1967 by W. C. Noble and subm. by Wilmeth. *Comment* (W.C.N.): date is acceptable, although earlier than expected, on basis of assumed cultural-terrace sequence at Windy Point (see GaK-1866). It is now apparent that tree-line burning in central dist. of MacKenzie is not totally consistent with sequence for S Keewatin. Closest correlation of Blackfly Creek

date is J. A. Larsen's 190 ± 80 B.C. (WIS-136) date from NE end of Artillery Lake (R., 1967, v. 9, p. 54) and 260 ± 160 B.C. (WIS-29) from Ennadai Lake (R., 1965, v. 7, p. 406). In contrast to Artillery Lake, spruce forest grew back and restabilized in Blackfly Creek (Winter Lake) area since it burned off ca. 400 B.C.

CaDu-8 site series, New Brunswick

Charcoal from CaDu-8 site, left bank of St. John R., opposite mouth of Eel R. and village of Meductic, on lowest terrace, New Brunswick (45° 0′ N Lat, 67° 29′ 30″ W Long). Site is on lowest terrace of large interval flooded annually. Matrix is river-deposited silty sand; Woodland period, with small basal-notched projectile points. Site is only component of this type dated in Madtaquac Reservoir. Est. age: 800 to 1000 yr. Coll. 1967 by D. Laverie and D. Sanger and subm. by R. Wilmeth.

GaK-1868. CaDu-site, Pit 4 **1260 ± 90 A.D. 690**

Charcoal (NMC-255) from test Trench 3, Pit 4, 40 cm below surface.

GaK-1869. CaDu-8 site, Pit 7 **2350 ± 100 400 B.C.**

Charcoal (MNC-256) from test Trench 3, Pit 7, 45 cm below surface.

General Comment (D.S.): date for GaK-1868 is a little earlier than expected but is not unreasonable. GaK-1869 should have dated very close to GaK-1868, and since an earlier component is not indicated, it must be erroneous.

Honna River site series, British Columbia

Charcoal from Honna River site (FhUa-1), E side of mouth of Honna R., Queen Charlotte Is., British Columbia (53° 15′ 15″ N Lat, 132° 7′ 30″ W Long). Stratified 3.6 m deep shell midden, overlain by 60 cm of recent humus accumulation. Site was not used by Historic Haida. Fauna differs greatly from that of mainland. Coll. 1967 by McMillan and C. Armstrong for G. F. MacDonald, Natl. Mus. Canada and subm. by R. Wilmeth.

GaK-1870. Honna River site, upper shell zone **3040 ± 100 1090 B.C.**

Charcoal (NMC-273) from upper zone of loose shell and mussel, depth ca. 2.5 m. Est. age: ca. 1750 yr.

GaK-1871. Honna River site, lower shell zone **3300 ± 100 1350 B.C.**

Charcoal (NMC-274) from lower shell zone at W end of profile overlying basal gravel. Est. age: ca. 2000 yr.

General Comment (G.F.M.): site was studied at suggestion of S. Brown who revealed this shell deposit on strand line of Graham I. dated ca. 8000 yr ago. Deposit represented a dump that was behind a prehistoric

village and had accumulated long after the drop in sea level that formed strand. Est. max. age for beginning of dump: 3500 yr, from position of the 2 samples.

Garden Island site series, British Columbia

Charcoal from Garden Island site (GbTo-23), Venn Passage, Prince Rupert, British Columbia (54° 19′ 5″ N Lat, 130° 23′ 15″ W Long). Shell midden covering small island (15 × 75 m) in coast Tsimpsian area. Midden averages 3 m depth. Coll. 1967 by G. F. MacDonald and subm. by R. Wilmeth.

910 ± 80

GaK-1872. Garden Island site, 47 cm **A.D. 1040**

Charcoal (NMC-275) from Sq. 2A, S 2.14 m W 2.11 m, depth 47 cm below datum. Assoc. with skeletal material and artifacts. Est. age: ca. 700 yr.

950 ± 90

GaK-1873. Garden Island site, 90 cm **A.D. 1000**

Charcoal (NMC-276) from Sq. 2A, SW corner, depth 90 cm below datum. From burnt shell hearth. Est. age: ca. 1200 yr.

1400 ± 100

GaK-1874. Garden Island site, 2.4 m **A.D. 550**

Charcoal (NMC-277) from Sq. 2A, loose mussel and clam shell immediately below Burial XVII:B-172 in E wall, depth 2.4 m below datum. Will date mass burial. Human skeletal sample will probably give physical type for area on this time level. Est. age: ca. 1900 yr.

3660 ± 110

GaK-1875. Garden Island site, 2.55 m **1710 B.C.**

Charcoal (NMC-278) from Sq. 4A3, S 2.1 m W 1.5 m, depth 2.55 m below datum. From peat layer cut by base of pit, Feature 3. Will date layer at base of midden, occupation prior to extensive use of shell fish. Est. age: ca. 2100 yr.

General Comment (G.F.M.): due to greatly accelerated accumulation rate of midden refuse, particularly shell, in upper levels acceleration curve and the maximum time depth of deposit was underestimated. The same observation applies to the other middens excavated on N coast. Three dates in the 3000 to 4000, and 2 dates in the 4000 to 5000-yr range indicate sea level has been relatively stable for the past 5000 yr on N coast as opposed to S coast, where stratified sites have accumulated only within the past 3000 yr.

Dodge Island site series, British Columbia

Charcoal from Dodge Island site (GbTo-18), Dodge I., Prince Rupert Harbour, British Columbia 54° 17′ 30″ N Lat, 130° 22′ 40″ W Long). One half of small island is covered by shell midden up to 3 m thick, underlain by thick humus containing shipped stone implements. Coll. 1967 by G. F. MacDonald and subm. by R. Wilmeth.

2000 ± 100

GaK-1876. Dodge Island site, 0.7 m **50 B.C.**

Charcoal (NMC-279) from Sq. J20, N 0, W 0.9, depth 0.7 m below datum (ca. 25 cm into black level). Will date occupation at base of midden. Est. age: 3400 to 4000 yr.

2480 ± 100

GaK-1877. Dodge Island site, 0.6 m **530 B.C.**

Charcoal (NMC-280) from Sq. J20, S 0.7, W 3.0, depth 0.6 m below datum (5 cm into top of black layer). Will date earliest occupation of site. Est. age: 3500 to 4000 yr.

2610 ± 100

GaK-1878. Dodge Island site, 2.3 m **660 B.C.**

Charcoal (NMC-282) from Sq. D6, Feature 8, rock-lined hearth in center at depth 2.3 m below datum (E6 stake). Est. age: 1500 yr.

4790 ± 100

GaK-1879. Dodge Island site, 2.8 m **2840 B.C.**

Charcoal (NMC-283) from Sq. D7, in decomposed rock, some crushed shell, and soil, depth 2.8 m below datum, floor of Feature 3. Est. age: ca. 1950 yr.

4130 ± 90

GaK-1880. Dodge Island site, 1.8 m **2180 B.C.**

Charcoal (NMC-284) from Sq. H8, Level 12 (black soil and decomposed stone), depth 1.8 m below datum. Burial and barbed point in same level adjacent to beach sand. Est. age: 2000 yr.

General Comment (G.F.M.): GaK-1876 may be contaminated by ground water saturation; this can be tested in future samples. Another explanation of more recent date than predicted may relate to a shift in settlement pattern to areas further from beach due to growth of village. The same applies to GaK-1877, from level slightly below GaK-1876. Gak-1879 was from base of cultural deposit, on top of sterile gravel. Date appears confirmed by other basal dates from British Columbian coast which suggested maximum age ca. 5000 yr for shell middens. Same comment for GaK-1880.

Nickerson Mound series, Manitoba

Wood from 3 S Manitoba mounds excavated 1913 and 1914. Samples now at Natl. Mus. of Canada, was described by Capes (1963) and assigned to Blackduck (Manitoba) focus (MacNeish, 1954) or to "closely related peoples influenced by accumulated traits that reach back to Middle Woodland times" (Capes, 1963). Suggested dates are late prehistoric and early historic. Wood assoc. with 3 of Nickerson's mounds subm. to test this conclusion. Coll. by W. B. Nickerson and subm. by R. Wilmeth.

390 ± 90

GaK-1881. Mound G **A.D. 1560**

Wood (NMC-291) from Mound G, right bank of Gainsborough Creek, Souris R. drainage, Manitoba (49° 8′ 30″ N Lat, 101° 2′ 40″ W Long). Part of decaying burial pole from base of mound, 50 cm high and 10 to 11 m diam. Untrimmed branches lay below mound. No primary interment, center disturbed. Fragment of human skull and tibia at depth 0.6 m.

850 ± 90

GaK-1882. Heath Mound **A.D. 1100**

Wood (NMC-292) from Heath Mound, right bank of Souris R., Manitoba (49° 9′ 50″ N Lat, 101° 1′ W Long). From 1.5 m NW of mound center driven into subsurface to depth 15 to 20 cm. Low broad mound 45 cm high and 12.6 to 12.8 m diam. A 4.5 m burned earth ring within mound with burned poles below, suggests a mud-plastered structure destroyed by fire; mound then built over ruin.

1330 ± 90

GaK-1883. Riverview Mound **A.D. 620**

Wood (NMC-293) from Riverview Mound, Souris R., Manitoba (49° 10′ 20″ N Lat, 101° 1′ W Long). From covering of burial pit, excavated into subsoil to depth 77 cm. Small dome-shaped mound, 75 cm high, and 12.3 to 10.5 m diam. Burial pit slightly S of center, contained 1 skeleton and parts of 2 others. Ocher-painted human bone outside pit.

General Comment (R.W.): date range indicates mounds built over longer period than originally thought. Two later dates are within Blackduck focus time range, but earliest date falls during transition from Middle to Late Woodland. In view of age of similar mounds in N and S Dakota (Neuman, 1967), S Manitoba mounds may represent cultural tradition surviving from Middle Woodland to Historic times.

Garden site series, Alaska

Charcoal from Garden site, NE shore of Healy Lake, Alaska (64° N Lat, 144° 43′ W Long). Stratified site, with historic Athabaskan material in upper levels, and below, in increasing order of age, are industries of Campus/Denali/Northwest Microblade tradition, Tuktu, and an earlier, as yet unidentified culture. Coll. 1967 by J. P. Cook, Univ. Alaska and subm. by R. Wilmeth.

1270 ± 80

GaK-1884. Garden site, red-brown stratum **A.D. 680**

Spruce charcoal (NMC-294) from Sq. S 10-15, W 20-25, in red-brown stratum. Should relate to Campus/Denali/Northwest Microblade tradition.

1260 ± 90

GaK-1885. Garden site, upper part **A.D. 690**

Spruce charcoal (NMC-295) from Sq. S 15-20, W 20-25, upper part of red-brown stratum. Should relate to later part of Camus/Denali/Northwest Microblade tradition.

General Comment (J.P.C.): dates should pertain to middle part of reddish-brown horizon of loess, *i.e.*, lower part of Level 1, slightly above "sweat-bath" features assoc. with points and microblades.

Village site series, Alaska

Charcoal from Village site, on E side Healy Lake at narrowest part (64° 1′ N Lat, 144° 44′ 50″ W Long). Stratified site, levels from top to bottom assigned respectively to historic Athabaskan, early or proto-Athabaskan, Campus/Denali/Northwest Microblade tradition, Tuktu, and an early, as yet unidentified, culture. Coll. 1967 by J. P. Cook and subm. by R. Wilmeth.

900 ± 90

GaK-1886. Village site, top of red loess **A.D. 1050**

Spruce and Birch/Alder charcoal (NMC-296) from Sq. N 15-20, E 10-15, from top of red loess, just below yellow-brown stratum, and 14 cm below datum. Should relate to early or proto-Athabaskan occupation. Est. age: within Christian era.

1360 ± 80

GaK-1887. Village site, red-brown stratum **A.D. 590**

Spruce charcoal (NMC-297) from Sq. N 25-30, W 45-50, from red-brown stratum. Should relate to later part of Campus/Denali/Northwest Microblade tradition.

General Comment (J.P.C.): dates from Level 1, internally consistent with each other and with GX-1340 (8960 ± 150) and GX-1341 (11,090 ± 170) from Levels 4 and 8, respectively.

1290 ± 80

GaK-1888. Eidlitz site, New Brunswick **A.D. 660**

Wood charcoal (NMC-298) from Eidlitz site (BgDs-4), on point locally known as Sunbury Shore, St. Andrews, New Brunswick (45° 4′ 30″ N Lat, 67° 4′ 30″ W Long). From hearth in Sq. E 16.5-17, S 0.5-1.0, depth below surface 35 to 40 cm. Site is shell midden, in ethnographic Passamaquoddy (Malecite) territory, ploughed for several yr, with disturbance of top 15 to 20 cm of deposit. Currently, 3 dates exist from St. Andrews area, all from culturally similar deposits, dated ca. A.D. 1. Ceramics and point styles from Eidlitz suggest much later occupation for which we have no dates in New Brunswick. Excavation is part of intensive program in Passamaquiddy area to continue for 2 or 3 more yr. Age of sample hard to estimate but should be ca. 1000 yr. Coll. 1967 by D. Sanger, Natl. Mus. Canada and subm. by R. Wilmeth. *Comment* (D.S.): date is a little earlier than expected on basis of artifacts recovered

in 1967. Artifacts coll. 1968 consistent with date. Site may have been occupied for some time and additional charcoal dates will be secured.

0 ± 80

GaK-1889. Sutton site, Alberta **A.D. 1950**

Charred wood (NMC-199) from Sutton site (GhPh-103), E shore of Calling Lake, SE ¼ Sec. 8, R21, T72 W4th, N Alberta (55° 15′ N Lat, 113° 15′ W Long). From Sq. IA 13, apparent hearth in top of gray silt zone. Shallow occupation extending ca. 30 cm below modern turf. Sample should date prehistoric occupation, but may be modern wood, since site area has been disturbed; this sample from coll. most likely to be reliable. Coll. 1966 by R. Gruhn, Univ. Alberta and subm. by R. Wilmeth. *Comment* (R.G.): plow marks on profiles is evidence of modern intrusion.

Montgomery Lake site series, Ontario

Charcoal from Montgomery Lake site (M5), N shore of Montgomery Lake, just E of outlet of Cartier Creek, Ontario (45° 56′ 7″ N Lat, 77° 33′ 36″ W Long). Middle Woodland site with Vinette 2 ceramics, generally lying 7.5 to 15 cm below present ground level. Red ocher-stained cremations present. Most popular ceramic decorative motif is banding, with short, closely spaced, oblique pseudo-scallop shell stamp. Coll. 1966 by B. M. Mitchell and subm. by R. Wilmeth.

2380 ± 90

GaK-1891. Montgomery Lake site, 42 to 60 cm **430 B.C.**

Charcoal (NMC-216) from Sq. 14/15, depth 42 to 60 cm, below a red-stained soil pocket 42 cm deep. Should date cremation burial in Sq. 14, accompanied by red ocher staining and grave goods. Est. age: A.D. 100.

GaK-1892. Montgomery Lake site, 38 to 43 cm **1860 ± 80 A.D. 90**

Charcoal (NMC-217) from Sq. 14, depth 38 to 43 cm, at base of red-stained soil pocket. Should date burial assoc. with GaK-1891. Est. age: A.D. 100.

General Comment (B.M.M.): dates are acceptable. An intermittent occupation by Middle Woodland groups over the date range is feasible, with at least one group practicing ochered cremations.

690 ± 80

GaK-1894. Blattner site, British Columbia **A.D. 1260**

Charcoal and charred wood (NMC-247) from Blattner site (EcQt-2) near NE corner of Otter Lake, in NW ¼ NE ¼ sec. 23, T7, R10, W6, Spallumcheen Dist., British Columbia (49° 24′ 40″ N Lat, 119° 14′ 10″ W Long). From charred and burned pole lying along N edge of House Pit 2, excavation Unit 30 N, 6 W, depth 78 cm. Stratum, Zone 2, is organically-stained deposit composing part of house pit fill. Pole remains lay along line at an old house pit wall, from ca. 29 N, 5.7 W to

edge of unit at 28.8 N, 3.5 W. Position indicates it is remnant left on cleaning house pit prior to final occupation. Site lies on terrace ca. 22 m above present level of Otter Lake. This terrace level extends E to 3rd terrace level 400 m away. Presently forested, site has 3 house pits and overlooks large but shallow open camp site on 1st terrace above lake. Finds in lower terrace indicate relative recency, but house pits may be only seasonal component of same culture, possibly Shuswap. Sample may date one of earlier house pit occupations and may be approx. terminal for deeper component lacking housepits and manifested mainly in large flake implements. Age is probably no more than 1000 yr estimated on basis of assoc. projectile points. Coll. 1967 by G. F. Grabert, Western Washington State College and subm. by R. Wilmeth. *Comment* (G.F.G.): date appears reasonable and is not at all incongruent with dates on a similar series of components from near mouth of river.

2500 ± 100

GaK-2335. Marron Valley site, British Columbia 550 B.C.

Bone (NMC-249) from Marron Valley site (DiQw-2), and old eroded terrace spur facing creek feeding into foot of Marron Lake, Similkameen Land Dist., British Columbia (49° 22′ 10″ N Lat, 119° 41′ 30″ W Long). From Excavation Unit 0 S 18 E, W half of unit, in provisional Stratum 3, a partially cemented sand, densely packed, and gray-white, containing remains of most intensive occupation zone aside from house pit. Cultural affiliation of late components probably Okanagan. Earlier components, if present, unidentified. Sample date presumed pre-house pit component. Est. age: >1500 yr. Coll. 1967 by G. F. Grabert and subm. by R. Wilmeth. *Comment* (G.F.G.): date seems reasonable; with GSC-998 (2130 ± 130) appears to bracket end of microblade techniques in N and probably S Okanagan valley.

7300 ± 150

GaK-2334. East Battle Creek site, Alberta 5350 B.C.

Charcoal (NMC-222) from E Battle Creek site (DjOm-114), N side Cypress Hills, Alberta (49° 39′ N Lat, 110° 2′ W Long). From lowest exposed cultural level at stream level, 4.5 m below ground surface. Stratified site exposed by flood. Soil horizon dated at 1 m below surface, with sequence of cultural levels below. Charcoal, bones (mostly bison), scrapers, and flakes occur in all cultural horizons, but diagnostic (notched) projectile points found only ca. 2 m below surface. Coll. by W. J. Elliott and subm. for A. L. Bryan, Univ. Alberta by R. Wilmeth. *Comment* (A.L.B.): scattered concentrations of occupational debris were periodically flooded by shallow stream depositing silty clay. Unexcavated earliest occupation is well below stream level, but rapid rate of accumulation (3.5 m in ca. 1 millennium) and difficult excavating make further work unfeasible. Despite low artifact yield, because it is the only known clearly stratified site, it will be key site for establishing a stratigraphic sequence for Cypress Hills.

22,700 ± 1000

GaK-2336. Eagle Cave, Alberta **20,750 B.C.**

Bone (NMC-253) from Eagle Cave, N side of Crowsnest Lake, Alberta (49° 37′ N Lat, 114° 38′ W Long). From Sq. 8W, brown cave-earth bed, depth 110 to 210 cm below surface. Solution cavern with stratified deposits ca. 90 m above lake, near Continental Divide. Dates bone deposit underlying glacial outwash gravels. Est. age: 25,000 B.C. Coll. 1967 by A. L. Bryan and subm. by R. Wilmeth. *Comments* A.L.B.): places deposition of bone bed prior to Late Wisconsin and shows that Crowsnest Pass was covered with ice >90 m deep some time during Late Wisconsin. No evidence of previous glaciation. (K.K.): dated on collagen.

620 ± 70

GaK-2337. Hughes site, Northwest Territories **A.D. 1330**

Charcoal (NMC-260) from Hughes site (JcRw-13) NW end of Fisherman Lake on 60 m terrace, N.W.T. (60° 22′ N Lat, 123° 50′ W Long). From Sq. 18, at base of late proglacial lake silt and on earlier verved lake clays. Single component site, with occupation at base of late proglacial lake silt. Should date latter part of time between early and late proglacial lake silt. Est. age: 1000 to 1400 yr. Coll. 1967 by J. F. V. Millar, Univ. Saskatchewan and subm. by R. Wilmeth. *Comment* (J.F.V.M.): sample from same undisturbed geologic horizon as one, previously dated at 5000 yr B.P., ca. 1 to 0.5 m away. Recent date suggests forest fire apparent at surface and dated charcoal fragments to be burned roots.

GaK-2338. Central Klondike site, Northwest Territories **3740 ± 110 / 1790 B.C.**

Charcoal (NMC-261) from Central Klondike site (JcRw-3B), NW end of Fisherman Lake, N.W.T. (60° 22′ N Lat, 123° 50′ W Long), from Sq. 40, H Horizon, from clayey loam 3 cm below heavy bone concentration in hearth. Central sec. of site has series of components with Plano assocs. overlying early Cordilleran component. Sample should date Horizon H in sequence. Est. age: 8000 to 9000 yr. Coll. 1966 by J. F. V. Millar and subm. by R. Wilmeth. *Comment* (J.F.V.M.): equivalent to Horizon H in adjoining part of site and some 7 m NW dated at 8720 ± 190. Sample from shallow water-soaked sec., which, although eroded, had clear stratigraphy. Data is incompatible with other dates at site or with comparable material elsewhere.

770 ± 80

GaK-2341. Shethanei Narrows site, Manitoba **A.D. 1180**

Charcoal (NMC-299) from shethanei Narrow site, at tip of esker on N side of narrows, N Manitoba (58° 48′ N Lat, 97° 45′ W Long). From Level 2, Pit 137E, 2N. Thin occupation layer with medium-sized stemmed, notched and triangular points. Few historic items mixed with upper prehistoric artifacts, suggesting late prehistoric occupation. Sample will date

assoc. stemmed point. Est. age: A.D. 1300. Coll. 1967 by R. J. Nash, Univ. Manitoba and subm. by R. Wilmeth. *Comment* (R.J.N.): this date and I-4149, 220 ± 95, from another part of site indicate materials are probably all late whether or not >1 component is involved. Materials are not easily equated with other late complexes in transitional forest which might also relate to Chipewyan.

GaK-2342. Egnolf Lake site, Manitoba **460 ± 80** **A.D. 1490**

Charcoal (NMC-300) from Egnolf Lake site, on spur of esker on NE shore of lake, N Manitoba (59° 3′ N Lat, 99° 52′ W Long). From occupation layer of Pit 9. Site consists of deeply-buried occupation layer with several hearths and considerable bone and scrapers. Although not *in situ*, a small side-notched point probably assoc. Sample will date site and side-notched point. Complex may be related to historic Chipewyan of area. Est. age: A.D. 1000. Coll. 1967 by R. J. Nash and subm. by R. Wilmeth. *Comment* (R.J.N.): seems somewhat late in view of 25 to 50 cm sand overlying occupation layer, but compatible with small side-notched point. Artifacts contribute to heterogeneity of late transitional forest occupations perhaps attributable to Chipewyan. Heterogeneity may be result of seasonal, functional, or historical factors.

GaK-2344. Sandgirt Lake Lodge site, Newfoundland **940 ± 70** **A.D. 1010**

Cracked caribou long bone (NMC-329) from Sandgirt Lake to small bay separated from lake by esker, at 455 to 456 m elev., Newfoundland (53° 54′ 15″ N Lat, 65° 18′ 45″ W Long). Bones dredged from muck along shore on N side of channel, assoc. with stone artifacts and seemingly connected with older, submerged beach. Site small temporary camp probably used at various times of year, at intersection of several major prehistoric canoe routes through central Labrador. Population probably prehistoric Montagnais-Naskapi. Lithic assemblage falls loosely into Shield Archaic. Sample will help date later phases of Shield Archaic and help interpret coastal-interior relations based on comparisons with material from Northwest R. Est. age: not >1000 or <500 yr. Coll. 1967 and 1968 by D. MacLeod, Natl. Mus. Canada and subm. by R. Wilmeth. *Comments* (D.M.): only radiocarbon-dated archaeologic site in Labrador interior, although lithic similarities almost certainly place at least 2 sites in region in same range. Date as estimated; older end of scale supports submerged beach hypothesis, involving temperature changes and precipitation since ca. A.D. 1000. Artifacts, though few are most, so far, from upper Churchill R. drainage, and with geographic features make FlDh-1 a "type site." But resemblances to both Wright's Shield Archaic and Fitzhugh's Northwest River assemblages are general and generic rather than specific. Material may very well pertain to prehistoric Montagnais/Naskapi, however. Location of finds at water's edge, and high

percentage of caribou bone (almost 100%) suggest use during summer and fall, at least for this part of site. (K.K.): dated on collagen.

810 ± 100

GaK-2747. Chesterfield, N.W.T. **A.D. 1140**

Wood (NMC-336) from 400 m E of Chesterfield (Igluligardjuk) KiJi-3, near crest of long slope to beach of Bay (63° 20′ N Lat, 90° 40′ W Long). From only house excavated in 1968, Sec. F of archaeologic plan diagram, near juncture of floor and lower wall foundation. Site from Thule period, with ca. 18 winter or autumn house depressions in a cluster near top of gentle slope. Sample should date house occupation. Probably, a one component site. Est. age: A.D. 1000 to 1600. Coll. 1968 by A. P. McCartney and subm. by R. Wilmeth. *Comment* (A.P.McC.): fits well with Thule occupation and dates house before historic period of 17th century. Close proximity and similar construction of adjacent houses, applies date to most if not all semi-subterranean houses at site. Site contemporaneous with Kamarvik and Silumiut.

820 ± 100

GaK-2748. Kamarvik site, N.W.T. **A.D. 1130**

Wood (NMC-338) from Kamarvik site (LeHv-1) over most of point of land on coast of Bay; 3 permanent house clusters occur, each ca. 800 m apart (64° 45′ N Lat, 87° 19′ W Long). Sample from "bone" house, S-most of clusters ca. 800 m from coast, in fan-shaped midden in front of entrance passage 25 cm below present surface. Site believed to be one component, of Thule period. Six large house depressions with bone detritus (whale) in most, occur within ca. 1-block area. Should date houses and some assoc. burials. Est. age: A.D. 1000 to 1600. Coll. by A. P. McCartney, 1968 and subm. by R. Wilmeth. *Comment* (A.P.McC.): date fits well with Thule occupation and 6 houses date about same. Site contemporaneous with those of Igluligardjuk and Silumiut. Other 2 house clusters are Thule features.

Cadboro Bay site series, British Columbia

Charcoal from Cadboro Bay site (DcRt-15), E of Gyro Park, Lot 6, Sec. 44, Saanich Municipality, Vancouver I., British Columbia (48° 27′ 35″ N Lat, 123° 16′ 25″ W Long). Shell midden ca. 600 × 21 m, eroded at seaward edge, clearly stratified, with 2 distinct artifact assemblages relating to Marpole and Early Developed Coast Salish. Artifact attributes from extreme lower levels suggest presence of Locarno Beach phase. Coll. 1966 by Susan Douglass, Prov. Mus. British Columbia and subm. by R. Wilmeth.

0 ± 80

GaK-2750. Cadboro Bay site, C-1 **A.D. 1950**

Charcoal (NMC-343) from base of hearth area at N 0 to 10 cm, E 12.8 to 12.9 m ca. 115 cm depth from Datum A, 90 cm depth from surface. From lowest level relating to Early Developed Coast Salish,

which will provide time sequence of cultural change, and estimate age of cairn burials, directly assoc. Est. age: more recent than A.D. 1300.

1810 ± 90

GaK-2751. Cadboro Bay site, C-2 **A.D. 140**

Charcoal (NMC-344) from basal black stratum at N 88 to 112 cm, E 147 to 172 cm ca. 133 cm deep from Datum A and 105 cm from surface. Closely assoc. to microblades, steatite carspool fragments, and rough chipped slate artifacts, which usually identify a Locarno Beach component. Early date will verify. Est. age: 1000 B.C.

General Comment (D. N. Abbott, Prov. Mus. British Columbia): both dates conform excellently with others for similar components in region.

Tolan's Property site series, British Columbia

Charcoal from Tolan's Property site (DfRu-24), Lot 2, Georgeson Bay, NW side of Active Pass, Galiano I., British Columbia (48° 51′ 55″ N Lat, 123° 20′ 55″ W Long). Shell midden ca. 200 m × 120 m. Earliest levels at 6 m depth, below present high tide. Artifacts relate to Locarno Beach and Montague Harbor I phases in lower levels; upper levels relate to Late Developed Coast Salish. Coll. 1968 by S. Douglass and subm. by R. Wilmeth.

750 ± 90

GaK-2752. Tolan's Property site, C-1 **A.D. 1200**

Charcoal (NMC-345) from matrix of black soil and fine broken shell N 0.20 to 0.30 m, E 0 to 0.03 m, ca. 190 to 196 cm deep from Datum A, 121 to 127 cm from surface. Sample from upper levels; estimates time period for Early Developed Coast Salish. Est. age A.D. 500.

2820 ± 100

GaK-2753. Tolan's Property site, C-3 **870 B.C.**

Charcoal (NMC-346) from black soil, sand and pea gravel, N 0.26 to 0.36 m, E 0.44 to 0.52 m, ca. 318 cm from Datum A, 232 to 234 cm from surface. Closely assoc. with similar artifacts from lower levels of Montague Harbor Site DrRu-13. Date may estimate time sequence of these stone artifacts and elucidate Locarno phase in Gulf region. Est. age: 1000 to 1500 B.C.

General Comment (D.N.A.): absurd date for GaK-2750 is unexplainable, which should have been a good sample from undisturbed hearth. Date for GaK-2751 should be confirmed. If correct, it will settle doubts as to whether or not it represents *a priori* "Locarno"-related occupation separate from main "Marpole"-related component overlying it. Date suggests a rather late "Marpole" period and that DcRt-15 is a 2 rather than 3-component site. Suspicious artifact forms are found in both contexts although perhaps more typical of earlier.

1670 ± 90

GaK-2754. False Narrows site, B.C. **A.D. 280**

Charcoal (NMC-347) from False Narrows site (DgRw-4), False Narrows, Santa Bay Beach sub-division, Lot 21, Gabriola I., British Columbia (49° 9′ 25″ N Lat, 123° 46′ 50″ W Long). From matrix of dark brown beach sand and pea gravel, N 11.70 to 12.20 m, E 5.00 m, ca. 142 to 150 cm depth from Datum D, 136 to 144 cm from surface. Site is shell midden ca. 2 km long, on flats above high tide water mark. Marpole and Developed Coast Salish Phases are apparent. Cairn burials relate to Developed Coast Salish but artifacts show transition between the 2 phases. Sample, from Tc-6, should date component of Marpole phase. Est. age: 200 B.C. Coll. by J. Sendey and subm. by R. Wilmeth. *Comment* (D.N.A.): date confirms theory of very close relationship between "Marpole" component of DgRw-4 and that at DgRs-1 (Beach Grove) based on burial practices, grave goods, and some similar artifact forms. Latter site yielded similar late dates for basically "Marpole" assemblage.

Grant Anchorage site series, British Columbia

Charcoal from Grant Anchorage site (FcTc-4), Giggins Passage, S end of Swindle I., Laredo Sound, British Columbia (52° 29′ N Lat, 128° 45′ W Long). Large shell midden (village site). Historically, territory of "Kitasu" (S Tsimshian). Coll. 1969 by B. Simonsen and subm. by R. Wilmeth.

2110 ± 110

GaK-2755. Grant Anchorage, Sec. A, I-A **160 B.C.**

Charcoal (NMC-361) from Sec. A, Unit I-A, S 56 m, E 2.12 m, below Datum I-A, 1.53 m, from charred wood feature near base of deposit.

480 ± 90

GaK-2756. Grant Anchorage, Sec. A, I-C **A.D. 1470**

Charcoal (NMC-362) from Sec. A, Unit I-C, S 1.15 m, E 1.30 m, below Datum I-C, 0.18 to 0.20 m. Represents historic and proto-historic deposits of site. But sample may not correlate with this latest occupation.

2090 ± 100

GaK-2757. Grant Anchorage, Sec. A, I-C **140 B.C.**

Charcoal (NMC-363) from Sec. A, Unit I-C, S 1.50 m, E W wall to 0.40 E (m), below Datum I-C, 1.59 m. Taken from charred "wooden dish" feature at point which also represents approx. middle of cultural deposits.

GaK-2758. Grant Anchorage, Sec. B, Test Trench B **3480 ± 140** **1530 B.C.**

Charcoal (NMC-365) from Sec. B, Unit test Trench B, S 1.47 m, E 1.33 m, below Datum T.T.-B, 1.51 m. Represents end of cultural

deposits overlying sterile gravel in Sec. B, which appears to be earlier component than that found at comparative depth, Sec. A.

General Comment (B.S.): dates seem acceptable. No estimate was made originally because of lack of comparative material from central coast and difficulties in matching sequence with others farther away, such as Fraser Valley or Prince Rupert Harbour sequence developed by C. E. Borden and G. F. MacDonald.

Silumiut site series, Northwest Territories

Wood from Silumiut site (KkJg-1) Keewatin Dist., N.W.T. (63° 41′ N Lat, 90° 5′ W Long), from island just off coast, ca. 4.8 km NE of village of Chesterfield. Near center of island on highest hill (ca. +3.1 m) are 28 winter house depressions ca. 400 to 800 m from surrounding coasts. Site is Thule-age occupation with 186 burial cairns, many meat caches, tent rings, etc. Coll. 1968 by A. P. McCartney and subm. by R. Wilmeth.

810 ± 70

GaK-2749. Silumiut site, cairn burial A.D. 1140

Wood (NMC-341) from cairn burial support (Sil-156), uncovered and exposed within rock cairn. Should date burial cairn construction. Est. age: A.D. 1300 to 1600.

690 ± 90

GaK-2759. Silumiut site, House 3, Unit E A.D. 1260

Wood (NMC-369) from House 3, excavation Unit E (mapped as Sample H), from floor gravel (20 cm from W sec. line 70 cm from W sec. line 70 cm from S sec. line); ca. 70 cm below ground surface on house floor. Will date occupation of House 3 and possibly other adjacent houses. Est. age: A.D. 1000 to 1700.

General Comment (A.P.McC): NMC-341: date can be accepted tentatively although lack of grave material does not permit check of age. According to C. F. Merbs, burial should be early (Thule-age) based on skeletal decomposition relative to slightly acid (pH 6.0) bed-rock floor and extensive lichen cover of cairn. Large bone toggle harpoon head found inside burial is not Thule in style and has 2 steel-drilled holes typical of historic harpoons, but, because it is well-preserved and above the lower skeletal elements, we presume this is a later historic intrusion and is not contemporaneous with the skeleton. Some of the Silumiut burials are historic as suggested by European items of manufacture and others might fall between historic and Thule periods spanning ca. 500 to 700 yr. NMC-369: date range overlaps those for Kamarvik and Igluligardjuk but is slightly more recent. Sample is thought to date Houses 3-6 but its application to the other deeper houses cannot be determined. Actual occupation date should fall toward earlier end of range given.

B. Japan

Nakada series, Hachioji

Carbonized wood from Nakada site, Hachioji City, Tokyo (35° 40′ N Lat, 139° 20′ E Long). Coll. and subm. 1967 by I. Kono, Hachioji City Bd. Educ.

GaK-1463. Nakada, B-5Y — **1230 ± 60** / **A.D. 720**

From house pit, B-5Y, 70 cm below ground surface.

GaK-1464. Nakada, C-7H — **1700 ± 100** / **A.D. 250**

From C-7H, 80 cm below ground surface.

GaK-1465. Nakada, B-12H — **1770 ± 80** / **A.D. 180**

From B-12H, 100 cm below ground surface.

GaK-1466. Nakada, D-20H — **790 ± 60** / **A.D. 1160**

From D-20H, 60 cm below ground surface.

Hoshino series, Tochigi Prefecture

Wood from Hoshino-machi, Yamaguchi, Tochigi Pref. (36° 27′ N Lat, 139° 39′ E Long). Coll. and subm. 1967 by C. Serizawa, Tohoku Univ. Serizawa (1966) described site in detail.

GaK-1246. Hoshino, 1 — **16,200 ± 400** / **14,250 B.C.**

From Layer 6, 10.5 m below surface. Assoc. with quartz and flint artifacts, overlain by disturbed Moka pumice.

GaK-1353. Hoshino, 2 — **19,100 ± 400** / **17,150 B.C.**

From same cultural level as GaK-1246.

GaK-1581. Kushiro Kaizuka — **7130 ± 120** / **5180 B.C.**

Wood charcoal from Higashi Kaizuka site, Kaizuka-cachi, Kushiro City, Hokkaido (42° 59′ 30″ N Lat, 144° 25′ 0″ E Long), 1.2 to 1.4 m below surface, assoc. with Early Jomon potsherds. Coll. 1967 by S. Sawa and subm. by Y. Okazaki, Hokkaido Univ. Educ. *Comment* (Y.O.): assoc. culture stratigraphically older than Numajiri type culture.

C. Israel

Khirbet et-Tell series

Charcoal from stratified layers on ruins of Khirbet et-Tell near Deir Dibwan, Israel (31° 55′ N Lat, 35° 16′ W Long). All samples from destruction debris on crushed soft chalky limestone surface, and covered by at least 1 m of earth. Coll. 1969 and subm. by J. A. Callaway, Southern Baptist Theological Seminary, Louisville.

4980 ± 120

GaK-2379. Khirbet et-Tell, D IV **3030 B.C.**

From Site D, Area IV, Sub-area 300, Layer 5. Wood charcoal from destruction of Early Bronze Age I building.

4160 ± 120

GaK-2380. Khirbet et-Tell, C IX **2210 B.C.**

From Site C, Area IX, Sub-area 800, Layer 10. Wood charcoal from destruction of Early Bronze Age II building.

5000 ± 120

GaK-2381. Khirbet et-Tell, C I **3050 B.C.**

From Site C, Area I, Sub-area 1, Layer 28b. Charred seeds from destruction of Early Bronze Age II building.

4840 ± 130

GaK-2382. Khirbet et-Tell, A III **2890 B.C.**

From Site A, Area III, Sub-area 201, Layer 4a. Charred wood from destruction of Early Bronze Age II building.

General Comment (J.A.C.): site was built into a city in Early Bronze Age I, during First Dynasty of Egypt and abandoned in Early Bronze III, probably about end of Fifth Dynasty in Egypt. GaK-2380 seems somewhat wrong, because it is stratigraphically contemporary with GaK-2382. Error may be in sampling or improper storage prior to assay. GaK-2379, GaK-2381, and GaK-2382 agree generally with chronology determined by pottery, objects, and correlations with Old Kingdom in Egypt.

D. Scotland

4070 ± 100

GaK-1714. Rothesay **2120 B.C.**

Charcoal from Neolithic settlement site at Townhead, Rothesay, Isle of Bute (55° 49′ N Lat, 5° 3′ W Long), discovered after removal of ca. 1 m topsoil and gravel, assoc. with hazel nut shells, fragments of bone, and Neolithic potsherds. Coll. ca. 1919 by L. M. Mann and subm. by J. G. Scott, Glasgow Mus. and Art Galleries. *Comment* (J.G.S.): age as expected.

Dun Mor Vaul series, Tiree Island

Samples from Dun Mor Vaul, Iron age dry-stone fort at Tiree I., Argyllshire (56° 32′ 50″ N Lat, 6° 48′ 12″ W Long). Coll. and subm. 1967 by E. W. MacKie, Hunterian Mus.

1460 ± 200

GaK-1520. Dun Mor Vaul, 1 **A.D. 490**

Jaw bone from N occupation Layer 2, immediately below Norse composite bone comb, in sticky brown earth under dry rubble Layer 1 in wall gallery. *Comments* (E.W.M.): jaw bone seems likely raw material for a composite bone comb and is probably of same age. (K.K.):

polyvinyl acetate coating was removed mechanically and dated on collagen.

2240 ± 80

GaK-1521. Dun Mor Vaul, 2 **290 B.C.**

Charcoal from Layer 1, Phase IV. *Comment* (E.W.M.): outer court filled with wind-blown earth, probably starting in Phase IIIB when drystone fort (broch) was converted to a dwelling. Date should be near end of use of site as farmstead.

REFERENCES

Capes, K. H., 1963, The W. B. Nickerson survey and excavations, 1912-1915, of the southern Manitoba mounds region: Natl. Mus. of Canada, Anthropol. Papers no. 4, p. 1-178.

Crane, H. R. and Griffin, J. B., 1966, University of Michigan radiocarbon dates XI: Radiocarbon, v. 8, p. 256-285.

Koriyama Research Group, 1966, ^{14}C age of Quaternary deposit in Japan IX: Chikyu Kagaku, v. 84, p. 37.

MacNeish, R. S., 1951, An archaeological reconnaissance in the Northwest Territories: Natl. Mus. of Canada, Bull. 123, p. 24-41.

———— 1954, The Stott mound and village, near Brandon, Manitoba; Natl. Mus. of Canada, Bull. 132, p. 20-65.

Merrilees, D., 1970, Two new fossil finds representing the large extinct diprotodontid marsupial Zygomaturus: West Aust. Nat., v. 11, p. 111-113.

Neuman, R. W., 1967, Radiocarbon dated archaeological remains on the northern and central Great Plains: Am. Antiquity, v. 32, no. 4, p. 471-486.

Serizawa, C., 1966, Hoshino site excavations report: Tokyo, New Science, 79 p.

Stuckenrath, R., Jr., Coe, W. R., and Ralph, E. K., 1966, University of Pennsylvania radiocarbon dates IX: Radiocarbon, v. 8, p. 348-385.

Wright, J. V., 1968, Cree culture history in the Southern Indian Lake region: Natl. Mus. of Canada Bull. 232, Contributions to Anthropology VII, Archaeol. Paper no. 1, p. 1-31.

[RADIOCARBON, VOL. 15, NO. 1, 1973, P. 68-74]

HAWAII INSTITUTE OF GEOPHYSICS RADIOCARBON DATES I

R. W. BUDDEMEIER* and T. H. HUFEN**

INTRODUCTION

The radiocarbon dating laboratory of the University of Hawaii was established with joint support of the Hawaii Institute of Geophysics, the Water Resources Research Center, the Department of Chemistry, and the Graduate Division. The laboratory is located in the Hawaii Institute of Geophysics, on the ground floor of a four-story concrete building, and contains two separate radiocarbon counting systems.

1. Gas proportional counter

The sample counter has a volume of ca. 850 cc, is built from a silvered quartz tube with nylon end-plugs and a 0.05 mm stainless steel anode wire. The guard counter is an annular, 9-wire, gas-proportional counter with plexiglas end-pieces and an aluminized plexiglas wall. Counting array is surrounded by, in order, one cm stainless steel, 3 cm Hg, one cm stainless steel, and 15 cm old iron (the breech section of an 8-in. 1945 howitzer).

The sample is converted to methane (Buddemeier *et al.*, 1970). Sample pressure is controlled by reference to a modified Wallace and Tiernan pressure gauge (Model 62A-2B-0120). The guard counter is filled with tank methane at the same pressure as the sample; to date, all determinations have been at a pressure of 2 atm, absolute.

A Power Designs 1556A HV power supply provides a negative 4660 v to the walls of both counters; this operates both sample and guard counters on their proportional plateaus. Charge-sensitive preamplifiers transmit the pulses to a Smith-Root Model 200 4-channel anticoincidence scaling unit. Channels monitored are: I) net sample above the upper discriminator; II) net sample between upper and lower discriminator; III) gross sample above lower discriminator; and IV) guard. Discriminators are adjusted empirically for optimum standard/background ratio; Channel II provides the sample count, Channel I monitors radon contamination, and the difference between Channel III and the sum of I and II represents the sum of cosmic ray count rate plus background; the relative constancy of this rate provides a simple check on the counting characteristics of the sample gas. Channel II triggers a Simplex printing time clock every 100 counts; Chauvenet's criterion for rejection of statistical data is applied to the resulting printout before final calculation.

Samples are measured in 2 one-day counts, at least one week apart. If the 2 counts differ by >1 standard deviation, the sample is counted a 3rd time. A normal counting sequence consists of an 8-day cycle containing 1 background, 3 samples, 1 NBS oxalic acid standard, and 3

* Hawaii Institute of Geophysics and Department of Chemistry
** Water Resources Research Center

more samples. Background samples are prepared by dry combustion of coal. All samples are aged at least 2 weeks to eliminate radon contamination.

For geophysical samples, δC^{14} values are reported; dates are based on the 5568 yr half-life. All values are reported with an error of one standard deviation, including the statistical uncertainty in the observed counting rate of the unknown and the uncertainty in the background and standard counting rates. For the samples cited below, the average of 11 background determinations was 1.96 ± 0.05 cpm and the average value of 95% of net NBS oxalic acid activity, based on 13 measurements, was 8.04 ± 0.10 cpm. In both cases, individual counts were distributed statistically around the mean, and 4-sample running averages revealed no significant trends.

Almost complete is a 2nd counter, similar to the 1st but with .025 mm anodes and a 10 kv power supply to permit measurements at higher pressures. Under development is a stable isotope laboratory which will permit determinations of δC^{13}.

2. Liquid scintillation counter

Since 1967, the Water Resources Research Center has used a Beckman LS-100 liquid scintillation counter to monitor "bomb" tritium and radiocarbon in Hawaiian natural waters. The instrument and procedures have been modified to a dating level. Variable discriminators, a variable high voltage control, and 5 cm of lead shielding above the counting chamber were added. Benzene is synthesized from sample CO_2 by the method of Noakes *et al.* (1965) and is counted in shortened Beckman low-background glass counting vials. Samples are diluted to a total net weight of 6.000 g with reagent grade benzene, also serving as background benzene.

Counting vials show slight variations in inherent background levels; relative values of these vials have been well established. A normal radiocarbon count consists of 2 backgrounds, 2 NBS oxalic standards, one "hot" efficiency check standard, and 6 samples, all cycled at 50 min. intervals for at least a week. Background values are determined by multiplying the background monitor samples by the appropriate vial ratios. Except for long-term accumulation of these ratios, each counting cycle is a self-contained set of determinations, permitting alternation of radiocarbon and tritium determinations without extensive recalibration.

Discriminator and voltage settings were selected for maximum stability of radiocarbon count rate with respect to system variations (Polach, 1969). Typically, values for 95% of net NBS oxalic acid activity are ca. 7.65 cpm/g carbon and for background, ca. 6.30 cpm for a 6 g blank. Standard deviations of all activities are estimated by counting statistics and by calculating standard deviations of the average of separate count intervals; the larger value is used for ($\pm 1\sigma$) uncertainties.

Unless stated otherwise, ground water activities were determined

on the liquid scintillation counter; other activities with the gas proportional counter.

ACKNOWLEDGMENTS

We gratefully acknowledge the invaluable advice of A. W. Young, University of Washington and H. A. Polach, Australian National University, on equipment design and laboratory procedures. A. Puccetti, A. Barres, and C. Hosokawa assisted in sample preparation. The support and encouragement of G. P. Woollard, L. S. Lau, K. E. Chave, R. G. Inskeep and R. L. Pecsok made development of the laboratory possible. This date list is the Hawaii Institute of Geophysics Contribution No. 446, Water Resources Research Center Cooperative Contribution No. 3.

SAMPLE DESCRIPTIONS

I. CORALS AND CORALLINE ALGAE

Samples are analyzed by x-ray diffraction; contents of > a few % calcite are noted. Samples are prepared by adding 3 N HCl to coral chips in a system purged with CO_2-free tank N_2. CO_2 is trapped with liquid nitrogen; if size permits, the 1st 10 to 15% of the gas evolved is discarded to reduce possible surface contamination. Since pre-bomb zero age of ocean surface water is approx. zero without δC^{13} correction and since coral carbonate is close to isotopic equilibrium with the water, uncorrected ages are reported for species grown at or near sea level; δC^{14} (‰) values are reported for all samples.

Interlaboratory check sample

14,045 ± 335

HIG-1. Great Barrier Reef, Australia **12,095 B.C.**

$\delta C^{14} = -826 \pm 7$‰

Specimen dated by Isotopes, Inc. at 13,600 ± 200; subm. by H. H. Veeh, described by Veeh and Veevers (1970). *Comment*: agreement is adequate; U-Th age of 17,000 ± 1000 yr has been reported.

Eniwetok series

Samples are from 3 sites: reef flat (11° 25′ 59″ N Lat, 162° 23′ 30″ E Long); algal ridge (11° 25′ 5″ N Lat, 162° 23′ 41″ E Long) and groove and spur system on reef front (11° 25′ 29″ N Lat, 162° 23′ 45″ E Long), Eniwetok Atoll, Marshall Is. Sites lie on a transect running WNW to ESE and centered ca. 1 km NE of Muti I. All samples coll., id. and subm. May-June 1971 by S. V. Smith and R. A. Kinzie, Univ. Hawaii.

4420 ± 140

HIG-2. Algal ridge-1 **2470 B.C.**

$\delta C^{14} = -423 + 10$‰

Large coral head cemented in matrix of algal-coral rubble limestone. Base of coral ca. 50 cm below surface of algal ridge pavement; surface approx. at present MSL. *Comment*: age should be of cementation of algal ridge pavement.

HIG-3. Reef flat-1 **4980 ± 150**
3030 B.C.
$\delta C^{14} = -462 \pm 10‰$

Base of coral head (*Acropora*) cemented into reef flat pavement by *Halimeda* sandstone. Ca. 1 m below present MSL. *Comment*: dates deposition, maximum age of cementation of reef flat pavement.

HIG-4. Reef flat-2 **3960 ± 135**
2010 B.C.
$\delta C^{14} = -389 \pm 10‰$

Flakes of loosely to moderately cemented *Halimeda* separated from a chunk of reef flat pavement, from 5 to 7 cm below pavement surface; ca. −1 m. *Comment* (S.V.S.): appears shallow and relatively unaltered; may date most recent marine cementation on reef flat.

HIG-5. Groove and spur-1 **345 ± 100**
A.D. 1605
$\delta C^{14} = -42 \pm 12‰$

Piece of coral rubble 2 to 13 cm below surface of large piece of limestone blasted from side of spur, at −2 to 3 m. Matrix above and beside sample consists of encrusting coralline algae; coral-algal rubble is below. *Comment* (S.V.S.): age suggests latest portion of spur and groove system history is constructional or combined constructional-erosional.

HIG-6. Groove and spur-2 **170 ± 100**
A.D. 1780
$\delta C^{14} = -21 \pm 12‰$

Coralline algal layer ca. 6 cm below HIG-5. *Comment*: age agrees with HIG-5 and supports comment.

Glover's Reef, British Honduras

HIG-7. Glover's Reef-1 **1945 ± 115**
A.D. 5
$\delta C^{14} = -215 \pm 11‰$

Coral (*Diploria strigosa*) from Glover's Reef, British Honduras (11° 28′ N Lat, 87° 27′ W Long), embedded in sandy phosphate rock ca. 30 cm below surface and ca. 1.6 m above present MSL. Coll. and subm. 1971 by K. E. Chave, Univ. Hawaii; id. by K.E.C. and F. R. Fosberg, Smithsonian Inst. *Comment* (K.E.C.): suggests date of deposition of phosphate rock on a coral atoll presently with neither birds nor roosting sites.

Deep-water coral series

To determine whether to use either "bomb" C^{14} or conventional radiocarbon dating to study growth rates and carbon sources of Hawaiian pink corals, samples of *Corallium secundum* were dredged from a coral bed ca. 8 km E of Makapuu Pt., Oahu (21° 12′ N Lat, 157° 32′ W Long), from depth 400 m. Samples were alive, and grew on a carbonate surface

swept by rapid bottom currents. Coll., id., and subm. by R. W. Grigg, Univ. Hawaii.

HIG-8. Pink coral-1 $\delta C^{14} = -42 \pm 15‰$

Tips of branches coll. August, 1970, and estimated to be 2 yr old. Diluted to 82.0% sample.

HIG-9. Pink coral-2 $\delta C^{14} = -55 \pm 12‰$

Material drilled from centers of 3 large coral trunks coll. 1968 and 1969. Diam. from 2.4 to 3.5 cm; inner 1 cm sampled from each and drillings combined.

General Comment: difference of activity is questionable, but if so, it is expected as a result of bomb C^{14} penetration into the intermediate water layer. Both activities are lower than expected from the water profile given below, which suggests that either the coral's source of skeletal carbon or its immediate environment is different from that assumed. Investigations are continuing.

II. OCEAN WATER

Station Gollum is in 4760 m of water 47 km N of Oahu (22° 10′ N Lat, 150° 00′ W Long), a site of various geochemical and oceanographic studies since 1969 (Gordon, 1970). C^{14} profiles were taken several times a year to observe rate of penetration of excess C^{14} into the intermediate water; the profile below was measured first for comparison with the deep water coral results given above. Samples were taken with a 60 L water sampler (Young *et al.*, 1969), aliquots analyzed for total CO_2 and salinity, and CO_2 stripped out as described by Fairhall *et al.* (1971).

TABLE 1

Sample no.	Date	Depth	δC^{14}(‰)
HIG-10	1 Apr. 70	Surface	+276 ± 15
HIG-11	"	300 m	+ 92 ± 13
HIG-12	"	500 m	− 49 ± 10
HIG-13	"	800 m	− 87 ± 12
HIG-14	"	1500 m	−123 ± 12

III. VOLCANIC ENVIRONMENTS

Kilauea Ohia series

These samples are initial results from a long-term study designed to use magmatic (dead) CO_2 as a tracer for volcanic product distribution (Chatters *et al.*, 1969) and to estimate total volcanic emission on the basis of CO_2 dilution contours. Samples coll. on a grid around Kilauea volcano on Hawaii I., and, unless otherwise specified, are of recent growth shoots of ubiquitous *Metrosideros* tree. Samples <3 mos old (Lamoreaux and Porter, 1971, Dept. Botany, Univ. Hawaii, *oral commun.*).

HIG-15. Kilauea I-8a $\delta C^{14} = -7 \pm 13‰$

Coll. 13 April 1971 in Sulfur Banks area of Volcano Natl. Park (19° 26′ 2″ N Lat, 155° 15′ 51″ W Long). Trees were on a bank above and ca. 3 m downwind of an active fumarole. Moderate to heavy vegetation, noticeable warmth and moisture and some vegetation damage from fumarolic gases. Alt. 2600 m.

HIG-16. Kilauea I-11 $\delta C^{14} = +462 \pm 16‰$

Coll. 14 April 1971 on Mauna Loa Summit trail NW of Kilauea (19° 30′ N Lat, 155° 25′ W Long). Area sparsely wooded, dry. Alt. 4100 m.

General Comment: HIG-16 should be relatively free of volcanic effects, but is at alt. of trade-wind inversion and may not fully represent unperturbed conditions at alt. of volcano. HIG-15 is depleted ca. 32% relative to HIG-16, suggesting an equivalent apparent age of ca. 3000 yr under pre-bomb conditions.

IV. HAWAIIAN GROUND WATER

Well, shaft, and spring water samples are regularly analyzed for radiocarbon, tritium, and chemical content for both geochemical research and water resource evaluation. These samples are from tunnels or shafts in the Koolau range on Oahu I. The geologic environment is almost exclusively basaltic, and heavily compartmented by dikes. Ground surfaces have abundant vegetation and virtually no human modification. The area receives large amounts of rain and is one of the major recharge area for Oahu's ground water. In Table 2, H is the approx. vertical distance between the tunnel and the overlying surface. Coll. by T. H. Hufen.

TABLE 2

Sample no.	Tunnel	Date	$H_{(m)}$	$\delta C^{14}(‰)$
HIG-17	Nuuanu	15 Nov. 71	20	+135 ± 16
HIG-18	Manoa	19 Nov. 71	40	+ 14 ± 14
HIG-19	Palolo	11 Sept. 71	60	+ 28 ± 16
HIG-20	Waihee	1 Nov. 71	80	− 19 ± 15
HIG-21	Luluku	18 Oct. 71	100	− 14 ± 14
HIG-22	Haiku	28 Sept. 71	260	− 47 ± 13

General Comment: HIG-19 contains no measurable tritium, HIG-20 yields a tritium count on the margin of significance; the others definitely contain bomb tritium. Results suggest the pre-bomb zero-age activity of ground water originating in the Koolau range is ca. −15‰. This supports assumptions that this area will have both rapid flow rates for water and a rapid turnover of soil carbon.

References

Buddemeier, R. W., Young, A. Y., Fairhall, A. W., and Young, J. A., 1970, Improved system of methane synthesis for radiocarbon dating: Rev. Sci. Instruments, v. 41, p. 652-654.

Chatters, R. M., Crosby, J. W., and Engstrand, L. G., 1969, Fumarole emanations: their influence on carbon-14 dates: Circ. 32, Coll. Engineering, Research Div. Washington State Univ., Pullman, Washington.

Fairhall, A. W., Buddemeier, R. W., Yang, I. C., and Young, A. W., 1971, Radiocarbon in the sea: USAEC rept. HASL-242, p. I-35—I-78.

Gordon, D. C., 1970, Chemical and biological observations at Station Gollum, an oceanic station near Hawaii, Jan. 1969 to June 1970: Hawaii Inst. of Geophysics tech. rept. HIG-70-22.

Noakes, J. E., Kim, S. M., and Stipp, J. J., 1965, Chemical and counting advances in liquid scintillation age dating: Radiocarbon and tritium dating, 6th internatl. conf. Proc., Pullman, Washington, p. 68-92.

Polach, H. A., 1969, Optimisation of liquid scintillation radiocarbon age determinations and reporting of ages: Atomic Energy in Australia, v. 12, no. 3, p. 21-28.

Veeh, H. H. and Veevers, J. J., 1970, Sea level at −175 m off the Great Barrier Reef 13,600 to 17,000 years ago: Nature, v. 226, p. 536-537.

Young, A. W., Buddemeier, R. W., and Fairhall, A. W., 1969, A new 60-liter water sampler built from a beer keg: Limnol. and Oceanog., v. 14, p. 634-637.

[RADIOCARBON, VOL. 15, No. 1, 1973, P. 75-85]

ILLINOIS STATE GEOLOGICAL SURVEY RADIOCARBON DATES IV

DENNIS D. COLEMAN

Illinois State Geological Survey, Urbana, Illinois 61801

This date list includes all samples processed from December 1970 through November 1971 at the Illinois State Geological Survey Radiocarbon Dating Laboratory. The benzene liquid scintillation method of Noakes, Kim, and Stipp (1965), and Noakes, Kim, and Akers (1967) was used. A new benzene synthesis system has been completed, and several changes in the sample preparation procedure have been made since the last date list report (Coleman, 1972). A brief summary of the benzene synthesis and sample pretreatment techniques used to determine the dates reported here follows.

All organic samples are boiled in 2N HCl for a minimum of 2 hours and thoroughly rinsed. Wood and fibrous peat samples are then boiled in 0.5N NaOH for 2 hours or more and rinsed several times with boiling water. Wood samples expected to contain large amounts of volatile material are pyrolized under N_2 before combustion to prevent explosions. Collagen is separated from bone samples by digestion in 1N HCl under partial vacuum. The insoluble residue is then washed with 0.5N NaOH and centrifuged.

Organic samples are burned in a Vycor tube under a positive O_2 pressure of ca. 1 psi. The CO_2 is purified by passing it successively through the following: platinized asbestos at ca. 550° C, CuO at 600° C, a 0.5N $AgNO_3$ solution, and a solution of 7.3 g $Na_2Cr_2O_7$ in 50% H_2SO_4. Water is then removed in a trap cooled by Dry Ice-isopropanol, and the CO_2 frozen out with liquid nitrogen. The synthesis of acetylene and its trimerization to benzene is carried out as described by Kim and Ruch (1969), and Kim, Ruch, and Kempton (1969).

CO_2 is evolved from carbonate samples with 50% H_3PO_4. The NBS oxalic acid reference standard is converted to CO_2 by wet oxidation with great care to achieve complete reaction.

All samples are counted in a modified Packard Tri-Carb Model 3375 liquid scintillation spectrometer operated at 1° C. Butyl PBD dissolved in toluene (50 mg/ml) is used as a scintillator. Samples expected to have ages greater than 40,000 years B.P. are counted in a 20 ml quartz vial containing 16 ml of sample benzene and 4 ml of scintillator solution. This vial gives a counting figure of merit (E^2/B) of ca. 520. Younger samples are counted in a 10 ml low-potassium glass vial containing up to 8 ml of sample benzene and 2 ml of scintillator solution. If 8 ml of sample benzene is not available, spectrochemical grade benzene is added. This vial has a figure of merit of ca. 730. Backgrounds are counted in the same vials as samples using spectrochemical grade benzene. Benzene prepared from the combustion of coal is also counted periodically to insure that there is no contamination during synthesis. Samples are

counted for a minimum of 24 hours, and backgrounds are counted before and after each sample. Benzene prepared from NBS oxalic acid reference standard is counted every 6 months to determine the efficiency of the instrument and a "hot sample" prepared from commercially available C^{14}-enriched benzene is counted monthly to guard against instrument drift.

All ages are calculated using a C^{14} half-life of 5568 years. Errors (1σ) reported account only for uncertainties in activity measurements of the sample, standard, and backgrounds. Samples with net count rates $< 4\sigma$ are reported as minimum ages. Samples with net count rates $< 4\sigma$ below the reference standard are considered modern, and for these, values for δC^{14} are reported where $\delta C^{14} = \frac{A_{sample} - A_{std}}{A_{std}} \times 1000$, and A is net cpm per gm benzene. No corrections have been made for isotopic fractionation or atmospheric C^{14} fluctuations.

Chao Li Liu assisted in sample preparation. All requests for analyses were evaluated by an Isotopic Analysis Committee consisting of J. P. Kempton (chairman), Charles Collinson, R. E. Bergstrom, D. D. Coleman, and J. C. Frye.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Illinois and Lake Michigan

ISGS-61. Morris North Section — **24,990 ± 280 / 23,040 B.C.**

Wood from silt in Grundy Co., SE¼ NE¼ NE¼ Sec. 33, T.34N, R.7E, on N edge of Morris, Illinois (41° 23′ 00″ N Lat, 88° 25′ 15″ W Long). From Peddicord Formation (Willman *et al.*, 1971). Coll. 1970 by J. C. Frye and H. B. Willman; subm. by J. C. Frye, Illinois State Geol. Survey. *Comment* (J.C.F.): confirms Farmdalian age of lake silts of Peddicord Formation and correlation with similar lake sediments at Wedron Section.

Garden Plain series

ISGS-106. Upper 60 cm — **34,630 ± 550 / 32,680 B.C.**

ISGS-64. Middle 15 cm — **39,000 ± 1100 / 37,050 B.C.**

ISGS-98. Lower 30 cm — **41,900 ± 1300 / 39,950 B.C.**

Organic-rich silt from Whiteside Co., SE¼ SE¼ NE¼ Sec. 3, T.20N, R.3E, 4 km S of Garden Plain, Illinois (41° 45′ N Lat, 90° 9′ W Long). From 1.2 m organic-rich silt unit below Peoria Loess and above till. Coll. 1971 and subm. by I. E. Odom, N. Illinois Univ., De Kalb. *Com-*

ment (I.E.O.): 1st reported occurrence of deposits in W Illinois equivalent to Plano Silt Member of Winnebago Formation. Ages are possible minimum and maximum for deposition of Plano Silt Member in area.

ISGS-97. Union Grove **37,420 ± 710 / 35,470 B.C.**

Organic-rich silt from Whiteside Co., SW¼ NW¼ NW¼ Sec. 10, T.21N, R.4E, 0.8 km SW of Union Grove, Illinois (41° 45′ 45″ N Lat, 90° 2′ W Long). Top 30 cm of 1.4 m peat bed. Coll. 1971 and subm. by I. E. Odom. *Comment* (I.E.O.): age equivalent to that of Plano Silt Member in E Illinois and agrees with dates from Garden Plain series.

Vandalia Core series, Pittsburg Basin

ISGS-65. J-3, 255 to 260 cm depth **24,200 ± 800 / 22,250 B.C.**

ISGS-67. J-4, 263 to 265 cm depth **34,000 ± 1200 / 32,050 B.C.**

ISGS-71. J-5, 295 to 297 cm depth **37,200 ± 900 / 35,250 B.C.**

Organic-rich silt from Fayette Co., SW¼ NE¼ SW¼ Sec. 3, T.5N, R.1W, 4.5 km SSW of Hagarstown, Illinois (38° 54′ 00″ N Lat, 89° 11′ 30″ W Long). From Equality Formation, 4 to 5 m above Hagarstown Member of Glasford Formation. Coll. 1969 by A. M. Jacobs and H. E. Wright; subm. by A. M. Jacobs, Illinois State Geol. Survey. *Comment* (A.M.J.): pollen assemblages of samples are characterized by high values of nonarboreal pollen (ca. 50%), and *Quercus* is dominant arboreal pollen type (Grüger, 1970). Grüger suggests that region, at time of deposition, was prairie with trees along river valleys or in oak savannas.

Relative position of ISGS-65 in core indicates date is ca. 9000 yr too young. Interpolation with 6 other finite dates from site (R., 1970, v. 12, p. 505; 1972, v. 14, p. 150), using relative pollen frequency and depth as controls, indicates that ISGS-65 should be ca. 33,000 yr old.

Samples ISGS-67 and -71 show sedimentation rate in Pittsburg Basin during late Altonian Substage of ca. 1 cm/100 yr. Other dates from basin indicate same order of magnitude for rates of sedimentation.

Clay mineralogy of sediments below ISGS-67 indicate no appreciable loess deposition in area before late Altonian time (Jacobs, 1970).

ISGS-68. Lake Michigan Core 212-2 **3460 ± 210 / 1510 B.C.**

Organic-rich silt from core sample, 54 km ENE of Waukegan, Illinois (42° 25′ 48″ N Lat, 87° 10′ 48″ W Long). From Waukegan Member of Lake Michigan Formation, 5 to 26 cm from top of core. Coll. 1970 by D. L. Gross, J. A. Lineback, and H. V. Leland; subm. by D. L. Gross, Illinois State Geol. Survey. *Comment* (D.L.G.): 1st date for Waukegan Member. Two previous dates from S Lake Michigan

(R., 1972, v. 14, p. 149) were from underlying Lake Forest Member (Lineback *et al.*, 1970).

910 ± 140

ISGS-100. Lake Michigan Core 836-5 **A.D. 1040**

Wood in clayey silt from core sample, 19 km SW of Benton Harbor, Michigan (42° 7′ 42″ N Lat, 86° 43′ 30″ W Long). From Waukegan Member, 72 to 95 cm below top of Lake Michigan Formation. Coll. 1971 by J. A. Lineback *et al.*; subm. by J. A. Lineback, Illinois State Geol. Survey. *Comment* (J.A.L.): delta-like wedge of sediment along Michigan shore is relatively young and deposited from sediment carried in by present-day rivers. Also indicates more rapid sedimentation rate along E side of lake than in central and W portions.

13,980 ± 200

ISGS-69. Parkland College **12,030 B.C.**

Silty peat from Champaign Co., SE¼ NW¼ SW¼ Sec. 3, T.19N, R.8E, 4 km NW of Champaign, Illinois (40° 7′ 57″ N Lat, 88° 17′ 30″ W Long). From 8 cm silty peat overlain by 2.4 m of silty clay. Coll. 1970 by W. H. Johnson and L. R. Follmer; subm. by W. H. Johnson, Univ. Illinois. *Comment* (W.H.J.): dates organic accumulation in final stage of sedimentation in small lake on Champaign Moraine. Unit was buried by loess and slopewash.

2850 ± 80

ISGS-74. Miller Creek **900 B.C.**

Wood in clay from Alexander Co., N½ NE¼ Sec. 9, T.15S, R.3W, 1.6 km NE of Thebes, Illinois (37° 13′ N Lat, 89° 26′ W Long). From 0.6 m sec. of sandy, silty clay overlain by 2.4 m alluvial and backwater silt and underlain by gravel. Coll. and subm. 1970 by W. F. Meents, Illinois State Geol. Survey. *Comment* (W.F.M.): ca. 3 m of Holocene alluvium was deposited in Miller Creek in last 2850 yr.

16,160 ± 140

ISGS-78. Reynolds School **14,210 B.C.**

Wood in silt from Rock Island Co., NW¼ SE¼ SE¼ Sec. 18, T.16N, R.5W, 6.4 km SE of Muscatine, Iowa (41° 22′ 30″ N Lat, 91° 00′ 00″ W Long). From terrace silt related to Shelbyville Drift (Henry Formation). Coll. 1970 and subm. by R. C. Anderson, Augustana College, Rock Island, Illinois. *Comment* (R.C.A.): wood buried by sand dunes during or shortly after deposition of valley train, which extends down Mississippi River from maximum position of Woodfordian glacier in Green River Lowland. Date is minimum for terminal position (Atkinson-Temperance Hill Moraines) of Green River Sublobe.

21,670 ± 130

ISGS-79. Mahomet SW **19,720 B.C.**

Wood in organic-rich silt from Champaign Co., SW¼ SE¼ NW¼ Sec. 20, T.20N, R.7E, 2.4 km SW of Mahomet, Illinois (40° 9′ 21″ N

Lat, 88° 26′ 20″ W Long). From Robein Silt. Coll. and subm. 1971 by W. H. Johnson. *Comment* (W.H.J.): silt overlain by 2 Woodfordian tills.

ISGS-80. RMM-1 **13,090 ± 110 / 11,140 B.C.**

Peat from Macon Co., SW¼ NW¼ NW¼ Sec. 4, T.16N, R.4E, 3.2 km E of Oakley, Illinois (39° 50′ 43″ N Lat, 88° 46′ 1″ W Long). From small depression bordered on 3 sides by Cerro Gordo Moraine and overlain by glacial outwash. Coll. 1971 and subm. by R. M. Mason, Univ. Illinois. *Comment* (R.M.M.): date is minimum for formation of Cerro Gordo Moraine.

Harmattan Strip Mine #4 series

Site in Vermilion Co., NE¼ NE¼ NW¼ Sec. 4, R.19N, T.12W, 8 km W of Danville, Illinois (40° 08′ 42″ N Lat, 87° 43′ 38″ W Long). Coll. 1971 by W. H. Johnson, D. L. Gross, L. R. Follmer, and A. M. Jacobs; subm. by W. H. Johnson.

ISGS-81. L-17B **20,800 ± 130 / 18,850 B.C.**

Wood from brown, silty till below Glenburn and Batestown Till Members.

ISGS-83. L-16 **20,500 ± 210 / 18,550 B.C.**

Wood from Robein Silt, overlain by silty till and Glenburn and Batestown Till Members.

General Comment (W.H.J.): dates Glenburn Till Member of Wedron Formation as Woodfordian.

ISGS-63. Higginsville **48,100 ± 1700 / 46,150 B.C.**

Wood fragments in silt from Vermilion Co., SW¼ SE¼ NE¼ Sec. 26, T.21N, R.13W, 1.6 km NW of Higginsville, Illinois (40° 14′ 45″ N Lat, 87° 46′ 30″ W Long). From organic-rich silt immediately below Glenburn Till Member of Wedron Formation. Coll. 1970 by W. H. Johnson and D. D. Coleman; subm. by W. H. Johnson. *Comment* (W.H.J.): organic-rich silt is Altonian and suggests overlying till (Glenburn Till Member) may also be Altonian. Regional stratigraphy and other radiocarbon dates (ISGS-81 and -83), however, indicate the Glenburn is Woodfordian in age.

ISGS-85. Fairmount Quarry **21,420 ± 720 / 19,470 B.C.**

Wood fragments in gray silt from Vermilion Co., SE¼ NW¼ SW¼ Sec. 20, T.18N, R.13W, 5.6 km SW of Fairmount, Illinois (40° 00′ 10″ N Lat, 87° 51′ 45″ W Long). From 2 m unit of interbedded silt, sand, and gravel overlain by 2.1 m till and underlain by 3.4 m till; entire sec. believed to be Batestown Till Member of Wedron Formation. Coll.

1971 and subm. by W. H. Johnson. *Comment* (W.H.J.): date is older than Batestown Till Member, as indicated by regional stratigraphy and radiocarbon dates (ISGS-81 and -83). Either old wood from Robein Silt was incorporated into silt, or interpretation of stratigraphy is incorrect and silt and lower till are not from Batestown Till Member.

ISGS-82. Clear Creek #2 **>48,000**

Wood in carbonaceous silt from Putnam Co., NW¼ NW¼ NE¼ Sec. 19, T.31N, R.1W, 8 km ENE of Henry, Illinois (41° 9′ N Lat, 89° 16′ W Long). From organic-rich silt overlying thick sand and overlain by calcareous till. Coll. 1971 by J. C. Frye, A. B. Leonard, and H. B. Willman; subm. by J. C. Frye. *Comment* (J.C.F.): date suggests that silt and contained molluscan fauna are probably Illinoian rather than Altonian as had been suspected.

Big Ridge series

ISG-84. Wood P7304 **20,600 ± 220**
18,650 B.C.

ISGS-87. Peat P7304 **20,900 ± 140**
18,950 B.C.

Site in Saline Co., SE¼ NW¼ NW¼ Sec. 19, T.9S, R.7E, 11 km W of Equality, Illinois (37° 43′ 54″ N Lat, 88° 14′ 52″ W Long). From Equality Formation. Coll. 1971 by J. C. Frye, A. B. Leonard, and H. B. Willman; subm. by J. C. Frye. *Comment* (J.C.F.): dates upper part of high-level fill of Lake Saline and indicates lower part of fill is older than previously believed. Wood and peat agree well.

ISGS-86. Bankston Fork $\delta C^{14} = +14 \pm 6‰$ **Modern**

Charcoal in silt from Williamson Co., NE¼ NW¼ NW¼ Sec. 24, T.9S, R.4E, 7.5 km E of Crab Orchard, Illinois (37° 43′ 53″ N Lat, 88° 43′ 15″ W Long). From top of probable lake sediments. Coll. 1971 by J. C. Frye, A. B. Leonard, and H. B. Willman; subm. by J. C. Frye. *Comment* (J.C.F.): siltation on top of deposits of Lake Saline is still in progress.

Little Cypress Ditch series

ISGS-88. Whole sample **17,510 ± 330**
15,560 B.C.

ISGS-95. >200 mesh **23,500 ± 960**
21,550 B.C.

ISGS-96. <200 mesh **19,160 ± 690**
17,210 B.C.

Organic-rich clayey sand from Gallatin Co., NW¼ NW¼ NW¼ Sec. 20, T.9S, R.9E, 1.2 km NW of Junction, Illinois (37° 43′ 54″ N Lat, 88° 14′ 52″ W Long). From Equality Formation. Coll. 1971 by

J. C. Frye, H. B. Willman, and A. B. Leonard; subm. by A. B. Leonard, Univ. Kansas. *Comment*: sample contained coal fragments; therefore was sieved in order to minimize contamination. Small age difference between coarse sample with visible coal and fine fraction without visible coal indicates all 3 dates are probably maximum. Slightly younger age of ISGS-88 points out heterogeneous coal contamination.

Big Cypress Ditch series

Site in Gallatin Co., NE¼ NW¼ SW¼ Sec. 20, T.9S, R.9E, 0.5 km NNW of Junction, Illinois (37° 43′ 47″ N Lat, 88° 13′ 31″ W Long). Coll. 1971 by J. C. Frye and H. B. Willman; subm. by J. C. Frye.

ISGS-101. Mollusk shells **12,780 ± 100 / 10,830 B.C.**

From top 60 cm of 2nd episode of lake fill in Lake Saline. *Comment* (J.C.F.): dates pond fauna overlying youngest episode of outwash fill.

ISGS-103. Unionid shell **13,030 ± 190 / 11,080 B.C.**

From 1 m below surface in sandy, silty lake filling. *Comment* (J.C.F.): confirms date of youngest fauna of Lake Saline (ISGS-101) immediately above youngest outwash fill.

ISGS-104. Wood fragments **$\delta C^{14} = -10 \pm 17‰$ / Modern**

From organic-rich silt, 1 to 1.2 m below surface. *Comment*: sample known to contain modern roots, but only wood not appearing to be root material was used. Date indicates most of wood in sample was from modern roots.

ISGS-90. Fancy Prairie **24,450 ± 280 / 22,500 B.C.**

Muck with wood fragments from Menard Co., SW¼ SE¼ SW¼ Sec. 24, T.18N, R.5W, 1.3 km SW of Fancy Prairie, Illinois (39° 59′ 30″ N Lat, 89° 37′ 00″ W Long). From basal 45 cm of Robein Silt. Coll. 1971 by L. R. Follmer and W. H. Johnson; subm. by L. R. Follmer, Illinois State Geol. Survey. *Comment* (L.R.F.): organic material began accumulating in early to middle Farmdalian time.

ISGS-89. Center School **20,500 ± 130 / 18,550 B.C.**

Wood in silt from Coles Co., NW¼ NW¼ SW¼ Sec. 15, T.11N, R.10E, 14 km SE of Charleston, Illinois (39° 23′ 45″ N Lat, 88° 4′ 50″ W Long). From Robein Silt. Coll. 1971 by W. H. Johnson and L. R. Follmer; subm. by W. H. Johnson. *Comment* (W.H.J.): indicates approx. time Robein Silt was buried by drift derived from a Woodfordian glacier at S margin of Woodfordian ice front.

Oakland series

From Coles Co., center SW¼ NE¼ Sec. 14, T.14N, R.10E, 1.2 km WNW of Oakland, Illinois (39° 39′ 44″ N Lat, 88° 03′ 30″ W Long). Coll. 1971 and subm. by J. P. Ford, Illinois State Geol. Survey.

ISGS-93. Organic-rich silt 70F17 **26,900 ± 1100 24,950 B.C.**

From base of Robein Silt. *Comment* (J.P.F.): reveals oldest age of Robein Silt in NE Coles Co. and, with date from nearby borehole of 20,000 ± 400 (I-2519, unpub.), dates approx. span of unit accumulation.

ISGS-94. Organic-rich till 70F17 **24,600 ± 1300 22,650 B.C.**

From ca. 30 cm above base of till underlying Glenburn Till. *Comment* (J.P.F.): till overlies Robein Silt ranging from ca. 20,000 to 27,000 yr B.P.; date suggests incorporation of Robein Silt in lower portion of till.

ISGS-99. Sugar Creek Valley, Boring 8 **22,700 ± 1100 20,750 B.C.**

Calcareous, organic-rich silt from Sangamon Co., NW¼ NE¼ SW¼ Sec. 28, T.16N, R.4W, 4 km E of Springfield, Illinois (39° 47′ 50″ N Lat, 89° 33′ 00″ W Long). From Robein Silt at 11 m depth. Coll. 1971 by W. H. Johnson; subm. by J. A. Miller, Univ. Illinois. *Comment* (J.A.M.): silt represents last episode of alluvial sedimentation in Sugar Creek, a tributary to Sangamon R., prior to lacustrine sedimentation in tributary valley. Ponding occurred when Sangamon R. tributaries beyond Woodfordian ice front were dammed by outwash.

ISGS-102. Sangamon River Valley, Boring 9 **24,640 ± 430 22,690 B.C.**

Organic-rich silt from Sangamon Co., NW¼ SW¼ NE¼ Sec. 22, T.16N, R.4W, 6.4 km E of Springfield, Illinois (39° 49′ 30″ N Lat, 89° 31′ 30″ W Long). From Robein Silt at depth 11.0 to 12.5 m. Coll. 1971 by W. H. Johnson; subm. by J. A. Miller. *Comment* (J.A.M.): represents last episode of alluvial valley fill prior to Woodfordian outwash aggradation in Sangamon Valley.

B. Other localities

ISGS-58. Port Talbot #1 **44,100 ± 1100 42,150 B.C.**

Peat from Elgin Co., Dunwich Con. XI, Lot 18, S end, 15 km WSW of Port Stanley, Ontario (42° 38′ N Lat, 81° 23′ W Long). From Port Talbot II Interstadial, at least 3 m below Lake Erie water level; broken out by waves and redeposited on present beach. Coll. 1958 and subm. by A. Dreimanis, Univ. W Ontario. *Comment* (A.D.): date agrees well with those of 3 other labs. (Dreimanis *et al.*, 1966) on peat balls from organic deposits of Port Talbot Interstadial.

Louisiana series

$\delta C^{14} = +114 \pm 6‰$

ISGS-60. Florida Parishes No. II-2 **Modern**

Wood in pebbly sand from Tangepahoa Co., Sec. 16, T.4S, R.7E, 2.5 km S of Amite City, Louisiana (30° 42′ N Lat, 90° 30′ W Long). From late Pleistocene pebbly sand underlying "Prairie Terrace" surface. Coll. 1970 and subm. by E. G. Otvos, Louisiana State Univ.

$\delta C^{14} = -17 \pm 9‰$

ISGS-62. Florida Parishes No. II-4 **Modern**

Wood in pebbly sand from E Baton Rouge Parish, Sec. 42, T.4S, R.3E, 1.4 km ESE of Baywood, Louisiana (30° 41′ N Lat, 90° 53′ W Long). From pebbly sand underlying intermediate Amite R. Terrace. *General Comment* (E.G.O.): samples from hydraulic dredging over large pit area: exact location not known. Dates indicate wood is not from units being dredged.

14,290 ± 130

ISGS-72. Richland Co. 533 **12,340 B.C.**

Wood in organic-rich silt with leaf and twig litter from Richland Co., SW¼ SE¼ NW¼ Sec. 17, T.23N, R.18W, 4.8 km SE of Shiloh, Ohio (40° 57′ 15″ N Lat, 82° 32′ 55″ W Long). From "forest bed" 15 cm thick, underlain by Hiram Till and overlain by gyttja and organic-rich silt. Coll. 1970 and subm. by S. M. Totten, Hanover College, Hanover, Indiana. *Comment* (S.M.T.): date is minimum for deglaciation of Hiram (Woodfordian) ice from N-central Ohio and represents earliest accumulation of organic matter in region following deglaciation.

Ernst Bros. Sand and Gravel Pit series

Site in Ozaukee Co., S½ NW¼ Sec. 17, T.9N, R.21E, 4 km NW of Mequon, Wisconsin (43° 15′ 00″ N Lat, 88° 00′ 30″ W Long). Coll. 1970 by J. C. Frye, H. B. Willman, and J. P. Kempton; subm. by J. C. Frye.

9270 ± 120

ISGS-73. P-7258 **7320 B.C.**

Wood from base of upper forest bed in bog sediments. *Comment* (J.C.F.): dates termination of pond sediments contemporaneous with stand of Valders glacier nearby.

12,500 ± 120

ISGS-75. P-7246 **10,550 B.C.**

Wood from base of Twocreekan forest bed. *Comment* (J.C.F.): date is check run on wood from below pond deposits. Previously dated 12,410 ± 100 (WIS-347, R., 1970, v. 12, p. 342).

12,020 ± 110

ISGS-76. Two Creeks **10,070 B.C.**

Wood in bedded red silt from Manitowoc Co., NE¼ NE¼ NE¼ Sec. 2, T.21N, R.24E, 3.2 km NE of Two Creeks, Wisconsin (44° 15′

N Lat, 87° 34′ W Long). Wood cut from log in lower part of forest bed in red silt and clay. Coll. 1970 by J. C. Frye and H. B. Willman; subm. by J. C. Frye. *Comment* (J.C.F.): date is check run on lowest wood at Two Creeks type locality.

17,180 ± 140

ISGS-91. De Baca Co. shells **15,230 B.C.**

Shells of gastropod (*Lymnaea*) from De Baca Co., New Mexico, SE¼ Sec. 23, T.3N, R.25E, 2.3 km W of Fort Sumner, New Mexico (34° 27′ N Lat, 104° 17′ W Long). From terrace deposit along Pecos R. Coll. 1971 by J. C. Frye and A. B. Leonard; subm. by J. C. Frye. *Comment* (J.C.F.): dates an intermediate terrace of Pecos R. Valley.

18,100 ± 370

ISGS-92. Acme Station **16,150 B.C.**

Shells, mostly gastropod (*Lymnaea*) in sand and silt from Chaves Co., NE¼ Sec. 30, T.8S, R.25E, 29 km NE of Roswell, New Mexico (33° 42′ N Lat, 104° 26′ W Long). From late Pleistocene sediments in formerly undrained depression that supported aquatic molluscan fauna. Coll. 1971 by J. C. Frye and A. B. Leonard; subm. by J. C. Frye. *Comment* (J.C.F.): dates fossiliferous pond deposit on a significant terrace level, E side of Pecos R. Valley.

II. ARCHAEOLOGIC AND TREE RING SAMPLES

Brynjulfson Cave series

From Boone Co., SW¼ NE¼ SW¼ Sec. 16, T.47N, R.12W, 19 km S of Columbia, Missouri (38° 51′ 07″ N Lat, 92° 16′ 50″ W Long). Subm. by P. W. Parmalee, Illinois State Mus., Springfield, Illinois.

2460 ± 230

ISGS-66. Brynjulfson Cave #2 **510 B.C.**

Collagen fraction of bone sample from darker of 2 horizontal soil layers, ca. 1 m above cave floor. Coll. 1969 by P. W. Parmalee and R. D. Oesch. *Comment* (P.W.P.): bone from animals comprising recent faunal species complex of cave. Date within time period anticipated for species represented and indicates more recent deposition of matrix than expected in neighboring Brynjulfson Cave #1.

9440 ± 760

ISGS-70. Brynjulfson Cave #1 **7490 B.C.**

Collagen fraction of bone coll. randomly from cave fill of ca. 12 m distance. Coll. 1962 by M. G. Mehl. *Comment* (P.W.P.): probably dates most recent period of occupation of cave by peccary, dire wolf, extinct skunk, etc.

546 ± 70

ISGS-77. Tree ring #12 **A.D. 1404**

Wood (*Juniperus virginiana* L.) cut in 1967. Portion dated from core, containing ca. 125 growth rings. Tree had 617 growth rings. Subm.

by J. C. McGregor, Univ. Illinois. *Comment*: used as check sample; portion dated is known to have grown between ca. A.D. 1350 and 1475.

ISGS-105. Puna O1 **8620 ± 300**
6670 B.C.

Gyttja intercalated in volcanic ash from Humahuaca, 150 km NW of Jujuy, Argentina (23° 17′ 00″ S Lat, 65° 42′ 00″ W Long). From Holocene fluvial terrace, Esquinas Blancas Formation. Coll. 1971 and subm. by Jorge Fernández, Mina Aguilar-Pcia de Jujuy, Argentina. *Comment* (J.F.): 1st date for Argentine Puna. Establishes base of Holocene sediments and approx. date for human industry "saladillense." Also dates last postglacial volcanic eruption.

REFERENCES

Coleman, D. D., 1972, Illinois State Geological Survey radiocarbon dates III: Radiocarbon, v. 14, p. 149-154.

Dreimanis, A., Terasmae, J., and McKenzie, G. D., 1966, The Port Talbot interstade of the Wisconsin glaciation: Canadian Jour. Earth Sci., v. 3, p. 305-325.

Grüger, E., 1970, The development of the vegetation of southern Illinois since late Illinoian time (preliminary report): Rév. Géog. Physique et Géol. Dynamique (2), v. 12, no. 2, p. 143-148.

Jacobs, A. M., 1970, Persistence of lake basins in southern Illinois, U.S.A., from late Illinoian time to the present: Rév. Géog. Physique et Géol. Dynamique (2), v. 12, no. 2, p. 137-142.

Kim, S. M. and Ruch, R. R., 1969, Illinois State Geological Survey radiocarbon dates I: Radiocarbon, v. 11, p. 394-395.

Kim, S. M., Ruch, R. R., and Kempton, J. P., 1969, Radiocarbon dating at the Illinois State Geological Survey: Illinois Geol. Survey Environmental Geol. Note 28, 19 p.

Lineback, J. A., Ayer, N. J., and Gross, D. L., 1970, Stratigraphy of unconsolidated sediments in the southern part of Lake Michigan: Illinois Geol. Survey Environmental Geol. Note 35, 35 p.

Noakes, J. E., Kim, S. M., and Akers, L. K., 1967, Recent improvements in benzene chemistry for radiocarbon dating: Geochim. et Cosmochim. Acta, v. 13, p. 1094-1096.

Noakes, J. E., Kim, S. M., and Stipp, J. J., 1965, Chemical and counting advances in liquid scintillation radiocarbon dating: 6th internatl. conf. radiocarbon and tritium dating Proc., Conf-650652, p. 68-98.

Willman, H. B., Leonard, A. B., and Frye, J. C., 1971, Farmdalian lake deposits and faunas in northern Illinois: Illinois Geol. Survey Circ. 467, 12 p.

[RADIOCARBON, VOL. 15, NO. 1, 1973, P. 86-112]

COPENHAGEN RADIOCARBON DATES X

HENRIK TAUBER

Carbon-14 Dating Laboratory

Department of Natural Sciences, National Museum, Copenhagen

The following list comprises a selected number of measurements made on archaeologic samples from 1959 to December 1971. Measurements of geologic samples will be given in a later date list. A survey of the radiocarbon chronology for the Danish Mesolithic and Neolithic, ensuing from these and previously published dates from the laboratory, has recently been compiled (Tauber, 1972).

Age calculations are based on a contemporary value equal to 0.95 times the activity of the NBS oxalic acid standard (this also applies to shell dates), and on a half-life for C^{14} of 5570 years. Results are reported in years before 1950, and in the A.D./B.C. scale. Errors quoted include standard deviations of the count rates for the unknown sample, contemporary value, and background. Because possible errors arising from isotopic fractionation, or from fluctuations in the atmospheric C^{14} activity, are not incuded, calculated errors smaller than 100 years were increased by rounding to that figure as a minimum.

Sample descriptions were prepared in collaboration with collectors and submitters of samples.

ACKNOWLEDGMENTS

Samples were selected by a committee of archaeologists and geologists consisting of H. Norling-Christensen*, Helge Larsen, J. Troels-Smith, and M. Ørsnaes, Natl. Mus., Copenhagen, and Sigurd Hansen and Johs. Iverson*, Geol. Survey of Denmark. Xylotomic determinations were made by E. Tellerup*, P. Wagner, and T. Bartholin, Natl. Mus., Copenhagen. Chemicals were prepared by Karen Skov Jensen and Birgit Rønne.

ARCHAEOLOGIC SAMPLES

A. Denmark

Draved Mose, Mesolithic dwelling place

Charcoal from Mesolithic dwelling place, No. 604 S, from shore of prehistoric "Draved Lake" in bog Draved Mose (55° 1′ N Lat, 8° 57′ E Long), S Jutland. Dwelling place was on former sand dunes, now covered by peat. Flint implements from Early Mesolithic culture (Kapel, 1964; Andersen, 1966). Coll. 1968 and 1969 by H. Kapel and E. Brinch Petersen; subm. by H. Kapel and A. Andersen, Geol. Survey Denmark. *Comment*: samples from Early Mesolithic dwelling places in Draved were previously dated (R., 1962, v. 4, p. 27-34; 1966, v. 8, p. 213-234; 1968, v. 10, p. 295-327). Dates agree well with oldest group of previous dates.

* Deceased.

K-1466. Draved Mose, D.G.U. 384 **9390 ± 120 / 7440 B.C.**

Charcoal of pine and deciduous species from gyttja layer together with worked flint. Layer pollen dated to time before immigration of hazel. Date is average of 2 measurements: 9330 ± 150 and 9460 ± 150.

K-1465. Draved Mose, D.G.U. 383 **9130 ± 150 / 7180 B.C.**

Charcoal of pine and deciduous species from gyttja layer with worked flint. Layer pollen dated to time shortly before immigration of hazel.

K-1605. Draved Mose, D.G.U. 407 **9280 ± 160 / 7330 B.C.**

Charcoal of pine and deciduous species from cultural layer, Field C/15, with flint implements.

K-1794. Draved Mose, D.G.U. 461 a+b **8790 ± 140 / 6840 B.C.**

Charcoal of pine from cultural layer, Field C/16 and D/16, together with flint implements.

Barmosen, Mesolithic dwelling place

Charcoal and peat from Mesolithic dwelling place, B I, in bog Barmosen (55° 3′ N Lat, 11° 54′ E Long), S Zealand, from 5 to 10 cm thick cultural layer with Early Mesolithic flint implements (Johansson, 1970), and from 30 to 40 cm thick peat cover. Coll. 1967 to 1968 and subm. by A. Johansson, Sydsjaellands Mus., Vordingborg and J. Troels-Smith, Natl. Mus., Copenhagen. *Comment*: cultural layer may have been uncovered for some time in antiquity (cp. K-1427 and K-1773); some mixing of cultural remains and organic matter may therefore have occurred, as dates suggest.

K-1359. Barmosen, B I, 2 **9240 ± 150 / 7290 B.C.**

Charcoal (*Betula* sp.) from 11 small finds from area 2 × 2 m in cultural layer.

K-1775. Barmosen, B I, 733 **8580 ± 110 / 6630 B.C.**

Charcoal (*Populus* sp.) from cultural layer. Date is average of 2 measurements: 8660 ± 140 and 8490 ± 140.

K-1774. Barmosen, B I, 621 **8330 ± 100 / 6380 B.C.**

Charcoal (*Populus* sp. or *Salix* sp.) from Pit A in cultural layer. Date is average of 3 measurements: 8300 ± 140, 8430 ± 140, and 8250 ± 140.

4470 ± 100

K-1773. Barmosen, B I, Hg 10969 **2520 B.C.**

Highly humified peat from 0 to 2 cm above upper part of cultural layer. A few flint pieces found in peat.

3690 ± 110

K-1427. Barmosen, B I, Pd 7052 **1740 B.C.**

Highly humified peat from 4 to 6 cm above upper part of cultural layer.

Klosterlund, Mesolithic dwelling place

Samples from profile just S of classic Klosterlund dwelling place (56° 11′ N Lat, 9° 22′ E Long), Jutland. Lowest in profile was sand, covered by 15 to 20 cm gyttja. Over gyttja was 5 to 6 cm brown peat with flint flakes of Klosterlund culture, covered by black peat. Samples were in or just below brown peat (cultural layer). Pollen dated to end of Zone IV, just before immigration of hazel. Coll. 1967 and subm. by A. Andersen, Geol. Survey Denmark.

8920 ± 140

K-1315. Klosterlund, D.G.U. 340 **6970 B.C.**

Bark (*Pinus* sp.) from upper part of brown peat. Presumably contemporary with Klosterund dwelling place.

9140 ± 150

K-1316. Klosterlund, D.G.U. 341 **7190 B.C.**

Outer year rings of wood (*Pinus* sp.) from lower part of brown peat. Probably just below cultural layer.

9230 ± 150

K-1317. Klosterlund, D.G.U. 342 **7280 B.C.**

Charred branch (*Pinus* sp.) from lowermost part of brown peat. Probably just below cultural layer.

9200 ± 140

K-1452. Klosterlund, D.G.U. 374 **7250 B.C.**

Outer year rings of branch (*Pinus* sp.) from lowermost part of brown peat.

Mullerup, Maglemose culture, type locality

Samples from old excavation of cultural layer on Sarauw's islet at classic Mullerup dwelling place (55° 30′ N Lat, 11° 13′ E Long), W Zealand. Early Maglemose culture in Zealand. Pollen dated to Zone Vb (K. Jessen). Coll. 1900 by G. F. L. Sarauw, subm. by E. Brinch Petersen, Univ. Copenhagen.

8660 ± 120

K-1609. Mullerup, A 18269/1 **6710 B.C.**

A single, large piece of charcoal (*Corylus* avel.) from lower part of cultural layer, Field I, H 1. Date is average of 2 measurements: 8720 ± 140 and 8610 ± 140.

K-1610. Mullerup, A 18269/2 **8500 ± 140**
6550 B.C.

Rolls of bark (*Betula* sp.) from lower part of cultural layer, Field III, B 5 and III, C 5.

K-1611. Mullerup, A 18269/3 **8520 ± 140**
6570 B.C.

Rolls of bark (*Betula* sp.) from lower part of cultural layer, Field IV, J 2.

K-1612. Mullerup, A 18269/4 **8330 ± 110**
6380 B.C.

Hazelnut shells from cultural layer. Date is average of 3 measurements: 8230 ± 140, 8440 ± 140, 8310 ± 140.

Ulkestrup, Maglemose culture

Samples from hut, House II, excavated at Ulkestrup Øst II (55° 35′ N Lat, 11° 32′ E Long), in bog Åmosen, W Zealand. Remains of hut was sealed in peat. Artifacts belong to youngest part of Maglemose culture, Svaerdborg phase, in Åmosen (Andersen, 1951, 1961). Pollen dated to Zone VI (ex Svend Jørgensen). Coll. 1951 and subm. by Knud Andersen, Natl. Mus., Copenhagen.

K-1507. Ulkestrup II, 16122, 16191 **8170 ± 120**
6220 B.C.

Rolls of bark (*Betula* sp.) from hut proper on a bark layer that formed floor of hut, covered by clay. Date is average of 2 measurements: 8320 ± 140 and 8030 ± 140.

K-1508. Ulkestrup II, 16351 **8030 ± 140**
6080 B.C.

Charcoal (*Pinus* sp.) 3 m from hut in refuse layer, 21 cm thick. Single piece of cleaved wood charred at one end.

K-1509. Ulkestrup II, 13885 **8050 ± 140**
6100 B.C.

Tinder, ca. 2.5 m from hut in refuse layer.

Kongemosen, Early Coastal culture

Samples from Mesolithic dwelling place at Kongemosen (55° 35′ N Lat, 11° 30′ E Long), in bog Åmosen, W Zealand. Cultural layer consisted of habitation layer, with many flint implements, on shore of former lake, and refuse layer of refuse from dwelling place embedded in gyttja off shore. Artifact assemblage characterized by rhombic arrowheads and large flint picks; represents Kongemose phase of Early Coastal culture (Jørgensen, 1956, 1961). Cultural layer presumably belongs to Pollen Zone VI (ex Svend Jørgensen). Coll. 1955 and subm. by Svend Jørgensen, Natl. Mus., Copenhagen. *Comment*: 2 pieces of wood from refuse layer were previously dated to 8830 ± 110 and 8400 ± 150 (R., 1966, v. 8, p. 213-234), *i.e.*, considerably older than these dates from habitation layer. Previous samples, therefore, can hardly originate from dwell-

ing place, but represent pieces of wood washed out from older deposits and later embedded in refuse layer.

7840 ± 140
K-1526. Kongemosen, II 20169 **5890 B.C.**

Swamp peat from immediately below habitation layer. Older than dwelling place.

7560 ± 120
K-1528. Kongemosen, XVIIa 20184 **5610 B.C.**

Hazelnut shells from habitation layer. Date is average of 2 measurements: 7840 ± 140 and 7630 ± 140.

7280 ± 130
K-1588. Kongemosen, XVIIb 20184 **5330 B.C.**

Bark (*Alnus* sp.) from habitation layer at dwelling place.

7350 ± 120
K-1589. Kongemosen, XI 20178 **5400 B.C.**

Bark (*Alnus* sp.) from refuse layer. Date is average of 2 measurements: 7380 ± 150 and 7320 ± 150.

6820 ± 120
K-1527. Kongemosen, XVI 20183 **4870 B.C.**

Swamp peat from immediately above cultural layer. Younger than dwelling place. Date is average of 2 measurements: 6800 ± 140 and 6850 ± 140.

Villingebaek, Early Coastal culture

Charcoal and wood from dwelling place at Villingebaek Øst A (56° 6′ N Lat, 12° 30′ E Long), at coast of N Zealand. Artifacts represent Kongemose phase of Early Coastal culture (Kapel, 1967, 1969). Cultural layer is older than, or contemporary with, 1st early-Atlantic Littorina transgression. Coll. 1966 to 1968 and subm. by H. Kapel, Natl. Mus., Copenhagen.

7280 ± 120
K-1368. Villingebaek, J, 18 **5330 B.C.**

Charred wood (*Corylus* sp.) from habitation layer on dwelling place. Layer was resting on sand and covered by clay deposited during following transgression.

7040 ± 120
K-1369. Villingebaek, C, 22 **5090 B.C.**

Charcoal (*Pinus* sp.) from habitation layer at land.

7030 ± 130
K-1486. Villingebaek, V, 12-4610a **5080 B.C.**

Twigs from fish trap from upper part of cultural layer, Fields H 13-14 and I 13-14.

K-1334. Villingebaek, 388 **7220 ± 120**
5270 B.C.

Outer 4 cm of tree trunk embedded in refuse layer, ca. 8 to 9 m outside old coast line.

K-1370. Villingebaek, 186 **7070 ± 120**
5120 B.C.

Charred branch (*Pinus* sp.) from refuse layer, ca. 5 to 6 m outside old coast line.

K-1371. Villingebaek, 345 **7090 ± 120**
5140 B.C.

Partly charred piece of branch (*Pinus* sp.) embedded in refuse layer, ca. 6 to 7 m from old coast line.

K-1372. Villingebaek, 387 **7120 ± 120**
5170 B.C.

Charred wood (*Pinus* sp.) from refuse layer, ca. 8 to 9 m from old coast line.

Månedalen, Early Coastal culture

Charcoal from dwelling place ca. 500 m S of previously mentioned dwelling place at Villingebaek (56° 6′ N Lat, 12° 30′ E Long), N Zealand. Artifacts represent Kongemose phase of Early Coastal culture and appear broadly contemporary to, or slightly older than, those from nearby Villingebaek dwelling place. Coll. 1969 to 1970 and subm. by H. Kapel. *Comment*: dates suggest dwelling places at Månedalen and Villingebaek are almost contemporary.

K-1826. Månedalen, F 17 **7150 ± 130**
5200 B.C.

Charcoal (*Ulmus* sp.) from cultural layer, Field F 17.

K-1825. Månedalen, B 12 **7040 ± 120**
5090 B.C.

Charcoal (*Pinus* sp.) from cultural layer, Field B 12.

K-1827. Månedalen, CDE 17 **7530 ± 130**
5580 B.C.

Charcoal (*Corylus* sp.) from pit below cultural layer, Fields CDE 17.

K-1303. Vedbaek, Early Coastal culture **6510 ± 110**
4560 B.C.

Wood (*Cornus* sp.) from dwelling place at Vedbaek Boldbane (55° 51′ N Lat, 12° 34′ E Long), Vedbaek, N Zealand. Part of wooden hafting sleeve, A 41666, from Field III C 2 at dwelling place, with artifacts characterized by core axes and dominance of rhombic arrowheads over transverse arrows (Mathiassen, 1946). Coll. 1946 by Th. Mathiassen; subm. by H. Norling-Christensen, Natl. Mus., Copenhagen. *Comment*: sample was treated with alun. Preservatives were extracted before dating.

Brovst, Early Coastal culture and Ertebølle culture

Shells and charcoal from former coastal dwelling place at Bratskov (57° 6′ N Lat, 9° 30′ E Long), Brovst, N Jutland. Dwelling place contained 2 cultural layers separated by marine sand, presumably deposited during a transgression. Lower cultural layer, representing phase of Early Coastal culture, consisted of clay and shells mixed with charcoal, bones, and flint tools, *e.g.*, rhombic arrowheads. It contained no ceramics. Upper cultural layer consisted mainly of minor isolated heaps of shells, with flake axes, transverse arrowheads and thick-walled, pointed-base ceramics from early phase of Ertebølle culture. Both layers were subdivided into a sequence (Andersen, 1970). Coll. 1969 to 1970 and subm. by O. Marseen and Søren H. Andersen, Forhist. Mus., Århus.

6680 ± 150
K-1661. Brovst, Pd 7567 **4730 B.C.**

Charcoal (*Quercus* sp.) from lower cultural layer, Field A 12, Layer 11.

6590 ± 130
K-1614. Brovst, SHg 902, 903 **4640 B.C.**

Shells (*Ostrea edulis*) from lower cultural layer at junction of Fields A 9, A 10, and E 1.

6420 ± 130
K-1660. Brovst, Pd 7569, 7570 **4470 B.C.**

Charcoal (*Ulmus* sp.) from lower cultural layer, Field A 22, Layer 2.

6560 ± 120
K-1860. Brovst, CYV **4610 B.C.**

Shells (*Ostrea edulis*) from lower cultural layer, Field 75/45, Layer 11(9).

6450 ± 120
K-1858. Brovst, CYM **4500 B.C.**

Shells (*Ostrea edulis*) from lower cultural layer, Field 58/39, Layer 11.

6160 ± 110
K-1862. Brovst, CZS **4210 B.C.**

Shells (*Ostrea edulis*) from lower cultural layer, Field 80/45, Layer 11(9).

5610 ± 100
K-1613. Brovst, SHg 900, 901 **3660 B.C.**

Shells (*Ostrea edulis*) from upper cultural layer at junction of Fields A 9, A 10, and E 1. Date is average of 2 measurements: 5680 ± 120 and 5550 ± 120.

5500 ± 100
K-1856. Brovst, CYJ **3550 B.C.**

Shells (*Ostrea edulis*) from upper cultural layer, Field 59/42, Layer 8. Date is average of 2 measurements: 5380 ± 110 and 5620 ± 110.

K-1859. Brovst, CYU **5490 ± 110**
3540 B.C.

Shells (*Ostrea edulis*) from upper cultural layer, Field 75/45, Layer 4.

K-1857. Brovst, CYL **5450 ± 110**
3500 B.C.

Shells (*Ostrea edulis*) from upper cultural layer, Field 57/42, Layer 4.

K-1864. Brovst, DAB **5420 ± 100**
3470 B.C.

Shells (*Ostrea edulis*) from upper cultural layer, Field 68/47, Layer 4. Date is average of 2 measurements: 5370 ± 110 and 5460 ± 110.

K-1855. Brovst, CYC **5410 ± 100**
3460 B.C.

Shells (*Ostrea edulis*) from upper cultural layer, Field 59/43, Layer 4. Date is average of 2 measurements: 5290 ± 110 and 5520 ± 110.

K-1863. Brovst, CZY **5400 ± 110**
3450 B.C.

Shells (*Ostrea edulis*) from upper cultural layer, Field 68/44, Layer 4.

K-1861. Brovst, CZO **5410 ± 110**
3460 B.C.

Shells (*Ostrea edulis*) from upper cultural layer, Field 80/45, Layer 4.

Henriksholm, Early Coastal culture

Charcoal from dwelling place at Henriksholm, Bøgebakken (55° 51′ N Lat, 12° 33′ E Long), N Zealand. Early coastal dwelling place with artifacts dominated by transverse arrowheads and core axes that suggest younger age than Vedbaek (this date list) and older than ceramic Ertebølle culture. Coll. 1924 by G. Hatt; subm. by E. Brinch Petersen, Univ. Copenhagen.

K-1829. Henriksholm, A 33003-3 **6170 ± 120**
4220 B.C.

Charcoal (*Quercus* sp.) from hearth in Fields Aj 1, Aj 2, Ba 1, and Ba 2 in lower part of cultural layer.

K-1828. Henriksholm, A 33003-2 **6050 ± 120**
4100 B.C.

Charcoal (*Corylus* avel.) from lower part of cultural layer in Fields Ag 1 and Ah 1, under small irregular stone packing.

K-1844. Henriksholm, A 33003-1 **5910 ± 120**
3960 B.C.

Charcoal (*Corylus* avel. and *Tilia* sp.) from stone-lined hearth in lower part of cultural layer, Field Aj 2.

Ertebølle, Ertebølle culture, type locality

Shells (*Ostrea edulis*) from kitchen midden at Ertebølle (56° 48′ N Lat, 9° 11′ E Long), N Jutland. A column of shells, 1 × 1 m and

1.33 m high, from center of Ertebølle midden, Field E 9, was transferred for exhibition in Natl. Mus., Copenhagen, at excavation in 1895. Samples from this column was taken at intervals of 20 cm. In levels of 22 to 104 cm above base, thick-walled ceramics of Ertebølle-type were found in adjacent fields in midden (Brinch Petersen, 1971). Topmost of dated samples may represent layer with later admixtures. Coll. 1895 by G. Sarauw; subm. by H. Tauber and E. Thorvildsen, Natl. Mus., Copenhagen.

5760 ± 100
3810 B.C.

K-1529. Ertebølle, Eb 1

Shells, 5 to 7 cm above base of column. Date is average of 2 measurements: 5810 ± 120 and 5710 ± 120.

5660 ± 120
3710 B.C.

K-1530. Ertebølle, Eb 2

Shells 22 to 23 cm above base.

5600 ± 120
3650 B.C.

K-1531. Ertebølle, Eb 3

Shells 44 to 45 cm above base.

5550 ± 110
3600 B.C.

K-1532. Ertebølle, Eb 4

Shells 67 to 68 cm above base.

5570 ± 110
3620 B.C.

K-1533. Ertebølle, Eb 5

Shells 84 to 85 cm above base.

5580 ± 110
3630 B.C.

K-1534. Ertebølle, Eb 6

Shells 102 to 104 cm above base.

5110 ± 100
3160 B.C.

K-1535. Ertebølle, Eb 7

Shells 125 to 127 cm above base. Date is average of 2 measurements: 5180 ± 110 and 5030 ± 110.

5630 ± 120
3680 B.C.

K-1612. Haldrup Strand, Ertebølle culture

Fragment of wooden shaft (*Fraxinus* sp.) of paddle or spade from submarine dwelling place at Haldrup Strand (55° 52′ N Lat, 9° 58′ E Long), Jutland. Cultural layer consisted of cardium gyttja and contained charcoal, flint, bones, and thick-walled ceramics, representing an early phase of Ertebølle culture. Coll. 1969 and subm. by Søren H. Andersen.

Ringkloster, Ertebølle culture and Early funnel beaker culture (A,B)

Charcoal and wood from inland dwelling place at former fresh water lake at Ringkloster (56° 1′ N Lat, 9° 57′ E Long), Jutland. Cultural layer consisted of refuse from dwelling place with assemblage of

flint, bone, antler, wood and ceramics; among bones were several of fur animals. Lower and middle cultural layer represents various phases of Ertebølle culture, upper part represents Early Neolithic funnel beaker culture. Coll. 1969 to 1970 and subm. by Søren H. Andersen.

K-1652. Ringkloster, Hg 11362 **5610 ± 110**
3660 B.C.

Charcoal (*Tilia* sp.) from lower part of cultural layer with thick-walled ceramics; in direct contact with old-type stag antler axe with shaft hole near burr.

K-1765. Ringkloster, ABRK **5500 ± 110**
3550 B.C.

Wood (*Quercus* sp.) from outer 14 year-rings of tree trunk from lower part of cultural layer.

K-1653. Ringkloster, Hg 11363 **5490 ± 100**
3540 B.C.

Charcoal (*Quercus* sp.) from middle of cultural layer with thick-walled ceramics; in direct contact with T-shaped stag antler axe. Archaeologically contemporaneous with Dyrholmen II phase. Date is average of 2 measurements: 5550 ± 110 and 5430 ± 110.

K-1654. Ringkloster, Pd 8459 **5320 ± 100**
3370 B.C.

Charcoal (*Fraxinus* sp.) from upper part of cultural layer with thin-walled sherds of A and B funnel beakers. Date is average of 2 measurements: 5390 ± 110 and 5250 ± 110.

Sølager, Ertebølle culture and Early funnel beaker culture (B,C)

Charcoal from old excavation of kitchen midden at Sølager (55° 56′ N Lat, 11° 54′ E Long), N Zealand. Midden contained several separate layers with different assemblages of artifacts. Lowest layer, I, represents a classic Ertebølle culture, Layer II, Early Neolithic Funnel Beaker culture, Phase B/C, and Layer IV, Middle Neolithic Funnel Beaker culture, Period II, with small admixture of artifacts belonging to Pitted Ware culture. Coll. 1901; subm. by J. Skårup, Univ. Copenhagen.

K-1723. Sølager, A 19733, R 6, 11 + U 7, 11, 12 **5520 ± 110**
3570 B.C.

Charcoal (*Quercus* sp.) from Layer I. Classic Ertebølle culture.

K-1724. Sølager, A 19733, S 7, 6 + T 7, 7 **4650 ± 100**
2700 B.C.

Charcoal (*Quercus* sp. and *Betula* sp.) from Layer II. Early Neolithic Funnel Beaker culture, Phase B/C. Date is average of 2 measurements: 4660 ± 110 and 4630 ± 110.

K-1725. Sølager, A 19733, P 6, 1 + S 7, 2 **4030 ± 100**
2080 B.C.

Charcoal (*Quercus* sp.) from Layer IV. Date is average of 2 measure-

ments: 4050 ± 100 and 4020 ± 100. *Comment*: date is incompatible with other dates for Middle Neolithic Funnel Beaker culture (R., 1964, v. 6, p. 215-225; 1966, v. 8, p. 213-234; and this list) and suggests that charcoal originates from Pitted Ware culture or later admixture.

K-1450. Flynderhage, 1564 RG, Ertebølle culture **5230 ± 100 3280 B.C.**

Piece of worked branch (*Corylus* sp.) from kitchen midden at Flynderhage (56° 1′ N Lat, 10° 14′ E Long), Jutland. From refuse layer at midden, with artifacts of Dyrholm II-type and thick-walled ceramics (Andersen, 1970). Coll. 1968 and subm. by Søren H. Andersen.

K-1659. Lindebjerg, Early Funnel Beaker culture (B) **5010 ± 100 3060 B.C.**

Charcoal (*Quercus* sp.) from long barrow of hitherto unknown type from Lindebjerg (55° 42′ N Lat, 11° 11′ E Long), NW Zealand. Sample was part of wooden flake, 30 × 30 cm, standing edgewise in Pit C, which also contained 5 Type B funnel beakers, considered a primary feature of barrow. Coll. 1969 and subm. by G. D. Liversage, Natl. Mus., Copenhagen.

Praestelyngen, dug-out and Early Funnel Beaker culture (A or C)

Wood and moss samples from dug-out boat, embedded in gyttja, from Praestelyngen (55° 35′ N Lat, 11° 35′ E Long) in bog Åmosen, W Zealand. Boat was 6 m long, of square-stern type, with rounded stem, and fixed in position by pointed sticks along sides. Clay plate with remains of a fire in stem. Stern was formed by bark flake supported by moss and clay. Resting on clay were 3 thick pointed sticks and many potsherds, presumably of funnel beaker, Type A or C. Coll. 1968 to 1969 and subm. by C. Christensen, Natl. Mus., Copenhagen.

K-1473. Praestelyngen, B II, 1 **5010 ± 100 3060 B.C.**

Wood (*Tilia* sp.) from stem of dug-out. Date is average of 2 measurements: 5020 ± 120 and 4990 ± 120.

K-1650. Praestelyngen, B II, 128 **4960 ± 110 3010 B.C.**

Wood (*Salix* sp.) from long, pointed stick, used for fixing boat in position.

K-1651. Praestelyngen, B II, 421, 428, 447 **4890 ± 110 2940 B.C.**

Moss from stern of dug-out.

Vroue, Middle Neolithic Funnel Beaker culture, Per. I to V

Charcoal from megalithic graves and stone packing graves at Vroue (56° 25′ N Lat, 9° 4′ E Long), Jutland. Represents time from transition between Early Neolithic and Middle Neolithic Funnel Beaker cul-

ture to end of Middle Neolithic Funnel Beaker culture. Coll. 1966 to 1967 and subm. by Erik Jørgensen, Haderslev Mus., Haderslev.

4570 ± 100

K-1566. Vroue, Sb. 89, No. 42 **2620 B.C.**

Charcoal (*Quercus* sp.) immediately below stone pavement in ruin of dolmen. Represents 1st megalithic habitation at site, transition between Early Neolithic and Middle Neolithic, Per. Ia. Date is average of 2 measurements: 4530 ± 110 and 4600 ± 110.

4560 ± 100

K-1568. Vroue, Sb 21, XI **2610 B.C.**

Charcoal (*Quercus* sp.) from original vegetation surface below barrow with passage grave, 1.5 m outside chamber. Represents time of construction of passage grave, Middle Neolithic, Per. Ib.

4430 ± 100

K-1567. Vroue, Sb. 21, III **2480 B.C.**

Charcoal (*Alnus* sp.) from same passage grave as K-1568. From below barrow, just inside circle of edge stones. Represents time of construction of passage grave, Middle Neolithic, Per. Ib.

4040 ± 100

K-1569. Vroue, Sb. 21, XIII **2090 B.C.**

Charcoal (*Quercus* sp.) from same passage grave as K-1568. From top of red-burnt sand on floor of chamber, containing artifacts belonging to Upper Grave period of Single Grave culture. *Comment*: date suggests charcoal is a remain from Single Grave people.

4980 ± 100

K-1570. Vroue, Sb. 115, IV, No. 5 **3030 B.C.**

Charcoal (*Quercus* sp.) from post hole between funeral House C and Grave D in stone packing grave complex from Middle Neolithic Funnel Beaker culture, Per. IV or V. Date is average of 2 measurements: 5070 ± 110 and 4900 ± 110. *Comment*: post hole was assumed contemporary with stone packing graves. Date suggests charcoal originates from earlier construction at site.

4300 ± 100

K-1571. Vroue, Sb. 117, I, No. 3 **2350 B.C.**

Charcoal (*Quercus* sp.) from under stone paving in funeral House C in stone packing grave complex from Middle Neolithic Funnel Beaker culture, Per. IV or V.

4230 ± 100

K-1572. Vroue, Sb. 117, II, No. 2 **2280 B.C.**

Charcoal (*Quercus* sp.) from under stone paving in funeral House C in stone packing grave complex from Middle Neolithic Funnel Beaker culture, Per. IV or V.

4270 ± 100

K-1573. Vroue, Sb. 112, VII, No. 5 **2320 B.C.**

Charcoal (*Quercus* sp.) from under stones in Graves A and B in stone packing graves from Middle Neolithic Funnel Beaker culture, Per. V. Date is average of 2 measurements: 4260 ± 100 and 4280 ± 100.

4210 ± 100

K-1574. Vroue, Sb. 112, VII, No. 6 **2260 B.C.**

Charcoal (*Quercus* sp.) from under stone paving in funeral House C in stone packing grave complex from Middle Neolithic Funnel Beaker culture, Per. V. Date is average of 2 measurements: 4240 ± 100 and 4180 ± 100.

Fovlum, Middle Neolithic Funnel Beaker culture, Per. I

Charcoal from cult building belonging to Middle Neolithic Funnel Beaker culture, Per. I, from Fovlum (56° 29′ N Lat, 9° 36′ E Long), Jutland. Coll. 1968 and subm. by H. Langballe, Viborg Stiftsmuseum, Viborg.

4540 ± 110

K-1601. Fovlum, 185 B 76 **2590 B.C.**

Charcoal (*Quercus* sp.) from supposed floor level in cult building; originates presumably from fallen wall planks. *Comment*: paraffin was poured over charcoal pieces, extracted before dating.

4530 ± 100

K-1602. Fovlum, 185 B 26 **2580 B.C.**

Charcoal and charred bark (*Quercus* sp.) from floor level, supposed remains of fallen roof of building. Date is average of 2 measurements: 4560 ± 110 and 4500 ± 110.

Herrup, Middle Neolithic Funnel Beaker culture, Per. I

Charcoal and bark from cult building from Herrup (56° 24′ N Lat, 8° 56′ E Long), W Jutland. Cult building belonged to Middle Neolithic Funnel Beaker culture, Per. I, same type as previously dated cult buildings at Tustrup and Ferslev (R., 1964, v. 6, p. 215-225) (Becker, 1969). Coll. 1967 and subm. by C. J. Becker, Univ. Copenhagen. *Comment*: dates agree well with dates for Tustrup and Ferslev, except for K-1770 which, as suspected by excavator, does not belong to Neolithic construction.

4650 ± 100

K-1766. Herrup, XXVI, 67 **2700 B.C.**

Charcoal (*Quercus* sp.) from wall post in E wall of building.

4530 ± 100

K-1768. Herrup, XXVI, 74 **2580 B.C.**

Charcoal (*Quercus* sp.) from layer below stones in building.

4530 ± 100

K-1769. Herrup, XXVI, 69 **2580 B.C.**

Charred bark from layer below stones, but above potsherds lying on floor. Assumed part of previous roof cover. Date is average of 2 measurements: 4610 ± 100 and 4450 ± 100.

4510 ± 100

K-1767. Herrup, XXVI, 107 **2560 B.C.**

Charcoal (*Quercus* sp.) from roof post in building.

780 ± 100

K-1770. Herrup, XXVI, 103 **A.D. 1170**

Charcoal from pit in cult building.

4510 ± 100

K-1771. Lånum, Middle Neolithic, Per. I-II **2560 B.C.**

Charcoal (*Sorbus* sp.) from funeral house in stone packing grave complex from Lånum II (56° 27′ N Lat, 9° 6′ E Long), Jutland. Found scattered in N ditch in funeral house, in which was narrow flint axe of thin butted type. Coll. 1970 and subm. by Ole Faber, Univ. Copenhagen.

4420 ± 110

K-1649. Praestelyngen, dug-out, B II 378 **2470 B.C.**

Wood from outer year rings of dug-out boat from Praestelyngen (55° 35′ N Lat, 11° 35′ E Long), in bog Åmosen, W Zealand. From same excavation as dug-out K-1473 (this list), but placed clearly higher in series of layers and therefore younger. Coll. 1969 and subm. by C. Christensen.

4310 ± 100

K-1789. Øster Ristofte, Middle Neolithic, Per. V **2360 B.C.**

Charcoal (*Quercus* sp.) from stone paving in stone packing grave complex at Øster Ristofte (56° 11′ N Lat, 8° 26′ E Long), W Jutland. Found with sherds of pot from Middle Neolithic Funnel Beaker culture, Per V. Sample XIV, K. Coll. 1966 and subm. by C. J. Becker.

4150 ± 100

K-1582. Vester Nebel, Single Grave culture **2200 B.C.**

Charcoal (*Corylus* sp.) from lowest layer in undisturbed circle grave at Vester Nebel (55° 33′ N Lat, 9° 25′ E Long), Jutland. Grave belongs to Younger Under Grave period during Single Grave culture. It contained 2 battle axes of Glob type D (Glob, 1945), 1 thick butted, and 1 thin bladed flint axe, and an amber dish and amber ring (Madsen, 1971). Sample 1595 R. Coll. 1969 and subm. by H. H. Andersen and H. J. Madsen, Forhist. Mus., Århus. Date is average of 2 measurements: 4170 ± 100 and 4130 ± 100.

4080 ± 100

K-1843. Gabøl, Single Grave culture **2130 B.C.**

Charcoal (*Quercus* sp.) from bottom layer in Single Grave, 45 cm below ancient surface at Gabøl (55° 15′ N Lat, 9° 9′ E Long), S Jutland.

In grave was battle axe of Glob type B (Glob, 1945), *i.e.*, from Early Under Grave period during Single Grave culture. Charcoal is supposedly from wooden coffin. Coll. 1970 and subm. by E. Jørgensen, Haderslev Mus., Haderslev.

4000 ± 100

K-1451. Gammelstrup, Single Grave culture **2050 B.C.**

Shells (*Ostrea edulis*) from stone cist at Gammelstrup (56° 30′ N Lat, 9° 13′ E Long), Jutland. In grave was straight-walled beaker ornamented with groups of vertical engraved lines, dating grave to transition between Younger Ground Grave and Upper Grave periods during Single Grave culture. Shells were covered by 60 to 70 cm thick sand that leaked into cist. Grave also contained bones of lower part of left leg of child, 7 to 10 yr old. Coll. 1968 and subm. by P. Seeberg.

4110 ± 100

K-1367. Kobberup, Single Grave culture **2160 B.C.**

Charcoal (*Quercus* sp.) from post in wooden fore-court to stone cist from Kobberup (56° 31′ N Lat, 9° 10′ E Long), Jutland. Post belonged to row of wooden post in S side of forecourt. Wooden coffin in stone cist contained several well-preserved wooden objects and a Glob type I battle axe (Glob, 1945). Coll. 1966 and subm. by P. Kjaerum, Forhist. Mus., Århus. Date is average of 2 measurements: 4110 ± 100 and 4120 ± 100. *Comment*: 1 to 2 yr old hazel twigs from under wooden coffin in stone cist previously dated to 3900 ± 120 (K-1284, R., 1968, v. 10, p. 295-327). Sample is more likely to date time of entombment, than oak post with several year rings.

3910 ± 100

K-1831. Hald, Single Grave culture **1960 B.C.**

Charcoal (*Quercus* sp.) from grave (B) in tumulus from late Single Grave culture at Hald (56° 36′ N Lat, 9° 13′ E Long), Jutland. Tumulus contained several entombments. Among artifacts in Grave B were 2 battle axes of Glob Type H and I. Coll. 1970 and subm. by Per Noe, Viborg Stiftsmus., Viborg.

4170 ± 100

K-1529. Vestensø, aurochs **2220 B.C.**

Fragment of rib (*Bos primigenius*) from drained lake Vestensø (56° 9′ N Lat, 10° 43′ E Long), Hasnaes, Jutland. Skeleton found *in situ* during plowing. Boreal type arrowhead assoc. with skeleton. Coll. 1968 and subm. by U. Møhl, Zoolog. Mus., Copenhagen.

3440 ± 100

K-1301. Hvorslev, crook-ard **1490 B.C.**

Wood (*Fraxinus* sp.) from Hvorslev-ard (Glob, 1951, p. 14), a 1-piece ard from bog in Hvorslev (56° 22′ N Lat, 9° 47′ E Long), Jutland. Coll. 1942; subm. by A. Steensberg, Univ. Copenhagen. Date is average of 2 measurements: 3460 ± 100 and 3420 ± 100. *Comment*: ard was

treated with alun before dating. Preservatives were extracted and lignin fraction was isolated and dated.

3470 ± 100

K-1339. Lundergaards Mose **1520 B.C.**

Wood (*Quercus* sp.) from tree trunk with carving of ship from bog Lundergaards Mose (57° 12′ N Lat, 9° 37′ E Long), N Jutland. Remains of a whole forest were found in bog. Trees were killed, and stumps preserved due to swamping. Tree trunk contained ca. 150 yr rings. Rings 1 to 40 from center were used; sample therefore ca. 130 yr older than time when tree was killed. Coll. 1966 and subm. by Palle Friis, Vendsyssel Mus., Hjørring. *Comment*: sample treated with preservatives, which were extracted, and lignin and cellulose were isolated and dated separately: lignin-fraction 3540 ± 100, cellulose fraction 3400 ± 100. Date is average of measurements. Sample from outer rings of another trunk in bog previously dated (R., 1966, v. 8, p. 213-234).

Stenmark, Early Bronze age, Per. II

Charcoal from Bronze age house and pit from Stenmark (57° 14′ N Lat, 9° 38′ E Long), N Jutland. Flint sickle and potsherds were found in post hole in house. The latter were of Early Bronze age type, presumably Per. II. No covering cultural layer found. Coll. 1967 and subm. by O. Marseen, Aalborg Mus., Aalborg.

3170 ± 100

K-1373. Stenmark, 30 **1220 B.C.**

Charcoal (*Alnus* sp.) from horizontal wooden flake from sand directly above untouched soil in oblong stone lined hearth in house.

3070 ± 100

K-1374. Stenmark, 57 **1120 B.C.**

Charcoal (*Alnus* sp.) 10 to 50 cm from K-1373 in same hearth.

3080 ± 100

K-1375. Stenmark, 49 **1130 B.C.**

Charcoal (*Alnus* sp., *Betula* sp., *Quercus* sp., and *Ulmus* sp.) in scattered positions in pit slightly E of house. Pit also contained a flint sickle and potsherds.

2890 ± 120

K-853. Else Made, holy spring **940 B.C.**

Wood (*Quercus* sp.) from hollowed out trunk inserted in well or holy spring at beach at Else Made (55° 50′ N Lat, 10° 32′ E Long), Samsø. Coll. 1963 and subm. by O. Bertelsen, Samsø Mus., Samsø.

2860 ± 100

K-1495. Vebbestrup, crook-ard **910 B.C.**

Wood (*Alnus* sp.) from Vebbestrup-ard (Glob, 1951, p. 16) from bog Kirketerp Mose (56° 43′ N Lat, 9° 49′ E Long), Vebbestrup, Jutland. Coll. 1928; subm. by A. Steensberg, Univ. Copenhagen. *Comment*:

sample treated with preservatives. These were extracted and lignin fraction was isolated and dated.

Jyderup Skov, Late Bronze age

Charcoal from ca. 8 m long, oblong pits below habitation layer at dwelling place in forest Jyderup Skov (55° 51′ N Lat, 11° 31′ E Long), NW Zealand. Layer contained bronze and ceramics from middle of Late Bronze age, Per. V (Thrane, 1971). Dates time when pits were used, and antedates habitation layer. Coll. 1970 and subm. by H. Thrane, Natl. Mus., Copenhagen.

2990 ± 100

K-1694. Jyderup Skov, XXXI, 29 cm **1040 B.C.**

Charcoal (*Quercus* sp.) 24 cm long, 4.5 cm wide, and 3 cm thick, in upright position, W side of Pit XXXI, 29.

2740 ± 100

K-1693. Jyderup Skov, XXXI, 29 cl **790 B.C.**

Charcoal (*Quercus* sp.) 38 cm long, 7 cm wide, and 3 cm thick, in horizontal position in same pit as K-1694.

2800 ± 100

K-1691. Jyderup Skov, II, 6q **850 B.C.**

Charcoal (*Quercus* sp.) from vertical branch or stick, Pit II 6.

2790 ± 100

K-1690. Jyderup Skov, II, 6p **840 B.C.**

Charcoal (*Quercus* sp.) from piece, 10 cm thick, lying horizontally in same pit as K-1691.

2750 ± 100

K-1692. Jyderup Skov, XXIX, 16 ab **800 B.C.**

Charcoal (*Quercus* sp.) 18 cm long, 7 cm wide, and 5 cm thick from Pit XXIX 16.

2580 ± 100

K-575. Bjergagergård, Late Bronze age, Per. VI **630 B.C.**

Charcoal (*Alnus* sp., *Quercus* sp., *Sorbus* sp., and *Betula* sp.) from pit below level field at Bjergagergård (55° 50′ N Lat, 9° 39′ E Long), Havrum, Jutland. Pit contained small circular stone with rock carving and potsherds from Late Bronze age, Per. VI (Glob, 1969). Coll. 1956 and subm. by P. V. Glob, Natl. Mus., Copenhagen.

2560 ± 100

K-1494. Døstrup, bow-ard **610 B.C.**

Wood (*Alnus* sp.) from Døstrup-ard (Glob, 1951, p. 36) from bog at Døstrup (56° 42′ N Lat, 9° 45′ E Long) N Jutland. Ard is with detachable, arrow-shaped share. Coll. 1884; subm. by A. Steensberg.

Grøntoft, Pre-Roman Iron age villages

Charcoal from complex of Iron age villages at Grøntoft (56° 10′ N Lat, 8° 35′ E Long), W Jutland. Several stages (named A, B, etc.)

of development of Iron age village were separated. Village and houses had been removed between different stages; 100 to 200 m between early stages and only very slightly between later stages. During later stages, village was surrounded by enclosures of varying extent, which helped separate different stages. Village consisted of 12 to 20 houses of which only post holes and wall furrows were left. Potsherds dated stages to various periods during Pre-Roman Iron age (Becker, 1965, 1968). Coll. 1961 to 1967 and subm. by C. J. Becker, Univ. Copenhagen.

2480 ± 100

K-1593. Grøntoft, E XVIII, 61b **530 B.C.**

Charcoal (*Quercus* sp.) from Post Hole 61b in House XVIII, Village E. Pre-Roman Iron age, Per. I/II.

2470 ± 100

K-1591. Grøntoft, E XII, 75 **520 B.C.**

Charcoal (*Alnus* sp.) from Post Hole 75 in House XII, Village E. Pre-Roman Iron age, Per. I/II.

2450 ± 100

K-1592. Grøntoft, E XII, 108 **500 B.C.**

Charcoal (*Quercus* sp.) from Pit 108 (a+b) in House XII, Village E. Pre-Roman Iron age, Per. I/II.

2390 ± 100

K-1625. Grøntoft, E V, 74b **440 B.C.**

Charcoal (*Quercus* sp.) from floor in House V, Village E. Pre-Roman Iron age, Per. I/II.

2300 ± 100

K-1590. Grøntoft, E VII **350 B.C.**

Charcoal (*Quercus* sp.) from N wall furrow in House VII, Village E. Pre-Roman Iron age, Per I/II.

2270 ± 100

K-1594. Grøntoft, E XXVI **320 B.C.**

Charcoal (*Quercus* sp.) from NE corner of House XXVI, Village E. Pre-Roman Iron age, Per. I/II.

2210 ± 100

K-1027. Grøntoft, B III (1) **260 B.C.**

Charcoal (*Corylus* avel.) from post hole in House III, Village B. Pre-Roman Iron age I.

2160 ± 100

K-1026. Grøntoft, B III (2) **210 B.C.**

Charcoal (*Alnus* sp.) from wall furrow in House III, Village B. Pre-Roman Iron age I.

2250 ± 100

K-1130. Grøntoft, A II, 1 **300 B.C.**

Charcoal (*Quercus* sp.) from Post Hole 1 in House II, Village A. Pre-Roman Iron age, Per. II. Date is average of 2 measurements: 2320 ± 100 and 2180 ± 100.

2160 ± 100

K-1132. Grøntoft, A III, W **210 B.C.**

Charcoal (*Quercus* sp.) from hearth in W part of House III, Village A. Pre-Roman Iron age, Per. II.

2140 ± 100

K-1129. Grøntoft, A I, 22 **190 B.C.**

Charcoal (*Quercus* sp.) from Post Hole 22 in House I, Village A. Pre-Roman age, Per. II.

2060 ± 100

K-1131. Grøntoft, A III, h **110 B.C.**

Charcoal (*Quercus* sp.) from hearth in House III, Village A. Pre-Roman Iron age, Per. II.

2050 ± 100

K-1133. Grøntoft, A **100 B.C.**

Charcoal (*Quercus* sp.) from Pit B 37 with potsherds in Village A. Pre-Roman Iron age, Per. II.

2400 ± 100

K-1185. Grøntoft, 338 **450 B.C.**

Charcoal (*Quercus* sp.) from Pit 338 assoc. with 6-fold row of posts crossing a grave field. Pit older than posts.

2240 ± 100

K-1186. Grøntoft, 292a **290 B.C.**

Charcoal (*Quercus* sp.) from Pit. 292a assoc. with 6-fold row of posts. Older than posts.

2210 ± 100

K-1184. Grøntoft, 438 **260 B.C.**

Charcoal (*Quercus* sp.) from Pit 438 assoc. with 6-fold row of posts. Younger than posts.

2180 ± 100

K-1187. Grøntoft, 453 **230 B.C.**

Charcoal (*Quercus* sp.) from Pit 453 assoc. with 6-fold row of posts. Younger than posts.

B. Greenland

4500 ± 110

K-1628. Gammel Nugdlit, Group I **2550 B.C.**

Bone (probably rib) of whale from house ruin on Paleo-Eskimo dwelling place "Gammel Nugdlit" at Nugdlit (76° 38′ N Lat, 70° 36′ W Long), Thule Dist., N Greenland. Oldest house ruins (Group I) are at ca. +11 m; a younger group of houses (Group II) ca. +8 m. Sample

from stone-lined ash pit in house ruin No. 13, Group I. Artifacts which include burins had similarities to those from Denbigh Flint Complex, but cannot be equated with any known Paleo-Eskimo culture. Coll. 1966 and subm. by E. Knuth, Natl. Mus., Copenhagen.

3620 ± 100

K-1537. Tuapagssuit, Sarqaq culture **1670 B.C.**

Charcoal (*Betula* sp. and *Salix* sp.) from fireplace on beach terrace (No. 4) +4 m at Paleo-Eskimo camp site at Tuapagssuit (64° 32′ N Lat, 51° 5′ W Long), Godthåb Dist., W Greenland. Campsite contained artifacts of Sarqaq culture. Fireplace was under 5 cm thick vegetational cover. Coll. 1968 and subm. by H. C. Gulløv, Natl. Mus., Copenhagen. Date is average of 2 measurements: 3600 ± 120 and 3640 ± 120.

Engnaes, Independence II culture

Samples of local plant material from Paleo-Eskimo ruins at Engnaes (82° 16′ N Lat, 35° 43′ W Long) at W end of Lakes Midsommer Søerne, Peary Land, N Greenland. Ruins contained artifacts of Independence II culture (Knuth, 1968). Coll. 1968 and subm. by E. Knuth. *Comment*: date for K-1522 agrees well with previous date for Independence II culture (K-1059, R., 1968, v. 10, p. 295-327), also made on local plant material.

3080 ± 100

K-1544. Engnaes, Ruin 1 **1130 B.C.**

Charcoal (*Salix* sp.) coll. in and around central hearth in Ruin 1. Date is average of 2 measurements: 3060 ± 100 and 3100 ± 100.

2610 ± 100

K-1522. Engnaes, Ruin 5 **660 B.C.**

Charcoal (*Salix* sp.) coll. in and around hearth in open air cooking place, Ruin 5. Many bones of trout found in hearth.

Nugdlit, Thule culture

Samples from house ruins on large Eskimo dwelling place representing early Thule culture at Nugdlit (76° 47′ N Lat, 70° 20′ W Long), Thule Dist., W Greenland. Dates arrival of early Thule culture to Greenland. Finds show close connection with early Thule culture in Alaska and Canada (Holtved, 1954). Coll. 1947 by E. Holtved; subm. by J. Meldgaard, Natl. Mus., Copenhagen. *Comment*: dates for different materials (tusk and wood) from same house ruin agree very well. Dates are older than expected.

1040 ± 100

K-1078. Nugdlit 29(A) **A.D. 910**

Tusk of walrus from house ruin No. 29 on Nugdlit dwelling place. Early Thule culture.

1020 ± 100

K-1099. Nugdlit 29(B) **A.D. 930**

Wood (*Pinus* sp.) from house ruin No. 29 (same ruin as K-1078) on Nugdlit dwelling place. Early Thule culture.

1010 ± 100

K-1080. Nugdlit 4(A) **A.D. 940**

Tusk of walrus from house ruin No. 4 on Nugdlit dwelling place. Early Thule culture.

1040 ± 100

K-1100. Nugdlit 4(B) **A.D. 910**

Wood (*Salix* sp.) from house ruin No. 4 (same ruin as K-1080) on Nugdlit dwelling place. Early Thule culture.

Ruin Island, Thule culture

Samples from Eskimo house ruins on Ruin I. (78° 50′ N Lat, 69° 15′ W Long), Thule Dist., N Greenland. Houses contained artifacts from late Nugdlit phase of Thule culture. House 6 also contained objects of Norse origin (Holtved, 1944, p. 74-78), these probably originate from later visit by Norse people. Coll. 1936 by E. Holtved; subm. by J. Meldgaard. *Comment*: samples of walrus tusk and wood may have been treated superficially with glycerine and phenol. Possible preservatives were extracted before dating. Eskimos tend to re-use artifacts. Dates (K-1487 and K-1488) suggest this occurrence at Ruin I.

1120 ± 100

K-1487. Ruin Island, R-1 **A.D. 830**

Tusk of walrus from quiver handle (L.3.2494) from floor in house ruin No. 4.

930 ± 100

K-1505. Ruin Island, R-1a **A.D. 1020**

Wood (*Picea* sp.) from fire drill (L.3.2495), from floor in house ruin No. 4.

1150 ± 100

K-1488. Ruin Island, R-2 **A.D. 800**

Walrus tusk, fragment with perforations (L.3.2599), from floor in house ruin No. 6.

880 ± 100

K-1506. Ruin Island, R-2a **A.D. 1070**

Wood (*Picea* sp.) from lamp trimmer (L.3.2583) from floor in house ruin No. 6. Date is average of 2 measurements: 850 ± 100 and 900 ± 100.

680 ± 100

K-1489. Ruin Island, R-3 **A.D. 1270**

Woolen cloth of Norse origin from floor in house ruin No. 6. *Comment*: not known if cloth was treated with preservatives, but it looked slightly greasy under microscope. Sample extracted several times with ether and acetone to remove possible preservatives.

730 ± 100

K-1449. Kølnaes, 6 **A.D. 1220**

Wood (*Quercus* sp.) from lock piece with 3 perforations used as part of umiaq (whale hunting boat) from Kølnaes (82° 40′ N Lat, 20° 65′ W Long), Herlufholms Strand, Peary Land, N Greenland. The umiaq has previously been dated on baleen to 460 ± 100 (K-566, R., 1960, v. 2, p. 5-11). Oak of Norse origin found in Inglefield Land by Holtved (1944). Submitter suggested that Eskimos acquired oak here passing through Smith Sound to Peary Land. Coll. 1949 and subm. by E. Knuth. *Comment*: date agrees with suggestion (cf. K-1489, Ruin I.).

C. Alaska

13,070 ± 280

K-1327. Trail Creek, Cave 9, Bison **11,120 B.C.**

Organic fraction of *calcaneus sinistra* of Bison found outside S entrance to Cave 9, Trail Creek (65° 48′ N Lat, 163° 13′ W Long), Alaska. Heel bone was apparently worked by man (Larsen, 1968). Found with scapula of horse dated as K-1210 (R., 1968, v. 10, p. 295-327). Coll. 1950 and subm. by H. Larsen, Natl. Mus., Copenhagen.

9570 ± 150

K-1583. Onion Portage, Akmak culture **7620 B.C.**

Organic fraction of scapula and bone fragments of Caribou found at Onion Portage (67° 6′ N Lat, 158° 15′ W Long), Alaska. A 3 m thick deposit with several stratified habitation layers discovered in gully. Sample from base of deposit below Band 8, supposedly contemporary with artifacts of Akmak culture (Andersson, 1970). Coll. 1966 and subm. by D. D. Anderson, Brown Univ., Rhode Island, U.S.A.

D. Poland

3880 ± 100

K-1836. Kesocha, Early Corded Ware culture **1930 B.C.**

Charcoal (*Pinus* sp.) from 0.9 m high mound at Kesocha (53° 8′ N Lat, 20° 36′ E Long), Warsaw prov., Poland. From lower parts of grave pit in mound. Base of pit 150 cm below ancient surface. Grave contained 3 pots, with a beaker similar to Glob Type C (Glob, 1945), Early Corded Ware culture. Coll. 1969 and subm. by A. W. Kempisty, Univ. Warsaw. Date is average of 2 measurements: 3970 ± 100 and 3780 ± 100.

3960 ± 100

K-1837. Miernow, Early Corded Ware culture **2010 B.C.**

Charcoal (*Quercus* sp.) from Barrow II at Miernow (50° 21′ N Lat, 20° 34′ E Long), Kielce prov., Poland. From various places below skeleton in lower part of grave pit No. 2 in mound. Pit contained stone axe, small cup, and bone-awl, Early Corded Ware culture. Coll. 1963 and subm. by A. W. Kempisty.

3450 ± 100

K-1838. Miernow, Bronze age **1500 B.C.**

Wood (*Quercus* sp.) from Barrow II at Miernow (50° 21′ N Lat, 20° 34′ E Long), Kielce prov., Poland. Rotten timber from timber construction covering pit in mound. Pit contained vessel of Trzciniec culture. Coll. 1963 and subm. by A. W. Kempisty.

E. Syria

Tall Sukas, Chalcolithic period to Iron age

Samples from city mound at Tall Sukas (35° 43′ N Lat, 35° 55′ E Long), Syria, excavated by Carlsberg Expedition to Phoenicia, 1958 to 1963. Samples from layers representing Chalcolithic period to Iron age. Excavation area was divided into 10 m squares; samples originate from Sq. G 11 (Riis, 1970). Coll. 1958 to 1960, subm. by P. J. Riis, Univ. Copenhagen.

5910 ± 100

K-936. Tall Sukas, 14 **3960 B.C.**

Charcoal (*Quercus* sp.) from Layer 58, Chalcolithic period. Date is average of 2 measurements: 5960 ± 120 and 5870 ± 120.

4450 ± 120

K-713. Tall Sukas, 13 **2500 B.C.**

Charred grains from Layer 48, Early Bronze Age I.

4290 ± 120

K-1124. Tall Sukas, 19 n **2340 B.C.**

Charcoal (*Olea europaea*) from Layer 39, Early Bronze age.

4220 ± 120

K-1128. Tall Sukas, 33 **2270 B.C.**

Charcoal (*Olea europaea*) from Layer 39, Early Bronze age.

4250 ± 120

K-1127. Tall Sukas, 32 **2300 B.C.**

Charcoal (*Olea europaea*) from Layer 38, Early Bronze age.

4260 ± 120

K-1126. Tall Sukas, 18, 2 **2310 B.C.**

Charcoal (*Olea europaea*) from Layer 38, Early Bronze age.

4320 ± 120

K-1125. Tall Sukas, 15 **2370 B.C.**

Charcoal (*Arbutus* sp.) from Layer 35, Early Bronze age.

4270 ± 120

K-1123. Tall Sukas, 13 c **2320 B.C.**

Charcoal (*Quercus* sp.) from Layer 33, Early Bronze age.

4210 ± 120
K-714. Tall Sukas, 7 **2260 B.C.**
Charcoal from Layer 27, Early Bronze age III.

3090 ± 100
K-937. Tall Sukas, 4 **1140 B.C.**
Charcoal (*Ostrya carpinifolia*) from Layer 7, Iron age. Date is average of 2 measurements: 3060 ± 110 and 3130 ± 110.

3660 ± 110
K-935. Tall Daruk, Middle Bronze age **1710 B.C.**
Charcoal (*Quercus* sp.) from mound at Tall Daruk (35° 41′ N Lat, 35° 56′ E Long), Syria. From sounding in mound, S and center ÷920/925, Layer 32, Middle Bronze age. Dated for comparison with corresponding layers at Tall Sukas (Riis, 1970). Coll. 1959 and subm. by P. J. Riis.

F. Thailand

Bang site, Neolithic Ban Kao culture

Charcoal from Neolithic site at Ban Kao (13° 57′ N Lat, 99° 20′ E Long), Kanchanaburi prov., Thailand. Bang site covers ca. 8000 m² of which ca. 400 m² was excavated. Situated on river terrace between R. Kwai and tributary river. Habitation layer was without clear stratification. It contained huge amounts of stone, bone implements, and ceramics. Many burials belonging to culture were embedded in habitation layer. Graves were separated into Group I (early subphase) and Group II (late subphase) (Sørensen, 1967). Coll. 1961 to 1962 and subm. by Per Sørensen, Natl. Mus., Copenhagen.

3720 ± 140
K-838. Bang site, 1 **1770 B.C.**
Charcoal from base of habitation layer, Field Ea, found with Neolithic ceramics. Earliest phase at locality.

3310 ± 140
K-842. Bang site, 3 **1360 B.C.**
Charcoal from undisturbed part of habitation layer, found with many Neolithic artifacts.

3520 ± 120
K-1088. Bang site, 6 **1570 B.C.**
Charcoal (*Dicotyledones*) from habitation layer. Directly above graves of Group II.

3440 ± 120
K-1089. Bang site, 7 **1490 B.C.**
Charcoal (*Dicotyledones*) from habitation layer. Directly above graves of Group I.

3290 ± 120

K-1090. Bang site, 8 **1340 B.C.**

Charcoal (*Dicotyledones*) from habitation layer. Directly above graves of Group I.

3280 ± 120

K-1087. Bang site, 5 **1330 B.C.**

Charcoal (*Dicotyledones*) from habitation layer. Directly above graves of Group II.

3260 ± 120

K-1091. Bang site, 9 **1310 B.C.**

Charcoal (*Dicotyledones*) from part of habitation layer with graves of Group II.

3250 ± 120

K-1092. Bang site, 10 **1300 B.C.**

Charcoal (*Dicotyledones*) from habitation layer. Directly above graves of Group II.

4370 ± 100

K-1474. Lue Site I, Neolithic Ban Kao culture **2420 B.C.**

Charcoal (*Xylia dolabriformis*) from Lue site (13° 57′ N Lat, 99° 20′ E Long), Kanchanaburi prov., Thailand. From dwelling place on small island in tributary river to R. Kwai. Habitation layer, ca. 1 m thick, contained Neolithic artifacts from a single phase which typologically is younger than late subphase at Bang site (this list). Charcoal ca. 1 m below base of habitation layer. Supposed to be the charred pointed base of post from house. Coll. 1962 and subm. by Per Sørensen. *Comment*: date older than expected. Suggests that sample is unrelated to cultural deposit.

Tham Ongbah, Mesolithic and Metal age

Charcoal from cultural deposits in cave at Tham Ongbah (15° 3′ N Lat, 98° 54′ E Long), Kanchanaburi prov., Thailand. Cave, ca. 98 m total length, had a N entrance and W entrance, and the following rooms: Hall I, Hall II, Gallery with stalactites, Hall III, and Hall IV. Layers in cave were stratified. Cultural deposits range from Mesolithic to Early Metal age. Coll. 1965 and subm. by Per Sørensen. *Comment*: K-1298 and K-1299 older than expected. Dates suggest apparently undisturbed layers in Hall 4 were mixed, possibly because of repeated burying in this part of cave.

11,180 ± 180

K-1366. Tham Ongbah, XII, e **9230 B.C.**

Charcoal from lower part of Layer III, which was resting on sterile layer, 7 to 8 m from N entrance in Hall I, Sec. B-D. Dates earliest occupation of cave.

10,760 ± 170

K-1340. Tham Ongbah, XI, a **8810 B.C.**

Charcoal from Layer III, 8 to 9 m from N entrance in Hall I, Sec. B-D. Layer contained bones and Mesolithic implements of Hoabinhian culture.

9970 ± 150

K-1365. Tham Ongbah, XII, d **8020 B.C.**

Charcoal from upper part of Layer III, 8 to 9 m from N entrance in Hall I, Sec. B-D.

10,010 ± 150

K-1364. Tham Ongbah, XII, c **8060 B.C.**

Charcoal from lower part of Layer II, separated from lowermost Layer III by 8 cm sterile layer, 8 to 9 m from N entrance in Hall I, Sec. B-D. Layer contained Mesolithic implements of Hoabinhian culture.

10,090 ± 160

K-1363. Tham Ongbah, XII, b **8140 B.C.**

Charcoal from upper part of Layer II, 8 to 9 m from N entrance in Hall I, Sec. B-D.

9750 ± 150

K-1341. Tham Ongbah, XI, b **7800 B.C.**

Charcoal from Layer II, 8 to 9 m from N entrance in Hall I, Sec. B-D.

9350 ± 140

K-1362. Tham Ongbah, XII, a **7400 B.C.**

Charcoal from lower part of Layer I, separated from Layer II by sterile layer, 7 to 8 m from N entrance in Hall I. Layer contained Mesolithic implements of Hoabinhian culture.

4240 ± 100

K-1298. Tham Ongbah, I, a **2290 B.C.**

Charcoal (*Monocotyledones*) from Layer 2 at S wall in Hall 4. Layer contained burials of late Metal age. Supposed age ca. 200 B.C., cf. K-1300.

3960 ± 100

K-1299. Tham Ongbah, I, c **2010 B.C.**

Charcoal (*Monocotyledones*) from Layer 5 at S wall in Hall 4. Layer contained traces of bronze. Supposed age ca. 200 B.C. cf. K-1300.

2180 ± 100

K-1300. Tham Ongbah, X, 2 **230 B.C.**

Charcoal (*Dalbergia* sp.) from partly burned wooden coffin under undisturbed layers in Gallery. Parallel to boat-shaped coffins from Szechwan prov. in SW China.

REFERENCES

Andersen, A., 1966, Geologi og Arkaeologi i Draved Mose: Dansk Geol. Foren. Medd., v. 16, p. 255-258.

Andersen, K., 1951, Hytter fra Maglemosetiden, Danmarks aeldste Boliger: Fra Nationalmus. Arbejdsmark, p. 68-76.

———— 1961, Veruphopladsen, en Maglemoseboplads i Åmosen (summary in German): Nord. Oldkyndighed og Hist., Aarbøger 1960, p. 118-151.

Andersen, S. H., 1970, Brovst, en kystboplads fra aeldre stenalder (English summary): Kuml 1969, p. 67-90.

Andersson, D. D., 1970, Akmak, an early archaeological assemblage from Onion Portage, Northwest Alaska: Acta Arctica, v. 16, p. 1-80.

Becker, C. J., 1965, Ein früheisenzeitliches Dorf bei Grøntoft, Westjütland: Acta Archaeol., v. 36, p. 209-222.

———— 1968, Das zweite früheisenzeitliche Dorf bei Grøntoft, Westjütland: Acta Archaeol., v. 39, p. 235-254.

———— 1969, En kultbygning fra yngre stenalder ved Herrup, Vestjylland: Nationalmus. Arbejdsmark 1969, p. 17-28.

Brinch Petersen, E., 1971, Ølby Lyng, en østsjaellandsk kystboplads med Ertebøllekultur (English summary): Nord. Oldkyndighed og Hist., Aarbøger 1970, p. 5-42.

Glob, P. V., 1945, Studier over den jydske Enkeltgravskultur (summary in French): Nord. Oldkyndighed og Hist., Aarbøger 1944, p. 1-283.

———— 1951, Ard og Plov i Nordens Oldtid: Jysk Arkaeol. Selskabs Skr., Århus, v. 1.

———— 1969, Helleristninger i Danmark (English summary): Jysk Arkaeol. Selskabs Skr., Århus, v. 7.

Holtved, E., 1944, Archaeological Investigations in the Thule District, I-II: Medd. om Grønland, v. 141, no. 1-2, p. 1-305; 1-184.

———— 1954, Archaeological Investigations in the Thule District, III: Medd. om Grønland, v. 146, no. 3, p. 1-135.

Jørgensen, S., 1956, Kongemosen, endnu en Åmose-boplads fra aeldre stenalder (English summary): Kuml 1956, p. 23-40.

———— 1961, Zur Frage der ältesten Küstenkultur in Dänemark: Int. Kongr. für Vor- und Frühgeschichte, V, Hamburg, 1958, Ber., p. 440-447.

Johansson, A. D., 1970, Barmose-gruppen, praeboreale bopladsfund med skiveøkser i Sydsjaelland: Hist. Samfund for Præstø Amt, Årbog 1968, p. 101-170.

Kapel, H., 1964, Nyere arkaeologiske undersøgelser i Tønder og Åbenrå amter: Sønderjyske Årbøger 1964, p. 253-260.

———— 1967, En aeldre-stenalders boplads ved Villingebaek: Årbog f. Frederiksborg Amts hist. Samfund, p. 1-14.

———— 1969, En boplads fra tidlig-atlantisk tid ved Villingebaek: Nationalmus. Arbejdsmark 1969, p. 85-94.

Knuth, E., 1968, The Independence II artefacts and the Dorset-evidence in North Greenland: Folk, v. 10, p. 61-80.

Larsen, H., 1968, Trail Creek: Acta Arctica, v. 15, p. 1-79.

Madsen, H. J., 1971, To dobbeltgrave fra jysk enkeltgravskultur (English summary): Kuml 1970, p. 249-260.

Mathiassen, T., 1946, En boplads fra aeldre Stenalder ved Vedbaek Boldbaner. Søllerød Bogen.

Riis, P. J., 1970, Sukas I, The North-East Sanctuary and the first settling of Greeks in Syria and Palestine: Kgl. Danske Videnskabernes Selskab, Hist.-Filos. Skr., v. 5, no. 1, p. 1-179.

Sørensen, P., 1967, Archaeological excavations in Thailand II, the Thai-Danish, Prehistoric expedition 1960-1962: Munksgaard, Copenhagen.

Tauber, Henrik, 1960, Copenhagen radiocarbon dates IV: Am. Jour. Sci. Radiocarbon Supp., v. 2, p. 12-25.

———— 1962, Copenhagen radiocarbon dates V: Radiocarbon, v. 4, p. 27-34.

———— 1964, Copenhagen radiocarbon dates VI: Radiocarbon, v. 6, p. 215-225.

———— 1966, Copenhagen radiocarbon dates VII: Radiocarbon, v. 8, p. 213-234.

———— 1968, Copenhagen radiocarbon dates IX: Radiocarbon, v. 10, p. 295-327.

———— 1972, Radiocarbon chronology of the Danish Mesolithic and Neolithic: Antiquity, v. 46, p. 106-110.

Thrane, H., 1971, En broncealderboplads ved Jyderup Skov i Odsherred: Nationalmus. Arbejdsmark 1971, p. 141-164.

[RADIOCARBON, VOL. 15, No. 1, 1973, P. 113-126]

UNIVERSITY OF KIEL RADIOCARBON MEASUREMENTS VII

H. ERLENKEUSER and H. WILLKOMM

C^{14} Laboratory of the Institut für Kernphysik, University of Kiel

This list contains data obtained during 1971. Unless otherwise stated, all organic samples or organic fractions are carefully washed with dil. HCl and dil. NaOH to remove all carbonates. Age calculations are based on 95% of NBS oxalic acid standard activity with modern value A.D. 1950. Results are calculated using the Libby half-life and are given in the B.P. scale. Also ages of shells are calculated with the NBS oxalic acid standard. Ages are not corrected for δC^{13} variations. Errors correspond to 1σ variation of sample net counting rate including statistics of modern standard and background. Sample activities, if given in per cent refer to 0.95 NBS oxalic acid standard activity.

ACKNOWLEDGMENTS

We thank Heidi Metzner for measuring δC^{13} values and Günter Enge for treating water samples. We are indebted to the Deutsche Forschungsgemeinschaft for financial support within the Sonderforschungsbereich (joined research program) 95-Interactions water sea-floor boundary.

I. GEOLOGIC SAMPLES

A. Terrestrial Samples

KI-330. Recent twigs, 1969 — **156.3 ± 0.8%**, $\delta C^{13} = -25.9‰$

Twigs (*Malnus domesticus*) grown summer 1969 near Kiel (54° 18.5′ N Lat, 10° 4.3′ E Long), Germany. Coll. Sept. 1969.

Esterweger Dose, peat development

Peat from Esterweger Dose (53° 3.1′ N Lat, 7° 37.1′ E Long), emerged bog near Papenburg, NW Germany. Coll. 1969 and subm. by K. Müller, Bot. Inst., Univ. Kiel. *Comment*: samples complete series in R., 1971, v. 13, p. 335.

KI-337. Light peat, 65 to 67 cm depth — **1650 ± 50**, **A.D. 300**, $\delta C^{13} = -25.3‰$

Underlies KI-336.

KI-344. Light peat, 10 cm depth — **100.2 ± 0.5%**, $\delta C^{13} = -24.8‰$

Peat (*Sphagnum cuspidatum*) with twigs of Ericaceae and *Scheuchzeria*.

KI-516.01. Leopold oak, tree-ring 90 to 95 — **3550 ± 55**, **1600 B.C.**, $\delta C^{13} = -25.0‰$

Oak with 380 rings, from excavations at center of Kiel (54° 19.4′ N Lat, 10° 8.5′ E Long), Germany. Coll. 1971 and subm. by F. R.

Averdieck, Inst. f. Ur-und Frühgeschichte, Univ. Kiel. *Comment*: tree is for dendrochronologic study of Schleswig-Holstein.

Mammoth tusk, Tettenhausen

Part of mammoth tusk, from gravel pit near Tettenhausen (47° 57.6′ N Lat, 12° 45.7′ E Long), Bavaria, Germany. Coll. 1969 by Johannes Seidel, 8221 Reichersdorf, Post Petting; subm. 1970 by Edith Ebers, 8121 Haunshofen. *Comment* (J.S. and E.E.): tusk was covered by 460 cm gravel ("Laufenschotter") and lay 530 cm underground. Contamination by lime is possible. *Comment*: sample is divided into pieces of different purity (visual criteria), yet age of any fraction is much lower than expected. Organic parts were too small to measure.

KI-358.031. **3620 ± 70**
1670 B.C.
$\delta C^{13} = -9.9‰$

Selected, purely white material, surface mechanically removed.

KI-358.041. **4030 ± 80**
2080 B.C.
$\delta C^{13} = -10.1‰$

Fragments like .031, but with small dark impurities.

KI-358.051. **4070 ± 60**
2120 B.C.
$\delta C^{13} = -11.1‰$

Remains of .031 and .041, darkened surface parts.

KI-457. Boxberg, 1971 **910 ± 30**
A.D. 1040
$\delta C^{13} = -27.4‰$

Soil containing mixture of fossil B_s-, B_h-, and A_h-horizons 80 to 100 cm under ground from slope of Boxberg (54° 4.3′ N Lat, 9° 45.0′ E Long), Schleswig-Holstein, Germany. Coll. 1971 and subm. by G. M. Stanschus, Geog. Inst., Univ. Kiel. *Comments* (G.M.S.): horizons are residues of solifluctions during last interglacial or late glacial. Measured C^{14} content indicates recent contamination. Rootlets were washed away carefully. Carbonates were removed in usual way by diluted HCl.

B. Lakes and Underground Water

Plöner See, recent water and plants

Series is continued from 1970 (cf. R., 1971, v. 13, p. 329).

KI-324. Potamogeton perfoliatus, Plön 1969 **122.7 ± 0.8%**
$\delta C^{13} = -18.7‰$

Aquatic plants ca. 50 to 100 cm under surface of Grosser Plöner See (54° 9.0′ N Lat, 10° 25.1 E Long), NW Germany. Coll. Sept. 1969 and subm. by F. R. Averdieck.

TABLE 1
C^{14} dates of Plöner See sediments

Kiel C^{14} Lab.		Grosser Plöner See		KI-85 and KI-246		
	Depth within	Organic fraction		Inorganic fraction		Difference
Lab. no.	sediment (cm)	Libby age ± 1σ B.P.	δC^{13} ‰	Libby age ± 1σ B.P.	δC^{13} ‰	of Libby ages (yr)
85.20	550 to 580	1620 ± 65	−29.7	3160 ± 90	−1.7	1540
85.21	580 to 608	1540 ± 80	−29.2	3260 ± 75	−1.4	1720
85.22	608 to 634	1700 ± 80	−30.6	3800 ± 65	−0.9	2100
85.23	650 to 680	1700 ± 90	−30.6	4230 ± 140	−1.4	2530
85.24	680 to 710	2160 ± 110	−32.2	3860 ± 110	−0.4	1700

122.2 ± 0.7%

KI-487. Aquatic plants, Plön 1971 $\delta C^{13} = -14.1‰$

Same position as KI-324, 150 to 180 cm under surface. KI-485, 486, and 487 coll. Sept. 1971 and subm. by G. Enge and H. Erlenkeuser.

120.9 ± 0.8%

KI-486. Surface water, Plön 1971 $\delta C^{13} = -3.8‰$

Pumped from 4 m under surface (total depth ca. 28 m) at (54° 9.5′ N Lat, 10° 25.1′ E Long). Well marked thermocline between 16 to 18 m.

121.1 ± 0.7%

KI-485. Depth water, Plön 1971 $\delta C^{13} = -7.6‰$

Pumped from 26.5 m under surface at same position as KI-486.

Plöner See series

Lake sediments of the Grosser Plöner See (54° 9.5′ N Lat, 10° 25.1′ E Long), NW Germany. Coll. and subm. 1966 by F. R. Averdieck and W. Ohle, Max-Planck-Inst. f. Limnol., Plön. Continuation of former dates (R., 1971, v. 13, p. 327). Dates are given in Table 1. *Comment*: results confirm large difference between organic and inorganic fraction in 6 to 7 m depth.

Ravensberg series

Lake sediments under small emerged bog near Süderlügum (54° 50.7′ N Lat, 8° 57.5′ E Long), NW Schleswig-Holstein, Germany. Coll. 1970 and subm. 1971 by Hartmut Usinger, Bot. Inst., Univ. Kiel, who also made pollen analysis.

12,080 ± 110
10,130 B.C.

KI-419. RB 12-14 $\delta C^{13} = -25.8‰$

Gyttja 462 cm under water surface. *Comment* (H.U.): expected age: some centuries before Bölling, ca. 11,400 B.C.

KI-420. RB 20-22 **12,650 ± 280**
10,700 B.C.
$\delta C^{13} = -23.9‰$

Gyttja 446 cm under water surface. *Comment* (H.U.): middle of Bölling.

KI-421. RB 28-30 **10,840 ± 130**
8890 B.C.
$\delta C^{13} = -20.5‰$

Gyttja 430 cm under water surface. *Comment* (H.U.): beginning of Alleröd. C^{14} age ca. 1100 yr too young.

Well series, Kiel 1971

Water samples of different wells near Kiel, Germany, coll. Sept. 1971 by G. Enge, Inst. f. Kernphysik, Univ. Kiel. CO_2 of 50 L acidified water was liberated on stirring by bubbling nitrogen and frozen out with liquid air (Enge, 1971).

KI-475. Brunnen der Universität **55.1 ± 0.4%**
$\delta C^{13} = -14.4‰$
38 to 65 m deep (54° 22.3′ N Lat, 10° 7.3′ E Long).

KI-476. Brunnen 11, Schulensee **52.8 ± 0.4%**
$\delta C^{13} = -13.3‰$
78 to 138 m deep (54° 17.6′ N Lat, 10° 6.1′ E Long).

KI-477. Brunnen 5, Kiel-Wik **36.39 ± 0.20%**
$\delta C^{13} = -13.8‰$
149 to 199 m deep (54° 20.7′ N Lat, 10° 7.1′ E Long).

C. Marine Samples

Kiel Bay Sediment

Muddy sediment from NW Kiel Bay (54° 46.3′ N Lat, 10° 11.3′ E Long), W Baltic Sea. Coll. and subm. by F. Werner, Geol. Inst., Univ. Kiel, and H. Erlenkeuser and H. Willkomm, March 1971. Sample is from surface sediment, at −26 m, with Box Corer (cross section 20 × 28 cm). Sediment core was cut into slices 1 cm thick parallel to sediment surface. Samples were boiled with 1% HCl to remove traces of carbonate, filtered, washed to neutrality, and dried. Samples were converted to CO_2 by dry combustion. Results are given in Table 2. *Comment*: sediment core is from area with high sedimentation rate (ca. 3 mm/year) with postglacial mud layers up to 20 m thick (Seibold *et al.*, 1971). Radiographic methods show a layered structure of sediment core between 0 to 90 mm depth, whereas below 160 mm sediment is homogeneous without recognizable structure. Measurements give an apparent age of pre-bomb sediments of ca. 1000 yr. Steep increase of C^{14} activity between at least 68 mm and surface is probably due to bomb-produced C^{14}. Significance of the older layer interposed at 100 to 70 mm is still under discussion.

Kiel Bay Macrobenthic series, 1971

Shells of live mollusks at different positions in W Kiel Bay. Coll. by A. Fritsche, R. S. Newton, F. Werner, Geol. Inst., Univ. Kiel, and H. Willkomm, March 1971; subm. by H. Erlenkeuser and H. Willkomm. Only carbonate fraction was dated. Large specimen (diam. > 5 cm) was used.

KI-407.011. Aero S.W., 11777 **129.5 ± 1.2%**
$\delta C^{13} = -0.1‰$

Cyprina islandica, (54° 46.3′ N Lat, 10° 11.3′ E Long), from black-gray muddy sediment surface, 26 m water depth.

KI-408.011. Aero S.W., 11779 **105.8 ± 0.8%**
$\delta C^{13} = +0.8‰$

Cyprina islandica, (54° 47.0′ N Lat, 10° 14.6′ E Long), from black-gray muddy sediment surface, 29 m water depth.

TABLE 2
C^{14} dates of Kiel Bay sediments
Age calculations are made without δC^{13} corrections

Kiel C^{14} Lab.	Kiel Bay sediments Aero S.W., 11777-3		KI-483
Lab. no.	Depth within sediment (mm)	Organic fraction Libby age ± 1σ B.P.	δC^{13} (‰)
483.01	0 to 20	540 ± 45	−23.3
483.02	20 to 32	450 ± 60	−22.5
483.03	32 to 44	680 ± 55	−22.8
483.04	44 to 56	955 ± 55	−22.5
483.05	56 to 68	900 ± 40	−21.9
483.06	68 to 80	1060 ± 85	−21.6
483.07	80 to 92	1625 ± 65	−21.6
483.08	92 to 104	1480 ± 60	−21.1
483.09	104 to 116	1475 ± 70	−21.3
483.10	116 to 128	1065 ± 60	−21.5
483.11	128 to 140	1325 ± 45	−21.1
483.12	140 to 152	1095 ± 80	−22.3
483.13	152 to 164	1120 ± 45	−20.1
483.14	164 to 188	1110 ± 55	−20.1
483.15	188 to 212	1055 ± 55	−20.5
483.16	212 to 236	920 ± 50	−20.3
483.17	236 to 260	810 ± 60	−20.7
483.18	260 to 284	—	—
483.19	284 to 308	750 ± 55	−20.0
483.20	308 to 332	940 ± 60	−21.5

103.4 ± 0.5%

KI-410.011. Aero S.W., 11818 $\delta C^{13} = +0.4‰$

Astarte borealis, (54° 50.1′ N Lat, 10° 5.6′ E Long), from fine grained sand bottom, 16 m water depth.

113.5 ± 0.4%

KI-411.011. Aero S.W., 11849 $\delta C^{13} = -0.1‰$

Cyprina islandica, (54° 46.9′ N Lat, 10° 5.4′ E Long) from fine grained sand bottom, 19 m water depth.

103.0 ± 0.8%

KI-412.011. Aero S.W., 11851 $\delta C^{13} = +2.0‰$

Cyprina islandica (54° 46.9′ N Lat, 10° 5.8′ E Long), from brown muddy sand bottom, 23 m water depth.

104.0 ± 0.5%

KI-413.011. Aero S.W., 11857 $\delta C^{13} = +1.0‰$

Big *Cyprina islandica* (8 cm diam.), (54° 43.0′ N Lat, 10° 4.2′ E Long) from gray muddy sand bottom, 13.5 m water depth.

106.7 ± 0.6%

KI-415.011. Aero S.W., 11859 $\delta C^{13} = +1.6‰$

Cyprina islandica, (54° 43.3′ N Lat, 10° 5.7′ E Long) from coarse grained sand bottom, 13 m water depth. *Comment*: shells show considerably low C^{14} activity compared with recent macrobenthic samples KI-414, -524, -528 and -529, even in view of life-span of mollusks, *i.e.*, ca. 10 yr (Kühlmorgen-Hille, 1963).

133.2 ± 0.9%

KI-414. Aero S.W., 11858 $\delta C^{13} = -23.0‰$

Laminaria digitata, (54° 47.5′ N Lat, 10° 4.0′ E Long) growing on lag sediment, 10 m water depth. Coll. and subm. by R. S. Newton and F. Werner, Geol. Inst., Univ. Kiel, and H. Erlenkeuser and H. Willkomm, March 1971.

Stoller Grund

Samples from 'Stoller Grund', (54° 31.8′ N Lat, 10° 10.7′ E Long) SW Kiel Bay. Grown on lag sediment. Coll. and subm. by H. Erlenkeuser, Nov. 1971.

132.4 ± 0.8%

KI-524. Stoller Grund, 1 $\delta C^{13} = -24.7‰$

Red algae assoc.

126.6 ± 2.6%

KI-525. Stoller Grund, 2 $\delta C^{13} = -28.8‰$

Red and brown algae assoc.

Stoller Rinne

Varied macrobenthic samples from 'Stoller Rinne' (54° 29.5′ N Lat, 10° 11.5′ E Long) SW Kiel Bay. Surface sediment is lag on till and

sand. Water depth ca. 10 m. Coll. and subm. by H. Erlenkeuser, Nov. 1971.

KI-528.01. Stoller Rinne, 1 **134.9 ± 1.2%**
$\delta C^{13} = -19.1‰$
Small specimen (*Astropecten irregularis*) diam. <1 cm.

KI-528.02. Stoller Rinne, 2 **132.5 ± 0.7%**
$\delta C^{13} = -27.3‰$
Bread-crumb sponges (*Halichondria panicea* Pall.)

KI-528.03. Stoller Rinne, 3 **130.8 ± 0.9%**
$\delta C^{13} = -31.8‰$
Red algae.

KI-528.04. Stoller Rinne, 4 **133.6 ± 0.7%**
$\delta C^{13} = -25.3‰$
Brown algae.

General Comment: if corrected for isotopic fractionation, sample activities do not show significant differences and are higher than water activity (KI-531).

Schilksee Bay

Varied macrobenthic samples from 'Grashügel' (54° 25.3′ N Lat, 10° 11.7′ E Long), submarine hillock in Schilksee Bay in outer Kiel Fjord, W Baltic Sea. Lag and sand sediment surface, 5 to 12 m water depth. Coll. and subm. by H. Erlenkeuser, Nov. 1971.

KI-529.01. Schilksee, 1 **129.1 ± 1.4%**
$\delta C^{13} = -24.9‰$
Bread-crumb sponge (*Halichondria panicea* Pall.)

KI-529.02. Schilksee, 2 **124.3 ± 2.0%**
$\delta C^{13} = -18.9‰$
Small specimen (*Astropecten irregularis*) diam. <1 cm.

KI-529.03. Schilksee, 3 **128.4 ± 1.1%**
$\delta C^{13} = -27.5‰$
Red algae.

General Comment: activity of KI-529 samples is significantly lower than open sea sample activity (KI-524, -525, and -528).

KI-531. Schönberger Strand **126.9 ± 0.7%**
$\delta C^{13} = -0.5‰$

Surface water (54° 25.0′ N Lat, 10° 25.0′ E Long), S Kiel Bay, CO_2 liberated from inorganic carbonates. Coll. and subm. by H. Erlenkeuser, Dec. 1971. Water was taken at head of groin built into the open sea, 50 m apart from strand. Water depth 5 m, sand sediment surface. *Comment*: activity corrected for isotopic fractionation seems too low compared to benthonic samples KI-414, -524, -525, -528, and -529.

Landsort Basin

Muddy sediments from Landsort Basin (58° 40′ N Lat, 18° 20′ E Long), middle Baltic Sea. Coll. and subm. 1971 by E. Suess, Geol. Inst., Univ. Kiel. Sediment surface, −459 m. Samples are from box core 9 m long. Depths refer to sediment surface.

KI-405.020. 150 to 190 cm depth

1700 ± 110
A.D. 250
$\delta C^{13} = -26.8‰$

Sample is treated with hot 1% HCl, filtered, washed, and dried before combustion. Final content of C_{org} is 1.4%.

KI-405.022. 180 to 190 cm depth

2560 ± 160
610 B.C.
$\delta C^{13} = -29.0‰$

Same material as KI-405.020. Treated with hot 1% HCl, filtered and washed. Additionally boiled with 1% NaOH, washed to neutrality by centrifuging and decanting. Final C_{org} content is 0.8%. *Comment*: as indicated by low δC^{13} value, KI-405.022 mainly consists of organic complexes that have become highly resistant to chemical attack during their history of diagenesis (Degens, 1969; Williams *et al.*, 1970).

KI-405.030. 340 to 348 cm depth

1770 ± 85
A.D. 180
$\delta C^{13} = -26.2‰$

Sample treated with 1% HCl only. Final C_{org} content 1.6%.

KI-405.040. 366 to 376 cm depth

11,030 ± 170
9080 B.C.
$\delta C^{13} = -21.1‰$

Sample dried only. C_{org} content is 4.5%. *Comment*: sample might be contaminated with inorganic carbonate as guessed from underlaying samples (undated). Correction for inorganic carbonate aided by δC^{13} value reduces C^{14} age to ca. 8300 yr B.P.; still too old in view of deeper samples.

KI-405.05. 436 to 450 cm depth

No chemical pretreatment. C_{org} content 2.0%. Carbonates ca. 0.10 mMol/g.

KI-405.05-20323.

3410 ± 95
1460 B.C.
$\delta C^{13} = -27.9‰$

First measurement of sample.

KI-405.05-20340.

3520 ± 160
1570 B.C.
$\delta C^{13} = -21.1‰$

Second measurement. *Comment*: same counting gas as KI-405.05-

20323, but purified a 2nd time. Gas was purified because 1st sample mass spectrum showed unusual mass lines due to unknown contaminants. Weighted mean C^{14} age: 3440 ± 85 B.P.

KI-405.06. 633 to 640 cm depth — **4430 ± 190 / 2480 B.C.**

$\delta C^{13} = -27.2‰$

No chemical pretreatment. C_{org} content 1.5%. Carbonates ca. 0.12 mMol/g. *Comment*: mass spectrum contaminated. δC^{13} might be too low (see KI-405.05).

KI-405.07. 880 to 890 cm depth — **4810 ± 95 / 2860 B.C.**

$\delta C^{13} = -29.2‰$

No chemical pretreatment. C_{org} content 1.2%. Carbonates ca. 0.02 mMol/g. *Comment*: mass spectrum contaminated. δC^{13} value might be too low (see KI-405.05).

General Comment: samples dated for chemical and microbiological studies on development of middle Baltic Sea (Suess, 1971).

Canary Islands

Mollusk shells from littoral terraces of different heights above sea level for dating ancient landlift of Canaries. Coll. 1965 and subm. 1970 by Heinz Klug, Geog. Inst., Univ. Kiel (Klug, 1968).

KI-359. Gran Canaria, Bañaderos, 65 m — **>37,900 (<0.89%)**

$\delta C^{13} = -1.2‰$

Shells from Gran Canaria (28° 38.5′ N Lat, 15° 32′ W Long) at +65 m, 5 to 90 cm below surface. Statistical certainty of age estimate is 90%.

KI-360. Gran Canaria, Arucas, 25 m — **>38,800 (<0.80%)**

$\delta C^{13} = +0.7‰$

Shells from Gran Canaria (28° 37.3′ N Lat, 15° 31′ W Long) from terrace at + 25 m, 5 to 25 cm below surface. Statistical certainty of age estimate is 90%.

KI-361. Fuerteventura, Jandia, 55 m

Different shells belonging to a terrace, +55 m, at Fuerteventura (28° 3′ N Lat, 14° 22′ W Long). The 3 largest shells were treated separately, and their carbonate gave following ages (activity in % of modern in brackets).

KI-361.011. — **(0.58 ± 0.22%)** — $\delta C^{13} = -0.5‰$ — **41,300 −4000 −2600 / 39,300 B.C.**

+1700
(2.49 ± 0.46‰) 29,700
−1400

KI-361.021. $\delta C^{13} = -3.1‰$ **27,700 B.C.**

(4.61 ± 0.24‰) 24,720 ± 420

KI-361.031. $\delta C^{13} = -0.9‰$ **22,770 B.C.**

Comment: according to different activity, at least the 2 older shells must have been redeposited.

22,730 ± 550

KI-362. Lanzarote, Montaña Roja, 6 m 20,780 B.C.

(5.91 ± 0.40‰) $\delta C^{13} = +3.5‰$

Purpura haemastoma L. from Lanzarote (28° 51.5′ N Lat, 13° 51′ W Long), at +6 m.

+4000
37,300
−2700

KI-363. Lanzarote, Los Ajaches, 55 m 35,300 B.C.

(0.21 ± 0.08‰) $\delta C^{13} = -2.6‰$

Vermetus Lumbicatis L., from Lanzarote (28° 51.5′ N Lat, 13° 46.3′ W Long) from terrace at +55 m.

>46,700

KI-364. Gran Canaria, Agaete Nord (<0.30‰)

$\delta C^{13} = +1.5‰$

Shells from Gran Canaria (28° 36′ N Lat, 15° 41′ W Long) from terrace at +85 to +91 m.

+4000
38,000
−2700

KI-365. Fuerteventura, Los Malinos, 6 m 36,000 B.C.

(0.88 ± 0.35‰) $\delta C^{13} = +2.9‰$

Shells (*Cassis* sp.) from W Fuerteventura (28° 31′ N Lat, 14° 4′ W Long).

>27,900

KI-501. Lanzarote, Montaña Roja, 6 m (<3.1‰)

Patella intermedia, from same position as KI-362. Statistical certainty of age estimate is 90%.

Probstei coastline series

Peat and wood from Baltic sea coast of Probstei, Schleswig-Holstein, indicating geomorphologic development of coastline.

1170 ± 100

KI-80. Schön 1 A.D. 780

$\delta C^{13} = -28.5‰$

Root of tree from peat covered with ca. 80 cm sand and gravel at Schönberg beach (54° 24.8′ N Lat, 10° 25.3′ E Long). Coll. 1966 and subm. by H. Willkomm.

KI-220. Schön 2

830 ± 40
A.D. 1120
$\delta C^{13} = -27.9‰$

Root of tree 30 m behind Schönberg beach (54° 25.7′ N Lat, 10° 22.7′ E Long). Sample lay 80 to 90 cm underground in peat covered by 50 cm sea sand indicating later transgression. Coll. 1967 and subm. by H. Willkomm.

KI-366. Köhler 2

3060 ± 100
1110 B.C.
$\delta C^{13} = -25.3‰$

Peat from surface of sea floor, ca. 30 m from shore (54° 25.7′ N Lat, 10° 23.3′ E Long). Coll. 1969 and subm. 1970 by Jürgen Köhler, Geog. Inst., Univ. Kiel.

KI-367. Köhler 1

3080 ± 65
1130 B.C.
$\delta C^{13} = -28.4‰$

Wood from peat covered with sand at sea floor near Stakendorf beach (54° 24.5′ N Lat, 10° 26.3′ E Long). Coll. 1969 and subm. 1970 by J. Köhler.

KI-381. 10056, 200 to 220 cm under sea floor

11,880 ± 100
9930 B.C.
$\delta C^{13} = -28.1‰$

Peat from bottom of Baltic Sea (54° 34.24′ N Lat, 10° 6.21′ E Long), water depth 29 m. Coll. 1969 and subm. 1970 by F. Werner, Geol. Inst., Univ. Kiel. *Comment*: continues Kieler Bucht series (R., 1971, v. 13, p. 334).

II. ARCHAEOLOGIC SAMPLES

KI-82. Burg Ahr

490 ± 40
A.D. 1460
$\delta C^{13} = -24.1‰$

Cut of ceiling rafter of Kemenate (ladies bower) of Ahr castle near Altenahr/Eifel (50° 30′ N Lat, 6° 59′ E Long), W Germany. Coll. 1966 and subm. by H. Erlenkeuser. *Comment*: it is really as old as the guide tells.

Alt-Lübeck

Plant residues under wooden foundation of mound of Slovanic castle Alt-Lübeck (53° 55′ N Lat, 10° 43′ E Long), ca. 5 km N of present Lübeck, Germany. Coll. 1968 and subm. 1969 by F. R. Averdieck.

KI-278. Sambucus twigs

1030 ± 40
A.D. 920
$\delta C^{13} = -26.4‰$

KI-289. Peat **1100 ± 45**
A.D. 850
$\delta C^{13} = -28.3‰$

Comment (F.R.A.): very local character of mixture of swamp and ruderal flora makes palynologic zonation difficult. Expected age of wood and peat is 11th century or later.

Haithabu

Wood from Haithabu (54° 30′ N Lat, 9° 33′ E Long), ancient Viking town near Schleswig, NW Germany. Coll. by Josef Bauch and Dieter Eckstein, Ordinariat f. Holzbiol., Hamburg 80; subm. 1967 by F. R. Averdieck. *Comment* (J.B. and D.E.): samples are connected to dendrochronology of Haithabu, which is not yet connected to present. Tree rings indicate KI-242 is 280 yr older than KI-241. Measured C^{14} ages are ca. 100 yr older than expected.

KI-241. Haithabu, Probe 4 **1250 ± 40**
A.D. 700
$\delta C^{13} = -25.7‰$

KI-242. Haithabu, Probe 5 **1630 ± 40**
A.D. 320
$\delta C^{13} = -25.9‰$

Saelborg skull

Wood and peat overlying skull from Saelborg shore near Esbjerg (55° 30′ N Lat, 8° 27′ E Long), Denmark. Coll. 1968 by Walter Wetzel, Geol.-Paläont. Inst., Univ. Kiel; subm. 1969 by Hermann Helmuth, now Univ. Peterborough/Toronto, Canada (cf. Wetzel and Helmuth, 1970). *Comment*: Libby age indicates wood must have been redeposited.

KI-297. Saelborg, peat **2750 ± 65**
800 B.C.
$\delta C^{13} = -29.9‰$

Sandy peat, overlying skull, dated by pollen analysis (F. R. Averdieck, Inst. f. Ur- und Frühgeschichte, Univ. Kiel) in Zone IXa (according to Overbeck, 1950). *Comment* (W.W.): Libby age is too young.

KI-298. Saelborg, wood **14,890 ± 160**
12,940 B.C.
$\delta C^{13} = -25.0‰$

Budrinna series

Organic remains of burials from Budrinna, Libya (26° 42′ N Lat, 13° 48′ E Long). Coll. and subm. 1970 by Helmut Ziegert, Seminar f. Vor- u. Frühgeschichte, Univ. Hamburg. *Comment* (H.Z.): samples are from different vaults of pre-Islamite burial place. Dates will help set chronology of pre-Islamite colonization of the Fezzan. Samples, except for KI-397, lay ca. 110 to 180 cm under surface (Ziegert, 1969; 1970).

KI-392. Budr. A/6/Pr. 7 — **1360 ± 60**, **A.D. 590**, $\delta C^{13} = -22.8‰$

Carbonized remains of burial.

KI-393. Budr. A/5/Pr. 7 — **1270 ± 60**, **A.D. 680**, $\delta C^{13} = -24.2‰$

Carbonized remains of brain.

KI-394. Budr. A/9/Pr. 5 — **1470 ± 110**, **A.D. 480**

Carbonized remains of brain.

KI-395. Budr. A/8/Pr. 12 — **1450 ± 55**, **A.D. 500**, $\delta C^{13} = -23.0‰$

Carbonized remains of brain.

KI-396. Budr. A/7/Pr. 22 — **1330 ± 40**, **A.D. 620**, $\delta C^{13} = -21.2‰$

Carbonized remains of brain.

KI-397. Budr. A/11/Pr. 2 + 3 — **1530 ± 160**, **A.D. 420**, $\delta C^{13} = -25.6‰$

Charcoal from fireplace above tomb, 45 cm under surface.

KI-398. Budr. A/11A/Pr. 11 — **1290 ± 45**, **A.D. 660**, $\delta C^{13} = -22.5‰$

Carbonized remains of brain.

KI-399. Budr. A/10D/Pr. 1 — **1780 ± 80**, **A.D. 170**, $\delta C^{13} = -23.9‰$

Twigs of tamarisc covering corpse in a vault.

KI-400. Budr. A/10B/Pr. 10 — **1840 ± 150**, **A.D. 110**, $\delta C^{13} = -23.2‰$

Carbonized remains of brain.

KI-401. Budr. A/10C/Pr. 7 — **1350 ± 50**, **A.D. 600**, $\delta C^{13} = -21.3‰$

Carbonized remains of brain.

1690 ± 110

KI-402. Budr. B/3/Pr. 2 **A.D. 260**

$\delta C^{13} = -26.4‰$

Stalks of a mat underlying corpse in a vault tomb.

1780 ± 65

KI-403. Budr. D/2/Pr. 7 **A.D. 170**

$\delta C^{13} = -27.8‰$

Carbonized remains of brain.

1050 ± 90

KI-438. Las Tortolas **A.D. 900**

$\delta C^{13} = -22.1‰$

Sample of a wood pile on top of Las Tortolas, 6330 m, Chile (29° 51.0′ S Lat, 69° 53.5′ W Long). Coll. 1971 and subm. by Klaus Krisch, Inst. f. Physiol. Chem., Univ. Kiel. *Comment* (K.K.): wood could have been piled during realm of Incas, for use in fire signals (summit of empire ca. A.D. 1400 to 1500).

References

Degens, E. T., 1969, Biochemistry of stable isotopes, *in*: Eglinton, G., Murphy, M. T. J. (eds.), Organic Geochemistry, Berlin, Springer Verlag, chap. 12, p. 304-329.

Enge, Günter, 1971, C^{13}- und C^{14}-Untersuchungen an rezenten Wasserproben: Staatsexamensarbeit, Kiel.

Klug, Heinz, 1968, Morphol. Studien auf den Kanarischen Inseln: Geog. Inst. Kiel Schr., v. 24, p. 3.

Kühlmorgen-Hille, G., 1963, Quantitative Untersuchungen der Bodenfauna in der Kieler Bucht und ihre jahreszeitlichen Veränderungen: Kieler Meeresforschungen, v. 19, p. 42-66.

Overbeck, Fritz, 1950, Die Moore Niedersachsens: Bremen-Horn, Niedersächsisches Amt für Landesplanung und Statistik, p. 65-68.

Seibold, E. *et al.*, 1971, Marine geology of Kiel Bay: 8th internatl. sedimentological cong., Heidelberg, Germany, 1971; Sedimentology of parts of Central Europe, Guidebook, p. 209-235.

Suess, Erwin, 1971, Diagenesis of organic matter in Baltic Sea sediments: 8th internatl. sedimentological cong., Heidelberg, Germany, 1971, abs., p. 99.

Weizel, Walter and Helmuth, Hermann, 1970, Ein fossiles trepaniertes menschliches Stirnbein: Naturw. Ver. Schlesw.-Holst. Schr., v. 40, p. 97-100.

Williams, P. M., Gordon, L. I., 1970, Carbon-13: Carbon-12 ratios in dissolved and particulate organic matter in the sea: Deep-Sea Research, v. 17, p. 19-27.

Ziegert, Helmut, 1969, Überblick zur jüngeren Besiedlungsgeschichte des Fezzan: Berliner Geog. Abh., no. 8, 1969, p. 49-58.

———— 1970, Human cultural development and climatic conditions in the Sahara during Pleistocene times: Internatl. conf. on African geol., Ibadan, Dec. 1970.

[RADIOCARBON, VOL. 15, No. 1, 1973, P. 127-133]

LOUVAIN NATURAL RADIOCARBON MEASUREMENTS XII

E. GILOT and P. C. CAPRON
Department of Nuclear Chemistry
University of Louvain, Louvain, Belgium

The following list comprises selected measurements made in the Louvain ^{14}C Dating Laboratory with the 0.6 L CH_4 proportional counter. Details of procedure are given in previous lists. Dates are reported in terms of the Libby half-life, 5570 ± 30 years and quoted with 1σ experimental error.

Descriptions, comments, and references to publications are based on information supplied by the submitters.

Much of the technical work for sample preparation was carried out by F. Frix and electronics maintenance by G. Michotte. Financial support was provided by the Fonds de la Recherche Fondamentale Collective, Brussels.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Sainte Gertrude series

Fibrous peat from Tenneville (50° 05′ 05″ N Lat, 5° 27′ 17″ E Long), Prov. Luxembourg, Belgium, alt. 540 m. Coll. 1967 by D. Trullemans and W. Mullenders; subm. by W. Mullenders, Lab. Palynol., Univ. Louvain. Pollen analyzed by D. Trullemans. *Comment*: NaOH-leach omitted.

Lv-555. Sainte Gertrude **790 ± 110** **A.D. 1160**

From 53 to 60 cm depth in peat bog. At this level pollen curve shows 3rd beech maximum F III (Trullemans, 1971). Date agrees with other C^{14} dates of same feature in High Belgium (Gilot *et al.*, 1969).

Lv-556. Sainte Gertrude **1240 ± 65** **A.D. 710**

From 83 to 87 cm in peat bog. Dated level represents 2nd beech maximum F II. Dates agrees with palynologic results.

Lv-523. Hour la Petite **2740 ± 80** **790 B.C.**

Wood from Hour la Petite (50° 10′ N Lat, 5° 01′ E Long), Prov. Namur, Belgium, alt. 120 m. From trunk overlain by upper layers of dejection cone next to Lesse R. Overlying sediments dated to final Würm. Coll. 1970 by M. J. Michel; subm. by P. Macar, Univ. Liege. C^{14} date proves a land slip because of undermining by the river.

Lv-517. Lac Long Inférieur, France **7410 ± 120** **5460 B.C.**

Humic matter from lacustrine sediments from Lac Long Inférieur (44° 33′ 28″ N Lat, 7° 27′ 26″ E Long), Dept. Alpes Maritimes, France,

alt. 2093 m. From 161 to 169 cm depth in gray clay containing organic remains. Coll. 1969 by J. L. de Beaulieu; subm. by A. Pons, Lab. Hist. Botany Palynol., Univ. Provence, Marseille. Pollen analysis, by J. L. de Beaulieu, shows evolution of vegetation in Maritime Alps since Younger Dryas. C^{14} date proves that increase of *Abies*, followed by *Larix* increase, begins as early as Atlantic period.

Méditerranée series

Carbonate fraction from deep-sea core in E Mediterranean Sea. Coll. 1967 by "Jean Charcot" oceanog. ship. *Comment*: no C^{12}/C^{13} correction.

8420 ± 130

Lv-504. Méditerranée 39.MO.67 **6470 B.C.**

Core 39.MO.67 (36° 11′ N Lat, 22° 47′ E Long) in Ionian Sea, W of Cythere, depth 1340 m. From 23 to 30 cm, black sapropelic mud horizon, overlain by 17 cm brownish mud. Subm. by H. Chamley, Lab. Marine Geol., Univ. Provence, Marseille. Dated horizon corresponds to water stagnation period in E Mediterranean Sea estimated as end of Boreal to beginning of Atlantic period (Chamley, 1971). C^{14} date as expected.

Lv-505. Méditerranée 44.MO.67 **>36,210**

Core 44.MO.67 (35° 46′ N Lat, 23° 28′ E Long) in N Crete Basin, E of Cythere, depth 910 m. From 117 to 125 cm, gray-green sapropelic horizon. Subm. by H. Chamley. Paleoclimatic study on clay horizons leads to attribute this level to Würm II-Würm III interstadial (Chamley, 1971). C^{14} date as expected.

9370 ± 140

Lv-506. Méditerranée 25.MO.67 **7420 B.C.**

Core 25.MO.67 (35° 51′ N Lat, 25° 50′ E Long) in N Crete Sea between Iraklion and Santorin, depth 790 m. From 28 to 32 cm, black sapropelic horizon overlain by 25 cm muddy horizon with scattered volcanic sand. Subm. by H. Chamley. Correlated to end of Boreal to beginning of Atlantic period. Date as expected.

8590 ± 160

Lv-508. Méditerranée 3.MO.67 **6640 B.C.**

Core 3.MO.67 (34° 26′ N Lat, 24° 50′ E Long) in S Crete Sea, depth 1950 m. From 30 to 35 cm, black sapropelic horizon overlain by 26 cm brownish muddy layer. Subm. by H. Chamley. C^{14} date confirms Boreal/Atlantic age.

12,690 ± 280

Lv-509. Méditerranée 17.MO.67 **10,740 B.C.**

Core 17.MO.67 (36° 15′ N Lat, 27° 20′ E Long), NW of Rhodes I., depth 630 m. From 93 to 98 cm, black sapropelic mud with light-colored spots. Subm. by L. Pastouret, Centre Océanolog. de Bretagne, France. From foraminifera and pteropod stratigraphy, this level is dated 5000 to 7000 B.C. (Pastouret, 1970). Discrepancy is yet unexplained.

11,290 ± 120

Lv-507. Méditerranée 11.MO.67 **9340 B.C.**

Core 11.MO.67 (35° 33′ N Lat, 27° 44′ E Long), S of Crete I., depth 1260 m from 43 to 51 cm, black sapropelic mud with light-colored spots. Subm. by L. Pastouret. Due to same reasons as Lv-509, date seems too old.

Furka series, Switzerland

Samples from Col de la Furka, Alpetli near Realp (46° 36′ 03″ N Lat, 8° 27′ 40″ E Long), Canton Uri, Switzerland. Coll. 1970 and subm. by H. Zoller and W. Mullenders.

3620 ± 85

Lv-484. Furka **1670 B.C.**

Rootlet peat from 92.5 to 97.5 cm in peat bog, alt. 2285 m, at base of layer overlying gravel-sandy sediments. Date shows that truly post-glacial moraines of the Tiefengletscher, revealed as far as thalweg of Urseren valley, are earlier than Sub-Atlantic cold phases of Göschener. Also shows that during these cold phases, the Tiefengletscher hardly surpass its positions of 17th and 19th centuries. *Comment*: NaOH-leach omitted.

1010 ± 60

Lv-561. Furka II **A.D. 940**

NaOH soluble humic matter from alpine humic podzol, alt. 2310 m; sample from 11 cm depth in peaty humus horizon, 3.5 cm thick, overlying 0.5 to 1 cm sesqui-oxide layer on sand and gravel. Profile overlies a Tiefengletscher moraine ca. 30 m from the 17th century moraine. Date proves that underlying moraine is older than A.D. 940 and thus would correspond to glacial advance of Göschener II dated 6th to 7th centuries.

Alpe Chierra series, Switzerland

Samples from Alpe Chierra near Faido (46° 30′ 28″ N Lat, 8° 45′ 15″ E Long), Leventina, Canton Tessin, Switzerland, alt. 2015 m. Coll. 1970 and subm. by H. Zoller.

5550 ± 90

Lv-527. Alpe Chierra T2 **3600 B.C.**

Gyttja partly mixed with highly decomposed brown peat, from 115 to 122 cm depth. In pollen curve, *Picea abies* rises from <1% to nearly dominance. Date consistent with previous determinations and suggests relatively late *Picea* competed with *Pinus cembra* and *Pinus mugo* near altitudinal forest limit in S Swiss Alps. *Comment*: NaOH-leach omitted.

7690 ± 110

Lv-528. Alpe Chierra T3 **5740 B.C.**

Brown peat from 155 to 160 cm. Level characterized by maximum of *Abies alba* pollen with presence of *Abies stomates*. Not much later,

at 150 cm depth, begins a 2-fold NAP phase with a short *Betula phase*. Date shows wide altitudinal distribution of *Abies* during Boreal period and confirms temporary depression during Atlantic ca. 5500 to 4000 B.C. (Misox cold phases). *Comment*: NaOH-leach omitted.

8000 ± 160

Lv-529. Alpe Chierra T4 **6050 B.C.**

Clayey and sandy gyttja overlying glacial clay, from 182 to 190 cm. After a pioneer phase rich in NAP, comes a *Pinus* dominance with large percentages of *Corylus*. Date shows, as in Val Priora, relatively late reforestation close to glaciers of "Schlussvereisung."

II. ARCHAEOLOGIC SAMPLES

10,380 ± 170

Lv-535. Remouchamps **8430 B.C.**

Bones from Remouchamps cave (50° 29′ N Lat, 5° 43′ E Long), Prov. Liege, Belgium, alt. 140 m. From 40 cm depth, Trench D, Layer 4, Side 5. Bones were between horizon estimated final Würm and stalagmitic floor attributed to milder climate. Coll. 1970 and subm. by M. Dewez, Univ. Liege. Assoc. lithic industry is Ahrensburg culture, probably a little more recent than Layer C in Geldrod I dated 9010 B.C. ± 85 (de Vries *et al.*, 1958). Bone study indicates cold period, with reindeer dominance. All results agree.

Kemmelberg series

Charcoal from Kemmelberg at Loker (50° 46′ 37″ N Lat, 2° 48′ 40″ E Long), Prov. W Flanders, Belgium, alt. 144 m. From charcoal layer 0.5 to 2 cm thick covered by levelling silty sand, 0 to 25 cm thick, red (burned) at base. Cultural horizon overlies this layer. Coll. 1970 by A. Van Doorselaer; subm. by P. Vermeersch, Univ. Louvain.

5000 ± 120

Lv-524. Kemmelberg M2 **3050 B.C.**

Sample K70.10.M2 from charcoal layer, 62 cm below present ground surface.

5020 ± 95

Lv-525. Kemmelberg M3 **3070 B.C.**

Sample K70.10.M3 from same layer, 65 cm depth.

General Comment: archaeol. industry of Kemmelberg is attributed to Middle Neolithic, presently without precision. Both C^{14} dates are consistent with assumptions.

3970 ± 100

Lv-503. Arquennes **2020 B.C.**

Charcoal from Bois de la Garenne at Arquennes (50° 34′ N Lat, 4° 17′ E Long), Prov. Hainaut, Belgium. From Layers IV and V, 40 to 70 cm below ground surface, sand layers containing charcoal, flint, and ceramics. Coll. 1969 and subm. by Y. Graff, Romana Soc., Braine l'Alleud,

Belgium. Culture is not yet steadily determined: Michelsberg or S.O.M. (Graff and Decoster, 1971). Ceramic paste with ground flint is of same composition as that from Chaumont-Gistoux dated 2090 B.C. ± 90 (Lv-301, R., 1969, v. 11, p. 109). Date as expected.

Lv-481. Opgrimbie **1940 ± 70** **A.D. 10**

Charred wood from Opgrimbie (50° 57′ N Lat, 5° 40′ E Long), Prov. Limburg, Belgium. From hearth at 60 cm depth in upper part of B_3-C horizon of humoferric podzol, 11 m from center of Mesolithic site of which artifacts are found in A_2 and B_2 horizons. Coll. 1969 and subm. by P. Vermeersch. Although assoc. between hearth and industry is unsteady, strat. evidence suggests C^{14} date is too young (Vermeersch *et al.*, 1972).

Lv-541. Saint Servais **2400 ± 110** **450 B.C.**

Charcoal from Saint Servais (50° 28′ N Lat, 4° 51′ E Long), Prov. Namur, Belgium. Charcoal layer, at 1 m depth, embedded in rampart of protohist. refuge. Coll. 1970 by M. Cahen; subm. by J. Mertens, Univ. Louvain. Sample dates one of numerous Gallic oppida in Belgium, where archaeol. material is missing. Result as expected.

Lv-497. Rosmeer 69.RO.14 **2430 ± 85** **480 B.C.**

Charcoal from Rosmeer (50° 51′ N Lat, 5° 35′ E Long), Prov. Limburg, Belgium, alt. 110 m. From 1 m depth in Pre-Roman detritus pit. Coll. 1969 by G. de Boe; subm. by J. Mertens. Archaeol. date is questionable: Neolithic or Iron age. C^{14} date agrees with Iron age.

Lv-519. Oudenburg 70.Ou.27 **2040 ± 60** **90 B.C.**

Charcoal from Oudenburg (51° 11′ N Lat, 3° 00′ E Long), Prov. W Flanders, Belgium, alt. 3 m. From Trench I, Level 5. Coll. 1970 and subm. by J. Mertens. Sample from burned layer, archaeol. dated to 3rd or 4th century.

Lv-431. Lacuisine 67.La.9 **370 ± 80** **A.D. 1580**

Wood from feudal castle at Lacuisine (55° 22′ N Lat, 5° 25′ E Long), Prov. Luxembourg, Belgium. From beam incorporated in a protection tower. Sample 67.La.9 from 1 m depth, Trench 67 II/A. Coll. 1967 and subm. by J. Mertens. Castle was destroyed A.D. 1521. After correction according to dendrochronologic correlation curve by Suess C^{14} date is compatible with hist. data.

Tongeren series

Charcoal from Tongeren (56° 42′ N Lat, 5° 43′ E Long), Prov. Limburg, Belgium, alt. 105 m. Coll. 1967 and subm. by J. Mertens. Samples from same level with Roman archaeol. material, but strat. horizons seemed altered. Both dates confirm this last interpretation.

780 ± 85

Lv-428. Tongeren 67.To.1 **A.D. 1170**

880 ± 65

Lv-429. Tongeren 67.To.23 **A.D. 1070**

910 ± 75

Lv-536. Corroy le Château **A.D. 1040**

Oak from Corroy le Château (50° 32′ N Lat, 4° 39′ E Long), Prov. Namur, Belgium, alt. 163 m. From principal rafter of primeval timberwork of NW wing of castle. Coll. 1970 by T. Cortenbos; subm. by L. F. Génicot, Univ. Louvain. Sample was fixed in building archaeol. attributed to 2nd half of 13th century (Cortenbos, 1971).

Grimbergen series

Charcoal from a feudal mound at Grimbergen (50° 55′ 45″ N Lat, 4° 24′ 30″ E Long), Prov. Brabant, Belgium, alt 28 m. Coll. 1967 and subm. by R. Borremans, Mus. Royaux d'Art et d'Hist., Brussels. Dated horizon corresponds to earliest occupation on top of mound. According to hist. data, castle was destroyed A.D. 1159.

830 ± 70

Lv-533. Grimbergen 1 **A.D. 1120**

From Sq. M10, Pit 1.

770 ± 65

Lv-534. Grimbergen 2 **A.D. 1180**

Pale from Sq. KL12, Layer 2.

1120 ± 65

Lv-532. Huizingen **A.D. 830**

Wood from Huizingen (50° 44′ N Lat, 4° 36′ E Long), Prov. Brabant, Belgium, alt. 33 m. From hollowed oak trunk containing human skeleton at 2.30 m depth, ca. 4 m from S wall of destroyed St. John Baptist church. Coll. 1967 and subm. by R. Borremans. C^{14} date agrees with assumed date of church foundation. It is 1st burial of that type found in Belgium.

790 ± 60

Lv-522. Vohémar, Madagascar **A.D. 1160**

Human bones from Vohémar (13° 20′ S Lat, 50° 00′ E Long), Madagascar. From 2 m depth, in cemetery of ancient Mohammedan settlement in NE sea coast of Madagascar. Coll. 1941 by M. Gaudebout and E. Vernier; subm. by J. Millot, Mus. de l'Homme, Paris. Site was occupied by Mohammedan colony during Middle ages, probably since 11th till 14th century (Vernier and Millot, 1971). Date agrees with archaeol. context and elucidates Indian Ocean history before European colonization.

References

Chamley, H., 1971, Recherches sur la sédimentation argileuse en Méditerranée: Thesis, Sci. Fac., Marseille, 401 p.

Cortenbos, T., 1971, Corroy le Château, Organisation d'une forteresse du XIIIe siècle: Mém., Univ. Louvain, 122 p.

de Vries, Hessel, Barendsen, G. W., and Waterbolk, H. T., 1958, Groningen radiocarbon dates II: Science, v. 127, p. 129-137.

Gilot, E., 1969, Louvain natural radiocarbon measurements VII: Radiocarbon, v. 11, p. 106-111.

Gilot, E. *et al.*, 1969, Evolution de la végétation et datations ^{14}C en Belgique: Centre Belge d'Histoire Rurale, pub. 15, 29 p.

Graff, Y. and Decoster, J., 1971, Le site néolithique du Bois de la Garenne à Arquennes: Romana Contact, v. 2.

Pastouret, L., 1970, Etude sédimentologique et paléoclimatique des carottes prélevées en Méditerranée orientale: Téthys, v. 2, no. 1, p. 227-266.

Trullemans, D., 1971, Etude palynologique de la tourbière de Sainte Gertrude en Ardenne belge: Mém., Univ. Louvain, 90 p.

Vermeersch, P., Paulissen, E., and Munaut, A. V., 1972, Fouilles d'un site mésolithique à Opgrimbie (Limbourg belge): Soc. royale belge anthropol. prehist. Bull., v. 83.

Vernier, E. and Millot, J., 1971, Archéologie malgache (Comptoirs musulmans): Paris, Mus. de l'Homme.

[RADIOCARBON, VOL. 15, NO. 1, 1973, P. 134-155]

LYON NATURAL RADIOCARBON MEASUREMENTS III

J. EVIN, G. MARIEN, and Ch. PACHIAUDI

Laboratoire de Radiocarbone du Département de Géologie,
Université de Lyon I, Institut de Physique nucléaire,
69 Villeurbanne, France

INTRODUCTION

The present list includes most of the samples measured since the establishment of the laboratory in 1965 and not yet published in the two previous dates lists.

Almost all the following samples were measured in the two proportional counters (0.5 effective volume filled with 3 atm CO_2 already described (R., 1969, v. 11, p. 112). The other measurements were made, using a liquid scintillation device, Model 3320 Tricarb. For routine counting the solution introduced in this detector is: 2 cc sample benzene, 13 cc inactive toluene, 0.4% PPO, 0.01% Dime POPOP. With this scintillator solution, background rate is about 10.1 cpm and the modern standard about 21.3 cpm. For each measurement a quenching correction is made with a ratio of 2 counting channels. The maximum determinable age is equal to 30,000 yr.

Chemical treatments remain unchanged except for adoption of a purification procedure by adsorption on Al_2O_3. Benzene preparation is performed according to the method of Tamers (1965) *i.e.,* Li_2C_2 formation at 625°C, C_6H_6 production by trimerization of C_2H_2 on catalyst (K. C. Perl Catalysator neu, Kalic Chemie Cie). Preparation yields are 95% for C_2H_2 and 90% for C_6H_6. The detection yield in the scintillator is ca. 65% and does not vary much with preparations.

The organic or carbonated samples are prepared in the classic way. For the bone samples we use the method of collagen extraction by solubilization in acid hot water. This method has been set up in the laboratory by R. Longin and summarized in (R., 1971, v. 13, p. 60-61) (see also Longin, 1971).

Ages are calculated using the half-life value 5570 with 1950 as reference year. The statistical errors, corresponding to one standard deviation, include the contribution of the contemporary standard, background, and sample counting.

δC^{13} values of geologic and archaeologic samples were measured with a mass spectrometer Model A.E.I. MS 20 Isotopic, which ensures the routine C^{13} measurements since 1970 with a $\pm$ 0.05 per mil precision. Age corrections have not been made on these results.

ACKNOWLEDGMENTS

We are grateful to J. Flandrin and P. Elouard, Department of Geology, for their continuous support, and to A. Sarazin, Dir. Nuclear Physic Institute, for his help and the technical assistance of his Institute. Also, we thank Y. Chiarlone for chemical preparations and most routine

operations since Dec. 1970, and we are indebted to the staff of the Institute, R. Viano and C. Devesa, for their technical help.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Ly-280. Glacier du Chardon, Isère **750 ± 130**
A.D. 1200

Fragment of tree trunk from marginal moraine, right bank of Glacier du Chardon, near La Bérarde, Isère (44° 54′ N Lat, 6° 18′ E Long). Coll. and subm. 1970 by R. Vivian, Inst. Géog. alpine, Grenoble. *Comment* (R.V.): presence of pine trunk, much higher than actual forest, marks warming phase, preceding "little glacial-age" *sensu stricto*, ca. 16th to 19th centuries. Optimal warming phase occurred in Middle ages, and date agrees well.

Gorner Glacier series, Valais, Switzerland

Pieces of wood from alt. ca. 2000 m in marginal moraine, right bank of Gorner Glacier, near Zermatt, Valais, Switzerland (45° 59′ N Lat, 7° 44′ E Long). Coll. and subm. 1970 by R. Vivian.

Ly-297. Gorner Glacier 1 **7360 ± 180**
5410 B.C.

Coll. at alt. of existing ice limit.

Ly-298. Gorner Glacier 2 **8160 ± 220**
6210 B.C.

Coll. at alt 2050 m.

General Comment (R.V.): samples are oldest from moraines of alpine glaciers of Valais, at alt. where trees no longer exist. Theses results and Ly-299 date ice retreat, higher than now, between 8000 and 5000 B.P. Dates may be compared to measurements from Mont-Blanc Massif (France-Italy) VRI-106: 5250 ± 110 and VRI-107: 6400 ± 100 (R., 1970, v. 12, p. 310).

Ly-299. Glacier de Ferpècle, Valais, Switzerland **6950 ± 150**
5000 B.C.

Tree trunk from alt. 1500 m in Les Haudières low valley, Val d'Herens, Valais (46° 5′ N Lat, 7° 31′ E Long) moved from alt. 1900 m by a debacle of Glacier Ferpècle. Coll. and subm. 1970 by R. Vivian. *Comment* (R.V.): as Ly-297 and Ly-298, date warming phase which caused maximal retreat of alpine glaciers.

Ly-490. Massif du Marsaou, Var **Modern**
$\delta C^{13} = -19.35‰$

Bits of charcoal and woody fragments (*Sphagnum plumosum* and *Polythium commune* roots), included in red earth of rhyolite alteration from N side Massif du Marsaou, Esterel Massif, Var (43° 31′ N Lat, 6° 55′ E Long). Coll. and subm. 1971 by H. Triat, Lab. Bot. Hist. Palynol., Fac. Sci. Saint-Jérôme, Marseille. *Comment* (H.T.): sample from 36 cm depth in pollen-analyzed soil. Analysis was made in order to follow

forest evolution and to explain surprising presence of certain plant species at site. Result excludes hypothesis of ancient origin of *Sphagnum*.

460 ± 100

Ly-363. Albigny, Rhône **A.D. 1490**

Ox and ass bones from ditches of a castle at Albigny, Rhone (45° 51′ N Lat, 4° 50′ E Long). Coll. and subm. 1969 by C. Guérin, Dept. Sci. de la Terre, Univ. Lyon I. *Comment* (C.G.): bones come from either a geologic deposit in low terrace of Saône R., or, as suggested by this post-Gallo-Roman fauna, from an artificial earthwork. Date confirms later hypothesis.

1980 ± 130

Ly-463. Costeplane, Alpes de Haute Provence **30 B.C.**

Charcoal from under landslide at Costeplane near Le Lauzet, Alpes de Haute Provence (44° 26′ N Lat, 6° 26′ E Long). Coll. and subm. 1970 by R. Chalavoux, Lyon. *Comment* (R.C.): age is maximum for landslide overlying charcoal whose age agrees with presence of indications of Roman occupation in region.

4630 ± 140

Ly-426. Hière sur Amby, Isère **2680 B.C.**

$\delta C^{13} = -24.32‰$

Fine charcoal debris included in calcareous tufa in Val d'Amby, near Hière sur Amby, Isère (45° 48′ N Lat, 5° 68′ E Long). Coll. and subm by J. Flandrin, Dept. Sci. de la Terre, Univ. Lyon I. *Comment* (J.F.): proves calcareous tufa is ancient as expected from thickness of deposit, rather than modern.

5380 ± 180

Ly-461. Laives, Saône et Loire **3430 B.C.**

Wood from argillaceous sediment at Laives, Saône et Loire (46° 40′ N Lat, 4° 49′ E Long). Coll. 1969 by P. Ciry and subm. by J. Combier, Dir. Antiquités préhistoriques, Romanèche-Thorins, Saône et Loire. *Comment* (J.C.): wood was part of accumulation of big tree trunks in low terrace of R. Grosne valley. Deposit indicates large development of vegetation which, as expected, is postglacial and more precisely, of Atlantic Period. No pollen analysis was made.

5600 ± 150

Ly-364. Le Pont des Clapets, Bouches du Rhône **3650 B.C.**

Peat at 4.10 m depth from boring in bog at Le Pont des Clapets, near Fos-sur-Mer, Bouches du Rhône (43° 27′ N Lat, 4° 52′ E Long). Coll. and subm. by H. Triat. *Comment* (H.T.): date supports pollen analysis in corresponding to Atlantic Period, with general forest expansion including species such as *Quercus pubescus, Q. ilex, Pinus, Corylus,* etc.

Polliat series, Ain

Wood from gravel pit excavated in Irance R. alluvia at Polliat,

Ain (46° 14′ N Lat, 5° 7′ E Long). Coll. and subm. 1967 by A. Billard, Centre de Recherches géog., Paris.

Ly-240. Polliat 1 **1810 ± 100**
A.D. 140

From 1 m depth, base of silt layer.

Ly-333. Polliat 2 **2130 ± 110**
180 B.C.

From same horizon at same depth as Ly-240.

Ly-241. Polliat 3 **8760 ± 140**
6810 B.C.

From center of trunk 1.7 m deep in coarse alluvia filling bottom of Irance R. valley.

Ly-334. Polliat 4 **8490 ± 180**
6540 B.C.

From another trunk in same level as Ly-241.

General Comment: Ly-241 and -334 date Boreal period, main filling of valley. Ly-240 and -333 prove upper silt layer of valley is recent.

Ly-387. Meyzériat, Ain **Modern**

Wood from spoil created by dredging of Veyrle R. (same alluvial plain as Irance R.), near Meyzériat, Ain (46° 14′ N Lat, 5° 3′ E Long). Coll. and subm. 1967 by A. Billard. *Comment*: despite similarity to preceding samples, measurement proves, contrary to collector's supposition, sample does not come from dredged ancient alluvia.

Ly-112. Enghien-les-Bains, Val d'Oise **11,240 ± 330**
9290 B.C.

Peat included in argilaceocalcareous sand from 6 m depth at Enghien-les-Bains, Val d'Oise (48° 56′ N Lat, 2° 15′ E Long). Coll. 1967 by Solétanche Cie and subm. 1968 by A. Marcé, Bur. Recherches géol. et min., Orléans La Source. *Comment* (A.M.): sample from Quaternary formation just overlying Saint-Ouen Tertiary limestone. Age may correspond to Allerød interstade but no pollen analysis was made.

Grotte Hué series, Alpes Maritimes

Calcium carbonate from stalactite on roof of submarine grotto at −25 m depth. Grotte Hué, is offshore in Juan-les-Pins Gulf, Alpes Maritimes (43° 38′ N Lat, 7° 6′ E Long). Coll. 1970 by H. de Lumley, Fac. Sci. St. Charles, Marseille. Stalactite has 3 plain concentric growth rings.

Ly-404. Grotte Hué, external part **10,500 ± 150**
8550 B.C.
$\delta C^{13} = -4.12‰$

From external ring of stalactite.

14,690 ± 550

Ly-403. Grotte Hué, median part **12,740 B.C.**

$\delta C^{13} = -11.10‰$

From median ring of stalactite. No measurement from central ring, which had central hole with traces of recrystallization.

General Comment: ages are calculated using 64.5% NBS standard as contemporary C^{14} value, according to G. Delibrias' measurements on stalactites from Aven of Orgnac, Ardèche (J. Labeyrie *et al.*, 1967). Despite the fact that calculation is only approximate, dates agree with expected age of sea-level rise.

18,800 ± 490

Ly-360. Saint Maurice l'Exil, Isère **16,850 B.C.**

Bones of mammal jaw from gravel pit near Saint-Maurice l'Exil, Isère (45° 23′ N Lat, 4° 46′ E Long). Coll. and subm. 1969 by C. Guérin. Pit is open in Rhône R. low terrace. *Comment* (C.G.): age, corresponding to end of Würm III, agrees with late Würm age for all low terraces of middle Valley of Rhône R. (David *et al.*, 1972).

Montrevel series, Ain

Wood extracted by dredging from Reyssouze R. lowest alluvia near Montrevel Ain (46° 20′ N Lat, 5° 8′ E Long). Coll. and subm. 1967 by A. Billard.

21,100 ± 500

Ly-246. Montrevel 5 **19,150 B.C.**

From ca. 8 m depth. Measurements made in normal conditions of CO_2 pressure in a proportional counter.

2800

25,700 ±

2400

Ly-386. Montrevel 6 **23,750 B.C.**

From ca. 10 m depth, ca. 400 m downstream from Ly-246. Measurement made with scintillator detector used for preparing C_6H_6, the only quantity of CO_2 normally used in a proportional counter. The experiment was made to compare statistical errors obtained.

General Comment: dates show deepest filling of this valley is much older than that of Irance R. (see Ly-241 and Ly-334, this list). It should correspond to cold phase in Würm III, considering *Elephas primeginus* and *Rhinoceros ticorhinus* found in same place at same depth.

Ly-242. Les Pierrets-Viriat, Ain **⩾32,000**

Fragments of big tree trunk coll. by boring between 9 and 14 m depth in Reyssouze R. lowest alluvia at Les Pierrets, near Viriat, Ain (46° 15′ N Lat, 5° 11′ E Long). Coll. and subm. 1967 by A. Billard. Site is 10 km downstream from Montrevel (Ly-246 and Ly-286, this list). *Comment*: expected age: same as Montrevel series, but appearance suggests it is redeposited Tertiary wood, such as already found on surface in Ain R. alluvia (see Ly-14, R., 1969, v. 11, p. 114).

Ly-437. Velars-Etrigny, Saône et Loire **⩾32,000**

Mammal vertebrae from grotto at Velars. Coll. by "Les Blaireaux" Soc. and subm. by C. Guérin. *Comment* (C.G.): fauna seems to be Würmian. Result eliminates attribution to Würm III or Würm IV.

Ly-339. Fossil wood of Martigues, Bouches du Rhône **⩾35,000**

Fossil wood from 18 m depth in bedrock of Etang de Berre under Martigues Bridge, Bouches du Rhône (45° 24′ N Lat, 5° 3′ E Long). Coll. 1966 by P. Couprie and subm. by Y. Thommeret, Lab. Radiocarbone de Monaco. *Comment*: limit age agrees with the date MC-100: 35,000 ± 4000 (R., 1969, v. 11, p. 119) from the same sample.

Ly-166. Carotte T 3 **31,300 ± 2100/1700 29,350 B.C.**

Calcareous-clayey marine mud from 1.85 m to 2.10 m below base of Mediterranean Sea, near Mallorca I. Coll. 1963 and subm. 1968 by L. Leclaire, Lab. Géol. du Mus., Paris. Measurement on total carbonate fraction; too little organic material to be extracted. *Comment* (L.L.): date a little older than expected, but part of carbonate fraction may be of terrigenous origin (Leclaire, 1972).

II. ARCHAEOLOGIC SAMPLES

A. Historical and Bronze age periods

Ly-456. Sées, Orne **Modern**

$\delta C^{13} = -15.77‰$

Human bones found near Saint-Martin church at Sées, Orne (48° 36′ N Lat, 0° 10′ E Long). Coll. and subm. 1970 by F. Evin, Sées, Orne. *Comment*: expected age was Middle age due to importance of Saint-Martin monastery during that period. Date proves maximal age is last century.

Sévrier series, Haute Savoie

Samples from coastal sta. submerged in Annecy Lake, near Sévrier, Haute Savoie (49° 39′ N Lat, 6° 9′ E Long). Coll. and subm. 1969 by R. Laurent, Centre de recherches archéol. lacustres, Tréserves Savoie.

Ly-117. Sévrier, 267 A 2 **490 ± 170 A.D. 1460**

Charcoal mixed with siliceous slag and iron oxide found with lacustrian chalk.

Ly-273. Sévrier, 267 A 5 **320 ± 100 A.D. 1630**

Little woody twigs from lacustrian chalk layer near preceding sample.

General Comment: Ly-273 dated to confirm Ly-117. Both dates confirm hypothesis that slag and iron oxides were contemporary with Bronze

Final occupation of coastal sta. (Laurent, 1968). But presence of such material remains unexplained at this site.

720 ± 105

Ly-450. Le Plessis Grimoult, Calvados **A.D. 1230**

Charcoal from under a wall of medieval edifice at Le Plessis-Grimoult, Calvados (48° 47′ N Lat, 0° 37′ W Long). Coll. and subm. 1971 by M. de Boüard, Centre de recherches archéol. médiévales, Caen, Calvados. *Comment* (M. de B.): a little younger than expected, but, considering 200 yr statistical range, a true age at start of 11th century is quite consistent with other archaeol. data on site.

1500 ± 110

Ly-68. Parc de la Tête d'Or, Lyon Rhône **A.D. 450**

Wood from a monoxyl barge found in 1862 in Rhône R. alluvia at Brénier-Cordon, Ain (Cordier, 1963), and now exhibited in town park La Tête d'Or, Lyon (45° 47′ N Lat, 4° 51′ E Long). Coll. 1967 by J. Evin. Average of 2 measurements. *Comment*: barge expected to be from Bronze age, then date seems much too young, which may be due to an eventual impregnation of organic components made in order to preserve the timber. Date is possible; monoxyl barges remained in use until High Middle age.

Ly-455. Château de Saint-Germain d'Ambérieu, Ain **1160 ± 150** **A.D. 790**

Charred corn found over burial in Saint-Germain Castle, near Ambérieu en Bugey, Ain (45° 57′ N Lat, 5° 23″ E Long). Coll. and subm. 1971 by J. F. Reynaud, Centre de recherches médiévales, Univ. Lyon II. *Comment*: date agrees with expected age of burials, end of 7th century.

L'Hortus series, Hérault

Charcoal from several levels of Paleochristian site in grotto of l'Hortus, near Valflaunès, Hérault (43° 48′ N Lat, 3° 50′ E Long). Coll. 1970 by G. Démians d'Archambault and subm. 1970 by H. de Lumley.

1400 ± 180

Ly-284. L'Hortus Zone 120, Level RC bis **A.D. 550**

Sample form Paleochristian offering-pit overlain by tumulus.

1610 ± 190

Ly-283. L'Hortus Zone F8, Level B F **A.D. 340**

Sample from one of upper levels of large pit, E part of grotto, assoc. with Paleochristian material.

1680 ± 100

Ly-282. L'Hortus Zone E7, Level F 4 **A.D. 270**

Sample from one of lower levels of same pit as Ly-283, assoc. with older industry.

General Comment: comparison between Ly-284 and -282 seems to confirm that offering pits is younger than large pit. Both Ly-283 and -282

are 100 yr older than expected (5th and 4th century) but remain in statistical range.

Briord series, Ain

Human bones from graves in several levels of Gallo-Roman cemetery at Les Plantis, near Briord, Ain (45° 46′ N Lat, 5° 27′ E Long). Coll. and subm. 1967 by R. Perraud, La Mure-sur-Azergues, Rhône.

Ly-454. Briord 284 **1670 ± 160** **A.D. 280**

Bones from grave 40 cm below actual soil. *Comment*: confirms late occupation of cemetery but older than expected age (7th century) for that type of grave.

Ly-61 bis. Briord 261 bis **1875 ± 100** **A.D. 75**

Bones from same grave as Ly-61: 2060 ± 200 B.P. (R., 1969, v. 11, p. 114). Grave ca. 1.20 m below actual soil. *Comment*: new collagen preparation gives more precise date which better agrees with Emperor Tiberius' coins from another grave at same level.

Ly-406. La Sartanette, Gard **2120 ± 170** **170 B.C.**

Charred acorns from Layer X, entrance of La Sartanette grotto, near Remoulins, Gard (43° 57′ N Lat, 4° 35′ E Long). Coll. and subm. 1970 by A. Bonnet, Nimes. *Comment* (A.B.): assoc. with ceramic industries of "Ferrière" type but possibilities of mixing exist and are confirmed by date which agrees with Roman occupation of site, only 1 km from famous Pont du Gard bridge (Bonnet *et al.*, 1971).

Ly-500. L'Etoile d'Alaï, Lyon, Rhône **2370 ± 160** **420 B.C.**

Charcoal from Gallo-Roman settlement under modern building in Etoile d'Alaï urban quarter, Lyon, Rhône (45° 45′ N Lat, 4° 47′ E Long). Coll. and subm. 1969 by L. Jeancolas, Tassin-la-demi-Lune, Rhône. *Comment* (J.L.): older than expected but with large statistical range; result can only mean that settlement was from 1st Roman occupation in Lyon.

Camp de Bierre series, Orne

Charcoal from base of wall of promontory site Le Camp de Bierre, near Merri, Orne (48° 50′ N Lat, 0° 3′ W Long). Coll. and subm. 1970 by G. Verron, Dir., antiquités préhistoriques, Caen, Calvados.

Ly-464. Camp de Bierre 1 **2320 ± 100** **370 B.C.**

$\delta C^{13} = -17.69‰$

From top of Layer IV from 110 cm to 120 cm depth.

2810 ± 120

Ly-465. Camp de Bierre 2 **860 B.C.**

$\delta C^{13} = -20.42‰$

From base of Layer IV from 120 cm to 130 cm depth.

2740 ± 110

Ly-466. Camp de Bierre 3 **790 B.C.**

$\delta C^{13} = -21.26‰$

From Layer IV.

General Comment (G.V.): Ly-465 and -466 give Bronze Final age for building of promontory site. Ly-464, 400 yr younger, indicates occupation of settlement continued till La Tène period (Vimont, 1884).

3410 ± 200

Ly-95. Culoz Square II, Layer IV **1460 B.C.**

Human bones from top Layer IV in W part of Sous-Balme site at Culoz, Ain (45° 51′ N Lat, 5° 47′ E Long). Coll. 1961 and subm. 1966 by R. Vilain, Dépt. Géol., Univ. Lyon I. *Comment* (R.V.): agrees with expected age but presence of Hallstatt and La Tène industries proves site was deeply excavated by recent tillage (Vilain, 1966).

2400 ± 140

Ly-279. Shrew of Ashmin, Low Egypt **450 B.C.**

Mummified shrews (*Crocidura* sp., group dolichura) from an hypogeum at Ashmin, Low Egypt (30° 26′ N Lat, 30° 58′ E Long). Coll. 1900 by Lortet and Chantre and subm. 1969 by P. Mein, Dépt. Sci. de la Terre, Univ. Lyon I. *Comment* (P.M.): shrew species belongs to warm fauna of Guinean type, extinct in Egypt. Older date would suggest evolution of shrew species to extant species, but relatively recent value proves shrew subsisted a long time before becoming extinct (de Balzac and Mein, 1971).

4010 ± 130

Ly-383. Nobles' Grave, Assouan, High Egypt **2060 B.C.**

Wood from Nobles' Grave at Assouan, High Egypt (24° 1′ N Lat, 32° 45′ E Long). Coll. by M. Baligan and subm. 1970 by R. Margrita, Centre d'études nucléaires de Grenoble, Isère.

B. Neolithic and Mesolithic periods

3810 ± 230

Ly-193. Le Rond du Lévrier, Haute Loire **1860 B.C.**

Burnt bones from rock shelter Le Rond du Lévrier, near Salette, Haute Loire (44° 51′ N Lat, 3° 58′ E Long). Coll. and subm. 1968 by A. Crémilleux, Le Monastier-sur-Gazeille, Haute Loire. *Comment* (A.C.): same value as Ly-196: 4380 ± 280 (R., 1971, v. 13, p. 59) was expected. Younger date means either presence of Late Neolithic previously dated in another part of site: Ly-195: 3570 ± 130 (R. 1971, v. 13, p. 59), or mixing with bones coming from overlying levels.

Ly-385. Ilôt des Roseaux, Lac de Chalain, Jura **4640 ± 140 / 2690 B.C.**

Wood from upper level, Level 0 of coastal sta. in Les Roseaux Islet, Chalain Lake near Doucier, Jura (46° 40′ N Lat, 5° 46′ E Long). Coll. and subm. 1969 by P. Pétrequin, Dir. Antiquités préhistoriques de Franche-Comté, Besançon. Coastal sta. has several Late Neolithic levels (Levels 4 to 1) and base of Level 0 (Late Bronze) is last occupation of coastal sta. *Comment* (P.P.): instead of expected Late Bronze age date is Late Neolithic, indicating, after last occupation of coastal sta., lake eroded its banks and deposited above Bronze level charcoal from underlying levels. Moreover, charcoal had floated aspect, and this type of apparent reversing of archaeologic layers is frequent in all coastal stas. dependent on lake-level fluctuations.

Ly-384. La Motte aux Magnins, Lac de Clairvaux, Jura **4640 ± 270 / 2690 B.C.**

Charcoal from Late Neolithic hearth from upper part of La Motte aux Magnins coastal sta., Grand Lac, near Clairvaux, Jura (46° 34′ N Lat, 5° 45′ E Long). Coll. and subm. 1969 by P. Pétrequin. *Comment* (P.P.): date seems a little too old for Late Neolithic and fits with Middle Neolithic, but both civilizations might be partially contemporaneous in that country.

Ly-335. Gondenans-lès-Montby, Doubs **5490 ± 140 / 3540 B.C.**

Charcoal from Level IX of La Tuilerie grotto at Gondenans-lès-Montby, Doubs (47° 26′ N Lat, 6° 27′ E Long). Coll. and subm. 1969 by P. Pétrequin. *Comment* (P.P.): level contains ceramic industry with stamped decoration, characteristic of "Rubané Récent Rösen" civilization. Same value as Gif-468: 5380 ± 250 (R., 1970, v. 12, p. 429) from Level E 6, La Baume de Gonvillars, Jura, site which is in same region and has same industry (Pétrequin, 1970).

La Hoguette series, Fontenay le Marmion, Calvados

Charcoal and bones from Neolithic tumulus with a dry-stone dolmen, at La Hoguette, near Fontenay le Marmion, Calvados (49° 6′ N Lat, 0° 22′ W Long). Coll. 1966, 1968 and subm. 1967 and 1970 by R. Caillaud and E. Lagnel, Caen, Calvados.

Ly-132. Tumulus de La Hoguette O/43 **4580 ± 150 / 2630 B.C.**

Charcoal from hearth overlying filling of Chamber V.

Ly-420. Tumulus de La Hoguette Ch VII **5050 ± 260 / 3100 B.C.**

Human bones from Chamber VII.

Ly-421. Tumulus de La Hoguette Ch V **5160 ± 190 / 3210 B.C.**

Human bones from Chamber V.

5560 ± 150

Ly-131. Tumulus de La Hoguette R/36 **3610 B.C.**

Charcoal and hearth ash from Chamber VI.

General Comment (R.C. and E.L.): Ly-131, -420, and -421 correspond to construction and utilization of tumulus and are in range of expected ages. Three values agree with date of charcoal from Chamber V made by Gif-sur-Yvette Radiocarbon lab.: 5000 ± 130 (R., 1972, v. 14, p. 280). Ly-131, however, is ca. 500 yr older than Ly-420, and Gif-1345. Difference can only be explained by statistical deviation. But Ly-132, 500 yr younger, corresponds to subsequent occupation of Chamber V (Caillaud and Lagnel, 1971).

3890 ± 140

Ly-422. Bois Sacré, Gard **1940 B.C.**

Charcoal from 30 cm to 80 cm depth in Bois-Sacré site, near Saint-Côme and Maruéjols, Gard (43° 53′ N Lat, 4° 11′ E Long). Coll. and subm. 1969 by J. L. Roudil, Montpellier, Hérault. Assoc. with rich ceramic industry. *Comment* (J.L.R.): level is presumed contemporary of "Fontbouïsse" civilization and the date agrees well. Cf. date on Prével grotto at Montclus, Gard: Gif-191: 3880 ± 180 (R., 1966, v. 8, p. 84) (Roudil, 1969).

4630 ± 110

Ly-462. Aven des Corneilles, Lozère **2680 B.C.**

Charcoal from center of hearth assoc. with "Fontbouïsse" industry at l'Aven des Corneilles, near Prades, Lozère (44° 19′ N Lat, 3° 27′ E Long). Coll. and subm. 1970 by G. Fages, Sainte Enimie, Lozère. *Comment* (G.F.): hearth is between Middle Bronze burial level and Chalcolithic settlement. Expected date was similar to Ly-422: 3890 ± 140, this list, Bois sacré site. Other measurements on "Fontbouïsse" civilization suggest Ly-462 is too old but rodent burrows might have carried charcoal in from underlying Chalcolithic horizon.

5510 ± 200

Ly-458. Limonesque, Hérault **3560 B.C.**

$\delta C^{13} = -20.49‰$

Charcoal from La Baume II of Limonesque site, near Le Caylar, Hérault (44° 25′ N Lat, 3° 31′ E Long). Coll. and subm. 1970 by G. B. Arnal, Montpellier, Hérault. Assoc. with Epicardial pottery industry, probably Atlantic period. *Comment* (G.B.A.): in expected range. Two other measurements on same type of industry from Levels 2A and 4A of Saint-Pierre-de-la-Fage site, 11 km from Limonesque: Gif-2180: 5520 ± 150 and Gif-1922: 6200 ± 400.

5560 ± 170

Ly-491. Grotte du Maquis, Ardèche **3610 B.C.**

$\delta C^{13} = -20.06‰$

Charcoal from Level 4A, Grotte du Maquis, near Vallon Pont d'Arc, Ardèche (44° 23′ N Lat, 4° 24′ E Long). Coll. and subm. 1970 by E. Tscherter, Roche de Molière, Loire. *Comment* (E.T.): levels of

grotto contain industries from Chassean until Protohistoric time, but sample is from level without characteristic industry. Level 3 has 3 Chassean layers; date agrees with stratigraphic position of Level 4A underlying Level 3.

Ly-423. Grotte de Combe Obscure **6400 ± 160 4450 B.C.**

Charcoal from Level 5, Grotto de Combe Obscure, near Sallèles, Ardèche (44° 29′ N Lat, 4° 8′ E Long). Coll. 1969 by H. Saumade and subm. 1969 by J. L. Roudil. Assoc. with early Cardial industry. *Comment* (J.L.R.): Combe Obscure Grotto is most N settlement where Early Cardial industry has been found. Date conforms to expected result, and may be compared with Ly-303/304:6220 ± 100 (R., 1971, v. 13, p. 62): Layer 4 Late Cardial, La Baume de Montclus, Gard (Escalon de Fonton, 1970).

Seuil des Chèvres series, Savoie

Samples from several levels of Seuil des Chèvres grotto, near La Balme, Savoie (45° 41′ N Lat, 5° 21′ E Long) (Vanbrugghe and Bill, 1968). Coll. and subm. 1969 by R. Vanbrugghe, Hellemes, Nord.

Ly-388. Seuil des Chèvres **5300 ± 180 3350 B.C.**

Fine charcoal powder from top of Layer IC. *Comment* (R.V.): assoc. with Neolithic pottery with decoration comparable to Cardial or to Augy Sainte-Pollaye pottery (Desbrosse, 1969). Same value as Ly-69: 5240 ± 100 (R., 1969, v. 11, p. 116) from base of same layer. Both dates may be also compared with Neolithic Level E 6X at La Baume de Gonvillard, Doubs: Gif-468: 5380 ± 250 with similar assoc. pottery (R., 1970, v. 12, p. 429).

Ly-389. Seuil des Chèvres E 7 **6320 ± 260 4370 B.C.**

Charcoal from hearth in Layer IV, assoc. with indeterminable pottery. *Comment* (R.V.): proves Ly-388 and Ly-389 hearths are not contemporary. Date seems too old for pottery in region but may be compared with Layer G 10 XIb, La Baume de Gonvillard, Jura: Gif-469: 6250 ± 300 (R., 1970, v. 12, p. 429) end of Early Neolithic.

Ly-405. Seuil des Chèvres C 9 **9700 ± 150 7750 B.C.**

Bones from lower part of Layer V, assoc. with industry attributable to Epi-Paleolithic. *Comment* (R.V.): confirms previous less precise measurement from same level, Seuil des Chèvres E 6: Ly-70: 8980 ± 400 (R., 1969, v. 11, p. 116). Agrees well with assoc. fauna.

Cours Moreau series, Macon, Saône et Loire

Charcoal from digging 7 m deep under Cours Moreau, Saône et Loire (46° 18′ N Lat, 4° 50′ E Long). Coll. and subm. 1966 by S. Dacher, Charnay-lès-Macon, Saône et Loire.

5150 ± 200
Ly-35. Cours Moreau, Level I **3200 B.C.**

7400 ± 200
Ly-73. Cours Moreau, Level II **5450 B.C.**

General Comment: both dates much older than expected, levels being attributed to "Roman" and "Celtic" ages.

Laang Spean series, Cambodia

Charcoal and bones from Laang-Spean grotto, Prov. Battambang, Cambodia (12° 51′ N Lat, 102° 55′ E Long). Coll. and subm. 1969 by C. Mourer, Dept. Sci. de la Terre, Univ. Lyon I.

3380 ± 150
Ly-265. Laang-Spean, Layer CRM **1430 B.C.**
From 10 to 30 cm depth.

4740 ± 100
Ly-266. Laang-Spean, Layer CN **2790 B.C.**
From 30 to 50 cm depth.

8750 ± 900
Ly-439. Laang-Spean, Layer CB **6800 B.C.**
From 50 to 70 cm depth.

General Comment: Layers CRM and CN contain Hoabinhian (Neolithic) industry with ceramics. Other charcoal from Layer CN was dated by Monaco Radiocarbon Lab.: MC-273: 6270 ± 70. Layer CB contains earlier industry without ceramics which then appears between MC-273 and Ly-439 (Mourer *et al.*, 1970).

5420 ± 130
Ly-408. Erg Admer, Sahara, Algeria **3470 B.C.**

Burnt bovine bones found lying on sand dune in Tahor Passage in Erg Admer, W Djanet, Algeria (24° 29′ N Lat, 9° 10′ E Long). Coll. and subm. 1970 by A. Bonnet, Nîmes. Assoc. with industries (ceramics, millstones, and flint) remained unaltered on sand dune. *Comment* (A.B.): date is minimum for dune formation. It is close to measurement of sample from 30 to 60 cm depth in Amekni site, Hoggar: Gif-464: 5500 ± 250 (R., 1970, v. 12, p. 436) with assoc. Neolithic ceramic of Sudan tradition; it is also close to Meniet site: Gif: 5400 ± 300 and Jabbaren I: Gif: 5470 ± 300 (Camps *et al.*, 1968).

6870 ± 150
Ly-407. Erg Tichodaïne, Sahara, Algeria **4920 B.C.**
$\delta C^{13} = -18.19‰$

Humic black soil from Passage of Erg Tichodaïne between Amguid and Fort-Gardet, Sahara, Algeria (26° 22′ N Lat, 6° 50′ E Long) Coll. and subm. 1970 by A. Bonnet. *Comment* (A.B.): agrees with expected age and with other dates of Sudan Neolithic tradition (Camps *et al.*, 1968). Sample assoc. with pottery was found on hillock isolated by deflation. Thus it is contemporary of oldest layer of Abouleg site, Hoggar:

UW-89: 6860 ± 100, and of Deleba en Emedi site, Tchad: Gif-352: 6900 ± 300 (R., 1970, v. 12, p. 438).

C. Magdalenian period

Ly-430. Grotte Colomb, Isère **8960 ± 420**
7010 B.C.
$\delta C^{13} = -18.31‰$

Marmot bones from Grotte Colomb, near Méaudre, Isère (45° 9′ N Lat, 5° 33′ E Long). Coll. 1921 by H. Muller and subm. 1971 by R. Desbrosse, Blanzy, Saône et Loire. *Comment* (R.D.): assoc. industry was assumed Romanelian (Late Magdalenian and Azilian) (Bourdier and de Lumley, 1956) and contemporary of Dryas III period. Date does not fit with these assumptions but stratigraphy of digging is not well known and sampling remains questionable.

Ly-451. Les Freydières, Drôme **11,380 ± 180**
10,430 B.C.
$\delta C^{13} = -14.47‰$

Bones from only layer of Les Freydières grotto site, near Saint-Agnan en Vercors, Drôme (44° 58′ N Lat, 5° 26′ E Long). Coll. 1965 and subm. 1971 by A. Bocquet, Inst. Dolomieu, Grenoble, and R. Desbrosse. *Comment* (A.B., R.D.): layer is attributed to Magdalenian VI. Date is younger than Ly-436: 12,800 ± 300, this list, from Campalou, site of same region. Difference may be due to more isolated geographic position and to alt. of Les Freydières site (Bocquet, 1969).

Ly-452. La Baume Loire II, Haute Loire **3950 ± 120**
2000 B.C.
$\delta C^{13} = -14.38‰$

Black earth from Rock Shelter II at La Baume Loire, near Solignac, Haute Loire (44° 56′ N Lat, 3° 54′ E Long). Coll. and subm. 1970 by A. Crémilleux, Le Monastier sur Gazeille, Haute Loire. *Comment* (A.C.): this black earth contains Late Paleolithic industry but archaeologic level is composed of rubble stones between which elements of overlying levels might be descended.

Ly-356. Grotte des Romains Niveau III, Ain **12,980 ± 240**
11,030 B.C.

Bones from Level III at Grotte des Romains Near Virignien, Ain (45° 41′ N Lat, 5° 21′ E Long). Coll. and subm. 1969 by R. Desbrosse. *Comment* (R.D.): date agrees better with expected age than previous measurement, Ly-16: 14,380 ± 380 (R., 1969, v. 11, p. 116) of charcoal from same level (Evin and Desbrosse, 1971).

Pont des Douattes series, Haute Savoie

Bones from Late Magdalenian level at Le Pont des Douattes rock shelter, near Mussiège, Haute-Savoie (46° 0′ N Lat, 5° 58′ E Long).

12,480 ± 260

Ly-435. Les Douattes, Level 7 **10,530 B.C.**

$\delta C^{13} = -15.04‰$

Coll. 1931 and subm. 1971 by A. Jayet, Geneva (Jayet, 1932).

10,680 ± 450

Ly-453. Les Douattes, Level b **8730 B.C.**

$\delta C^{13} = -14.08‰$

Coll. 1959 by L. Pradel and subm. 1971 by R. Desbrosse (Pradel and Pradel, 1960).

General Comment (R.D.): both Levels 7 and b correspond to same Late Magdalenian horizon. Then Ly-453 is probably contaminated and Ly-435 agrees well with industry and may be compared with Ly-356: 12,980 ± 240, this list, from Level III Les Romains grotto.

12,040 ± 270

Ly-440. Blois-sur-Seille, Jura **10,090 B.C.**

Bones from only level of Le Chamois Boivin grotto, near Blois-sur-Seille, Jura (46° 45′ N Lat, 5° 40′ E Long). Coll. 1953 by M. Vuillemey and subm. 1971 by R. Desbrosse. *Comment* (R.D.): agrees with expected Magdalenian VI age and with fauna which indicates a dry and cold climate, end of Wurm IV (Gauthier, 1955).

12,800 ± 300

Ly-436. Campalou, Drôme **10,850 B.C.**

$\delta C^{13} = -16.17‰$

Bones from Campalou rock shelter near Saint-Nazaire-en-Royan, Drôme (45° 15′ N Lat, 5° 12′ E Long). Coll. and subm. 1970 by J. and J. Brochier, Romans, Drôme. Assoc. with Late Magdalenian industry with Azilian characters. *Comment* (J. and J.B.): date proves, despite Azilian character, this Magdalenian is rather old. Cf. Les Deux-Avens grotto: Ly-321/322: 12,340 ± 200 (R., 1971, v. 13, p. 63).

Solutré series, Saône et Loire

Bones from Level P. 16, Sq. 88-89, Solutré site, Saône et Loire (46° 18′ N Lat, 4° 43′ E Long). Coll. and subm. 1969 by J. Combier, Dir. régionale Antiquités préhistoriques, Romanèche-Thorins, Saône et Loire. Site is mainly composed of thick mass of horse bones in large rock rubble at foot of limestone cliff.

3350 ± 350

Ly-392. Solutré 15 **1400 B.C.**

Burned bones treated as unburned bones, *i.e.*, by collagen extraction. *Comment* (J.C.): unexplained high pollution.

12,580 ± 250

Ly-393. Solutré 16 **10,600 B.C.**

Unburned bones. *Comment* (J.C.): perfect agreement with assoc.

Late Magdalenian industry. Date marks last occupation of site and end of formation large rock rubble with horse bones whose same levels were previously dated: see Ly-313/315/316 and Ly-317 (R., 1971, v. 13, p. 63-64).

Ly-425. Enval Layer XII, Puy de Dôme **13,000 ± 300**
11,050 B.C.
$\delta C^{13} = -22.73‰$

Earth with fine charcoal fragments from Layer XII in Enval site, near Vic-le-Comte, Puy-de-Dôme (45° 29′ N Lat, 3° 14′ E Long). Coll. and subm. 1970 by Y. Bourdelle, Clermont-Ferrand, Puy-de-Dôme. *Comment* (Y.B.): layer corresponds to beginning of Late Magdalenian. It is in rock rubble which might be contemporary with volcanic explosion phase dated ca. 12,800 B.P. Date is maximum for statuette "Venus of Enval" 5 cm above hearth dated here (Bourdelle *et al.*, 1971).

Saint-Roman series, Isère

Bones from 2 levels in Le Calvaire rock shelter, near Saint-Roman, Isère (45° 7′ N Lat, 5° 20′ E Long). Coll. 1921 by H. Muller and by F. Bourdier 1938, and subm. by R. Desbrosse and A. Bocquet (Bourdier and de Lumley, 1956).

Ly-431. Saint-Roman Series III **12,970 ± 300**
11,020 B.C.
$\delta C^{13} = -17.21‰$

Ly-432. Saint-Roman Series IV **13,450 ± 300**
11,500 B.C.
$\delta C^{13} = -16.20‰$

General Comment (R.D.): both dates agree with stratigraphy and with Late Magdalenian industry. As expected, Series III (Ly-431) may be contemporary with Level III of La Grotte des Romains site. But expected age of Series IV (Ly-432) was a little younger.

Ly-433. La Colombière, Ain **13,390 ± 300**
11,440 B.C.
$\delta C^{13} = -17.44‰$

Fragment of mammoth bone from Level D in La Colombière rock shelter, near Neuville-sur-Ain, Ain (46° 5′ N Lat, 5° 22′ E Long). Coll. 1913 by L. Mayet and J. Pissot (Mayet et Pissot, 1915) and subm. 1971 by R. Desbrosse. Assoc. with art work (specially engraved pebbles). *Comment* (R.D.): 4 other C^{14} measurements exist from site. The nearest result is: L-177: 14,150 ± 400 (Science, v. 126, p. 1329); other results are W-150: 11,750 ± 600 (Science, v. 121, p. 487); L: 15,500 ± 700 and L: 14,700 ± 300 (Movius and Judson, 1956). Ly-433 seems a little too young to archaeologists who attribute industry of site to Leroi-Gourhan's Style IV Magdalenian.

La Croze-sur-Suran series, Ain

Mammoth bone from only level, attributed to Magdalenian III of La Croze-sur-Suran site, near Saint-Martin-du-Mont, Ain (46° 5′ N Lat, 5° 21′ E Long). Coll. 1913 by J. Tournier and T. Costa de Beauregard (Tournier et Costa de Beauregard, 1922) and subm. 1971 by R. Desbrosse.

Ly-357. La Croze-sur-Suran 1 **14,330 ± 260**
12,380 B.C.

Ly-434. La Croze-sur-Suran 2 **14,850 ± 350**
12,900 B.C.
$\delta C^{13} = -15.15‰$

General Comment (R.D.): both dates correspond to each other. The difference of 1000 to 1500 yr between these 2 Magdalenian III dates and those of preceding Late Magdalenian sites is quite possible. But connections between La Croze-sur-Suran and neighboring site, La Colombière, remain indeterminate.

Ly-361. Esclauzure, Corrèze **14,540 ± 300**
12,600 B.C.

Mammal bones from filling of grotto at Esclauzure, near Lissac, Corrèze (45° 18′ N Lat, 1° 28′ E Long). Coll. 1970 by P. Andrieu and subm. 1970 by C. Guérin. *Comment* (C.G.): estimated age was Early Magdalenian or Solutrean considering similarity of lithic industry of site with that of neighboring grotto Badegoule. Date rather suggests a Magdalenian age (Andrieu, 1971).

III. HYDROGEOLOGIC SAMPLES

The following samples come from several aquifers of France or Africa, coll. 1967-70 by Bur. Recherches Géol. et Min. Selection of sampling points, supervision of chemical preparations on ground, and analysis of results were made by Y. Vuillaume, Dept. Géol. Aménagement, Bur. Recherches Géol. et Min. Orléans La Source, Loiret. Carbonate species were extracted at sampling sites by $BaCO_3$ precipitated, adding NaOH and $BaCl_2$ in a 100 L metal tank, then sent to the radiocarbon lab. either as a dry $BaCO_3$ precipitate, or a 2 L flask filled with $BaCO_3$ unseparated from NaOH solution. Radiocarbon content is reported as % of modern without correction from δC^{13} measured by R. Letolle, Lab. Géol. Dynamique, Univ. Paris VI.

Rhône delta series, France

Ground water samples in Rhône R. alluvia in its delta, near Fos-sur-Mer, Bouches du Rhône. Dated 1969 to determine extent of a "salt-intrusion" in alluvia bordering Gulf of Fos, W Mediterranean Sea.

	Samples	N Lat E Long	Ions Cl^- ppm	δC^{13} ± 0.15	C^{14}% modern
Ly-182.	La Fromagère Well X 2. Fresh free ground water	(43°28′ 4°53′)	32	−10.55‰	81.2% ± 1.4
Ly-200.	Les Clapets Well X Ibis. Fresh water underlying salt confined ground water	(43°27′ 4°52′)	106	−14.09‰	79.1% ± 0.9
Ly-199.	Raffinerie de Fos Well X 3. Brackish confined ground water	(43°26′ 4°56′)	6780	−17.61‰	74.3% ± 1.9
Ly-198.	Salin de Caban Well X 6. Salt confined ground water	(43°25′ 4°43′)	20,200	− 5.38‰	45.8% ± 1.7

General Comment (Y.V.): C^{14} contents indicate that apparent age of water increases with ion Cl^- content. Water from X 6 well (Ly-198) seems trapped since some millennia likely since aquifer was formed.

Ground water of Calcaire Carbonifère of Bassin du Nord series, France and Belgium

The following samples, subm. 1969-70 come from ground water in calcareous aquifer, ca. 100 m deep, Lille region, Nord. Coll. April, 1969 during a general study of ground water to determine its supply and renewal conditions.

Some C^{14} measurements of boring-cutting from the aquifer were also made to determine an eventual exchange between water and calcareous matrix of aquifer.

	Ground water samples	N Lat E Long	δC^{13} ± 0.15	C^{14}% modern
Ly-259.	Antoine 363, Belgium	(50°34′ 3°27′)	−18.57‰	65.5% ± 1.0
Ly-258.	Saint-Léger 362, Belgium	(50°42′ 3°18′)	—	41.1% ± 0.8
Ly-251.	Annapes Sen 351, France	(50°38′ 3°9′)	−11.74‰	41.4% ± 0.8
Ly-252.	Roubaix A. Motte 353, France	(50°42′ 3°10′)	−10.36‰	32.9% ± 0.7
Ly-253.	Lille Grande Brasserie 354, France	(50°38′ 3°2′)	− 2.48‰	21.9% ± 0.9
Ly-257.	Mouscron 361, Belgium	(50°45′ 3°12′)	−11.62‰	15.6% ± 0.6
Ly-256.	Mouscron 360, Belgium	(50°45′ 3°12′)	−10.48‰	12.6% ± 0.6
Ly-255.	Frelingheim Gillet Thaon 358, France	(50°43′ 2°56′)	+ 0.25‰	12.6% ± 2.3
Ly-268.	Commines 357, France	(50°46′ 3°0′)	− 3.77‰	<1.6%
Ly-254.	Halluin Cratry 356, France	(50°47′ 3°6′)	− 2.48‰	<1.9%

Cutting samples	N Lat E Long	δC^{13} ± 0.15	C^{14}% modern
Ly-291. Lille Grande Brasserie, −54 m 364, France	(50°38′ 3°2′)	—	<1.9%
Ly-292. Lille Grande Brasserie, −80 m 365, France	(50°38′ 3°2′)	−5.35‰	<1.6%
Ly-293. Lille Grande Brasserie, −97 m 366, France	(50°38′ 3°2′)	+4.37‰	<1.7%
Ly-294. Wambrechies Dièves, −91 m 368, France	(50°41′ 3°3′)	+1.82‰	<1.9%
Ly-295. Wambrechies Calcaire −125 m 369, France	(50°41′ 3°3′)	+1.52‰	<2.1%

General Comment (Y.V.): a dissolution of carbonates, confirmed by δC^{13} values, entails very old apparent ages. Radioactivity decreases toward W part of basin in opposite direction of supply zone, localized toward E. Null values of cutting samples indicate that any exchange of detectable amounts of C^{14} active carbonate occurred in the aquifer between rocks and water.

Ground water of the Craie of Bassin du Nord series, France

Samples subm. 1969, 1970, from ground water in a chalky aquifer. Coll. April, 1969 during a general study of ground water to determine its supply and renewal conditions. This ground water is above Calcaire Carbonifère ground water. Its depth increases from E to W parts of basin where it becomes confined.

Water samples	N Lat E Long	δC^{13} ± 0.15	C^{14}% modern
Ly-262. Lille Grande Brasserie 355	(50°38′ 3°2′)	—	79.0% ± 1.0
Ly-261. Annapes Sen 352	(50°38′ 3°9′)	—	56.1% ± 0.9
Ly-263. Frelingheim La Houlette 359	(50°43′ 2°56′)	−12.98‰	20.5% ± 0.9
Ly-260. Wambrechies Distillerie 350	(50°41′ 3°3′)	− 0.78‰	<2.0%

General Comment (Y.V.): in its free part, ground water is normally supplied by rain water. C^{14} contents indicate that in confined part, the supply of ground water is slow. As in Calcaire Carbonifère ground water, radioactivity decreases to W part of aquifer.

Ground water of the Albian of Sahara series

Samples subm. in 1968 and 1969 from ground water in sands of N Sahara Albian. Study was to determine supply conditions of aquifer.

Water samples	N Lat	E Long	δC^{13} ± 0.15	C^{14}% modern
Ly-153. Laghouat II 276	(33°46′	2°53′)	−11.50‰	108.6% ± 2.1
Ly- 77. Laghouat I 275	(33°46′	2°53′)	− 7.76‰	58.5% ± 1.2
Ly-158. Ouargla Fittante 311	(32°0′	5°18′)	—	18.6% ± 1.1
Ly-159. Tougourt Aïn Thaleb 312	(33°5′	6°6′)	—	18.4% ± 1.5
Ly- 75. Bou Azoua 279	(33°46′	7°28′)	—	17.0% ± 0.8
Ly-155. Tougourt Sidi Mandi 295	(33°5′	6°6′)	−11.60‰	13.3% ± 1.3
Ly- 76. Zelfana II 280	(32°24′	4°12′)	− 7.61‰	11.2% ± 0.7
Ly-154. Berriane II 278	(32°50′	3°47′)	− 5.70‰	10.5% ± 1.4
Ly-156. Tougourt Ranou 301	(33°5′	6°6′)	− 3.70‰	10.7% ± 1.2
Ly-157. Ouargla II 294	(32°0′	5°18′)	—	10.1% ± 0.7

General Comment (Y.V.): values indicate gradient of apparent ages from N part of aquifer (waters the youngest) to SE part (water the oldest).

Several aquifers in Tchad series

Samples subm. 1967, 1968 by Bur. Recherches Géol. et Min. Fort-Lamy, Tchad, and coll. by J. L. Schneider of the Bureau.

Water samples	N Lat	E Long	δC^{13} ± 0.20	C^{14}% modern
Ly- 53. Koro-Toro 248 Free ground water in Pliocene	(18°30′	16°5′)	ca. −7.50‰	81.1% ± 1.5
Ly- 52. Abou-Garga 204-247 Confined ground water in Pliocene	(16°25′	11°50′)	−5.27‰	64.2% ± 1.0
Ly- 54. Iféna R 2 203-237 Confined ground water in Continental	(18°45′	13°30′)	ca. −7.50‰	64.6% ± 1.2
Ly-160. Largeau 261-265 Artesian ground water in Primary	(19°5′	17°55′)	—	37.5% ± 0.9
Ly- 65. Bokoyo 241 Deep confined ground water in Pliocene	(15°40′	12°0′)	—	5.5% ± 0.5
Ly- 51. Abou-Bazan 244 Deep confined ground water in Pliocene	(15°50′	12°10′)	ca. −7.50‰	4.2% ± 0.6

General Comment (Y.V.): measurements performed on several aquifers to determine approx. recharge date. No general conclusion can be drawn, without more results.

Ly-232. Zouerat, Mauritania **46.6 ± 0.9% modern**

$\delta C^{13} = -10.63 \pm 0.20‰$

Water sample from ferruginous quartzite of Zouerat, Mauritanie. Sample coll. to study water supply of iron mines. *Comment* (Y.V.): this only result suggests water is renewed slowly which is propitious element for mining.

REFERENCES

Andrieu, P., 1971, La Grotte d'Esclauzure près de Lissac, Corrèze; étude paléontologique par C. Guérin: Mélange Vazeille; E. Ogier Imp. Tulle.

de Balzac, H. and Mein, P., 1971, Les musaraignes momifiées des hypogées de Thèbes: Mamalia, v. 35, p. 220-224.

Bocquet, A., 1969, L'Isère pré et protohistorique: Gallia Préhist., v. 12, no. 2, p. 315-316.

Bonnet, A., Bonnet, E., and Malaval, M., 1971, Résultats préliminaires obtenus au cours de nouvelles fouilles réalisées dans la grotte de La Sartanette à Remoulins, Gard: Soc. Etudes Sci. Nat. Nimes Bull., v. 51, p. 381-403.

Bourdelle, Y., Delporte, H., and Vernon, J., 1971, Le gisement magdalénien et la "Vénus" d'Enval, commune de Vic-le-Comte: l'Anthropologie, v. 75, p. 119-128.

Bourdier, F. and de Lumley, H., 1956, Magdalénien et Romanello-Azilien en Dauphiné: Mus. Anthropol. Préhist. de Monaco Bull., v. 3, p. 128-176.

Broecker, W. S. and Kulp, J. L., 1957, Lamont natural radiocarbon measurements IV: Science, v. 126, p. 1324-1334.

Caillaud, R. and Lagnel, E., 1971, Le Tumulus de La Hoguette: Gallia Préhist., in press.

Camps, G., Delibrias, G., and Thommeret, J., 1968, Chronologie absolue et succession des civilisations préhistoriques dans le Nord de l'Afrique: Lybica, v. 16, p. 9-28.

Cordier, G., 1963, Quelques mots sur les pirogues monoxyles de France: Soc. française Préhist. Bull., v. 60, p. 307.

David, L. *et al.*, 1972, Datation par le radiocarbone de la terrasse quaternaire de Saint-Rambert-d'Albon, Drôme: Acad. sci. [Paris] Comptes rendus, ser. D, v. 274, p. 2007-2008.

Delibrias, G., Guillier, M. T., and Labeyrie, J., 1966, Gif natural radiocarbon measurements II: Radiocarbon, v. 8, p. 74-95.

———— 1970, Gif natural radiocarbon measurements V: Radiocarbon, v. 12, p. 421-443.

———— 1972, Gif natural radiocarbon measurements VII: Radiocarbon, v. 14, p. 280-320.

Desbrosse, R., 1969, Les fouilles préhistoriques en Bugey en 1968-1969: Annales du Bugey, v. 56, p. 43-59.

Escalon de Fonton, M., 1970, Les civilisations Néolithiques du Midi de la France: Cong. Préhist. Proc., Narbonne, Feb. 1970, in press.

Evin, J. and Desbrosse, R., 1971, Datations au C^{14} de gisements Magdaléniens du Jura et des Préalpes du Nord: 8th internatl. cong. Union Préhist. and Protohist. sci. Proc., Belgrade, Sept. 1971, in press.

Evin, J., Longin, R., and Pachiaudi, Ch., 1969, Lyon natural radiocarbon measurements I: Radiocarbon, v. 11, p. 112-117.

Evin, J., Longin, R., Marien, G., and Pachiaudi Ch., 1971, Lyon natural radiocarbon measurements II: Radiocarbon, v. 13, p. 52-73.

Felber, Heinz, 1970, Vienna Radium Institute radiocarbon dates I: Radiocarbon, v. 12, p. 298-318.

Gauthier, H., 1955, Information des antiquités historiques de la Franche-Comté: Gallia Préhist., v. 13, p. 110.

Jayet, A., 1932, Le paléolithique de la région de Genève: Le Globe, v. 22.

Labeyrie, J. *et al.*, 1967: Etude des températures des climats anciens par la mesure O^{18}, C^{13}, C^{14}, dans les concrétions des cavernes: I.A.E.A., conf. on radioactive dating and methods of low-level counting Proc., Monaco, p. 153-159.

Laurent, R., 1968, Apparition de la métallurgie du fer dans les stations littorales du Bronze final: Soc. linnéenne Lyon Bull., 37ème année, no. 4, p. 150-158.

Leclaire, L., 1970, Aspect of late quaternary sedimentation on the Algerian precontinent and the adjacent Algerian-Balearic bassin: 8th internatl. sedimentology cong. Proc., Heidelberg, in press.

Longin, R., 1971, New method of collagen extraction for radiocarbon dating: Nature, v. 230, p. 241-242.

Mayet, L. and Pissot, J., 1915, Abri sous roche préhistorique de La Colombière près de Poncin, Ain: Annales Univ. Lyon, ser. 1, v. 39, 205 p.

Mourer, C., Mourer, R., and Thommeret, Y., 1970, Premières datations absolues de l'habitat préhistorique de la Grotte de Laang-Spean (Cambodge); Acad. sci. [Paris] Comptes rendus, v. 270, p. 471-473.

Movius, H. L. and Judson, S., 1956, The rockshelter of La Colombière: Archeological and geological investigations of an Upper Perigordian site near Poncin, Ain: Cambridge, Peabody Mus. Press.

Pétrequin, P., 1970, La Grotte de La Balme de Gonvillard: Annales lit., Univ. Besançon, 1970, 186 p.

Pradel, L. and Pradel, J. H., 1960, Magdalénien et Azilien de l'Abri des Douattes, commune de Mussièges, Haute-Savoie: Soc. française Préhist. Bull., v. 57, p. 75-79.

Roudil, J. L., 1969, L'habitat campaniforme de Saint-Come et Maruéjols, Gard: Soc. française Préhist. Bull., v. 66, no. 3, p. 88-91.

Rubin, Meyer and Suess, H. E., 1955, U.S. Geological Survey radiocarbon dates II: Science, v. 121, p. 481-488.

Tamers, M. A., 1965, Routine C^{14} dating using liquid scintillation technique: 6th internatl. conf. on C^{14} and T^3 dating Proc., Pullman, Washington, 1965.

Thommeret, J. and Thommeret, Y., 1969, Monaco radiocarbon measurements III: Radiocarbon, v. 11, p. 118-129.

Tournier, J. and Costa de Beauregard, T., 1922, Deux stations préhistoriques du Jura dans la vallée de l'Ain et dans la vallée du Suran: l'Anthropologie, v. 32, p. 383-408.

Vanbrugghe, R. and Bili, J., 1968, La grotte du Seuil des Chèvres à La Balme, Savoie, fouilles de 1967: Soc. linnéenne Lyon Bull., 37è année, no. 4, p. 150-158.

Vilain, R., 1966, Le gisement de Sous-Balme à Culoz (Ain) et ses industries microlithiques: Lab. Géol., Fac. Sci. Lyon doc., v. 13, 220 p.

Vimont, E., 1884, Le camp de Bierre: Soc. hist. archéol. Orne Bull., v. 3, p. 198-210.

[RADIOCARBON, VOL. 15, NO. 1, 1973, P. 156-164]

UNIVERSITY OF CAMBRIDGE NATURAL RADIOCARBON MEASUREMENTS XI

V. R. SWITSUR and R. G. WEST
Sub-department of Quaternary Research, 5 Salisbury Villas, Station Road, Cambridge, England

The measurements presented in this paper were carried out at the University Radiocarbon Dating Research Laboratory during the second half of 1971 using carbon dioxide counting. The counting equipment used was substantially that described by Switsur, Hall, and West (1970). Oxidation of samples of sufficiently high carbon content was performed in a stainless steel high pressure combustion bomb, developed at this laboratory, otherwise by 'wet' oxidation using acidified permanganate solutions for lake mud and samples of low organic content.

The measured activities were converted to ages using the conventional Libby half-life of 5568 ± 30 years with uncertainties expressed in terms of one standard deviation of the counting statistics. Studies made during this period were mainly concerned with dating pollen zones at various sites within the British Isles.

ACKNOWLEDGMENTS

We wish to thank C. R. P. Devine and A. P. Ward for their competent technical help, and Sir Harry Godwin for his continued interest and support. Financial support for setting up the laboratory was generously provided by the Science Research Council and the National Environmental Research Council, to whom we express our thanks.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

British Isles

Pollen Zone Boundary determinations (Nant Ffrancon series)

Third site of project of F. A. Hibbert and V. R. Switsur to determine extent of synchroneity for pollen zone boundaries in British Isles and N Europe. Core of lacustrine sediments in glacial basin in a straight valley extending 5.6 km SSE from Bethesda, Caernarvonshire, Wales (53° 2′ N Lat, 4° 9′ W Long, Natl. Grid Ref. SH 632633). Two or three samples, indicated by depth in pollen diagram, taken as thin slices at each boundary, and at intermediate points corresponding to significant changes in pollen diagram. Samples were from 10 cm core, except for Q-890 and Q-890 bis, which were from 5 cm core a few m from main 10 cm coring site (depths given for Q-890 and Q-890 bis refer to correlated depth in main core). Lower layers were mud of low organic content, which increased up the core. For general description of area, see Seddon (1962). Samples were oxidized as suspension, after acid and alkali pretreatment, in hot acidified potassium permanganate, and CO_2 was rigorously purified before counting.

Sequence extends from near beginning of Flandrian to late Flandrian. Results will be discussed elsewhere, and compared with results from Tregaron SE Bog (Switsur and West, 1972) in this area and with other sites in this investigation such as Red Moss (Hibbert, Switsur, and West, 1971). Coll. and pollen analysis by F. A. Hibbert; radiocarbon measurements by V. R. Switsur.

10,080 ± 220

Q-890. Nant Ffrancon, 608 to 620 cm **8130 B.C.**

12 cm silty lake mud representing 1st organic deposition. *Juniperus* pollen curve rising. In *Betula-Pinus-Juniperus* pollen assemblage zone.

9915 ± 220

Q-890 bis. Nant Ffrancon, 597 to 608 cm **7965 B.C.**

10 cm silty lake mud, in *Betula-Pinus-Juniperus* pollen assemblage zone, at peak of *Juniperus* curve.

9820 ± 200

Q-891. Nant Ffrancon, 587 to 591 cm **7870 B.C.**

4 cm lake mud at decline of *Juniperus* pollen curve, in *Betula-Pinus-Juniperus* pollen assemblage zone.

9745 ± 200

Q-892. Nant Ffrancon, 584 to 587 cm **7795 B.C.**

3 cm lake mud taken near end of fall of *Juniperus* pollen curve, in *Betula-Pinus-Juniperus* pollen assemblage zone.

9631 ± 200

Q-893. Nant Ffrancon, 570 to 573 cm **7681 B.C.**

3 cm lake mud taken near end of fall of *Juniperus* pollen curve, to check Q-892. In *Betula-Pinus-Juniperus* pollen assemblage zone.

9098 ± 180

Q-894. Nant Ffrancon, 562 to 565 cm **7148 B.C.**

3 cm lake mud at point where *Corylus* expansion begins. Opening of *Betula-Pinus-Corylus* pollen assemblage zone.

8932 ± 170

Q-895. Nant Ffrancon, 557 to 560 cm **6982 B.C.**

3 cm lake mud, check on Q-894, dating beginning of *Ulmus* curve. In *Betula-Pinus-Corylus* pollen assemblage zone.

8809 ± 170

Q-896. Nant Ffrancon, 551 to 554 cm **6859 B.C.**

3 cm lake mud, dating rise of *Corylus*. In *Betula-Pinus-Corylus* pollen assemblage zone.

8642 ± 150

Q-897. Nant Ffrancon, 546 to 549 cm **6692 B.C.**

3 cm lake mud dating beginning of *Corylus-Pinus* pollen assemblage zone.

8455 ± 150

Q-898. Nant Ffrancon, 528 to 531 cm **6505 B.C.**

3 cm lake mud at opening of *Pinus-Corylus-Ulmus* pollen assemblage zone. *Alnus* curve begins here.

8118 ± 120

Q-899. Nant Ffrancon, 509 to 512 cm **6168 B.C.**

3 cm lake mud, in *Pinus-Corylus-Ulmus* pollen assemblage zone, at level of *Corylus* peak in this zone. Q-894 to 899 date closely course of *Corylus* rise.

8162 ± 120

Q-899 bis. Nant Ffrancon, 502 to 508 cm **6212 B.C.**

6 cm lake mud check on Q-899.

6884 ± 110

Q-900. Nant Ffrancon, 420 to 423 cm **4934 B.C.**

3 cm lake mud, slightly more organic than lower part of core. Onset of rise of *Alnus* pollen curve, and beginning of *Quercus-Ulmus-Alnus* pollen assemblage zone.

6790 ± 100

Q-901. Nant Ffrancon, 410 to 413 cm **4840 B.C.**

3 cm organic lake mud. *Alnus* pollen rising rapidly in *Quercus-Ulmus-Alnus* pollen assemblage zone.

6726 ± 100

Q-902. Nant Ffrancon, 400 to 403 cm **4776 B.C.**

3 cm organic lake mud at completion of *Alnus* rise in *Quercus-Ulmus-Alnus* pollen assemblage zone.

5160 ± 70

Q-903. Nant Ffrancon, 215 to 218 cm **3210 B.C.**

3 cm organic lake mud immediately before *Ulmus* decline. First of 3 samples dating this decline.

5054 ± 70

Q-904. Nant Ffrancon, 207 to 210 cm **3104 B.C.**

3 cm coarse wood peat. *Ulmus* pollen declining and weed pollen increasing in frequency.

4870 ± 60

Q-905. Nant Ffrancon, 190 to 193 cm **2920 B.C.**

3 cm organic lake mud with wood fragments. Last of 3 samples defining *Ulmus* decline, see Q-903, Q-905.

4422 ± 60

Q-906. Nant Ffrancon, 170 to 172 cm **2472 B.C.**

3 cm wood fragments with organic lake mud. The frequency of *Ulmus* pollen shows a slight recovery.

4256 ± 50

Q-907. Nant Ffrancon, 164 to 166 cm **2306 B.C.**

2 cm wood peat. *Ulmus* pollen lower than Q-906 with weeds of cultivation reaching high frequencies. Onset of major deforestation.

General Comment: results are internally consistent and fully comparable with those obtained at Scaleby Moss (R., 1959, v. 1, p. 63-65), Red Moss (R., 1970, v. 12, p. 590-598) and Tregaron (R., 1972, v. 14, p. 240-242).

Loch Maree series (West Ross)

Core of lake muds from Loch Maree, West Ross, Scotland (57° 41′ N Lat, 5° 30′ W Long, Natl. Grid Ref. 28/915714). Coll. by H. H. Birks and V. R. Switsur, Sub-dept. Quat. Research, Univ. Cambridge, to study dates of pollen zone boundaries in Scotland. Area of present and past native pine forest, differing from other areas investigated. Core taken by 5 cm diam. Mackereth type borer July 1969. Samples id. by depth in pollen diagram. All were of low organic content and were oxidized in hot acidified potassium permanganate suspension.

4206 ± 55

Q-1005. Loch Maree, M1, 200 to 212 cm **2256 B.C.**

12 cm lake mud at point in pollen diagram showing marked decrease in *Pinus sylvestris* pollen, assoc. with peaks of *Pteridum aquilinum* spores and increase of pollen and spores of *Calluna vulgaris, Sphagnum* and other bog plants, and start of a continuous curve of *Plantago lanceolata*. This horizon probably reflects 1st major deforestation of region.

5150 ± 65

Q-1006. Loch Maree, M1, 250 to 260 cm **3200 B.C.**

10 cm lake mud at point where pollen diagram shows slight but definite decline of *Ulmus* frequencies with 1st appearance of *Plantago lanceolata*.

6513 ± 65

Q-1007. Loch Maree, M1, 319 to 326 cm **4563 B.C.**

7 cm lake mud taken at point where *Alnus glutinosa* pollen increases.

8250 ± 100

Q-1008. Loch Maree, M1, 377 to 391 cm **6300 B.C.**

14 cm lake mud taken at point where *Pinus sylvestris* pollen increases.

8951 ± 120

Q-1009. Loch Maree, M1, 424 to 435 cm **7001 B.C.**

11 cm silty lake mud taken at point where *Betula* and *Corylus* pollen increases simultaneously with rapid decline of *Juniperus*.

9085 ± 120

Q-1010. Loch Maree, M1, 435 to 445 cm **7135 B.C.**

10 cm lake mud taken after peak of *Juniperus* pollen near beginning of Flandrian stage. *Comment*: dates are internally consistent and exhibit a high correlation with depth. They agree well with those from Loch Clair, 16 km S of Loch Maree and with those from Loch Sionascaig ca. 80 km N, thus placing chronology of region on a firm basis. Alder rise appears to be much later in Scotland than in England (Birks, 1972).

Bodmin Moor series

Samples coll. from Hawks Tor and Dozmary Pool by A. P. Brown and V. R. Switsur, Sub-dept. Quat. Research, Univ. Cambridge, to date classical pollen zone boundaries and pollen assemblage zones for SW England for 1st time. Dates inter-relate SE England, the rest of Great Britain, and Europe in terms of vegetational changes during late Weichselian and Early Flandrian. For earlier work at Hawks Tor, see Godwin and Willis (1959a).

Hawks Tor 2 series

Monolith of peat 10 cm², coll. from face in China clay quarry by A. P. Brown in April 1970 at Hawks Tor (50° 33′ N Lat, 4° 37′ W Long, Natl. Grid Ref. SX/153747) Cornwall, and sampled in lab for pollen analysis: radiocarbon analysis V. R. Switsur. Samples pretreated with acid and alkali and oxidized in high pressure combustion bomb. Samples id. by depth in pollen diagram.

11,069 ± 220

Q-1015. Hawks Tor, 199 to 201 cm **9199 B.C.**

2 cm slice peat monolith containing *Betula* wood, at end of *Cyperaceae-Potentilla* pollen assemblage zone.

10,884 ± 210

Q-1016. Hawks Tor, 179 to 181 cm **8934 B.C.**

2 cm silty, moderately humified sedge peat, at base of *Cyperaceae-Rubiaceae* pollen assemblage zone.

9654 ± 190

Q-1017. Hawks Tor, 153 to 155 cm **7704 B.C.**

2 cm coarse unhumified sedge peat, at lower boundary of *Rumex acetosa* sub-zone of *Gramineae-Cyperaceae* pollen assemblage zone.

9544 ± 180

Q-1018. Hawks Tor, 150 to 152 cm **7594 B.C.**

2 cm moderately humified sedge peat, in *Rumex acetosa* sub-zone of *Gramineae-Cyperaceae* pollen assemblage zone.

9295 ± 180

Q-1019. Hawks Tor, 143 to 145 cm **7345 B.C.**

2 cm moderately humified sedge peat, in *Empetrum* sub-zone of *Gramineae-Cyperaceae* pollen assemblage zone.

9061 ± 160

Q-1020. Hawks Tor, 141 to 143 cm **7111 B.C.**

2 cm fen wood peat containing fresh *Betula* twigs. Lower boundary of *Betula-Corylus* pollen assemblage zone.

Dozmary Pool series

Three cores taken by Livingstone borer 5 cm diam. through raised bog at SW end of Dozmary Pool, Cornwall (50° 33′ N Lat, 4° 33′ W Long, Natl. Grid Ref. SX/192744). Coll. by A. P. Brown, August 1971.

Samples oxidized in high pressure combustion bomb; id. by depth in pollen diagram.

Q-1021. Dozmary Pool, 230 to 235 cm **9053 ± 120**
7103 B.C.

5 cm organic silt at base of organic deposition, resting on kaolin clay and gravel. Base of *Gramineae* pollen assemblage zone.

Q-1022. Dozmary Pool, 219 to 223 cm **8829 ± 100**
6879 B.C.

4 cm fine detritus mud at base of *Cyperaceae* sub-zone of *Corylus-Gramineae* pollen assemblage zone. Continuous curve of *Ulmus* pollen starts here.

Q-1023. Dozmary Pool, 205 to 209 cm **7925 ± 100**
5975 B.C.

4 cm *Salix* fen wood peat, in lower part of *Corylus*-type pollen assemblage zone.

Q-1024. Dozmary Pool, 187 to 191 cm **6793 ± 70**
4843 B.C.

4 cm covering junction of sedge peat with raised bog peat containing charcoal, in *Corylus*-type *Pteridium* pollen assemblage zone. *Alnus* pollen makes 1st appearance here.

Q-1025. Dozmary Pool, 183 to 189 cm **6451 ± 65**
4501 B.C.

6 cm raised bog peat with *Eriophorum vaginatum* and *Calluna vulgaris* twigs and leaves. Sample spans alder rise.

General Comment: dates compare well in chronology they provide with others from other W British sites (Hibbert, Switsur, and West, 1971). Q-1017, Q-1018 suggest a non-sequence at opening of Flandrian since dates are later than beginning of Pollen Zone IV in W (ca. 10,300 B.P.). Admixture of older material during post Allerød solifluction (Hawks Tor *Rubiaceae* pollen assemblage zone) may be responsible for similarity of Q-1016 and Q-1015, which are separated by 20 cm sedge peat. *Ulmus* expansion occurred ca. 200 yr after that of *Quercus*, reverse of situation in rest of Britain but similar to SW France (Oldfield, 1964).

Chesil Beach (Abbotsbury) series

Large rafts of peat (3 × 3 × 1 m) eroded from beach from ca. −2 m O.D. thrown up on beach December 1970, (50° 39′ N Lat, 2° 36′ W Long, Natl. Grid Ref. 576831). Dates required to relate rafts to peat beds below pebble beach. Coll. by M. W. Blackley; subm. by A. P. Carr, Unit Coastal Sedimentation, Taunton, Somerset.

Q-1028. Abbotsbury, peat **4234 ± 60**
2284 B.C.

Peat containing *Phragmites* and pieces of pine, birch, and oak.

4251 ± 60

Q-1029. Abbotsbury, humic **2301 B.C.**

Extract of peat as in Q-1028 with sodium hydroxide solution. Material precipitated by hydrochloric acid was dated.

5058 ± 70

Q-1030. Abbotsbury, wood **3108 B.C.**

Wood, unid., derived from peat raft.

General Comment: samples dated in connection with discrepancy of dates for peat from Isotopes Teledyne (I-5670, 5270 ± 110 B.P.) and East Kilbride Scottish Reactor Centre (SRRC-12, 4023 ± 50 B.P. and SRRC-31, 4095 ± 60 B.P.) radiocarbon labs. Q-1028 and Q-1029 agree well, indicating no peat fractionation. The wood is probably derived.

Featherbed Moss series, Snake Pass, Derbyshire

Upper layers of ombrogenous (blanket) peat in S Pennines typically exhibit a series of alternating horizontal bands of fresh *Sphagnum* peat and of more highly humified *Ericaceae* or *Cyperaceae* peat. Pollen analysis indicates that several of these *Sphagnum* peat layers are roughly contemporary between one site and another, and correspond to recognized recurrence surfaces; and thus are climatically determined. The *Sphagnum* peat layers occur in definable positions relative to anthropogenic effects (clearance phases) apparent in the pollen diagrams, and thus can be used to date them.

Samples were all slices 1 cm thick cut from a peat monolith from Featherbed Moss, at summit of Snake Pass (53° 26′ N Lat, 1° 52′ W Long, Natl. Grid Ref. SK/091928) at alt. 500 m. Coll. 1965 by J. H. Tallis, Univ. Manchester. Depths are measured from ground surface (Tallis, 1964; Hicks, 1971).

491 ± 50

Q-849. Featherbed Moss 1 **A.D. 1459**

Fresh *Sphagnum* peat from depth 25 cm. Sample dates beginning of peat growth.

717 ± 50

Q-850. Featherbed Moss 2 **A.D. 1233**

Fresh *Sphagnum* peat from depth 32.5 cm immediately underlying highly humified peat formed during 'Little Climatic Optimum'.

1023 ± 50

Q-851. Featherbed Moss 3 **A.D. 927**

Fresh *Sphagnum* peat from depth 42 cm at base of layer. Coincides with rise of weed pollen frequencies of Viking and Early Mediaeval times.

1400 ± 50

Q-852. Featherbed Moss 4 **A.D. 550**

Fresh *Sphagnum* peat from depth 82 cm at base of series of ill-defined bands coinciding with decline of weed pollen frequencies.

Q-853. Featherbed Moss 5 **2028 ± 50**
78 B.C.

Humified peat from 115 cm, where weed pollen frequencies begin to rise.

Q-854. Featherbed Moss 6 **2251 ± 50**
301 B.C.

Fresh *Sphagnum* peat from 120 cm at top of band underlying highly humified peat.

Q-855. Featherbed Moss 7 **2685 ± 50**
735 B.C.

Fresh *Sphagnum* peat from depth 130 cm from base of 'upper peat' (Conway, 1954) at Classical Zone VIIb/VIII boundary.

General Comment: dates will provide a broad chronology for correlation of many pollen diagrams in area.

Scottish Tree Stump series

Q-1031. Inverpolly Pine Trunk **4674 ± 60**
2724 B.C.

Wood (*Pinus sylvestris*) from middle of trunk sec., semi-submerged in water of small lochan close to N shore Loch Sionascaig (58° 4′ 15″ N Lat, 5° 8′ 45″ W Long, Natl. Grid Ref. NC/127146). Dates former pine forest in area now covered by blanket bog. Coll. 1970 by R. V. Collier, Nature Conservancy. Subm. by H. H. Birks.

II. ARCHAEOLOGIC SAMPLES

Somerset Levels, SW England

Continuation of collaboration between F. A. Hibbert, Liverpool College Technol.; V. R. Switsur, and J. M. Coles, Dept. Archaeol. and Anthropol. Univ. Cambridge, in excavation and dating of complex of prehistoric trackways in Somerset Levels.

Q-1027. Honeygore (West) W **4742 ± 50**
2792 B.C.

Q-1028. Honeygore (West) B **4780 ± 50**
2830 B.C.

Check samples for date of Honeygore track. Both determinations were from one sample of *Betula* wood from trackway (51° 11′ N Lat, 2° 50′ W Long, Natl. Grid Ref. ST/416428). Q-1027 was oxidized using acidified permanganate solution while Q-1028 was oxidized with high pressure oxygen in the combustion bomb. Dates agree within one standard deviation of each other and with other dates of this trackway, see Q-999 (Switsur and West, 1972).

Burtle Bridge Track series

Another Neolithic trackway discovered 1971 at Edington Burtle, Somerset (51° 11′ N Lat, 2° 52′ W Long, Natl. Grid Ref. ST/393426), a multi-layered construction with assoc. Neolithic pottery. Birch wood

from track coll. by C. F. Clements from beneath 65 cm peat. The 3 pieces dated overlay one another.

Q-1038. Burtle Bridge Track (A) — **4327 ± 60** / **2377 B.C.**
Wood of track overlying Q-1036.

Q-1036. Burtle Bridge Track (B) — **4231 ± 60** / **2281 B.C.**
Wood of track, overlying Q-1035.

Q-1035. Burtle Bridge Track (C) — **4355 ± 60** / **2405 B.C.**
Lowest layer of track, resting on peat.

References

Birks, H. H., 1972, Studies in the vegetation history of Scotland III. A radiocarbon dated pollen diagram from Loch Maree, Ross and Cromarty: New Phytologist, v. 71, in press.

Conway, V. M., 1954, Stratigraphy and pollen analysis of Southern Pennine Blanket Peats: Jour. Ecol., v. 42, p. 117.

Godwin, H. and Willis, E. H., 1959a, Radiocarbon dating of the late-glacial period in Britain: Royal Soc. [London] Proc. B, v. 150, p. 199-215.

———— 1959b, Cambridge University natural radiocarbon measurements I: Am. Jour. Sci. Radiocarbon Supp., v. 1, p. 63-75.

Hicks, S. P., 1971, Pollen-analytical evidence for the effect of prehistoric agriculture on the vegetation of North Derbyshire: New Phytologist, v. 70, p. 647-667.

Hibbert, F. A., Switsur, V. R., and West, R. G., 1971, Radiocarbon dating of Flandrian pollen zones at Red Moss, Lancashire: Royal Soc. [London] Proc. B, v. 177, p. 161-176.

Oldfield, F., 1964, Late Quaternary vegetational history in South West France: Pollen et Spores, v. 6, p. 157-168.

Seddon, B., 1962, Late-glacial deposits at Llyn Dwythwch and Nant Ffrancon, Caernarvonshire: Royal Soc. [London] Phil. Trans. B, v. 244, p. 459-481.

Switsur, V. R., Hall, M. A., and West, R. G., 1970, University of Cambridge natural radiocarbon measurements IX: Radiocarbon, v. 12, p. 590-598.

Switsur, V. R. and West, R. G., 1972, University of Cambridge natural radiocarbon measurements X: Radiocarbon, v. 14, p. 239-246.

Tallis, J. H., 1964, Studies on southern Pennine Peats II. The pattern of erosion: Jour. Ecol., v. 53, p. 333-344.

[RADIOCARBON, VOL. 15, No. 1, 1973, P. 165-178]

UNIVERSITY OF ROME CARBON-14 DATES X

M. ALESSIO, F. BELLA, S. IMPROTA

Istituto di Fisica, Università di Roma

G. BELLUOMINI, G. CALDERONI, C. CORTESI, and B. TURI

Istituto di Geochimica, Università di Roma

This list includes age measurements made from November 1970 to December 1971. All archaeologic and geologic samples come from Italian territory. Laboratory equipment, largely unchanged but expanded and technically improved, was previously described (Alessio *et al.*, 1970a). Charcoal and wood samples underwent standard pretreatment by boiling with 5 to 10% HCl; α-labeled samples were given additional leaching with 6% NH_4OH or 0.2N NaOH.

The activity of our "modern standard" wood grown near Rome between 1949 and 1953, was checked repeatedly with 95% of the counting rate of NBS oxalic acid and measurements were found coincident within 1σ. For each sample of CO_2, the counting rate was corrected according to mass-spectrometrically measured C^{13}/C^{12} ratio as described previously (Alessio *et al.*, 1969). Dates are reported in conventional radiocarbon years, using the Libby half-life of 5568 ± 30 yr, with 1950 as the standard year of reference.

ACKNOWLEDGMENTS

We thank Consiglio Nazionale delle Ricerche for providing partial financial support. We also thank our technicians for their assiduous, fine work, A. Fruscalzo in mass-spectrometric measurements and B. Petrocchi in activity measurements.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC AND HISTORIC SAMPLES

A. Italy

R-375. Lago Lucone, piroga — **3360 ± 50** / **1410 B.C.** / $\delta C^{13} = -29.3‰$

R-375α. Lago Lucone, piroga — **3160 ± 50** / **1210 B.C.** / $\delta C^{13} = -29.4‰$

Excavations made by Gruppo Grotte Gavardo in 1965 revealed pirogue from bottom peaty sediments of old intermorainal, now dried-up lacustrine basin of Lucone, near Polpenazze, prov. Brescia, Lombardy (45° 33′ 05″ N Lat 10° 30′ 00″ E Long) (Cornaggia Castiglioni, 1967). Darkened wood (*Quercus sp.*) from pirogue coll., 1965 and subm. 1968 by Cornaggia Castiglioni, Sopr. Monumenti della Lombardia, Milan. *Comment*: pirogue was found at prehistoric settlement built on stacked timber platform or "bonifica" attributed to Polada culture. Dates agree

well with some dates for this culture, widespread in Po Valley and chronologically controversial (Alessio *et al.* 1971).

R-786α. Bande di Cavriana, piroga **3520 ± 50**
1570 B.C.
$\delta C^{13} = -27.2‰$

Darkened wood from pirogue excavated 1970 from prehistoric "bonifica" settlement in Holocene peat bog, Bande di Cavriana, ca. 37 km N Mantua, Lombardy (45° 22′ 15″ N Lat, 10° 35′ 00″ E Long). Coll. and subm. 1970 by O. Cornaggia Castiglioni. *Comment*: date agrees with Polada culture in this site: R-25, 3495 ± 60 (R., 1965, v. 7, p. 215).

R-359α. Lago di Fimon, piroga **4580 ± 50**
2630 B.C.
$\delta C^{13} = -26.0‰$

Darkened wood, fragment of pirogue from peat bog, Val di Marca, near Lake Fimon, Berici Mts., ca. 9 km S Vicenza, Veneto (45° 29′ 00″ N Lat, 11° 31′ 53″ E Long). Coll. 1945 and subm. 1967 by O. Cornaggia Castiglioni. *Comment*: little is known of pirogue typology, which may be attributed to local facies of Early Bronze age. This date, in Po Valley, may be compared to age of a wooden artifact from "bonifica" settlement of Lagozzetta di Besnate, NW Lombardy, dated, according to Cornaggia Castiglioni, to beginning of Bronze age civilization of area: R-336, 4385 ± 50 (R., 1968, v. 10, p. 357) (Cornaggia Castiglioni, 1967; 1968).

General Comment on pirogues: up to 1967, ca. 60 prehistoric boats were known, mainly in N Italy, particularly in Po Plain. These are generally one-piece pirogues, found whole or in fragments, mostly lost. Typology of only ca. 20 is known, and most are attributed to local cultures of Early Bronze age. Cornaggia Castiglioni (1967) made the 1st systematic study of Italian prehistoric pirogues. Three dates in this list are so far the only ones available for prehistory. Another pirogue from Valle Isola near Comacchio, Emilia, housed in Mus. Archeol. Ferrara, is from Roman age: R-2, 1810 ± 140 (Bella and Cortesi, 1957) and dugout from shore of Lake Trasimeno, Umbria, is from Late Middle age; Pi-84, 744 ± 110 (R., 1961, v. 3, p. 103).

R-819. Castelliere C. Marchesetti **3430 ± 50**
1480 B.C.
$\delta C^{13} = -25.1‰$

In 1970 G. Stacul, Ist. Storia Antica, Univ. Trieste, on behalf of Sopr. Antichità Trieste, made excavations at Castelliere C. Marchesetti, near Slivia, Commune of Duino-Aurisina, prov. Trieste, Venezia Giulia (45° 46′ 00″ N Lat, 13° 40′ 35″ E Long). Trench was dug into S slope of hill near enclosure wall of "castelliere". Through sec., ca. 2 m thick, 6 layers and 3 archaeol. horizons id. from assoc. pottery and animal bone remains, probably food refuse (Stacul, 1970; 1972). Charcoal from lower cultural hoizon coll. 1970 and subm. 1971 by G. Stacul. *Comment*: place name "castellier" or "castelliere" designates prehistoric settlements, probably fortified villages, throughout Giulian Karst region and Dalmatia

generally formed by remains of dry stone walls surrounding hill tops, with traces of stone buildings in walled area. Based on type of pottery in "castellieri", so-called Castellieri culture may be divided into at least 2 phases, between Late Bronze age and Iron age, likely up to Roman epoch (Marchesetti, 1903; Battaglia, 1958; Radmilli, 1963). C^{14} date is only one available for Castellieri culture and dates to Middle-Late Bronze age archaic cultural horizon of Castelliere C. Marchesetti.

Basilica di Monastero di Aquileia series

Wall foundation piling timbers from Basilica di Monastero, 1.5 km NE Aquileia, prov. Udine, Friuli (45° 46′ 39″ N Lat, 13° 22′ 16″ E Long). Coll. 1969 and subm. 1970 by L. Bertacchi, Dir., Mus. Archeol. Aquileia.

R-698. Basilica di Monastero 1 **1490 ± 50**
A.D. 460
$\delta C^{13} = -27.1‰$

Wood from foundation timber of Basilica's perimeter wall, with floor mosaic from late 4th to early 5th century A.D.

R-699. Basilica di Monastero 2 **1470 ± 50**
A.D. 480
$\delta C^{13} = -27.2‰$

Wood from foundation timber of transverse wall of 3 small rooms, also mosaic-floored, outside and adjacent to N side of Basilica. Mosaics are of same workmanship and level as those in Basilica.

General Comment: dated to determine construction stages of Basilica. Wood is coeval and ages agree with epoch of mosaics (Brusin, 1957: Bertacchi, 1965).

S. Michele di Valestra series

Since 1956, Comitato Sci. CAI Modena, Gruppo Archeol., has been excavating prehistoric settlement S. Michele di Valestra, ca. 6 km E Carpineti, prov. Reggio nell'Emilia (44° 27′ 08″ N Lat, 10° 33′ 22″ E Long). Deposit, occupying a whole plateau, ca. 120 m × 9 to 20 m, slightly below ridge of Mt. Valestra, revealed 3 archeol. layers with pottery, bone, horn, bronze and copper objects, animal bone remains, and charcoal. Finds in II and III layers attributed to Late Bronze age and Proto-Villanovan culture (Bertolani, 1967; Comitato Sci. CAI, 1970; Bellodi *et al.*, 1971). Charcoal from Layers II and III coll. 1969 and subm. 1970 by M. Bertolani, Ist. Min., Univ. Modena.

R-734α. S. Michele di Valestra II **2660 ± 50**
710 B.C.
$\delta C^{13} = -24.7‰$

Charcoal from Layer II.

R-735α. S. Michele di Valestra III **2830 ± 50**
880 B.C.
$\delta C^{13} = -25.0‰$

Charcoal from Layer III.

General Comment: dates confirm Proto-Villanovan culture.

R-676. Grotta dell'Orso di Sarteano **6080 ± 50**
4130 B.C.
$\delta C^{13} = -24.6‰$

Charcoal from lower Neolithic levels of Grotta dell'Orso, Villa Contucci near Sarteano, 9 km SW Chiusi, prov. Siena, Tuscany (42° 59′ 25″ N Lat, 11° 52′ 08″ E Long). Coll. 1963 and subm. 1970 by R. Grifoni, Ist. Antropol. e Paleontol. Umana, Univ. Pisa. Cave was discovered 1954 (Maetzke, 1954) and excavations made 1960-63 by A. M. Radmilli, G. Cremonesi, and R. Grifoni for Ist. Antropol., Univ. Pisa, with Sopr. alle Antichità dell'Etruria (Radmilli, 1960, 1962, 1963). In main deposit of cave's entrance chamber, various cultural horizons were id.: a) upper horizons—materials from Bronze age, Apennine, Sub-Apennine, and Proto-Villanovan cultures, only a few attributable to Anaeolithic (Cremonesi, 1968); b) lower horizons—Neolithic pottery of Linearbandkeramik cultural complex, or Sasso-Fiorano culture in Italy, some features similar to Bükk culture. Cave was also used as a burial place (Grifoni, 1967). *Comment*: date agrees with age of cultural horizon of Ripabianca di Monterado, attributed to early phase of Middle Neolithic, where both impressed pottery and elements of Fiorano culture are present: R-598, 6210 ± 75; R-598α, 6140 ± 70 and R-599α, 6260 ± 85 (R., 1970, v. 12, p. 602-603).

B. Elba Island

Golfo di Procchio shipwreck series

The following series completes dating of Roman merchant ship from basal sand in Procchio Gulf, N coast Elba I. (42° 47′ 31″ N Lat, 10° 14′ 56″ E Long), water depth ca. 1.90 m (see R., 1971, v. 13, p. 398). Partially preserved wooden ship, discovered 1966 by G. Brambilla, was dug out of sand and described by G. Monaco and A. Fioravanti for Sopr. Antichità dell'Etruria, Florence. Various objects from cargo were found in ship and within radius ca. 30 m around it (Ferri Ricchi, 1969; Fioravanti and Ferri Ricchi, 1970; Fabiani, 1971; Zecchini, 1971). Wood, id. by M. Follieri, Ist Bot., Univ. Rome (pers. commun.) and huntite samples coll. 1969 by A. Fioravanti and G. Brambilla and subm. 1971 by G. Maetzke, Sopr. Antichità dell'Etruria, Florence.

R-832. Golfo di Procchio Wreck 3 **1810 ± 50**
A.D. 140
$\delta C^{13} = -25.2‰$

Fairly well-preserved wood (*Picea* sp.) from ship's outer planking. See R-835α comment.

R-833. Golfo di Procchio Wreck 4 **1720 ± 50**
A.D. 230
$\delta C^{13} = -26.5‰$

Fairly well-preserved wood (*Abies* sp.) from ship's inner planking. See R-835α comment.

R-834α. Golfo di Procchio Wreck 5 **1650 ± 50**
A.D. 300
$\delta C^{13} = -26.8‰$

Darkened wood (*Ulmus* sp.) from a ship shelf-piece. See R-835α comment.

R-835α. Golfo di Procchio Wreck 6 **1660 ± 50**
A.D. 290
$\delta C^{13} = -27.4‰$

Darkened wood (*Ulmus* sp.) from a ship frame. *Comment*: R-833/R-835α dates agree with R-678 age: 1610 ± 50 (R., 1971, v. 13, p. 398) and confirm wreck as Imperial age Roman merchant ship.

R-836α. Golfo di Procchio Wreck 7 **1600 ± 50**
A.D. 350
$\delta C^{13} = -28.3‰$

Darkened wood found inside ship, but apparently unconnected with structure. *Comment*: date of another piece of wood found inside ship: R-679, 1670 ± 50 (R., 1971, v. 13, p. 398).

R-831Aα. Golfo di Procchio Wreck 8 **1710 ± 50**
A.D. 240
$\delta C^{13} = -27.0‰$

Darkened wood (*Larix* sp.) from board forming base of wooden box ca. 40 × 30 × 20 cm full of huntite on sea floor a few m from shipwreck. See R-831Cα comment.

R-831Bα. Golfo di Procchio Wreck 9 **1760 ± 50**
A.D. 190
$\delta C^{13} = -25.2‰$

Darkened wood (*Larix* sp.) from thinner board forming one side of above mentioned box. See R-831Cα comment.

R-831Cα. Golfo di Procchio Wreck 10 **1670 ± 50**
A.D. 280
$\delta C^{13} = -25.3‰$

Darkened wood, another fragment from board referred to above under R-831B. *Comment*: R-831A/Cα dates confirm that, as inferred, box belonged to Roman ship's cargo.

R-853. Golfo di Procchio huntite **>42,000**
$\delta C^{13} = +4.6‰$

Huntite sample from content, ca. 10 kg, of box found near shipwreck belonging to cargo (see R-831A/Cα). *Comment*: upon recovery, this uncommon mineral, magnesium and calcium carbonate, Mg_3Ca-

$(CO_3)_4$, appeared as a white plastic mass which, in drying, turned into impalpable powder. Id. as huntite by chemical, x-ray, and differential-thermal analyses and electron microscopy. Material was not pretreated prior to CO_2 extraction by acid. C^{14} measurement was made because of initial supposition that huntite formed during long period on sea floor by exchange reactions with seawater ions (Ca^{++}, CO_3^{--}) of more common magnesium minerals, particularly magnesite, known to have been used and traded in antiquity, or even of hydromagnesite or possibly *magnesia usta*. Inactivity of mineral, however, disproves origin from hydromagnesite or *magnesia usta*, while thermodynamic study of reaction: $4MgCO_3 + Ca^{++} \rightarrow Mg_3Ca(CO_3)_4 + Mg^{++}$ would deny possibility of formation from magnesite. We should therefore conclude huntite, as such, was originally in box, and was part of cargo leaving source of this rare mineral in doubt.

C. Sicily

R-718. Avola, anchor **1950 ± 50**
A.D. 0
$\delta C^{13} = -25.9‰$

Wood from wooden core of ancient lead anchor stock, length 1.67 m, weight 107 kg, found in sea at ca. 16 m depth, near mouth of Fiumara torrent, ca. 4 km S Avola, prov. Siracusa (36° 51′ 30″ N Lat, 15° 08′ 38″ E Long) and since housed in Mus. Nazionale di Siracusa, marking: SIR A 155, inventory no. 58560. Coll. 1965 by Montenero and subm. 1970 by L. Bernabò Brea, Sopr. Antichità Sicilia Orientale, and G. Kapitän. *Comment*: numerous ancient lead anchor stocks have been found in Mediterranean on shipwrecks of known age, but no wooden-core anchor stock has yet been found on datable wrecks (Benoit, 1952, 1955). Thus, C^{14} age establishes for 1st time that this type of anchor was also used during Roman epoch.

II. GEOLOGIC SAMPLES

Italy

R-783α. Rubiera **3440 ± 50**
1490 B.C.
$\delta C^{13} = -26.0‰$

Slightly darkened fossil wood (*Quercus* sp.) id. by D. Bertolani Marchetti, from large trunk, ca. 7 m long, in horizontal position under alluvial gravel of Secchia R. near Rubiera, prov. Reggio nell'Emilia (44° 39′ 19″ N Lat, 10° 47′ 45″ E Long). Coll. 1970 and subm. 1971 by D. Bertolani Marchetti, Ist. Bot., Univ. Bologna. Fossil forest was buried under alluvial sandy gravel ca. 9 m thick. Several large tree stumps both *in situ* and in horizontal position, the latter 7-8 m long, were found. *Comment*: forest probably belongs to *Quercetum-Carpinetum* vegetation, which characterized Po R. valley since Sub-Atlantic, confirmed by date.

R-715α. Monte Somma-Vesuvio **1800 ± 50**
A.D. 150
$\delta C^{13} = -24.8‰$

Carbonized wood, fragments of little branches, from reworked pyroclastic formation, overlying pumice, on road from Ercolano to Mt. Vesuvio near junction of Osservatorio Vesuviano Rd. (40° 46′ 50″ N Lat, 14° 39′ 03″ E Long). Coll. and subm. 1970 by M. Fornaseri, C. Cortesi, and G. Calderoni, Ist. Geochim., Univ. Rome. *Comment*: date attributes pyroclasts to A.D. 79 Plinian eruption of Somma-Vesuvius volcano. Age of carbonized bread from a storehouse of ancient Pompei: L-371E, 1830 ± 50 (R., 1959, v. 1, p. 26).

Campi Flegrei, Napoli

The following series include a 2nd group of systematic dates of carbonized wood and humified layers of paleosols interbedded in pyroclasts of Campi Flegrei volcanic region. The preceding date list (R., 1971, v. 13, p. 403-409) reported the more significant outlines of long activity and structure of this volcanic system and essential bibliography. Humified layers were pretreated with 8N HCl; when not otherwise indicated, humic acids were extracted with 6% NH_4OH and precipitated again by dilute HCl. Wood id. by M. Follieri.

1st Phlegrean period

R-824. Torre di Franco **>42,000**
$\delta C^{13} = -25.2‰$

Sec. ca. 100 m W Torre di Franco, from cartway to large "piperno" quarry (40° 51′ 07″ N Lat, 14° 11′ 31″ E Long) exposes light stratified tuffs "Tufi di Torre di Franco" with several interbedded humified layers, underlying "piperno" and "breccia museo" complex (Rittmann *et al.*, 1950, p. 146, 151). Humic acids from humified layer underlying Torre di Franco tuffs coll. and subm. 1971 by A. Scherillo and E. Franco, Ist. Min., Univ. Naples, and M. Fornaseri, C. Cortesi, and G. Calderoni. *Comment*: age is as expected from stratigraphic position of Torre di Franco tuffs.

Tufo grigio campano or "Ignimbrite Campana" series

Carbonized wood embedded in "Campanian gray tuff" or "Campanian Ignimbrite" (Di Girolamo, 1970). Samples from various localities coll. and subm. 1971 by P. Di Girolamo and C. Porcelli, Ist. Min., Univ. Naples.

R-821. Monte della Taglia, Cicciano I-1 **36,000 ± 2000**
34,050 B.C.
$\delta C^{13} = -23.4‰$

R-821α. Monte della Taglia, Cicciano I-1 **35,300 ± 1000**
33,350 B.C.
$\delta C^{13} = -23.6‰$

Carbonized wood, fragment of branch, embedded in middle-upper

part of Campanian gray tuff, yellow facies, Monte della Taglia quarry, ca. 2 km NW Cicciano, prov. Naples, Campania (40° 58′ 10″ N Lat, 14° 33′ 58″ E Long).

R-822. Atripalda — **33,000 ± 1500** / **31,050 B.C.** / $\delta C^{13} = -22.6‰$

Carbonized wood (*Pinus* sp.) embedded in Campanian gray tuff, yellow facies, from sec. near Villa Limongelli at entrance of road from Atripalda to Salerno, ca. 4 km E Avellino, Campania (40° 54′ 50″ N Lat, 14° 49′ 18″ E Long).

R-784. Lazzaretto — **29,700 ± 800** / **27,750 B.C.** / $\delta C^{13} = -23.3‰$

R-784α. Lazzaretto — **28,300 ± 800** / **26,350 B.C.** / $\delta C^{13} = -23.5‰$

Carbonized wood, fragment of little trunk, embedded in "cinerazzo" upper gray loose part of Campanian gray tuff, yellow facies, from quarry sec. at Lazzaretto, suburb of Avellino, Campania (40° 54′ 45″ N Lat, 14° 48′ 33″ E Long). Through sec. Campanian gray tuff, 10 m thick, overlying Pleistocene conglomerate, covered by pyroclasts mainly from A.D. 79 Plinian eruption of Somma-Vesuvius volcano.

R-820. S. Martino Valle Caudina — **30,000 ± 900** / **28,050 B.C.** / $\delta C^{13} = -21.9‰$

Carbonized wood, fragment of trunk, embedded in upper part, yellow facies, of Campanian gray tuff from quarry sec. 3 km E S. Martino Valle Caudina, at border of Avellino and Benevento provs., Campania (41° 01′ 50″ N Lat, 14° 41′ 53″ E Long). In sec. gray facies appears in lower part of Campanian gray tuff which overlies Pleistocene polygenic conglomerate, covered by A.D. 79 Plinian eruption of Somma-Vesuvius products.

General Comment: these dates confirm Würm age of "Campanian gray tuff" (Campanian Ignimbrite) as from stratigraphic evidence (Brancaccio, 1968). Age of carbonized wood in lower part of Campanian gray tuff: R-567, >40,000 yr (R., 1971, v. 13, p. 404). For K/Ar dates referred to Campanian gray tuff, see R., 1971, v. 13, p. 405.

R-714. Spiaggia di Acquamorta, Monte di Procida — **31,700 ± 1400** / **29,750 B.C.** / $\delta C^{13} = -23.6‰$

Carbonized wood, fragments of little branches, from humified layers interbedded in thick series of pyroclasts on Acquapendente shore facing Procida channel, 0.5 km SW Monte di Procida, Campi Flegrei, Napoli (40° 47′ 42″ N Lat, 14° 02′ 37″ E Long). Coll. and subm. 1970 by E. Franco. Humified layers with carbonized wood are interbedded in chaotic

gray pozzolana-pumice and lapilli layer overlying scoriae of trachyte lava dome of S. Martino later intruded in pyroclastic series. *Comment*: pyroclasts believed to belong to 1st period of Phlegrean activity and C^{14} age agrees.

R-823. Valle del Verdolino **16,390 ± 180**
14,440 B.C.
$\delta C^{13} = -25.2‰$

Humic acids from lower humified layer interbedded in upper part of stratified whitish tuffs underlying Neapolitan yellow tuff, old "piperno" quarry sec. E side Verdolino Valley, Campi Flegrei (40° 51′ 08″ N Lat, 14° 12′ 37″ E Long) U.T.M. system 33T VF 333(5) 231(8). Coll. and subm. 1971 by A. Scherillo, E. Franco, M. Fornaseri, C. Cortesi and G. Calderoni. (Rittman, 1950, p. 139 ff.). *Comment*: lower pyroclasts of 2nd period and Neapolitan yellow tuff, most widespread product of main phase of 2nd period, were dated 12,800 to 11,600 and 10,000 B.P. (R., 1971, v. 13, p. 407). C^{14} age of whitish tuff formation agrees with upper part of 1st Phlegrean period. See also Campanian gray tuff series, this list.

R-825. Vallone delle Fontanelle **15,090 ± 140**
13,140 B.P.
$\delta C^{13} = -25.3‰$

Humic acids from thick strongly humified pozzolana layer, Fontanelle Valley sec. on road to Castagneto locality, NW suburb of Naples (40° 51′ 38″ N Lat, 14° 13′ 59″ E Long). Coll. and subm. 1971 by A. Scherillo, E. Franco, M. Fornaseri, C. Cortesi and G. Calderoni. *Comment*: Fontanelle Valley stratigraphic series can be compared to similar one of Verdolino Valley (R-823, this list). Agreement of dates could confirm assumption.

General Comment to 1st Phlegrean period: new dates integrate C^{14} chronology of volcanic events preceding eruption of yellow Neapolitan tuff and indicate that this activity ranges from >12,000 to ca. 15,000 B.P. with an upper limit of 12,800 B.P. representing youngest of organic materials underlying the yellow Neapolitan tuff.

2nd and 3rd Phlegrean periods

Pomigliano D'Arco series

Secs. in large pozzolana and volcanic sand quarry on plain not far from N side of Somma-Vesuvio volcano, SE suburb of Pomigliano D'Arco, Napoli (40° 54′ 10″ N Lat, 14° 23′ 53″ E Long) expose volcanic formation, ca. 15 m high, with interbedded Somma-Vesuvio and Phlegrean products. Humified layers coll. and subm. 1971 by A. Scherillo, P. Di Girolamo, M. Fornaseri, C. Cortesi, and G. Calderoni. Samples were pretreated with 8N HCl; humic acids extracted both with 6% NH_4OH (–A labeled samples) and 0.2N NaOH (–B labeled samples) and precipitated again by dilute HCl: no difference between 2 dates.

R-826. Pomigliano D'Arco II-1 **12,280 ± 100**
10,330 B.C.
$\delta C^{13} = -26.1‰$

Humic acids from lower Layer 1 underlying 2nd Phlegrean products. *Comment*: date agrees with other C^{14} ages related to humified layers interbedded or underlying lower pyroclasts of 2nd period in Ponti Rossi and Masseria Ferrara quarries, and in Via Provenzale and Capodichino secs. (R., 1971, v. 13, p. 406-407).

R-827A. Pomigliano D'Arco II-2 **11,240 ± 80**
9290 B.C.
$\delta C^{13} = -26.2‰$

R-827B. Pomigliano D'Arco II-2 **11,360 ± 100**
9410 B.C.
$\delta C^{13} = -26.1‰$

Humic acids from Layer 2 underlying Agnano products and overlying lower pyroclasts of 2nd period. *Comment*: date agrees with age of humified layers in similar stratigraphic position at Masseria Ferrara quarry: R-704, 10,740 ± 90 (R., 1971, v. 13, p. 407).

R-828A. Pomigliano D'Arco III-3 **8620 ± 70**
6670 B.C.
$\delta C^{13} = -25.3‰$

R-828B. Pomigliano D'Arco III-3 **8510 ± 50**
6560 B.C.
$\delta C^{13} = -25.5‰$

Humic acids from Layer 3 interbedded in middle 3rd Phlegrean period pyroclasts and overlying Agnano products. *Comment*: date is the only one available for pyroclasts overlying Agnano products.

R-829A. Pomigliano D'Arco III-5 **4800 ± 60**
2850 B.C.
$\delta C^{13} = -26.0‰$

R-829B. Pomigliano D'Arco III-5 **4800 ± 50**
2850 B.C.
$\delta C^{13} = -26.0‰$

Humic acids from Layer 5 interbedded in upper part of middle 3rd period Phlegrean products and underlying Astroni products. *Comment*: date agrees with other C^{14} ages of layers underlying Astroni at Masseria Ferrara quarry, Rione Mofete and Bivio di Quarto secs.; see R-703, 592, and 596 (R., 1971, v. 13, p. 407-409).

R830A. Pomigliano D'Arco III-6 **3510 ± 50**
1560 B.C.
$\delta C^{13} = -24.5‰$

R-830B. Pomigliano D'Arco III-6 **3610 ± 50**
1660 B.C.
$\delta C^{13} = -25.1‰$

Humic acids from Layer 6 overlying Astroni products. *Comment*: date agrees with ages of layer overlying Astroni at Rione Mofete and Bivio di Quarto secs.; see R-591 and 597 (R., 1971, v. 13, p. 408-409), and with ages of carbonized wood in Astroni products; see R-785 and 707 to 713.

General Comment: R-828A/B ages date for the 1st time upper limit of Agnano eruptions. Dates of other humified layers confirm once more previous Phlegrean C^{14} chronology of main events of 2nd and 3rd periods, summarized in preceding date list (R., 1971, v. 13, p. 407 and 409; Alessio, Bella, Belluomini, *et al.*, 1971).

R-785. Via Terracina, Napoli **4070 ± 50**
2120 B.C.
$\delta C^{13} = -25.0‰$

Carbonized wood, little trunk (*Quercus* sp., deciduous group), from small outcrop of pozzolana and pumice at Via Terracina, Nuovo Rione S. Paolo, W suburb of Naples (40° 50′ 22″ N Lat, 14° 11′ 12″ E Long) U.T.M. system 33T VF 315 215. Coll. and subm. by E. Franco. *Comment*: date confirms Astroni volcano products. Age of other carbonized wood from same outcrop: R-682, 4000 ± 50 (R., 1971, v. 13, p. 408).

Astroni series

Several carbonized fragments of small trunks or branches, are scattered through Astroni products; some of them have been found in pumice and pozzolana quarry in N side of well-preserved Astroni crater, Campi Flegrei (40° 51′ 15″ N Lat, 14° 08′ 50″ E Long) U.T.M. system 33T VF 282 232. Coll. and subm. by A. Scherillo, E. Franco, M. Fornaseri, C. Cortesi, and G. Calderoni.

R-707. Astroni III-1 **3650 ± 50**
1700 B.C.
$\delta C^{13} = -24.3‰$

Carbonized wood from Astroni crater, E side of quarry.

R-708. Astroni III-2 **3680 ± 50**
1730 B.C.
$\delta C^{13} = -24.2‰$

Carbonized wood from Astroni crater, E side of quarry. *Comment*: R-708 age: 3520 ± 50 (R., 1971, v. 13, p. 408).

R-709. Astroni III-3 **3830 ± 50**
1880 B.C.
$\delta C^{13} = -26.0‰$

R-709α. Astroni III-3 **3670 ± 50**
1720 B.C.
$\delta C^{13} = -25.7‰$

Carbonized wood (*Quercus ilex*) from Astroni crater, E side of quarry.

R-710. Astroni III-4 **3710 ± 50**
1760 B.C.
$\delta C^{13} = -24.6‰$

Carbonized wood (*Quercus ilex*) from Astroni crater, W side of quarry.

R-711. Astroni III-5 **3700 ± 50**
1750 B.C.
$\delta C^{13} = -24.6‰$

R-711α. Astroni III-5 **3710 ± 50**
1760 B.C.
$\delta C^{13} = -24.8‰$

Carbonized wood (*Populus* sp.) from Astroni crater, W side of quarry.

R-712. Astroni III-6 **3790 ± 50**
1840 B.C.
$\delta C^{13} = -24.9‰$

R-712α. Astroni III-6 **3780 ± 50**
1830 B.C.
$\delta C^{13} = -25.3‰$

Carbonized wood from Astroni crater, W side of quarry.

R-713. Astroni III-7 **3640 ± 50**
1690 B.C.
$\delta C^{13} = -25.1‰$

R-713α. Astroni III-7 **3760 ± 50**
1810 B.C.
$\delta C^{13} = -24.9‰$

Carbonized wood from Astroni crater, W side of quarry.

General Comment: R-707 and 710 were pretreated with only 5% HCl because humic charcoal was completely soluble in 0.2N NaOH; other samples R-708/9/11/12/13 also additional leaching with 0.2N NaOH were given: difference between 2 ages, not very significant, shows abundant humic fraction extracted was not contaminating but belonged to charcoal humic fraction. Complex of dates of carbonized wood in Astroni products at Via Terracina (see R-785, this list) and from Astroni crater places eruptions between 3600 and 4100 B.P.

References

Alessio, M., *et al.*, 1965, University of Rome carbon-14 dates III: Radiocarbon, v. 7, p. 213-222.

Alessio, M., *et al.*, 1971, Datazioni con il metodo del carbonio-14 di carboni e livelli umificati (paleosuoli) intercalati nelle formazioni piroclastiche dei Campi Flegrei (Napoli): Soc. italiana mineralog. e petrolog. Rend., v. 27, p. 305-308.

Alessio, M., *et al.*, 1968, University of Rome carbon-14 dates VI: Radiocarbon, v. 10, p. 350-364.

Alessio, M., *et al.*, 1969, University of Rome carbon-14 dates VII: Radiocarbon, v. 11, p. 482-498.

Alessio, M., *et al.*, 1970a, Report on the equipments and activities of Rome University's carbon-14 dating laboratory: Quaternaria, v. 13, p. 357-376.

———— 1970b, University of Rome carbon-14 dates VIII: Radiocarbon, v. 12, p. 599-616.

———— 1971, University of Rome carbon-14 dates IX: Radiocarbon, v. 13, p. 395-411.

Battaglia, R., 1958, I castellieri della Venezia Giulia e Tridentina: Le Meraviglie del passato, v. 2, p. 419-434.

Bella, F. and Cortesi, C., 1957, Attività del Laboratorio dell'Università di Roma per le datazioni con il C^{14}: Ricerca sci., v. 27, p. 2678-2680.

Bellodi, L., *et al.*, 1971, Ricerche preliminari sull'abitato preistorico di S. Michele di Valestra (Reggio E.): Atti Soc. dei Naturalisti e Matematici di Modena, v. 102, p. 109-124.

Benoit, F., 1952, L'archéologie sous-marine en Provence: Riv. Studi Liguri, v. 18, p. 305-308.

———— 1955, Jas d'ancre et pièces d'outillage des épaves de Provence: Riv. Studi Liguri, v. 21, p. 117-128.

Bertacchi, L., 1965, La basilica di Monastero di Aquileia: Aquileia Nostra, v. 36, p. 79-134.

Bertolani, V., 1967, Relazione di scavi effettuati negli anni 1965 e 1966 a S. Michele di Valestra (Reggio Emilia) e alla Grotta della Gaibola (Bologna): Deputazione Storia Patria per le antiche Prov. modenesi Atti e Mem., s. 10, v. 2, p. 209-213.

Brancaccio, L., 1968, Genesi e caratteri delle forme costiere nella Penisola Sorrentina: Soc. naturalisti Napoli Boll., v. 77, p. 247-274.

Brusin, G. B., 1957, La chiesa di Monastero, *in*: Brusin, G. B. and Zovatto, P. L., Monumenti paleocristiani di Aquileia e Grado, Udine, p. 299-349.

Com. Sci. C.A.I. di Modena, Gruppo Archeol., 1970, Gli scavi a S. Michele di Valestra negli anni 1968 e 1969: Emilia Preromana, v. 6, p. 49-50.

Cornaggia Castiglioni, O., 1967, Le piroghe preistoriche italiane. Problematica e inventario dei reperti: Natura, v. 58, p. 5-48.

———— 1968, L'insediamento su bonifica della Lagozzetta di Besnate e gli inizi della Civiltà del Bronzo nella Lombardia nord-occidentale: Natura, v. 59, p. 177-184.

Cremonesi, G., 1968, La Grotta dell'Orso di Sarteano: Origini, v. 2, p. 247-331.

Di Girolamo, P., 1970, Differenziazione gravitativa e curve isochimiche nella "Ignimbrite Campana" ("Tufo grigio campano" Auct.): Soc. italiana mineralog. e petrolog. Rend., v. 26, p. 547-588.

Fabiani, C., 1971, Il relitto di Procchio: Mare, Supp., v. 9, no. 2, Pescare, p. 16-20.

Ferrara, G., Fornaca Rinaldi, G., and Tongiorgi, E., 1961, Carbon-14 dating in Pisa-II: Radiocarbon, v. 3, p. 99-104.

Ferri Ricchi L., 1969, Come nuova l'oneraria dell'Elba: Mondo Sommerso, v. 11, p. 989-995.

Fioravanti, A. and Ferri Ricchi, L., 1970, Naufragio all'Elba: Atlante, v. 11, no. 62, p. 76-83.

Grifoni, R., 1967, La Grotta dell'Orso di Sarteano I. Il Neolitico: Origini, v. 1, p. 53-115.

Maetzke, G., 1954, Sarteano. Grotta preistorica in località Villa Contucci: Studi Etruschi, v. 23, p. 341-343.

Marchesetti, C., 1903, I castellieri preistorici di Trieste e della Regione Giulia, Trieste.

Olson, E. A. and Broecker, W. S., 1959, Lamont natural radiocarbon measurements V: Radiocarbon, v. 1, p. 1-28.

Radmilli, A. M., 1963, La preistoria d'Italia alla luce delle ultime scoperte: Firenze, Ist. Geog. Militare, p. 38-48.
———— 1960, Resti della cultura tipo Sasso-Fiorano e della cultura Sub-appenninica nella Grotta dell'Orso di Sarteano di Siena: Riv. sci. preistoriche, v. 15, p. 214-216.
———— 1962, Sarteano (Prov. Siena): Riv. sci. preistoriche, v. 17, p. 293.
———— 1963, Sarteano (Prov. di Siena): Riv. sci. preistoriche, v. 18, p. 321.
Rittmann, A., *et al.*, 1950, Rilievo geologico dei Campi Flegrei: Soc. geol. italiana Boll., v. 69, p. 117-362.
Stacul, G., 1970, Esplorazioni archeologiche nel Carso triestino: Umana, v. 19, p. 29-30.
———— 1972, Il Castelliere C. Marchesetti presso Slivia, nel Carso triestino (Scavo 1970): Riv. sci. preistoriche, v. 27, p. 145-162.
Zecchini, M., 1971, L'archeologia nell'arcipelago Toscano: Pisa, Pacini editore.

[RADIOCARBON, VOL. 15, No. 1, 1973, P. 179-184]

REHOVOT RADIOCARBON MEASUREMENTS II

A. KAUFMAN, I. CARMI, and R. SCHLESINGER

The Weizmann Institute of Science, Rehovot, Israel

This list contains results obtained since July 1970. They are mainly hydrologic and geologic samples prepared and counted as described in our previous date list, (Carmi *et al.*, 1971). The coordinate system used to describe sampling locations is the local one.

SAMPLE DESCRIPTIONS

I. HYDROLOGIC SAMPLES

Samples from the Galilee were subm. by E. Wackshall, Hebrew Univ.; those from Samaria by E. Rosenthal, Geol. Inst., and G. Dror, Hydrol. Service; those from the Judean Desert by U. Baida, Water Planning Comm. for Israel, Ltd.; those from Chamat Gader and Sample RT-307E by E. Mazor, Weizmann Inst., and Sample RT-322 by A. Issar, Geol. Inst. This last sample is much less active than the shallow Sample RT-140 in our previous date list. δC^{13} values, relative to PDB, were measured to permit apparent age estimation according to Ingerson and Pearson (1964). These ages are not given due to the uncertain validity of their assumptions.

Sample	Name	Well (W) or spring (S)	Local grid coordinates	Sampling date	δC^{13}‰	C^{14} (% Modern)
			A. Galilee			
RT-305A	Einan 2	W	20386/27637	8/70	−13.7	41.4 ± 1.1
RT-305B	Chindaj 2	W	20150/27167	8/70	−13.7	59.3 ± 0.8
RT-305C	Chazon 2	W	18563/25467	8/70	−12.6	77.8 ± 1.2
RT-305D	Bir Ubah	W	19530/27570	8/70	−11.5	15.8 ± 0.4
RT-305E	Chittin 4	W	19188/24648	9/70	−15.0	63.1 ± 0.9
RT-306	Chittin 3	W	19318/24760	9/70	−14.5	50.5 ± 0.8
RT-344A	Einan 5	W	20390/27650	8/70	−11.6	42.9 ± 0.9
RT-344B	Chulah 3	W	20150/29550	8/70	− 8.7	22.3 ± 0.5
RT-344C	Ein Zahav	S	20360/29130	8/70	−11.4	59.1 ± 1.2
RT-345D	Ga'aton 2	W	16679/26874	10/70	−14.2	60.5 ± 1.2

Sample	Name	Well (W) or spring (S)	Local grid coordinates	Sampling date	$\delta C^{13}‰$	C^{14} (% Modern)
			B. Samaria			
RT-324A	Ma'ayan Charod	S	1837/2172	2/71		42.9 ± 0.6
RT-324B	Ein Amal	S	19210/21245	2/71	−11.9	35.0 ± 0.4
RT-324D	Tel Yosef 'T'	W	18905/21426	2/71	−12.0	45.9 ± 0.6
RT-324E	Argaman	W	20116/17687	2/71	− 9.0	15.3 ± 0.7
RT-325	Chaman el Malich	S	1950/1927	2/71	−13.3	10.4 ± 0.6
RT-335A	Revaya 1	W	1926/2067	5/71	−11.3	22.0 ± 0.6
RT-335B	Ein Soda	S	2013/21355	5/71	−11.3	77.8 ± 1.3
			C. Judean Desert			
RT-349A	Ein Fawar	S	1366/1832	6/71	−11.5	61.9 ± 1.8
RT-349B	Ein Duyuk	S	1447/1900	6/71	−12.7	82.5 ± 1.6
RT-349E	Ein Sultan	S	1418/1923	6/71	−12.4	86.0 ± 2.1
			D. Chamat Gader			
RT-307A	Spring A	S	2327/2130	10/10	−14.1	18.6 ± 0.5
RT-307B	Spring B	S	2321/2128	10/70	−12.4	13.2 ± 0.2
RT-307C	Spring C	S	2322/2125	10/70	−11.4	13.4 ± 0.5
RT-307D	Spring D	S	2320/2127	10/70	− 9.5	9.2 ± 0.3
RT-333	Spring B	S	2321/2128	5/71	−12.2	14.4 ± 0.4
			E. Lake Tiberias area			
RT-307E	Ein Noon	S	2497/1982	10/70	−13.7	60.0 ± 0.9
			F. Central lowlands			
RT-308	Lod 19	W	154/141	10/70	—	37.1 ± 0.6
			G. Sinai			
RT-322	Nahel (Deep)	W	9260/0290	2/71	− 7.4	2.9 ± 0.3

II. GEOLOGIC SAMPLES

A. Lake Kinneret cores

Two cores were coll. from lake bottom sediments by M. Stiller. Core 'D' coll. Nov. 1969 in 42 m water at position $\frac{2467}{2070}$, and Core 'F' Oct. 1970 in 25 m water at position $\frac{2508}{2025}$. Typical sediment includes 50% carbonate and 2% organic matter; these 2 phases were run separately.

		Organic fraction			Inorganic fraction		
Core	Interval	Sample	δC^{13}‰	C^{14} (% Modern)	Sample	δC^{13}‰	C^{14} (% Modern)
D	0-8 cm	RT-225	—	63.8 ± 3.1	RT-224	—	74.2 ± 1.0
D	16.5-24.5 cm	RT-219	—	84.3 ± 3.6	RT-218	—	73.2 ± 1.0
D	32-42 cm	RT-223	—	75.3 ± 5.2	RT-222	—	35.3 ± 0.7
F	0-10 cm	RT-318D-ORG	−29.1	76.3 ± 2.0	RT-318D	−2.4	80.7 ± 1.2
F	10-20 cm	RT-318A-ORG	−30.7	63.9 ± 1.4	RT-318A	−2.2	69.2 ± 1.0
F	20-30 cm	RT-318B-ORG	−30.8	94.5 ± 3.7	RT-318B	−2.7	74.3 ± 1.1
F	30-40 cm	RT-318C-ORG	−30.2	89.1 ± 2.8	RT-318C	−1.0	78.2 ± 1.7
F	40-50 cm	RT-315-ORG	−30.7	85.9 ± 2.4	RT-315	−1.4	75.8 ± 1.2

B. Secondary calcites

Results on other samples from 1st 3 series mentioned here (Qsalon, Sha'ar Hagai, and Hermon) appear in Carmi *et al.* (1971). Samples coll. by M. Magaritz, March 1970 to Oct. 1970, except for N'tiv Halamed Hai series which was coll. June 1971. Ages are calculated assuming precipitations from bicarbonate solutions whose carbon is derived from soil CO_2 ($\%C^{14} = 100$, δC^{13}-25‰) and country rock ($\%C^{14} = 0$, δC^{13} = as measured). In each case, δC^{13} of the country rock is given (see p. 182-3).

C. Dead Sea area carbonates

RT-321A. **10,700 ± 150**

Travertine from hillside above Ein Fescha $\left(\frac{1247}{1925}\right)$, coll. 1969 by F. Yaron.

RT-321B. **4200 ± 150**

$\delta C^{13} = +1.3$‰

Travertine coll. 2 m from RT-321A.

RT-342B. **3800 ± 240**

$\delta C^{13} = +0.4$‰

Precipitated carbonate crust from cliff overlooking Ras Fescha $\left(\frac{1231}{1927}\right)$ at −392 m, coll. July 1971 by C. Klein.

Sample	Area	Local grid coordinate	$\delta C^{13}‰$ in sample	$\delta C^{13}‰$ in country rock	Age (B.P.)	Comment
RT-237	Qsalon	1313/1532	−11.2	+1.0	Modern	Uppermost Na'ari of Qsalon series.
RT-301A	Sha'ar Hagai	1358/1524	−10.1	−1.0	>33,000	Fine-grained calcite from Cenomanian stratum.
RT-301B	" "	" "	− 8.6	"	>32,000	Coarse-grained calcite from Cenomanian stratum.
RT-301D	Hermon	2960/2203	+ 2.0	−0.5	*	Calcite from ancient karst cavity.
RT-301E	"	"	−10.0	"	>31,000	Calcite near magmatic body.
RT-323A	Imwas	145/153	−10.2	−3.0	20,000 ± 800	Na'ari within Senonian chalk
RT-331A	"	"	−10.4	"	12,800 ± 300	" " " "
RT-331B	"	"	−10.2	"	18,300 ± 700	" " " "
RT-302C	Ramallah	150/172	−11.7	−0.5	>33,000	Calcite from cave in Cenomanian dolomite.

* It is impossible to calculate an age by the method used here since RT-301D has more positive δC^{13} than does the country rock. The Hermon sample will be treated in a separate paper. This sample had $\%C^{14}$ (modern) ≤ 0.8.

Sample	Area	Local grid coordinate	$\delta C^{13}/_{00}$ in sample	$\delta C^{13}/_{00}$ in country rock	Age (B.P.)	Comment
RT-320	Imwas	1385/1522	− 8.5	−1.0	500 ± 160	Na'ari cementing pottery fragments; from top of Miocene.
RT-323B	Gimzo	1425/1452	− 3.2	0.0	>21,200	Calcite from cave in Turonian limestone.
RT-323C	Imwas	145/154	−10.5	−1.0	>27,000	Calcite vein assoc. with iron-rich mineralization in Turonian limestone.
RT-338B	N'tiv Halamed Hai	1222/1509	−11.2	+1.0	17,500 ± 600	Na'ari 280 cm above Cenomanian limestone base.
RT-338C	" "	" "	− 9.7	+1.0	20,200 ± 1,100	Na'ari 40 cm below 338B.
RT-339A	" "	" "	−10.8	"	13,100 ± 800	Na'ari 120 cm below 338B.
RT-339D	" "	" "	−10.3	"	19,800 ± 900	Na'ari 240 cm below 338B.
RT-339B	" "	" "	—	—	Modern	Tree root immediately adjacent to 339A.

D. Carbonates from other areas

RT-319. **1740 ± 120**

$\delta C^{13} = -2.3‰$

Oolites from Ras Matarma lagoon, N Gulf of Suez, $\left(\frac{876}{930}\right)$, subm. Dec. 1970 by A. Nissenbaum.

RT-348. **≥31,000**

$\delta C^{13} = -0.9‰$

Reef coral from erosion surface near Sharm-El-Sheik $\left(\frac{698}{081}\right)$ coll. July 1971 by R. Garson.

III. ATMOSPHERIC SAMPLES

Two atmospheric CO_2 samples were absorbed with a concentrated NaOH solution. *Comment* (A.K.): results show confirmation of 1969 decrease noted in Rehovot atmosphere (Carmi *et al.*, 1971) and a levelling off during 1970.

RT-352A. **$\delta C^{14}‰ = 50.3 \pm 3.0$**

Exposed 26 Jan.-30 Jan. 1970.

RT-352B. **$\delta C^{14}‰ = 51.5 \pm 3.0$**

Exposed 17 Jan.-24 Jan. 1971.

REFERENCES

Carmi, I., Noter, Y., and Schlesinger, R., 1971, Rehovot radiocarbon measurements I: Radiocarbon, v. 13, p. 412-419.

Ingerson, E. and Pearson, F. J., 1964, Estimation of ages and rate of motion of ground water, Recent researches in the field of hydrosphere, atmosphere and nuclear geochemistry: Tokyo, Maruzen Co., Ltd., p. 263-283.

[RADIOCARBON, VOL. 15, NO. 1, 1973, P. 185-192]

RICE UNIVERSITY RADIOCARBON DATES I

BARRY F. BECK*
Department of Geology, Rice University, Houston, Texas 77001

The radiocarbon dating laboratory at Rice University first became operative in the fall of 1970. A workable technique has been developed although operations are still in a state of flux. The benzene liquid scintillation counting method is used, the benzene being prepared as outlined by Noakes, Kim, and Akers (1967) with the following modifications. The CO_2 is further purified prior to storage and measuring by passing it through 3 gas bubblers containing potassium permanganate solution, silver nitrate solution, and a sulfuric acid-sodium dichromate solution (S. Valastro, pers. commun., 1970). Since no C^{12} C^{13} analyses are available at present, to insure a complete reaction, both the CO_2 generation and the C_2H_2 generation are continued for ½ hr after all visible signs of reaction have disappeared.

After the trimerization of the acetylene to benzene, the benzene is passed through a shielded Dehydrite** trap prior to removal and bottling to remove residual water vapor previously found in minor quantities in the benzene. Polach (1969) noted that standard vials were unsuitable for low activity ambient temperature C^{14} counting; our experience verifies this. The only previous solution to this problem (*ibid.*) appeared economically unsuitable for our operation; consequently, another technique for sealing the vials was developed. A Teflon** disk is fitted to provide an air-tight, unreactive seal.

The benzene is counted in a Beckman LS-100 soft beta spectrometer. NBS oxalic acid standards are prepared by wet oxidation, background standards prepared from Cretaceous El Abra Limestone, and samples are counted for 20 minute periods and recycled. An external standard ratio, which is a measure of quenching (Beckman Instruments, 1967), is automatically determined for each vial prior to the C^{14} counting. In some cases quenching was detected, probably due to chemical contaminants accumulating over long periods in the synthesis line and to minor variations in the counting vial geometry.

Despite the quenching we obtained useful data from the measurements. In many cases a quenched sample could be matched with an equally quenched oxalic-acid standard, thus assuring an equal machine efficiency for each count. Quenching was assumed equal when the external standard ratios were within 0.15 of each other (an average value for one standard deviation of the external standard ratio's distribution when the master gain control of the LS-100 was set at 510, as determined by the author). If the external standard ratios did not match within this limit, a quench correction was applied.

Ages are calculated using an Olivetti-Underwood Progamma 101

* Present address: Bureau of Water Mgt., Area of Natural Resources, Dept. of Public Works, Stop 23, Santurce, Puerto Rico 00910.

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computer with a program suggested by John Noakes (pers. commun., 1970) utilizing raw count-rate data and weights, based on the Libby half-life of 5568 years (Libby, 1955). The standard error for an unquenched age determination is given as one standard deviation of the counting statistics. The error assigned to the quench-corrected age is given as the sum of the errors which would be determined if the counting data for each of the two oxalic acid standards closest in quenching had been used. If the ages reported are quench corrected this is duly noted; samples which fell in the nonlinear portion of the quench-calibration curve were discarded. It is regrettable that quench correction was necessary but several check samples were dated in this manner and the answers were found satisfactory. In future it is hoped that both causes of quenching will be eliminated.

A. Interlaboratory check samples

Several interlaboratory check samples were dated at Rice University. Some samples were processed twice and some were counted several times.

RU-44. Isla Cancun, NE Yucatan Peninsula, Mexico 999 ± 254*

Portion of large shell (*Strombus gigas*), coll. by W. C. Ward from N end of Isla Cancun (Punta Cancun) beneath 7.6 m of Cancun Eolianite (21° 8′ N Lat, 86° 45′ W Long). Pieces of same shell were dated at 1030 ± 80 yr B.P. by ORINS and at 2700 ± 110 and 2730 ± 75 yr B.P. by LSUNO (W. C. Ward, pers. commun., 1970). *Comment*: age agrees with ORINS date, yet older LSUNO date is undoubtably correct since a midden occurring stratigraphically above the shell was dated at "250 B.C." (Andrews, 1969, p. 57). Since alteration of aragonite to calcite has generally caused shell ages from this area to appear younger (see p. 191), outer, altered layers were possibly included to a greater extent in ORINS and RU samples than in LSUNO sample. The RU sample was acid rinsed, but not leached to any great extent since the shell appeared hard and unaltered. See also RU-46.

RU-46. Isla Cancun, NE Yucatan Peninsula, Mexico
1) 1044 ± 83
2) 837 ± 81

Another portion of same shell as RU-44. *Comment*: 1st age agrees perfectly with ORINS date and 2nd age is very close.

RU-48. Cancun Lagoon, NE Yucatan Peninsula, Mexico 2098 ± 239*

Shells (*Codakia orbicularis*), coll. by M. Brady (No. 86A) ca. 1.5 m below sediment surface in Cancun Lagoon (21° 5′ N Lat, 86° 47′ W Long). Several other *Codakia orbicularis* shells from same sample were dated at 2108 ± 189 yr B.P. by Mobil Oil Co. (H. Nelson, pers. commun., 1970-71). *Comment*: perfect agreement of the 2 dates.

* Quench corrected.

RU-49. Isla Cancun, NE Yucatan Peninsula, Mexico **1) 3177 ± 142**
2) 3231 ± 76

Shells (*Codakia orbicularis*) id. and coll. by M. Brady (No. 87C) in a core from N end of Isla Cancun (21° 8′ N Lat, 86° 45′ W Long). Several shells (*Lucina pennsylvania*) from same sample were dated at 3087 ±188 yr B.P. by Mobil Oil Co. (H. Nelson, pers. commun., 1970-71). *Comment*: 2 counts agree well and both agree with Mobil age.

RU-50. Isla Cancun, NE Yucatan Peninsula, Mexico **1) 2949 ± 89**
2) 2967 ± 257*

Separate portion identical to RU-49. *Comment*: 2 count-rate determinations agree and both agree with Mobil date. Samples RU-49 and -50 bracket Mobil determination.

RU-55. Yalahau Lagoon, NE Yucatan Peninsula, Mexico **1) 1051 − 231***
2) 1168 − 131

Shells (*Chione cancellata*) id. and coll. by M. Brady (No. 72B) in Yalahau Lagoon ca. 1.2 m below sediment surface (21° 32′ N Lat, 87° 13′ W Long). Other *Chione cancellata* shells from same sample were dated at 1814 ± 195 yr B.P. by Mobil Oil Co. (H. Nelson, pers. commun., 1970-71). *Comment*: discrepancy between Mobil and RU dates has no obvious cause; neither date is invalidated by geologic context.

RU-76. Cancun Lagoon, NE Yucatan Peninsula, Mexico **512 ± 155**

Gastropod and pelecypod shells coll. by M. Brady (No. 87B) ca. 1.5 m below sediment surface in Cancun Lagoon (21° 8′ N Lat, 86° 45′ W Long). Sample was scrubbed and leached in HCl until outer 20% was removed. Mobil previously dated sample at 685 ± 174 yr B.P. and overlying interval ca. 1.2 m below surface at 946 ± 185 yr B.P. (H. Nelson, pers. commun., 1970-71). *Comment*: sample was measured near end of this project, indicating our techniques remained satisfactory, since age agrees well with Mobil date, within statistical limits. Inverted sequence of ages here may be due to an error in Mobil's determination of overlying date or a more complicated sedimentologic reason, e.g., mixing of shells by burrowing or differential settling.

RU-78. Yalahau Lagoon, NE Yucatan Peninsula, Mexico **469 ± 142**

Gastropod and pelecypod shells coll. by M. Brady (No. H-82) in NW corner of Yalahau Lagoon ca. 2.3 m below water sediment interface (21° 30′ N Lat, 87° 24′ W Long). Sample dated by Mobil at 354 ± 171 yr B.P. (H. Nelson, pers. commun., 1970-71). *Comments* (M.B.): Mobil date appears very young for sample overlain by 2.3 m sediment; (B.B.): however, Rice date confirms this age, within statistical limits. This sample also processed at finish of project and reconfirms agreement with other labs.

* Quench corrected.

B. NE Yucatan shore samples

Behind backswamp of Isla Blanca Lagoon, 2 trails wind into jungle. Vegetation is tropical and very dense; gently undulating limestone topography is marked by rare small sinks ca. 3 m deep. Samples were coll. from limestone along these trails in order to date Pleistocene coastal accretion.

RU-56. Isla Blanca-A **27,240 ± 1302**

Sample from large shell (*Strombus gigas*) coll. by B. Beck along S trail behind Isla Blanca Lagoon at backswamp shoreline (21° 19′ N Lat, 81° 51′ W Long). Staining with Feigel's Solution showed shell to be principally aragonite (95% +) and therefore probably not significantly mineralogically altered.

RU-57. Isla Blanca-B **1) 27,147 ± 2115**
2) 22,403 ± 1375

Gastropod and pelecypod shells from a marly coquina coll. by B. Beck on surface ca. 1.6 km inland on S trail behind Isla Blanca Lagoon (21° 19′ N Lat, 81° 53′ W Long). Shells were hard and lustrous and almost all matrix was removed in cleaning; staining with Feigel's Solution showed shells to be aragonite.

RU-58. Isla Blanca-C **1) 25,841 ± 2485***
2) 27,464 ± 2629

Pelecypod shells from loosely cemented calcarenite coll. by M. Brady on surface ca. 1.6 km inland on N trail behind Isla Blanca Lagoon (21° 22′ N Lat, 81° 54′ W Long). Shells were hard and lustrous and loosely cemented matrix was readily removed in cleaning; staining with Feigel's Solution showed shells to be aragonite and the matrix calcite.

RU-59. Isla Blanca-D **12,289 ± 2444***

Large piece of coral coll. by M. Brady along N trail behind Isla Blanca Lagoon at backswamp shoreline (21° 22′ N Lat, 81° 52′ W Long). Specimen was much weathered and extremely porous (very low density), and contained soil in exterior pores. Exterior soil and outer portion of coral were removed in cleaning.

RU-61. Isla Blanca-E **19,664 ± 1303***

Large piece of coral coll. by M. Brady ca. 2.9 km inland on N trail behind Isla Blanca Lagoon (21° 22′ N Lat, 81° 54′ W Long). Sample was highly weathered and soil-ridden but porosity was not as evident as in RU-59. Exterior soil and outer portion of coral were removed in cleaning.

RU-62. Isla Blanca-F **18,144 ± 495**

Whole-rock portion of marly coquina coll. by B. Beck on surface ca. 1.6 km inland on S trail behind Isla Blanca Lagoon (21° 19′ N Lat, 81° 53′ W Long); shells from same coquina were analyzed as RU-57. Staining with Feigel's Solution showed shells and some matrix to be aragonite but

* Quench corrected.

some large amorphous areas of matrix were calcite. *Comment*: position and shape of calcitic areas suggested alteration by permeating water flow.

RU-63. Isla Blanca-G **19,816 ± 3855***

Pelecypod and gastropod shells from marly coquina coll. by B. Beck ca. 1.6 km inland on S trail behind Isla Blanca Lagoon (21° 19′ N Lat, 81° 53′ W Long), ca. 90 m shoreward of RU-57. Matrix was difficult to remove and shells could only be partially cleaned; <5% matrix contamination remained.

RU-81. Isla Blanca-H **19,998 ± 1135**

Another portion of large piece of coral, RU-61. *Comment*: date agrees perfectly with previous determination.

General Comment: since ocean waters are generally deficient in C^{14} with respect to the atmosphere, marine shells from surface waters generally give an age ca. 400 yr too old (Olsson, 1968); but for this study, 400 yr is not significant compared to the statistical error and we will neglect this correction. Taft and Harbaugh (1964) list 4 methods of shell contamination: mixing of materials of various ages in the sample; assimilation of dead carbon from ancient limestone in solution and subsequent secretion of the carbon in shell material (hard-water effect); burrowing of organisms into previously formed, older sediments; and ingestion of older carbonate particles with food by shell secreting organisms. Postdepositional recrystallization of carbonate shell material by ground water is also a possibility and could produce older dates by exchange with ancient limestone carbon or younger dates by exchange with modern atmospheric carbon.

Chappel (Polach *et al.*, 1969, p. 261) states that "almost all recrystallized samples appear falsely young . . ." referring to a series of samples from uplifted reefs on the New Guinea coast.

Of the samples dated, the least altered gave the oldest dates, ca. 27,000 B.P. Another *Strombus gigas* sample from this general area was dated by LSUNO at 30,225 ± 1075 B.P. (pers. commun., W. C. Ward, 1972). It is probable that the coastal limestone is ca. 30,000 yr old and corresponds with the high sea-level stand ascribed by many authors to that time (Curray, 1965; Shepard and Curray, 1967; Milliman and Emery, 1968).

C. Isla Blanca Lagoon samples

Isla Blanca is an elongated peninsula, ca. 25 km long and ca. 0.2 to 1.6 km across, extending N-ward from, almost parallel to, coast of NE Yucatan. Protected from coastal wave action by this barrier, a large, shallow, quiet-water lagoon exists behind Isla Blanca. The sediment within the lagoon consists entirely of carbonates in the form of mud, sand, and some larger shell particles.

The coarse portion of the sediment is both allochthonous and autochthonous, and includes "echinoids, corals, coralline algae, hard-

* Quench corrected.

pellets, coated grains, and lithoclasts which are not indigenous to the lagoon" (Brady, 1971, pt. IV, p. 23). The fine sediment is principally high strontium aragonite needles from Codiacean algae and is predominantly allochthonous (Brady, 1971). Since currents within the lagoon are slight, sedimentation occurs primarily near the mouth. The fine portion of the sediment was sampled along the length of the lagoon to date approximately the growth rate of the spit. Brady (1971) did not detect any significant mineralogic variation within the lagoon.

RU-68. Blanca Lagoon Surface Sediment-A **352 ± 238***

Fine sediment from Brady's surface sample I.B. 59 (21° 26′ N Lat, 86° 47′ W Long). Sediment est:** 67% aragonite, 30% magnesium calcite, and 3% calcite (Brady, 1971).

RU-69. Blanca Lagoon Surface Sediment-B **294 ± 360***

Fine sediment from Brady's surface sample I.B. 58 (21° 25′ N Lat, 86° 47′ W Long). Sediment est:** 68% aragonite, 29% magnesium calcite, and 3% calcite (Brady, 1971).

RU-75. Blanca Lagoon Surface Sediment-C **656 ± 238***

Fine sediment from Brady's surface sample I.B. 49 (21° 20′ N Lat, 86° 48′ W Long). Sediment est:** 76% aragonite, 23% magnesium calcite, and 1% calcite (Brady, 1971).

RU-72. Blanca Lagoon Surface Sediment-D **1006 ± 153***

Fine sediment from Brady's surface sample I.B. 43 (21° 15′ N Lat, 86° 47′ W Long). Sediment est:** 78% aragonite, 21% magnesium calcite, and 1% calcite (Brady, 1971).

RU-77. Blanca Lagoon Surface Sediment-E **1398 ± 255***

Fine sediment from Brady's surface sample I.B. 40 (21° 12′ N Lat, 86° 47′ W Long). Sediment est:** 57% aragonite, 41% magnesium calcite, and 2% calcite (Brady, 1971).

General Comment: ages range from ca. 300 yr B.P. for the 2 samples which are probably actively accreting at the mouth of the lagoon to 1400 yr B.P. for the innermost sample in the lagoon and the trend is distinct. If a normal marine correction of ca. 400 yr is made, the sediment at the mouth of the lagoon is accreting at present. Dilution of the lagoon sediment by more recent additions will only increase the measured age gradient into the lagoon. Brady's (1971) theory of spit accretion is supported by these dates and the accretion rate appears rapid (ca. 25 km/2000 yr). Aerial photographs support this or indicate it might be even more rapid.

* All Blanca Lagoon surface samples were counted simultaneously and quench-corrected with the same ideal relationship so that the difference between ages should have the most validity possible.

** Estimated from strontium content (Brady, 1971).

D. Miscellaneous dates from NE Yucatan

The dates below were processed to clarify ambiguities or inconsistencies in the information which M. Brady had gathered in his study of lagoonal sedimentation in NE Yucatan (Brady, 1971).

RU-60. Blanca Lagoon Backswamp **1676 ± 67**

Peat fibers with shells (principally gastropod), shell hash, and caliche, coll. by M. Brady ca. 0.9 m below sediment surface in backswamp behind Isla Blanca Lagoon (21° 19′ N Lat, 81° 50′ W Long). The sample was acidified with HCl and CO_2 was generated from the included carbonate portion, *not the peat itself*. Mobil Oil Co. previously dated peat at 1668 ± 125 yr B.P. (H. Nelson, pers. commun., 1970-71). *Comment*: perfect agreement between the 2 dates is unexpected; caliche portion of sample was significant (10-20%); this alone could alter date. Further study is needed.

RU-73. Yalahau Lagoon **1) 3623 ± 179**
2) 4061 ± 140

100% calcite mud from marsh deposit underlying lagoonal sediments 25 cm below water-sediment interface in Yalahau Lagoon (21° 29′ N Lat, 87° 9′ W Long); coll. by M. Brady. Water depth over sample locality 3 m. *Comment* (M.B.): date for sediment is approx. date of transgression of sea over marsh.

RU-74. Cancun Lagoon **1) 3352 ± 102**
2) 3105 ± 153

Pelecypod and gastropod shells; 1 *Strombus gigas* shell fragment comprised ¾ sample, coll. by M. Brady ca. 2m below water sediment interface in Cancun Lagoon (21° 6′ N Lat, 86° 47′ W Long). Sample was scrubbed and leached in HCl until outer 20% was removed. Mobil dated this interval at 666 ± 174 yr B.P. and overlying interval ca. 1.5 m below sediment surface at 2108 ± 189 yr B.P. (H. Nelson, pers. commun., 1970-71). *Comment* (M.B.): date of overlying sediments fits geologic context. Mobil's date may be wrong; RU date is more logical.

RU-76. Cancun Lagoon **512 ± 155**

Gastropod and pelecypod shells coll. by M. Brady ca. 1.5 m below sediment surface in Cancun Lagoon (21° 8′ N Lat, 86° 45′ W Long). Sample was scrubbed and leached in HCl until outer 20% was removed. Mobil previously dated sample at 685 ± 174 yr B.P. and overlying interval ca. 1.0 to 1.2 m below surface at 946 ± 185 yr B.P. (H. Nelson, pers. commun., 1970-71). *Comment*: RU date agrees with Mobil date within statistical limits; also reported as interlaboratory check sample.

RU-78. Yalahau Lagoon **469 ± 142**

Gastropod and pelecypod shells coll. by M. Brady in NW corner of Yalahau Lagoon ca. 2.1 to 2.4 m below water-sediment interface (21° 30′ N Lat, 87° 24′ W Long). Sample was dated by Mobil at 354 ± 171 yr B.P. (H. Nelson, pers. commun., 1970-71). *Comments* (M.B.): Mobil date

appears too young for sample overlain by ca. 2.4 m sediment; (B.B.): however, RU date agrees well within statistical limits; also reported as an interlaboratory check sample.

References

Andrews, E. W., IV, 1969, The archaeological use and distribution of mollusca in the Maya lowlands: Middle America Research Inst. Pub. 34, Tulane Univ., New Orleans.

Beckman Instruments, Inc., 1967, LS-100 liquid scintillation system and direct data readout module: Fullerton, California, Beckman Instruments, Inc., 103 p.

Brady, M., 1971, Sedimentology and diagenesis of carbonate muds in coastal lagoons of NE Yucatan: Ph.D. thesis, unpub., Rice Univ., Houston, Texas.

Curray, J. R., 1965, Late Quaternary history, continental shelves of the United States, *in*: Wright, H. E. and Frey, D. G., The Quaternary of the United States: Princeton, N.J., Princeton Univ. Press, p. 723-735.

Libby, W. F., 1955, Radiocarbon dating: Chem. Brit., v. 5, no. 12, p. 548-552.

Milliman, J. D. and Emery, K. O., 1965, Sea levels during the past 35,000 years: Science, v. 162, p. 1121-1123.

Noakes, John, Kim, S. M. and Akers, L. K., 1967, Recent improvements in benzene chemistry for radiocarbon dating: Geochim. et Cosmochim. Acta, v. 31, p. 1094-1096.

Olsson, I. U., 1968, Modern aspects of radiocarbon dating: Earth-Science Reviews, v. 4, p. 203-218.

Polach, H. A., 1969, Optimisation of liquid scintillation radiocarbon age determinations and reporting of ages: Atomic Energy in Australia, v. 12, no. 3, p. 21-28.

Polach, H. A., Chappell, J., and Lovering, J. F., 1969, ANU radiocarbon date list III: Radiocarbon, v. 11, p. 245-262.

Shepard, F. P. and Curray, J. R., 1967, Carbon-14 determination of sea level changes in stable areas: *in*: Progress in Oceanography, v. 4, The Quaternary history of the ocean basins, Oxford, Pergamon Press, p. 283-291.

Taft, W. H. and Harbaugh, J. W., 1964, Modern carbonate sediments of Southern Florida, Bahamas, and Espiritu Santo Island, Baja, California: a comparison of their mineralogy and chemistry: Stanford Univ. Pubs., Geol. Sci., v. 8, no. 2, 133 p.

[RADIOCARBON, VOL. 15, NO. 1, 1973, P. 193-211]

UNIVERSITY OF SASKATCHEWAN RADIOCARBON DATES VI

A. A. RUTHERFORD, J. WITTENBERG, and K. J. McCALLUM

Saskatchewan Research Council

University of Saskatchewan, Saskatoon, Saskatchewan, Canada

This series reports some of the measurements made since publication of the previous list. Equipment and methods remain as described in Saskatchewan II (R., 1960, v. 2, p. 73). The laboratory operates now commercially, administered by the Saskatchewan Research Council under the direction of A. A. Rutherford.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

S-232. Wiseton, Saskatchewan — **10,600 ± 140 / 8650 B.C.**

Mammoth bone from 91.4 cm depth in lacustrine silt near Wiseton, Saskatchewan (51° 19′ N Lat, 107° 39′ W Long). Coll. 1931 by F. H. Edmunds; subm. 1964 by W. O. Kupsch; Dept. Geol. Sci., Univ. Saskatchewan, Saskatoon. *Comment* (W.O.K.): bone cores from left femur of museum specimen (*Archidiskodon imperator*) (Osborn, 1942, p. 997). Youngest dated mammoth bone in Saskatchewan.

Truelove Inlet series, Northwest Territories

Shell fragments (*Mya truncata, Hiatella arctica*) from emerged beach near Truelove Inlet, Devon I., N.W.T. (75° 40′ N Lat, 84° 35′ W Long). Coll. 1966 by R. H. King; subm. 1967 by W. O. Kupsch.

S-410. — **8370 ± 115 / 6420 B.C.**

Shells from emerged beach, alt. +24.75 m, 50.8 cm below surface (75° 37′ 46″ N Lat, 84° 30′ 20″ W Long).

S-411. — **9040 ± 110 / 7090 B.C.**

Shells from soliflucted beach, alt. +12.56 m, 30.5 cm below surface (75° 37′ 46″ N Lat, 84° 30′ 20″ W Long).

S-412. — **12,800 ± 160 / 10,850 B.C.**

Shells from emerged beach, alt. +15.24 m, 30.5 cm below surface (75° 39′ 53″ N Lat, 84° 33′ 30″ W Long).

S-413. — **9570 ± 130 / 7620 B.C.**

Shells from emerged beach, alt. +22.98 m, 30.5 cm below surface (75° 39′ 53″ N Lat, 84° 33′ 30″ W Long).

General Comment (R.H.K.): all dates considerably older than expected from alt. of beaches (King, 1969, p. 115-120). S-412 and S-413 predicted as 6300 and 7100 B.P., respectively. S-411 possibly contaminated by mixing

during solifluction. Beaches previously dated, S-412 at 8240 ± 120 B.P. and S-413 at 13,120 ± 200 B.P. (Müller and Barr, 1966, p. 263-269).

S-425. Patience Lake, Saskatchewan >39,000

Wood from 43.89 to 47.55 m depth in fine-grained, well-sorted sand, Shaft No. 2, Potash Co. of America, Patience Lake, Saskatchewan (52° 09′ 10″ N Lat, 106° 22′ 30″ W Long). Alt. of ground 533.7 m. Coll. 1967 by N. L. Ball; subm. 1967 by W. O. Kupsch. *Comment* (W.O.K.): sand with wood fragments is underlain by till, probably correlative with Upper Till of Sutherland group. Date is minimum for uppermost part of that group (Christiansen, 1970, p. 4).

3915 ± 70

S-427. Rankin Inlet, Northwest Territories 1965 B.C.

Bones from seal skeleton at 43.2 to 48.3 cm depth in gravel of emerged beach on Thompson I., Rankin Inlet, N.W.T. (64° 49′ N Lat, 92° 00′ W Long). Alt. +44.20 m. Coll. 1967 by P. A. James; subm. 1967 by W. O. Kupsch. *Comment* (P.A.J.): probably dates emerged beach. Age ca. 4000 yr for beach of alt. +44.2 m agrees with expected date according to rate of uplift of Hudson Bay (see Lee, 1962; Andrews, 1970).

Truelove Valley series, Northwest Territories

Peat samples from peat hummock (palsa), basal peat underlain by clear ground ice, S slope of Truelove Valley, Devon I., N.W.T. (75° 38′ 14″ N Lat, 84° 25′ 27″ W Long). Coll. 1967 by R. H. King; subm. 1967 by W. O. Kupsch.

6900 ± 115

S-428. 4950 B.C.

Peat at 1 m 52.4 cm to 1 m 82.9 cm, alt. +57.3 m.

4200 ± 85

S-429. 2250 B.C.

Peat at 76.2 cm to 96.5 cm.

General Comment (R.H.K.): basal peat (S-428) ca. 2000 yr younger than expected from alt., minimum date for postglacial peat formation. Dates indicate 81.3 cm peat formed in 2700 yr. Ages consistent with pollen analyses.

4300 ± 95

S-430. Truelove Valley, N Devon Island 2350 B.C.

Peat from 0.9 m depth obtained by ice-corer from frozen deposit 1.5 km NE of head of Truelove Inlet, Devon I., N.W.T. (75° 37′ N Lat, 84° 27′ W Long). Alt. of ground +27 m. Coll. 1967 by W. Barr and W. Elcock; subm. 1968 by W. O. Kupsch. *Comment* (W.B.): minimal age for postglacial marine emergence, however, lower elev. samples (S-431 and S-432) are older, suggesting that peat formed much earlier (probably 7500 B.P.). Either peat accumulation was delayed until long after emergence or was contaminated by younger roots.

5280 ± 100

S-431. Northern Devon Island **3330 B.C.**

Driftwood from base of frozen peat on seaward flank of emerged beach ridge, 300 m SW of Base Camp, Arctic Inst. North America, N Devon I., N.W.T. (75° 42′ N Lat, 84° 39′ W Long). Alt. +10.8 m. Coll. 1966 by W. Barr and H. G. Lloyd; subm. 1968 by W. O. Kupsch. *Comment* (W.B.): well preserved wood, id. by R. J. Moot, Geol. Survey Canada, as *Picea* or *Larix*, probably latter. Date contributes to more reliable history of postglacial uplift than previous interpretations based on dated marine mollusks (Müller and Barr, 1966), S-431 younger than mollusk found at lower elev. Also bears on postglacial uplift of E. Queen Elizabeth Is. (Blake, 1970, p. 655).

6100 ± 125

S-432. Northern Devon Island **4150 B.C.**

Bone, dense, ivory-like from ear region of whale skull (*Balaena mysticetus*) id. from photo by R. Lowes, Cambridge Univ., embedded in limestone-pebble gravel on seaward side of 1st emerged beach ridge across lake, W of Base Camp, Arctic Inst. North America, N Devon I., N.W.T. (75° 39′ N Lat, 84° 35′ W Long). Alt. +11 m. Coll. 1967 by W. Barr and W. Elcock; subm. 1968 by W. O. Kupsch. *Comment* (W.B.): substantiates S-431 and invalidates postglacial uplift curve based on marine mollusks from lower alts. (Müller and Barr, 1966).

2900 ± 85

S-433. Northern Devon Island **950 B.C.**

Bone, dense, solid from ear region of whale skull (*Balaena mysticetus*) id. from photo by R. Loves, embedded in limestone-pebble gravel, upper surface of skull flush with ground, lower part in permafrost on emerged beach ridge 2 km NW of Base Camp, Arctic Inst. North America, N Devon I., N.W.T. (75° 40′ N Lat, 84° 37′ W Long). Alt. +3 m. Coll. 1967 by W. Barr and W. Elcock; subm. 1968 by W. O. Kupsch. *Comment* (W.B.) date in part invalidates uplift curve (Müller and Barr, 1966) based on marine mollusks (Y-1294, at +3.4 m dated 6980 ± 120 B.P.). S-433 believed more reliable (dense bone, no rootlets), useful check on basal peat sample (I-3231 dated 2650 ± 90 B.P.) of same area and alt. which is minimum for emergence. S-433 and S-432 not corrected for any radiocarbon deficiency in arctic sea water (Barr, in press).

8200 ± 140

S-434. Truelove Valley, N Devon Island **6250 B.C.**

Shells of marine mollusks (*Mya truncata* and *Hiatella arctica*) embedded in silt from top of solifluction slope, W side of low rocky knoll, 2.6 km E of head of Truelove Inlet, N Devon I., N.W.T. (75° 36′ N Lat, 84° 22′ W Long). Alt. +30 m. Coll. 1966 by W. Barr and H. G. Lloyd; subm. 1968 by W. O. Kupsch. *Comment* (W.B.): shells from surface, not *in situ* but believed not to have moved appreciable distance

as close to top of slope. Highest alt. in Truelove Valley, minimum age for deglaciation and marine invasion. Mollusks died at same water depth as whale skull in area (+42 m) almost identical age 8270 ± 150 B.P. (GSC-991: R., 1970, v. 12, p. 46-86).

Cape Hardy series, Northwest Territories

Shell and marine algae from near vertical sea cliff, S across bay from E extremity of Cape Hardy, N Devon I., N.W.T. (75° 47′ N Lat, 83° 35′ W Long). Coll. 1967 by W. Barr and W. Elcock; subm. 1968 by W. O. Kupsch.

S-435. Shells, marine mollusks **8100 ± 150 6150 B.C.**

Whole valves and fragments of *Macoma calcarea* on sand surface top of cliff. Alt. +11 m.

S-436. Marine algae **9300 ± 175 7350 B.C.**

From beds up to 5 cm thick interbedded with fine marine sand exposed at alt. +4.2 m of 11 m cliff.

S-437. Shells, marine mollusks **8500 ± 150 6550 B.C.**

Many articulated whole valves (mostly *Mya truncata* and *Macoma calcarea*) in unconsolidated marine sands exposed at alt. +2.9 m on 11 m cliff.

General Comment (W.B.): samples coll. to date postglacial emergence (Müller and Barr, 1966). Algae appears anomalous in series, marine mollusks from higher (S-435) and lower (S-437) alt. dated younger. S-436 confirms Jones Sound area free of glacier by 7350 B.C. Mollusks apparently were dead for a considerable time prior to uplift as drift wood (S-431) at comparable alt. (+10.8 m) dated 3330 B.C.

S-438. Northern Devon Islands, Northwest Territories **6300 ± 115 4350 B.C.**

Marine algae, well-preserved in permafrost, interbedded with fine sand 70 to 90 cm depth, seaward flank of emerged beach ridge, stream cut 800 m NW Base Camp, Arctic Inst. North America, N Devon I., N.W.T. (75° 40′ N Lat, 84° 35′ W Long). Alt. of ground +6.7 m. Coll. 1967 by W. Barr and P. Barrett; subm. 1968 by W. O. Kupsch. *Comment* (W.B.): coll. to date time of emergence, anomalous date compared to higher alt. samples which have younger dates (S-431, driftwood +10.8 m, 3330 B.C. and S-432, whalebone, +11 m, 4150 B.C.).

S-458. Broughton Island, Northwest Territories **>32,000**

Shells, mostly fragmented, includes some undamaged *Hiatella arctica,* in silty clay of marine terrace, N part of E coast, Broughton I., N.W.T. (67° 33′ N Lat, 63° 47′ W Long). Alt. +16 m. Till in major terminal and ground moraines, deposited by readvance of small cirque glacier,

overlies marine terrace. Coll. 1968 by J. T. Andrews and J. H. England; subm. 1968 by W. O. Kupsch. *Comment* (J.T.A.): sea at +72 m during deposition of marine terrace silt and clay. Deposition related to Early Wisconsin Glaciation which did not extend onto E coast, alt. ca. 300 m. Further N on E coast Baffin I., sea cliffs cut into marine deposits with shells dated >54,000 yr. (Løken, 1966, p. 1378-1380).

S-459. Broughton Island, Northwest Territories **24,100 ± 850** **22,150 B.C.**

Fragmented shells in coarse sand behind premises Hudson Bay Co., W-central Broughton I., N.W.T. (67° 32′ N Lat, 64° 02′ W Long). Alt. +13 m. Cut exposed shell beds distinct but correlative, moraine shells thick-walled, shells in marine deposit thin-walled and assumed *in situ*. Coll. 1968 by J. T. Andrews and J. H. England; subm. 1968 by W. O. Kupsch. *Comment* (J.T.A.): shells occur in moraine that marks a deglaciation phase, mid-Wisconsin age when sea level dropped from 72 m (early Wisconsin) to 15 m above present level. Thick-walled shells (moraine) date from 32,000 B.P. (England and Andrews, ms. in preparation).

S-492. Bute Inlet, British Columbia **1025 ± 80** **A.D. 925**

Semi-solid, dark waxy material which floats on Bute Inlet waters, British Columbia (50° 30′ N Lat, 125° 10′ W Long), during extremely cold winters (solubility effect). Nearby land area is forested Mesozoic and Cenozoic mts. composed of intrusive rocks. Coll. 1968 and subm. 1969 by T. C. Jain, Univ. Victoria, Victoria. *Comment* (A.A.R.): date supports forest residue source, possible origin discussed by Williams (1957, p. 13). Chemical analyses reported by Jain (Jain *et al.*, 1969, p. 785).

II. ARCHAEOLOGIC SAMPLES

Garratt series, Saskatchewan

Charcoal from layers of prehistoric occupation site, Garratt site (EcNj-7), Moose Jaw, Saskatchewan (55° 22′ 25″ N Lat, 105° 33′ 23″ W Long). Layer 6 contained butchered bone and pottery assoc. with Avonlea-type projectile points. Layer 8 contained Besant points. Coll. and subm. 1966 by G. C. Watson, Saskatchewan Mus. Nat. History, Regina.

S-406. Layer 6, 0.79 m below surface **1450 ± 70** **A.D. 500**

S-408. Layer 6, 0.67 m below surface **1280 ± 60** **A.D. 670**

S-409. Layer 8, 1.07 m below surface **1990 ± 75** **40 B.C.**

General Comment (G.C.W.): 1st occurrence of ceramic material with Avonlea culture. Layer 6 related period to Gull Lake site, Layers 26 and 31a (S-254 and S-255: R., 1968, v. 10, p. 375).

Unalakleet series, Alaska

Charcoal and wood samples from 3 or 4 Norton Sound Eskimo village sequence near Unalakleet, Alaska (63° 53′ 12″ N Lat, 160° 47′ 42″ W Long). Coll. 1963 and subm. 1967 by D. R. Burnor.

500 ± 60

S-417. Charcoal **A.D. 1450**

From sterile beach sand under midden deposit of present village, 1.22 m below surface.

280 ± 60

S-418. Wood **A.D. 1670**

From house wall log, 1.22 m below surface in permafrost.

2100 ± 100

S-419. Charcoal **150 B.C.**

From hearth on floor of semi-subterranean house, 0.91 mm below surface.

General Comment (D.R.B.): mouth of Unalakleet R. has been contact point for N and S coastal Eskimo groups and Athabascan Indians of interior Alaska. S-419 proves that the earliest inhabitants of the Unalakleet area followed Norton tradition, and S-417, S-418 indicate that elements of this culture persisted into historical times.

2800 ± 75

S-441. Bradwell, Saskatchewan **850 B.C.**

Left tibia of human male at 1.22 to 1.52 m depth in gravel near Bradwell, Saskatchewan (51° 48′ N Lat, 106° 09′ W Long). Alt. +576 m. Coll. 1936 by Pius Fischer; subm. by W. O. Kupsch. *Comment* (W.O.K.): human skeletal remains possible assoc. with eagle-claw necklace and chipped scraper, coll. before radiocarbon dating (Edmunds *et al.*, 1938). Geologic and archaeologic significance discussed by Kupsch *et al.* (1970).

910 ± 70

S-453. Crooked Lake, Saskatchewan **A.D. 1010**

Wood sample from central roof support post of burial mound structure, Moose Bay Burial Mound site (EdMg-1) near Crooked Lake, Saskatchewan (50° 37′ N Lat, 102° 4′ W Long). Coll. 1968 and subm. by G. C. Watson. *Comment* (G.C.W.): most N plains burial mound location known, compares to Glen Ewen Burial Mound series (S-258 and S-259: R., 1968, v. 10, p. 377).

Bloody Falls series, Northwest Territories

Charcoal from Bloody Falls site (MkPk-3), Coppermine R., Dist. of MacKenzie, N.W.T. (67° 45′ N Lat, 115° 22′ W Long). Sec. of site has 2 stratified components, upper consisting of large stone Thule culture house, and lower related to Arctic Small Tool tradition. Latter seems relatively late pre-Dorset variant of tradition. Coll. 1968 by P. D. Sweetman for R. McGhee; subm. by R. Wilmeth, Natl. Mus. Canada, Ottawa.

S-462. Bloody Falls site, Structure 1, Sq. Q-14 **840 ± 60**
A.D. 1110

Charcoal (NMC-340) from apparent hearth area in yellow sand, 5 to 20 cm below lowest flagstones marking base of Thule occupation and 20 to 35 cm above bedrock. Few chert flakes found but no Arctic Small Tool tradition or Thule culture artifacts. Should date Arctic Small Tool tradition occupation.

S-463. Bloody Falls site, Structure 1, Sq. O-17 **3330 ± 90**
1350 B.C.

Charcoal (NMC-305) from apparent hearth in yellow sand 55 to 60 cm below surface and 30 to 35 cm below base of Thule layer. Burins and other Arctic Small Tool tradition artifacts assoc. with hearth area. *General Comment* (R.M.): S-463 acceptable date for Arctic Small Tool tradition occupation. S-462 not of this period, suspect contamination from overlying Thule housefloor or sample may represent a Thule occupaton buried during later construction of Thule house.

S-464. Ouimet site, Northern Ontario **1700 ± 225**
A.D. 250

Carbonized birch bark (NMC-319) from Ouimet site (FbIx-2), on W end of island (Oblate mission) opposite Lansdowne House, Attawapiskat Lake, N Ontario (52° 13′ 30″ N Lat, 87° 53′ 30″ W Long). Stratified site with Late Woodland (Blackduck) component above Laurel component in turn above possible Archaic component. Bark found assoc. with Laurel tradition sherds in Test Pit 1, a relatively well-defined Laurel component. Should assist in resolving temporal position of Laurel tradition, also 1st Laurel date in Hudson Bay drainage. Coll. 1968 by J. V. Wright; subm. 1969 by R. Wilmeth. *Comment* (J.V.W.): date consistent with estimate of Laurel tradition.

S-465. Sandwillow site, Northwest Territories **1790 ± 70**
A.D. 160

Unburned caribou bone (270 g) and burned carbon bone (10 g) (NMC-301) from Sandwillow site, in large sand blowout on edge of 85 m terrace, 400 m W of Coppermine and 1500 m NNW of Bloody Falls, MacKenzie Dist., N.W.T. (67° 45′ N Lat, 115° 22′ W Long). Site appears to represent single occupation, small temporary caribou-hunter camp. Artifacts and refuse exposed on surface of blowout, included 5 lanceolate stemmed points, resemble Scottsbluff type in Plains area. Type appeared as isolated finds in several N Canadian locations, but so far not in dateable context. Should date occupation using lanceolate stemmed points. Coll. 1968 by R. McGhee; subm. 1969 by R. Wilmeth. *Comment* (R.M.): site location on high waterless terrace and style of artifacts suggests much earlier date (age 4000 to 8000 yr). Possibility bone not assoc. with occupation but unlikely. Acceptance would suggest extremely late persistence of large lanceolate point style and a penetration of Indian

cultures to Arctic coast when most of Arctic was occupied by Dorset Eskimo.

Lapointe site series, Northwest Territories

Charcoal and caribou bone from Lapointe site (MkPk-7), on eroding point of 85 m terrace 200 m W of Coppermine R., ca. 2 km downstream from Bloody Falls, Mackenzie Dist., N.W.T. (67° 45′ N Lat, 115° 22′ W Long). Site appears to represent relatively heavy occupation by band of caribou hunters. Artifacts included 4 large lanceolate points of general "Agate Basin-like" or Keewatin Lanceolate type. Similar points occur on an early horizon throughout NW Canada but not yet securely dated. Coll. 1968 by R. McGhee; subm. 1969 by R. Wilmeth.

1380 ± 105

S-466. Lapointe site, 70 to 75 cm depth **A.D. 570**

Willow charcoal and burned caribou bone (NMC-302) from apparent hearth area in Sq. E-11, 70 to 75 cm depth and from wash slope below (eroded from cultural layer).

2730 ± 90

S-467. Lapointe site, 20 to 40 cm depth **780 B.C.**

Unburned caribou bone (NMC-303) from cultural layer Sq. E-10, 20 to 40 cm below datum. Cultural layer is thin continuous band of sand stained by organic matter, packed with bone refuse, a few flakes and artifacts. Layer is soliflucted and disturbed by ground squirrels, but forms single stratigraphic unit over site area.

General Comment (R.M.): part of S-466 consisted of surface material, possible contamination by burned bone by more recent occupants. S-467 not contaminated as above, definitely assoc. with main occupation. Tentative date on lanceolate point sites in N.W.T.

1450 ± 80

S-468. Willowherb site, Northwest Territories **A.D. 500**

Unburned caribou bone and teeth (NMC-306) from Willowherb site (MkPk-9) in large sand blowout on edge of 85 m terrace, 300 m N of LaPointe site (MkPk-7) and directly W of small rapid in Coppermine 2 km below Bloody Falls, Mackenzie Dist., N.W.T. (67° 45′ N Lat, 115° 22′ W Long). Blowout area over 200 sq. m, 2 occupation areas exposed. Sample from N-most occupation site and represents small temporary caribou hunter camp. Assoc. artifacts included round-based, thin, lanceolate biface, cultural affiliation not clear. Should date occupation using thin, round-based, lanceolate points and may provide useful terminal date for formation of 85 m terrace. Coll. 1968 by R. McGhee; and subm. 1969 by R. Wilmeth. *Comment* (R.M.): same range as S-465 from Sandwillow site and S-466 from Lapointe site. See comment on S-465.

2535 ± 150

S-470. Donaldson site, Ontario **585 B.C.**

Charcoal (NMC-320) from Donaldson site (BdHi-1), N side of Sau-

geen R., ca. 3.2 km from mouth, Lots 56-57, Amabel Twp., Bruce Co., Ontario (44° 30′ 30″ N Lat, 81° 21′ W Long). Test pit immediately W of 1960 excavation Unit VIII (Wright and Anderson, 1963, p. 3) from basal yellow clay of Midden A deposit, depth 0.61 m. Charcoal in direct assoc. with Saugeen focus ceramics and a single Laurel tradition rim sherd. Site belongs to Saugeen focus of early Middle Woodland period. Coll. 1968 by J. V. Wright; subm. 1969 by R. Wilmeth. *Comment* (J.V.W.): sample confirms earlier radiocarbon dates of 530 B.C. +60 (S-119: R., 1962, v. 4, p. 77) from Donaldson and 669 B.C. +220 (C-608, Libby, 1955, p. 91) from related Burley site.

Boardwalk site series, British Columbia

Charcoal from Boardwalk site (Gb.To-31), NW side of Elizabeth Point, Digby I., Prince Rupert Harbour, British Columbia (54° 17′ 40″ N Lat, 130° 22′ 35″ W Long). Prehistoric winter village of Gispakloates tribe of Tsimshian. Shell midden containing ca. 310,000 cu. m of cultural material. Coll. 1968 by G. F. MacDonald; subm. 1969 by R. Wilmeth.

S-471. Boardwalk site, Sq. G6 **125 ± 70**
A.D. 1825

Charcoal (NMC-324) from Sq. G6, 1.93 m N, 0.61 m W, depth 20.3 to 30.5 cm below datum, highest undisturbed level of midden.

S-472. Boardwalk site, Sq. I6, N wall **3460 ± 80**
1510 B.C.

Charcoal (NMC-325) from Sq. I6, N wall, below datum, lowest cultural zone.

S-473. Boardwalk site, Sq. I6, hearth feature **3450 ± 80**
1500 B.C.

Charcoal (NMC-326) from Sq. I6, NW quad. hearth feature, depth 2.84 m to 2.90 m below datum, upper part of lowest cultural unit, zone of slow refuse accumulation.

General Comment (G.F.M.): S-471 possible contamination by cultivation or occupation during latter part of 19th century. Subsequent excavations produced no historic material in assoc. with undisturbed deposits, estimate abandonment of site at ca. A.D. 1700. S-472 acceptable date, accumulation more rapid than expected (S-473).

S-474. Snare River site, Northwest Territories **210 ± 80**
A.D. 1740

Charcoal (NMC-243) from Snare R. site (LbPf-2), N bank of Snare R. at entrance to E end of Snare Lake, N.W.T. (64° 18′ 20″ N Lat, 113° 42′ 30″ W Long). From hearth buried 7.6 cm deep in black humus under surface covering of moss and lichen. Cultural materials and buried bone assoc. Component of Taltheilei Shale tradition. Coll. 1967 by W. C. Noble, McMaster Univ.; subm. 1969 by R. Wilmeth. *Comment* (W.C.N.): site represents a late prehistoric component of Taltheilei Shale tradition which is ancestral to historic Yellowknife Indians, speakers of the most

archaic dialect of Chipewyan. Date and cultural materials compare favorably with late prehistoric Observation site (KeNw-4) on E Great Slave Lake, dated A.D. 1765 (I-4375).

S-475. Trout Bay site, Northwest Territories **Modern**

Burned bone (NMC-244) from Trout Bay site (Lb-Pg-7), N shore of Snare Lake, 1.61 km E of Snare Lake Dogreb Indian village, N.W.T. (64° 11′ 30″ N Lat, 114° 05′ W Long). From large roasting hearth with numerous pieces of fire-broken rock. Cultural materials assoc. Component of Taltheilei Shale complex. Coll. 1967 by W. C. Noble, Univ. Calgary (now McMaster Univ); subm. 1969 by R. Wilmeth. *Comment* (W.C.N.): date on very small bone sample is inconsistent with estimated age A.D. 900.

1760 ± 100

S-476. Deception Point site, Northwest Territories **A.D. 190**

Carbonized wood (NMC-245) from Deception Point site (LbPf-5), on esker-ridge point on N shore of Snare Lake, 14 km W of E end of lake, N.W.T. (64° 14′ 20″ N Lat, 113° 56′ 50″ W Long). Esker is 9.14 to 12.19 m above present lake level. Sample from within and under fire-broken rock hearth in Unit A. Hearth lay within cultural horizon 7.6 cm thick, buried 35.6 cm under sterile aeolian sands capped by a presently stable ground surface of moss and spruce trees. Cultural horizon also marks former buried soil development. Artifacts include chert, gray silicious shale, and quartzite materials. Coll. 1967 by W. C. Noble; subm. 1969 by R. Wilmeth. *Comment* (W.C.N.): date is reasonable, but does place a late occurrence on small tools, including microblades and burins, in interior regions of central Mackenzie Dist. Site represents a late component of the author's Tundra tradition. Date is consistent with site stratigraphy; a non-cultural buried burned forest horizon lying 10.2 cm below cultural zone has returned a date of 3120 ± 140 B.C. (I-4376).

Nunguvik site series, Northwest Territories

Plant material and burned organic matter from Nunguvik site (PgHb-1), W coast of Navy Board Inlet, Borden Peninsula, Baffin I., N.W.T. (73° 01′ 30″ N Lat, 80° 38′ W Long). Site contains ca. 80 ruins of dwellings belonging to early and possibly late Dorset and early and late Thule (Rousseliere, 1968). Plant material predominately *Cassiope Tetragone* (L), and also *Salix, Dicranium*, and *Hepaticae*, id. by D. Don and M. J. Shchepanek, Natl. Herbarium Canada. Coll. 1967 by Fr. G. Mary-Rousseliere, Catholic Mission, Pond Inlet; subm. 1969 by R. Wilmeth.

860 ± 90

S-477. Nunguvik site, early Thule **A.D. 1090**

Plant material (NMC-265) from beneath flagstone on platform of House 42, early Thule house. Plant material platform cover should date early occupation.

1380 ± 95

S-478. Nunguvik site, late Dorset **A.D. 570**

Burnt material (NMC-267) from fireplace, S corner, House 72, Dorset, ca. 25 cm below surface, <1 m above highest tide, could not have been inhabited at sea levels higher than present, should be latest Dorset house at site.

715 ± 60

S-516. Nunguvik site, early Thule **A.D. 1235**

Plant material from upper layer House 42, early Thule, used as platform cover probably contemporaneous with latest occupation.

General Comment (G.M.R.): House 42 is slightly older than expected (600 to 800 yr B.P.) but acceptable. S-477 and S-516 consistent, give mean occupation span of 145 yr, probably frequently inhabited, indicated by refuse material both inside and outside. Dates early Thule for E arctic. S-478 consistent with nearby and higher House 71 (Gak-2339) between A.D. 560 and 800. Houses probably inhabited during A.D. 560 to 685 period. Date confirms no sea level change in region for at least 1200 yr.

3130 ± 110

S-479. Steeprock Lake, Manitoba **1180 B.C.**

Charcoal (NMC-272) from Steeprock Lake site (C3-UN-55), Prov. Govt. Camp Ground, Steeprock Lake, Porcupine Forest Reserve, Manitoba (52° 36′ 05″ N Lat, 101° 21′ 30″ W Long). Main site on 2 terraces, upper relatively undisturbed except forest dead-fall, lower modified by early high water level of lake. Cultural material assoc. upper terrace (dark red sand, water-worn component of lower terrace gravels) is combination late Paleo-Indian forms (Northern Plano style, Agate Basin and Plainview) and Archaic forms (side-notched ground base similar to W26, Jennings, 1957, p. 121). Early artifacts overlain by later undisturbed cultural material. Sample from bottom dark red sand zone, Sq. 200N30W, 76.2 cm S, 121.9 cm E, on floor of Level 5 at 25.4 cm below surface. Should date earliest habitation and may date 5th uplift (Johnston, 1946). Coll. 1967 by A. A. Simpson for W. M. Hlady, Manitoba Archaeol. Soc.; subm. 1969 by R. Wilmeth. *Comment* (A.A.S.): 2 non-ceramic tool assemblages id., older designated Steeprock "A" assoc. dark red sand include Agate Basin, Plainview, and Archaic side-notched projectile forms (similar to Simonsen, Logan Creek); more recent Steeprock "B" assoc. overlying gray-red and sand-contained crude flat side-notched, basal-notched McKean variant and thin crude eared, stemmed corner-notched projectile forms. On lower terrace "A" materials correlate with water-disturbed component while "B" related to undisturbed upper stratum. Date appears too recent for Steeprock "A", more applicable to Steeprock "B" material, possible that shallow fire pit penetrated underlying dark red sand zone.

1560 ± 60

S-490. Dunfermline, Saskatchewan **A.D. 390**

Charred bone from Harder site on a sand flat 9.65 km N of Dunfermline, Saskatchewan (52° 12′ 37″ N Lat, 107° 03′ 06″ W Long). Assoc. with occupation remains including Oxbow projectile points in buried soil 0.40 to 0.55 m below surface. Coll. 1969 and subm. by I. G. Dyck, Univ. Manitoba, Winnipeg. *Comment* (I.G.D.): dates occupation of site and provides more recent minimal temporal boundary for Oxbow culture. Site appears to have been large summer base camp (Dyck, 1970, p. 1-29).

1960 ± 90

S-491. Elbow, Saskatchewan **10 B.C.**

Bone material recovered from Sand Mound 1 of several low mounds, Melhagen site (EgNn-1), 19.31 km E of Elbow, Saskatchewan (51° 04′ N Lat, 106° 21′ W Long). Coll. 1968 and subm. by T. S. Phenix, Archaeol. Soc., Saskatoon. *Comment* (T.S.P.): dates single component of Besant kill site.

Potlatch series, British Columbia

Charcoal from Potlatch site (FeSi-201), S shore of Little Anahim Lake 4.83 km NW of Anahim Lake community on Hwy 20, central interior British Columbia (52° 29′ 30″ N Lat, 125° 20′ 30″ W Long). Site includes 1 large rectangular structure, 4 semi-subterranean houses, 2 of which are typical Chilcotin winter lodges, other 2 shallower and lack interior roof supports. Historic Chilcotin component, earlier one characterized by microblades. Coll. 1969 by Neil Vallance, Univ. Victoria and Paul Donahue, Univ. Wisconsin for R. Wilmeth; subm. 1969 by R. Wilmeth.

1615 ± 80

S-500. Potlack site, House 1 **A.D. 335**

Charcoal (NMC-348) from concentration of charcoal lumps on floor level, 40 cm b.d. in area ca. 30 cm sq. (0 to 0.3 N/O.s to 0.6 W) next to hearth stones, Bes Yaz House. House differs from Chilcotin pattern, lacks historic-period material and yielded a number of microblades, some from floor level. Sample should date occupation and assoc. microblades (Wilmeth, 1969).

1870 ± 75

S-501. Potlatch site, House 2 **A.D. 80**

Charcoal (NMC-349) from bottom of pit (Feature 5), 1.25 N/1.34 W, 44.5 cm b.d., SW quad., T'okut House. House form differs from Historic Chilcotin, with historic material at surface level only. House partly underlies historic trash mound.

General Comment (R.W.): dates suggest that House 2 (T'okut) somewhat older than House 1 (Bes Yaz) rather than reverse as originally expected. Microblades assoc. with both. Dates considerably later than those assoc. with microblades elsewhere in interior plateau of British Columbia, but

are within range for microblades on coast (Borden, 1968). Chipped wedges (pièces esquillées) present in these houses, not previously reported in assoc. with microblades in this area.

710 ± 80

S-502. Goose Point site, British Columbia A.D. 1240

Charcoal (NMC-352) from Goose Point site (FcSi-200), W bank of Dean R., short stretch connecting Little and Big Anahim Lakes; adjacent to mouths of Pelican and Corkscrew Creeks and below Harry Squinas Cabin, central interior British Columbia (52° 29′ 40″ N Lat, 125° 20′ 30″ W Long). Sample from fireplace, 22 cm below surface, floor of Suzchet House. Site includes 2 houses circular, semi-subterranean, on bank of Dean R.; Fishing Sta. 1 structure, Bes Tco House, is historic Chilcotin winter lodge; other, Suzchet House is shallow basin locking post holes, resembles Bes Yaz and T'okut Houses, Potlatch site. Coll. 1969 by Neil Vallance for R. Wilmeth; subm. 1969 by R. Wilmeth. *Comment* (R.W.): date is significantly later than S-500 and S-501, similar structures at Potlatch site. Microblades were not found in Suzchet house but wedges assoc. with microblades in Bes Yaz and T'okut houses were present in small numbers.

610 ± 75

S-503. Nodwell site, Ontario A.D. 1340

Charcoal (NMC-353) from Nodwell site (BcHi-3), N edge of town Port Elgin, Saugeen Twp. Bruce Co., Ontario (44° 26′ 20″ N Lat, 81° 23′ 30″ W Long). Trench 1, Unit C, Small Pit 108 in House 1. Middleport substage, site of Ontario Iroquois tradition, only village of its type in Bruce Co. Should date approx. W-ward push of Middleport substage into Bruce Co. Coll. 1969 by J. V. Wright; subm. 1969 by R. Wilmeth. *Comment* (J.V.W.): date acceptable, close agreement with related Beswetherick site, Simcoe Co., A.D. 1360 ± 100 (M-1526) and raises possibility that classic Middleport substage sites are closer to A.D. 1350 than A.D. 1400.

3250 ± 90

S-504. Knechtel (Upper) site, Ontario 1300 B.C.

Charcoal (NMC-354) from Knechtel (Upper) site (BbHj-2), Lot 54 Con., 9, Sec. A, Kincardine Twp., Bruce Co., Ontario (44° 15′ 20″ N Lat, 81° 35′ 30″ W Long), Test Sec. 1, top portion of Feature 1 in Stratum III, depth 94.0 to 109.2 cm Stratified Inverhuron Archaic site. Dates richest intact component of site and adds meaning to substantial faunal material recovered. Coll. 1969 by J. V. Wright; subm. 1969 by R. Wilmeth. *Comment* (J.V.W.): date consistent with estimated age 3000 to 3500 B.P.

3025 ± 90

S-506. Aberdeen Lake, Northwest Territories 1075 B.C.

Peat (NMC-356) from Aberdeen Lake (LdLl-2) W end of Aberdeen Lake at embouchure of Thelon R., S side, Keewatin Dist., N.W.T.

(64° 37′ 20″ N Lat, 99° 49′ 35″ W Long). Sq. J19, 22.9 cm W and 22.9 cm S. Peat core-beginning depth 10.2 cm below surface; max. depth 21.6 cm (some compaction) in SW sec. of House 1. Site contains Paleo-Indian and Pre-Dorset Specimens but predominately relates to Shield Archaic. House 1 interpreted as late Shield Archaic structure. Date should be minimum for House 1 and estimate temporal placement of late Shield Archaic in Keewatin Dist. Coll. 1969 by J. V. Wright; subm. 1969 by R. Wilmeth. *Comment* (J.V.W.): date acceptable, raises possibility of contemporaneity of major Shield Archaic occupation and minor Pre-Dorset occupation at site.

1780 ± 110

S-507. Dougall site, Ontario **A.D. 170**

Charcoal (NMC-357) from Dougall site (BdGu-2), W side Couchiching Narrows, Simcoe Co., Ontario (44° 37′ N Lat, 79° 23′ W Long). Sq. D—Middle Woodland concentration in SE corner, charcoal from below sherds, depth 17.8 to 30.5 cm. Continuous occupation from Middle Woodland to Historic period. Mostly superposition of occupations. Should date early Point Peninsula material in Simcoe Co. Coll. 1969 by J. V. Wright; subm. 1969 by R. Wilmeth. *Comment* (J.V.W.): date consistent with estimate: 2000 B.P.

5240 ± 80

S-509. Allumette Island-1 site, Quebec **3290 B.C.**

Human long bones (NMC-360) from Allumette Island site, S side of Allumette I. E of Hwy 8 bridge, Pontiac Co. Quebec (45° 49′ N Lat, 77° 01′ W Long). Burial A-6, Late Vergennes focus, Laurentian Archaic site. Should date earlier half of Laurentian tradition, Ottawa valley and add temporal significance to numerous copper, bone, and stone tool varieties from site. Coll. by C. C. Kennedy; subm. 1969 for J. V. Wright by R. Wilmeth. *Comment* (J.V.W.): date appears to be quite adequate for a late Vergennes component. Two earlier dates from Allumette Island site (M-1548, 3060 ± 150 B.P. and M-1549, 1100 ± 100 B.P.) were much too young for Vergennes focus.

925 ± 80

S-510. Carson site, New Brunswick **A.D. 1025**

Charcoal (NMC-368) from Carson site (BgDr-5), Digdeguash Harbour, Passamaquoddy Bay, New Brunswick (45° 09′ 45″ N Lat, 66° 57′ 00″ W Long). From Unit KK at N 24.70 m, W 15.40 m, depth from surface 25 cm, below datum 2.40 m. Sample assoc. with area of burned shell and bone, 25 cm W of Feature 6, an extensive rock hearth lacking sufficient charcoal for assay. Site is shell midden on sloping rhyolite exposure with cover of grass, poplar, and cedar. Two components recognized: Component I, uppermost, and probably includes most of shell midden accumulation; Component 2 probably assoc. with rotted shell and subsoil. Component 1 includes narrow notched, corner- and side-notched points, and cord-wrapped stick decorated ceramics. Component 2 is preceramic. Sample believed to date Component 1 similar to several other undated

sites in area, probably "type" sta. for period, since it contains largest assemblage of its kind in area. Coll. 1969 by J. B. Keenlyside for D. Sanger; subm. 1969 by R. Wilmeth. *Comment* (D.S.): date satisfactory.

Klo-kut site series, Yukon

Charred and uncharred caribou bone from Klo-kut site (MjV1-1), right bank of Porcupine R., ca. 9.65 km above Old Crow, N Yukon Territory (67° 54′ N Lat, 139° 41′ W Long). Large finely stratified site occupied by Athabaskans during last millennium. Coll. 1968 by R. E. Morlan, Natl. Mus. Canada and J. Cinq-Mars, Univ. Wisconsin; subm. 1969 by R. Wilmeth.

775 ± 50

S-511. Klo-kut site, W700 block **A.D. 1175**

Uncharred caribou bone (NMC-377), combined sample from 3 adjacent 1.52 m sqs. in W 700 block, depths 76.2 to 86.4 cm below surface, N15/0, N10/0, and N5/W5. All levels represent buried soil and adjacent sediment unit, Profile Units 20 and 21 in Zone C, Layer VI. Should date later part of early occupation period, lower part of Layer VI.

895 ± 75

S-512. Klo-kut site, W600 block **A.D. 1055**

Uncharred caribou bone (NMC-378), combined sample from 3 adjacent 1.52 m sqs. in W600 block, depths 81.3 to 88.9 cm below surface, N20/E60 N15/E60, and N10/E60. All levels represent Profile Unit 23, Zone C, Layer VII. Should date earlier part of early occupation period, top of Layer VII.

810 ± 80

S-513. Klo-kut site, E100 block **A.D. 1140**

Uncharred caribou bone (NMC-379) from N10/E10, Level 14, representing buried soil with lens of bone, Profile Unit 18, Zone C, Layer VI. Should date later part of early period of occupation, lower part of Layer VI.

830 ± 75

S-514. Klo-kut site, E700 block **A.D. 1120**

Uncharred caribou bone (NMC-380), combined sample from 2 1.52 m sqs. in E700 block (Area 1A), Sqs. 5 and 7, Layer 8. Represents buried soil, Profile Unit 21, Zone C, Layer VII. Should date end of earlier part of early occupation period, top Layer VII. Earliest major occupation in this part of site.

855 ± 60

S-515. Klo-kut site, E700 block **A.D. 1095**

Charred caribou bone (NMC-381) from E700 block, (Area 1A), Sq. 7, Level 8, Feature 68T. Large hearth on prominent soil, Profile Unit 21, Zone C, Layer VII. Should date earliest major occupation in this part of site, top of Layer VII.

General Comment (R.E.M.): 5 samples mutually consistent and generally consistent with previous dates on charcoal samples (R., v. 11, p. 309-311;

R., v. 11, p. 36-37; Wilmeth, 1969, p. 67-127). Klo-kut site periods; Early Prehistoric between 900 to 600 yr. B.P.; Late Prehistoric between 600 to 100 yr B.P.; Historic component dating to the last century. Bone samples appear to provide more consistent results than charcoal samples.

1700 ± 55

S-517. Karpinsky site, Alberta **A.D. 880**

Charcoal (NMC-332) from Karpinsky site (GkQn-100), N flanks of Birch Hills, Alberta (55° 42′ N Lat, 118° 10′ W Long). Combined sample from below plow zone in adjacent Sqs. E12, E13, and F12. Portion F12 assoc. with artifacts, range in form from side-notched to lanceolate with straight bases and shallow lateral indentations; all seem to have been made by same flaking technique, most of black chert. Single occupation campsite of restricted area uncovered by breaking plow. Coll. 1968 by A. L. Bryan, Univ. Alberta; subm. 1969 by R. Wilmeth. *Comment* (A.L.B.): should date occupation, 1st site excavated in Peace R. area of Alberta.

365 ± 55

S-518. Calling Lake, Alberta **A.D. 1585**

Charcoal (NMC-333) from GbPh-102 site, Calling Lake area, Alberta (55° 14′ N Lat, 113° 13′ W Long). From Sq. E10, 20 to 50 cm W and 150 to 175 cm S of Stake E10, depth 2 to 12 cm below Stake E10, in dark gray silt (Ah horizon of podsol). Camp site possibly occupied over long period with cultural stratigraphy compressed. Coll. 1968 by M. Doll for R. Gruhn, Univ. Alberta; subm. 1969 by R. Wilmeth. *Comment* (R.G.): date consistent with late prehistoric estimate (Gruhn, 1969, p. 8-14).

210 ± 50

S-519. Harris Site 2, Manitoba **A.D. 1740**

Charcoal (NMC-334) from Harris Site 2 (C3-CO-2), Manitoba (49° 46′ N Lat, 99° 43′ W Long). From Sq. N165 E5, Level 2, depth 7.6 to 15.2 cm. Sample occurred on Terrace 2 in stratified context, level partly assoc. with bison kill, includes late ceramics and lithic artifacts. Mixture of Manitoba and Silkirk phases seems to exist. Coll. 1967 by D. Tottle for W. M. Hlady, Manitoba Archaeol. Soc.; subm. 1969 by R. Wilmeth. *Comment* (W.M.H.): this site and other adjacent sites have not yet produced any contact material. Assiniboine people occupied area with Plains Cree E of Red R. at time of contact. Assiniboine around Lake Winnipeg known to have established trade at Fort Frances, Ontario earlier, A.D. 1684.

4985 ± 75

S-520. St. Brieux, Saskatchewan **3035 B.C.**

Human femur from a sandy kame on lacustrine plain near St. Brieux, Saskatchewan (52° 34′ N Lat, 104° 53′ W Long). Alt. +518 m. Articulated human skeletal remains from elongated face-down position 1.83 m below surface. Coll. 1965 by T. R. Smith; subm. 1969 by W. O.

Kupsch. *Comment* (T.R.S.): date indicates contemporaneity with Oxbow culture. Details of site and skeleton to be pub. elsewhere.

2900 ± 100

S-521. Churchill, Manitoba **950 B.C.**

Seal bones (*Pusa Lespida*) from Seahorse Gully site across Churchill R. from Churchill, Manitoba (58° 45′ N Lat, 94° 15′ W Long). Bones found immediately below surface as thin waste deposit within ruins of a rectangular Pre-Dorset dwelling, assoc. with typical Pre-Dorset artifacts. Coll. 1968 by R. J. Nash; subm. 1970 by David Meyer, Univ. Manitoba, Winnipeg. *Comment* (D.M.): should date most S extenson of Pre-Dorset culture along W coast of Hudson Bay area.

1560 ± 60

S-542. Grandora, Saskatchewan **A.D. 390**

Charred bone from Grandora site on sand dune 1.61 km NW of Grandora, Saskatchewan (52′ 07′ 46″ N Lat, 107° 00′ 00″ W Long). Coll. in 2 adjoining excavation units from buried soil 61 cm below surface. Assoc. with hearth and occupation remains including Besant projectile points. Coll. 1969 and subm. 1970 by I. G. Dyck, Univ. Manitoba, Winnipeg. *Comment* (I.G.D.): dates occupation of site, consistent with previous Besant age estimates (Reeves, 1970).

Kamloops series, British Columbia

Elk antlers coll. 1967 to 1969 from area of Kamloops, British Columbia to establish period of habitation. Elk do not inhabit region today nor is there historic record of occurrence since 1st settlement by man. Coll. and subm. 1969 by R. W. Ritcey, Dept. Recreation and Conservation, Kamloops.

1740 ± 75

S-454. Elk antler **A.D. 210**

From lake bottom, McGlashan Lake, British Columbia (50° 30′ N Lat, 120° 05′ W Long).

184 ± 75

S-493. Elk antler **A.D. 1766**

Partially buried near Pennask Lake, British Columbia (50° 00′ N Lat, 120° 09′ W Long).

1430 ± 85

S-495. Elk antler **A.D. 520**

From lake bottom, Dominic Lake, British Columbia (50° N Lat, 120° W Long).

390 ± 75

S-496. Elk antler **A.D. 1560**

From meadow surface, 3.22 km S of W end Upper Loon Lake and 40.23 km ENE of Clinton, British Columbia (51° 10′ N Lat, 121° 05′ W Long).

367 ± 75

S-497. Elk antler **A.D. 1583**

From meadow surface, 3.22 km S of W end Upper Loon Lake and 40.23 km ENE of Clinton, British Columbia (51° 10′ N Lat, 121° 05′ W Long).

Williams Lake series, British Columbia

Elk antlers coll. from area of Williams Lake, British Columbia to establish period of elk habitation. Coll. 1969 and subm. 1970 by H. B. Mitchell, Dept. Recreation and Conservation, Williams Lake.

110 ± 55

S-537. Elk antler **A.D. 1840**

Found near Maze Lake, British Columbia (51° 49′ N Lat, 122° 47′ W Long).

3625 ± 75

S-538. Elk antler **1675 B.C.**

Found near Dog Creek, British Columbia (51° 35′ N Lat, 122° 15′ W Long).

615 ± 70

S-539. Elk antler **A.D. 1335**

From Moose Meadow, British Columbia (51° 49′ N Lat, 121° 48′ W Long).

1200 ± 65

S-540. Elk antler **A.D. 750**

Found near Squak Lake, British Columbia (52° 03′ N Lat, 121° 34′ W Long).

1105 ± 65

S-541. Elk antler **A.D. 845**

Found near Chezacut, British Columbia (52° 20′ N Lat, 124° 01′ W Long).

General Comment (A.A.R.): combined dates for Kamloops and Williams Lake series support long period of elk habitation for interior British Columbia prior to settlement by man. Habitation not necessarily continuous for region (periods 1675 B.C. to A.D. 210; A.D. 845 to 1335) or local areas.

REFERENCES

Andrews, J. T., 1970, A geomorphological study of postglacial uplift with particular reference to Arctic Canada: Inst. British Geographers, spec. pub. 2, 156 p.

Barr, W., Postglacial isostatic movement in northeastern Devon Island, N.W.T.—a reappraisal: Arctic (in press).

Blake, W., Jr., 1970, Studies of glacial history in Arctic Canada. I. Pumice, radiocarbon dates, and differential uplift in the eastern Queen Elizabeth Islands: Canadian Jour. Earth Sci., v. 7, no. 2, p. 634-664.

Borden, C. E., 1968, New evidence of early cultural relations between Eurasia and western North America, *in*: 8th internatl. cong. anthropol. and ethnolog. sci., Tokyo, Japan, 1968.

Christiansen, E. A. (ed.), 1970, Physical environment of Saskatoon, Canada: Ottawa, Natl. Research Council Pub. no. 11378, p. 4.

Crane, H. R. and Griffin, J. B., 1965, University of Michigan radiocarbon dates X: Radiocarbon, v. 7, p. 123-152.
Dyck, I. G., 1970, Two Oxbow settlement types in central Saskatchewan: Napao, v. 2, no. 2, p. 1-29.
Edmunds, F. H. *et al.*, 1938, Some skeletal remains in Saskatchewan: Am. Antiquity, v. 3, no. 3, p. 244-246.
Gruhn, R., 1969, Summary of field work at Calling Lake, Northern Alberta, Summer 1968: Archaeol. Soc. Alberta Newsletter, no. 19, p. 8-14.
Jain, T. C., Owen, G. L., and Striha, R. J., 1969, Pristane: A norditerpene hydrocarbon from Bute Inlet wax: Phytochemistry, v. 8, p. 785-787.
Jennings, J. D., 1957, Danger Cave: Soc. Am. Archaeol. Mem. no. 14: Am. Antiquity, v. 23, no. 2, pt. 2, Salt Lake City.
Johnston, W. A., 1946, Glacial Lake Agassiz, with special reference to the mode of deformation of the beaches: Canada Geol. Survey Bull. 1, 20 p.
Kigoshi, K., Aizawa, H., and Suzuki, N., 1969, Gakushuin natural radiocarbon measurements VII: Radiocarbon, v. 11, p. 295-326.
King, R. H., 1969, Periglaciation on Devon Island, N.W.T.: Ph.D. thesis, unpub., Univ. Saskatchewan.
Kupsch, W. O., McCallum, K. J., and Spinks, J. W. T., 1970, Human skeletal remains near Bradwell, Saskatchewan: Saskatchewan Archaeol. Newsletter, no. 28, p. 7-9.
Lee, H. A., 1962, Method of deglaciation, age of submergence, and rate of uplift west and east of Hudson Bay, Canada: Biul. Peryglacjalny, ser. 3, no. 11, p. 239-245.
Libby, W. F., 1955, Radiocarbon dating, 2nd ed.: Chicago, Univ. Chicago Press, IX, 175 p.
Løken, O. H., 1966, Baffin Island refugia older than 54,000 years: Science, v. 153, p. 1378-1380.
Lowden, J. A., Wilmeth, R., and Blake, W. Jr., 1969, Geological Survey of Canada radiocarbon dates VIII: Radiocarbon, v. 11, p. 22-42.
Lowden, J. A. and Blake, W. Jr., 1970, Geological Survey of Canada radiocarbon dates IX: Radiocarbon, v. 12, p. 46-86.
McCallum, K. J. and Wittenberg, J., 1962, University of Saskatchewan radiocarbon dates III: Radiocarbon, v. 4, p. 71-80.
———— 1968, University of Saskatchewan radiocarbon dates V: Radiocarbon, v. 10, p. 365-378.
Müller, F. and Barr, W., 1966, Postglacial isostatic movement in northeastern Devon Island, Canadian Arctic Archipelago: Arctic, v. 19, no. 3, p. 263-269.
Osborn, H. F., 1942, Proboscidia: N.Y. Am. Mus. Natl. History, v. 2, p. 1675.
Reeves, B. O. K., 1970, Culture change in the Northern Plains, 1000 B.C.-A.D. 1000: Ph.D. thesis, unpub., Univ. Calgary.
Rousseliere, G. M., 1968, Reconnaissance archaeologique dans la region du Pond Inlet, Territoires du Nord-Ouest: Centre d'Etudes Nordiques, Travaux Divers, v. 21, Quebec.
Stuiver, Minze, 1969, Yale natural radiocarbon measurements IX: Radiocarbon, v. 11, p. 545-658.
Williams, M. Y., 1957, Bute Inlet wax: Royal Soc. Canada Trans., v. 51, ser. 3, p. 13.
Wilmeth, R., 1969, Canadian archaeological radiocarbon dates: Natl. Mus. Canada Bull. 272, paper 3, p. 67-127.
Wright, J. V. and Anderson, J. E., 1963, The Donaldson site: Natl. Mus. Canada, Bull. 184, Anthropol. ser. 58, Ottawa.

[RADIOCARBON, VOL. 15, NO. 1, 1973, P. 212-228]

BELFAST RADIOCARBON DATES V

A. G. SMITH, G. W. PEARSON, and J. R. PILCHER
Palaeoecology Laboratory, Queen's University,
Belfast, Northern Ireland

INTRODUCTION

The dating equipment and operating conditions remain essentially as previously described. Samples in this list were counted at filling pressures equivalent to either 152 or 380 cm Hg at 20°C. Pretreatments are as given in previous lists unless otherwise specified. All wood samples were treated with sodium chlorite and dilute HCl to leave a cellulose-rich residue. Pine wood was in some cases extracted with petroleum spirit in a Soxhlet apparatus before this treatment, to remove resins.

Carbon isotope ratios were determined on a Vacuum Generators Micromass 602 unit. We maintain a large stock of CO_2 derived from 1840 wood as a working sub-standard, which we and 3 other British laboratories calibrated relative to the PDB standard. For these measurements the NBS Solenhöffen limestone (Isotope Ref. No. 20), and sub-standards related to it, have been employed. The mean of the δC^{13} measurements is $-25.36 \pm 0.2‰$. Our current oxalic acid standard CO_2, prepared by dry combustion, has a δC^{13} of $-18.49 \pm 0.1‰$ relative to PDB. The oxalic acid counts have been normalized to $-19‰$ relative to PDB and the sample counts to $-25‰$ relative to PDB (cf. Craig, 1961).

The calculated error of our results is as described by Callow, Baker and Hassal (R., 1965, v. 7, p. 156-161) except that no allowance is made for the De Vries effect. All samples are from Ireland unless otherwise stated.

ACKNOWLEDGMENTS

Most of the pretreatments and routine operation of the dating apparatus were done by Florence Qua and Anise Colville to whom we are much indebted. We thank The Ministry of Finance for Northern Ireland and The New University of Ulster for financial support for dating some samples. We gratefully acknowledge the help of M. S. Baxter, N. Shackleton, D. B. Smith, and R. Otlet in calibrating our 1840 wood standard. We thank the archaeologists who have contributed material, for their cooperation in the field and help in the preparation of this list.

I. CHECK SAMPLE

UB-66. Pyramid of Teti, Sakkara, Egypt, Sample 2/67 **3950 ± 70 2000 B.C.**

Wood, *Pinus* sp. (probably *P. pinea* L.) id. by F. R. Richardson, Jodrell Lab., Royal Bot. Gardens, Kew, Surrey, from Pyramid of Teti, Sakkara, Egypt (29° 51′ N Lat, 31° 14′ E Long). Outermost growth rings of large beam (1.45 × 0.19 × 0.19 m) supporting royal sarcophagus which cannot have been moved since it was placed *in situ* (Leclant, 1966). Coll. 1967 by G. T. Martin, Univ. Coll., London. Sample provided by H.

Barker and R. Burleigh, British Mus. Research Lab. *Comment*: archaeologic estimate of age ca. 2350 B.C. Date by British Mus. Research Lab.: BM-331, 3770 ± 85 (R., 1971, v. 13, p. 161) includes correction for fractionation.

II. ARCHAEOLOGIC SAMPLES

Meadowlands series, Downpatrick, Co. Down

Samples from Bronze age occupation site in Meadowlands, Downpatrick town, Co. Down (54° 19′ N Lat, 5° 43′ W Long; Irish Grid Ref. J 488450; alt. 5.5 m). Site excavated 1962 by D. M. Waterman, Archaeol. Survey N. Ireland and A. J. Pollock. Subm. 1971 by D. M. Waterman. Ref.: Pollock and Waterman, 1964.

UB-471. Meadowlands, Layer 7 **3575 ± 70**
1625 B.C.

Charcoal from lower occupation Layer 7 in Cutting 5.

UB-472. Meadowlands, Pit 1 **3795 ± 75**
1845 B.C.

Charcoal from occupation soil over and around edge of pit, equivalent to Layer 7 (UB-471).

UB-473. Meadowlands, Cutting 4, Slot **3265 ± 80**
1315 B.C.

Charcoal from upper black layer of stone filled slot.

UB-474. Meadowlands, Upper Black Layer 2 **3325 ± 75**
1375 B.C.

Charcoal from NE of hollow with stone filled slot.

General Comment: dates reflect presence of sterile layer between upper level (UB-473 and -474) and lower level (UB-471 and -472). Cordoned urn pottery in both layers. Beaker pottery in lower layer. Material assoc. with cordoned urn from Grandtully, Perthshire gave date 3220 ± 100 (Gak-603) (Coles, 1969).

Newferry archaeologic series, Co. Antrim

Samples from cultural layers stratified in diatomite at Newferry, 13 km WSW of Ballymena, Co. Antrim (54° 49′ 30″ N Lat, 6° 27′ 30″ W Long; Irish Grid Ref. H 992982; alt. 16 m). Site excavated in 1970, 1971 by P. C. Woodman, Ulster Mus. Belfast with members of the Palaeoecol. Lab. Previous work at site: Movius, 1936; Smith and Collins, 1971.

UB-487. Newferry, Complex IX, Sample 1 **8190 ± 120**
6240 B.C.
$\delta C^{13} = -27.2‰$

Branch from basal sand (Complex IX) in Trench J7W. Wood pretreatment.

5415 ± 95

UB-489. Newferry, Complex III, Sample 1 **3465 B.C.**

$\delta C^{13} = -26.4‰$

Charcoal from lower part of Complex III, Trench F7 (Field notation: Layer 2d).

6215 ± 100

UB-490. Newferry, Complex IV, Sample 1 **4265 B.C.**

$\delta C^{13} = -24.9‰$

Selected charcoal from top of Complex IV, Trench F7 (Field notation: Layer 3a).

7485 ± 115

UB-496. Newferry, Complex VII, Sample 1 **5535 B.C.**

$\delta C^{13} = -25.4‰$

Selected charcoal from thin black layer in Complex VII, Trench F7 (Field notation: Layer 8).

5795 ± 105

UB-508. Newferry, Complex III, Sample 2 **3845 B.C.**

$\delta C^{13} = -25.7‰$

Selected charcoal from top of Complex III, Trench J7E (Field notation: Layer 5).

7175 ± 105

UB-514. Newferry, Complex VI, Sample 1 **5225 B.C.**

$\delta C^{13} = -25.4‰$

Selected charcoal from Complex VI, Trench H7W (Field notation: Layer 14).

6955 ± 60

UB-516. Newferry, Complex VII, Sample 2 **5005 B.C.**

$\delta C^{13} = -25.8‰$

Selected charcoal from Complex VII, Trench H7W (Field notation: Layer 18, top).

7190 ± 110

UB-517. Newferry, Complex VII, Sample 3 **5240 B.C.**

$\delta C^{13} = -25.9‰$

Selected charcoal from Complex VII, Trench H7W (Field notation: Layer 18, base). *Comment*: sample was from lower part of same layer as UB-516 (above).

General Comment (P.C.W. and A.G.S.): determinations are 1st of large series from complex site which was intermittently re-occupied. Detailed comment reserved until further dating.

1220 ± 45

UB-589. Antiville Ring Fort, Co. Antrim **A.D. 730**

$\delta C^{13} = -24.5‰$

Charred twigs from ring-fort (rath) in Antiville Td., in Larne town, Co. Antrim (54° 55′ N Lat, 5° 51′ W Long; Irish Grid Ref. D 391031; alt. ca. 90 m). Sample from secondary floor in house structure excavated

1957 by D. M. Waterman, Archaeol. Survey N. Ireland. Coll. 1957 and subm. 1971 by D. M. W. Ref.: Waterman (1971). *Comment*: similar material dated by Dublin Lab to 1470 ± 120 (D-66; R., 1961, v. 3, p. 36).

UB-608. Beaghmore Stone Circles 71, Hearth **4135 ± 80**
2185 B.C.
$\delta C^{13} = -25.4‰$

Charcoal from hearth in stone circle complex at Beaghmore Td., 14 km N of Cookstown, Co. Tyrone (54° 42′ N Lat, 6° 56′ W Long; Irish Grid Ref. H 685843; alt. ca. 200 m). Sample from hearth found during conservation work in 1971, NE of alignment of stones extending from Cairn 6. Coll. 1971 by D. M. Waterman. *Comment* (J.R.P.): sample considerably older than samples from Cairn 10 (UB-11) and Flint Hoard (UB-23) (R., 1970, v. 12, p. 292) and suggests hearth is Late Neolithic or Beaker. Other hearths on site had Neolithic pottery (May, 1953).

UB-599. Carnkenny Ring Cairn **2815 ± 50**
865 B.C.

Charcoal from ring cairn in Carnkenny Td., 1 km SE of Ardstraw, Co. Tyrone (54° 45′ N Lat, 7° 30′ W Long; Irish Grid Ref. H 353868; alt. 65 m). Sample from old ground surface sealed below 0.5 m of cairn stones to NNE of central area, assoc. with cremated bone. Soil was intensely reddened and contained charcoal and burnt bone. Site excavated 1970 by C. J. Lynn for Archaeol. Survey N. Ireland. Coll. 1971 by S. McBride, Newtownstewart, Co. Tyrone. Subm. by D. M. Waterman. *Comment* (C.J.L.): site yielded flat-rimmed ware, slag, crude inversely-retouched flint arrowhead, polished stone axe and perforated stone discs. Finds are not inconsistent with date in the later Bronze age.

UB-546. Glenviggan 'Bull Roarer' **2060 ± 45**
110 B.C.
$\delta C^{13} = -26.9‰$

Peat assoc. with 'Bull roarer' from Glenviggan Td., 14.5 km WSW of Draperstown, Co. Londonderry (54° 44′ N Lat, 6° 56′ W Long; Irish Grid Ref. H 690880; alt. 230 m). 'Bull roarer' from depth ca. 2 m. Coll. 1965 by J. Gunn, St. Colm's School, Draperstown. Subm. 1971 by E. E. Evans, Inst. Irish Studies, Queen's Univ., Belfast. Acid pretreatment. *Comment*: if 'Bull roarer' same age as peat, then apparently Iron age.

Tully (Aldergrove) Ring Fort series, Co. Antrim

Samples from ring fort (rath) at Aldergrove airport, 19 km W of Belfast, Co. Antrim (54° 40′ N Lat, 6° 13′ W Long; Irish Grid Ref. J 164807; alt. 76 m). Site excavated in 1970 by A. E. T. Harper, Hist. Monuments Branch, Min. Finance, N. Ireland.

UB-536. Aldergrove, Q3, Phase I, Sample 1 **1635 ± 65**
A.D. 315
$\delta C^{13} = -25.9‰$

Charcoal from SE corner of Trench Q3.

UB-537. Aldergrove, Q3, Phase 1, Sample 2 **1470 ± 45** **A.D. 480**
$\delta C^{13} = -26.1‰$

Charcoal from surface of earliest occupation, Phase 1, Trench Q3.

UB-538. Aldergrove, Q3, Phase 1, Sample 3 **1600 ± 65** **A.D. 350**
$\delta C^{13} = -26.4‰$

Wood from Phase 1, Trench Q3.

UB-539. Aldergrove, Q3, Phase 1, Sample 4 **1540 ± 65** **A.D. 410**
$\delta C^{13} = -25.2‰$

Selected charcoal from base of hearth in N face of Trench Q3.

UB-545. Aldergrove, Q3, Phase 1, Sample 5 **1395 ± 40** **A.D. 555**
$\delta C^{13} = -24.3‰$

Sample from yr 36 to 46 of 46-yr-old oak from doorway (Tree 572).

UB-540. Aldergrove, Q3, Phase 2 **1385 ± 65** **A.D. 565**
$\delta C^{13} = -27.4‰$

Fragmentary charcoal from small rectangular hearth in Phase 2.

UB-541. Aldergrove, P4, Phase 1 **1560 ± 35** **A.D. 390**
$\delta C^{13} = -25.7‰$

Charcoal from hearth and surround, Phase 1, Trench P4.

UB-542. Aldergrove, P4, Phase 2 **1345 ± 65** **A.D. 605**
$\delta C^{13} = -26.0‰$

Charcoal from Hearth A in E face, Trench P4.

UB-544. Aldergrove, P4, Phase 3 **1230 ± 45** **A.D. 720**
$\delta C^{13} = -26.2‰$

Charcoal from upper part of hearth, Trench P4.

General Comment (with A.E.T.H.): means of 6 dates for lowest occupation (Phase 1) fall within 3rd to 6th centuries A.D. Date for UB-545 suggests house was built in later part of this period. Dumb-bell bead and a bone comb from this phase are consistent with a late-Roman to post-Roman phase in Iron age. This earliest phase yielded no pottery. Dates for later phases (2, 3) suggest continued occupation into 7th to 8th centuries A.D. Phase 2 yielded 2 bronze ring-headed pins and pottery of 'Souterrain Ware' type.

Winetavern St. series, Dublin

Samples from Viking and Medieval town at Winetavern St., Dublin

(53° 25′ N Lat, 6° 15′ W Long; Irish Grid Ref. O 142340; alt. ca. 15 m). Site under excavation by B. O'Riordain, National Mus. Ireland.

UB-616. Winetavern St. IDWT 752 **1045 ± 60** **A.D. 905**

$\delta C^{13} = -23.9‰$

Oak post from Pit 6/1, Sq. I. Coll. 1971 by M. G. L. Baillie. *Comment* (M.G.L.B.): wood-lined pit yielded hoard of Medieval tokens in top of primary fill (Dolley and Seaby, 1971). Sample from yr 126 to 146 of 256-yr floating master dendochronologic sequence for pit. From dendrochronologic and archaeologic evidence pit was constructed in mid-13th century.

UB-614. Winetavern St. IDWT 725 **1150 ± 65** **A.D. 800**

$\delta C^{13} = -25.0‰$

Ash-wood beam forming part of presumed drain in Sq. II. Top of drain was decorated with incised sketch of ship. Coll. 1971 by M. G. L. Baillie. *Comment* (M.G.L.B.): timber from late 11th century level. Sample from yr 10 to 30 of 118-yr-old tree. Timber may have been re-used.

UB-527. Winetavern St. IDWT 802 **1265 ± 50** **A.D. 685**

$\delta C^{13} = -25.4‰$

Charcoal from Sq. I, Pit 26/1, depth 2.45 m. Coll. 1970 by B. O'Riordain. *Comment* (B.O'R.): sample from pit dug into sub-soil below well-attested 9th/10th century occupation levels and suggests possible activity on site pre-dating Viking levels.

UB-615. High Street, Dublin, IDHS 1971:67 **1190 ± 60** **A.D. 760**

$\delta C^{13} = -25.7‰$

Wood from Viking settlement at High St., Dublin (53° 25′ N Lat, 6° 15′ W Long; Irish Grid Ref. O 142340, alt. ca. 30 m). Sample of branches from pit dug into basal boulder clay in Sq. I of excavation. Site under excavation by B. O'Riordain. Coll. 1971 by M. G. L. Baillie. *Comment* (M.G.L.B.): sample from below well-attested 9th/10th century occupation levels. Date suggests activity on site around period of 1st Viking influence.

General Comment (Winetavern St. and High St., Dublin samples): archaeologically, each date in this series appears to be earlier than expected. Future dendrochronologic calibration may attribute this to the De Vries effect.

UB-617. Blackwater boat **410 ± 55** **A.D. 1540**

$\delta C^{13} = -24.6‰$

Oak wood from clinker built boat from point of entry of R. Blackwater into Lough Neagh (54° 30′ 30″ N Lat, 6° 34′ 30″ W Long; Irish Grid Ref. H 922636; alt. 16 m). Coll. 1969 by C. S. Briggs, Archaeol.

Dept., Queen's Univ. *Comment*: timbers from boat studied dendrochronologically give sequence of 190 yr.

Ballynagilly series I, Co. Tyrone

More samples from series reported in R., 1971, v. 13, p. 105-108, from site 'The Corbie' in Ballynagilly Td., Co. Tyrone (54° 42′ N Lat, 6° 51′ W Long; Irish Grid Ref. H 743837; alt 200 m). Series is from excavations made by A. M. ApSimon, Dept. Archaeol., Univ. Southampton, for Ministry of Finance, N. Ireland, 1966 to 1970. Samples are from Neolithic and later occupations. Coll. by A. M. ApSimon.

UB-559. Ballynagilly, Pit F(L)135 — **5500 ± 85** / **3550 B.C.** / $\delta C^{13} = -23.2‰$

Charcoal from same location as UB-197 (R., 1970, v. 12, p. 289), from large pit with burnt clay and Western Neolithic pottery. *Comment*: date appears slightly younger than UB-197, 5625 ± 50 (R., 1970, v. 12, p. 289) from same pit, but confirms very early Neolithic age of pit and contents.

UB-551. Ballynagilly, 'Cooking Place' F(M)67 — **5290 ± 50** / **3340 B.C.** / $\delta C^{13} = -25.3‰$

Charcoal from cooking place, stratigraphically pre-Bell-Beaker. Coll. 1967-8. *Comment*: date suggests cooking place is contemporary with Neolithic house on site by comparison with UB-199 (house post-hole) 5230 ± 125 (R., 1971, v. 13, p. 106) and UB-201 (house wall planking) 5165 ± 50 (R., 1970, v. 12, p. 298).

UB-625. Ballynagilly, Pit F(L)162 — **4835 ± 55** / **2885 B.C.** / $\delta C^{13} = -24.8‰$

Charcoal from pit with Western Neolithic pottery. *Comment*: date shows pit and included pottery belong to same phase of occupation as pit with similar pottery dated by UB-301, 4190 ± 90 (R., 1971, v. 13, p. 106).

UB-552. Ballynagilly, Pit F(M)179 — **4205 ± 50** / **2255 B.C.** / $\delta C^{13} = -26.2‰$

Charcoal from sealed pit with flint and potsherd, dug into area with pottery previously described as Middle Neolithic dated by UB-306, 4480 ± 110 (R., 1971, v. 13, p. 106). *Comment*: pit is younger than layer from which sample UB-306 was obtained; see also comments on UB-553, 554 below.

UB-553. Ballynagilly, F(M)180 — **4055 ± 50** / **2105 B.C.** / $\delta C^{13} = -26.5‰$

Charcoal from dark layer linked to F(M)179 (UB-552) which joined F(M)170 (UB-554). Layer contained 2 Neolithic flint implements.

4110 ± 50

UB-554. Ballynagilly, F(M)170 **2160 B.C.**

δC^{13} —23.8‰

Charcoal from depression with a dark layer. *Comment*: UB-553, -554, and -552 may date phase of Late Neolithic activity immediately prior to Beaker activity (see comment on UB-558, below).

4050 ± 50

UB-555. Ballynagilly, Long Pit F(G)102 **2100 B.C.**

δC^{13} —26.1‰

Charcoal from long pit with Beaker pottery and flints.

3860 ± 50

UB-556. Ballynagilly, Hearth Pit F(G)7 **1910 B.C.**

δC^{13} —25.1‰

Charcoal from large hearth pit; contents included Beaker potsherd with false-relief decoration.

3780 ± 70

UB-557. Ballynagilly, Pit F(G)123 **1830 B.C.**

δC^{13} —25.2‰

Charcoal from pit with Beaker pottery with finger-tip decoration.

4010 ± 80

UB-558. Ballynagilly, F(G)8 **2060 B.C.**

δC^{13} —25.3‰

Charcoal from depression with dark fill containing Beaker sherds with comb decoration. *Comment*: UB-555-557, above, and this sample which are all for charcoal closely assoc. with Beaker pottery, all fall close to previous group of similar samples: UB-316, 3960 ± 75; UB-356, 3905 ± 75; UB-200, 3905 ± 120; UB-309, 3850 ± 55 (R., 1971, v. 13, p. 106-107).

General Comment (A.M.A.): UB-559 confirms previous dates (UB-197, UB-305, UB-307, R., 1970, v. 12, p. 289 and R., 1971, v. 13, p. 106) suggesting Earliest Neolithic occupation with Western Neolithic pottery ca. 5700 to 5500 B.P. These are earliest such dates yet obtained for British Isles and with UB-116 (R., 1971, v. 13, p. 111) suggest that Neolithic culture appeared considerably earlier than previously thought and well before major Landnam horizons. In complete series (refs. above), 2 further dated groups of Western Neolithic pottery is to be noted, first is Early Neolithic, with house, ca. 5250 to 5150 B.P., 2nd is Middle Neolithic, ca. 4850 B.P.

Carnanbane series, Co. Tyrone

Samples from Carnanbane court cairn in Ballybriest Td., 12 km NNW of Cookstown, Co. Londonderry (54° 44′ N Lat, 6° 49′ W Long; Irish Grid Ref. H 762885, alt. ca. 250 m). Neolithic dual court cairn excavated 1937 by E. E. Evans (1939). Coll. 1970 by A. M. ApSimon and E. E. Evans, Inst. Irish Studies, Univ. Belfast.

4930 ± 80

UB-534. Carnanbane, CH2 **2980 B.C.**

$\delta C^{13} = -25.7‰$

Charcoal from black layer below cairn, on top of till. Directly assoc. with sherds of Western Neolithic pottery.

5045 ± 95

UB-535. Carnanbane, CH5/6 **3095 B.C.**

$\delta C^{13} = -24.9‰$

Charcoal from black Layer 4 around Neolithic pot and from under large stone with large black potsherd.

General Comment: dates broadly as expected.

III. PALAEOECOLOGIC SAMPLES

Altnahinch monolith series, Co. Antrim

Peat samples from valley bog in Altnahinch Td., 12 km SW of Cushendall, Co. Antrim (55° 3′ N Lat, 6° 15′ W Long; Irish Grid Ref. D 233125; alt. ca. 250 m). Samples from monolith from which pollen diagram has been prepared by A. Goddard from exposed peat face to N of reservoir dam. Measurements are from peat surface. Coll. 1969 and pretreated by A.G.

1525 ± 80

UB-428. Altnahinch monolith, 63 to 65 cm **A.D. 425**

Fine particulate fraction of blanket peat. Total tree pollen starts its final decline to very low values.

2820 ± 75

UB-427. Altnahinch monolith, 131 to 133 cm **870 B.C.**

$\delta C^{13} = -25.2‰$

Fine particulate fraction of blanket peat. Total tree pollen values decrease from 62% to 26%. Pine and elm pollen curves do not decline. Just above this sample plantain, grass and sedge pollen values rise.

3025 ± 70

UB-425. Altnahinch monolith, 145 to 147 cm **1075 B.C.**

$\delta C^{13} = -26.0‰$

Fine particulate fraction of blanket peat. Rise of total tree pollen values from 47% to 66%, due mainly to rise of hazel and alder pollen curves. Plantain, sedge, and grass pollen values decrease.

2985 ± 90

UB-410. Altnahinch monolith, 148 to 151 cm **1035 B.C.**

Fine particulate fraction of blanket peat. Tree pollen percentages ca. 47%. Plaintain, grass, and sedge pollen values high.

3165 ± 90

UB-426. Altnahinch monolith, 155 to 159 cm **1215 B.C.**

Fine particulate fraction of blanket peat. End of period of high heath pollen values (max. 40%). Hazel, oak, and alder pollen curves remain unchanged.

4880 ± 105

UB-423. Altnahinch monolith, 241 to 243 cm **2930 B.C.**

Fine particulate fraction of blanket peat. Just above transition from fen peat to blanket peat, and at end of elm and pine declines which mark Pollen Zone VIIa-b boundary (Jessen, 1949). Birch and heath pollen values high.

6340 ± 100

UB-422. Altnahinch monolith, 277 to 279 cm **4390 B.C.**

Fine particulate fraction of fen peat. Just above level at which alder curve rises above value of 1% marking Pollen Zone VI-VII boundary (Jessen, 1949).

7880 ± 110

UB-421. Altnahinch monolith, 317 to 319 cm **5930 B.C.**

$\delta C^{13} = -26.8‰$

Fine particulate fraction of fen peat. Beginning of continuous curve for oak pollen and at end of period of high sedge pollen values.

8420 ± 105

UB-420. Altnahinch monolith, 331 to 333 cm **6470 B.C.**

$\delta C^{13} = -27.0‰$

Fine particulate fraction of woody fen peat. End of peak of hazel pollen values and at beginning of rise of sedge pollen values.

8895 ± 115

UB-418. Altnahinch monolith, 369 to 371 cm **6945 B.C.**

$\delta C^{13} = -26.7‰$

Particulate fraction of moss/sedge peat. Beginning of rise of hazel curve marking Pollen Zone IV-V boundary (Jessen, 1949), and decline of birch curve. Beginning of rise in total tree pollen curve.

9045 ± 125

UB-419. Altnahinch monolith, 381 to 384 cm **7095 B.C.**

$\delta C^{13} = -26.1‰$

Particulate fraction of fine detritus mud. Maximum of birch pollen values (30%). Grass and sedge pollen values high, *Myriophyllum* and *Filipendula* pollen present.

9555 ± 135

UB-411. Altnahinch monolith, 388 to 391 cm **7605 B.C.**

Particulate fraction of fine detritus mud. Rise of birch values from 6% to 22%: to be regarded as Pollen Zone III-IV boundary *sensu* Jessen (1949).

General Comment: for other dates referring to pollen zone boundaries, see R., 1971, v. 13, p. 455-460.

Slieve Gullion monolith series, Co. Armagh

Blanket peat samples from monolith beside passage grave on S summit of Slieve Gullion, 9 km SE of Newry, Co. Armagh (54° 07′ N

Lat, 6° 26′ W Long; Irish Grid Ref. J 025203; alt. 570 m). Pollen diagram prepared by J. R. Pilcher. Cairn, excavated 1961 by Collins and Wilson, has central chamber containing stone cut basins; sampling point indicated in Collins and Wilson (1963, fig. 4). All samples had acid pretreatment. Coll. 1964 by A.G.S. and J.R.P.

UB-179. Slieve Gullion monolith, 0 to 2 cm **5215 ± 95**
3265 B.C.
$\delta C^{13} = -27.2‰$

Mineral soil with small organic content from 0 to 2 cm above bedrock. Includes rise of alder pollen and is just below fall of pine curve.

UB-180. Slieve Gullion monolith, 3 to 5.5 cm **3955 ± 75**
2005 B.C.
$\delta C^{13} = -27.7‰$

Stony soil with small organic content from 3 to 5.5 cm above bedrock. Stones forming layer at ca. 2.5 to 5.5 cm possibly debris resulting from construction or disturbance of cairn.

UB-181. Slieve Gullion monolith, 5.5 to 8.0 cm **4035 ± 85**
2085 B.C.
$\delta C^{13} = -27.7‰$

Well humified blanket peat from 5.5 to 8.0 cm above bedrock. At decline of elm pollen (5.5 cm).

UB-182. Slieve Gullion monolith, 11 to 13 cm **3250 ± 80**
1300 B.C.
$\delta C^{13} = -27.8‰$

Rooty blanket peat from 11 to 13 cm above bedrock. At major peak of plantain pollen and dip in total tree pollen curve.

UB-183. Slieve Gullion monolith, 16 to 18 cm **2670 ± 70**
720 B.C.
$\delta C^{13} = -29.4‰$

Rooty blanket peat from 16 to 18 cm above bedrock. Marked decline of tree pollen and rise of plantain pollen.

General Comment: dates confirm slow deposition rate suspected from pollen analysis. Deposition rate is ca. 140 yr/cm. If stone layer is connected with cairn construction, this must have been before ca. 4000 B.P. (UB-180). Further discussion in Smith and Pilcher (1972).

Behy series, Co. Mayo

Blanket peat from monolith beside court cairn at Behy Td., 29 km NW of Ballina, Co. Mayo (54° 18′ N Lat, 9° 29′ W Long; alt. 150 m). Pollen diagram shows present windswept hillside had been forested with oak. Time of cairn building tentatively placed at 27 to 28 cm in monolith, based on pollen sample beneath cairn stones. Site excavated in 1963 and later, by R. DeValera, Univ. Coll., Dublin. Coll. 1963 by A.G.S.

UB-153 F. Behy monolith, 24 to 28 cm **3890 ± 110**
1940 B.C.
Fine particulate fraction of blanket peat.

UB-153 C. (humic acid) 3245 ± 70
$\delta C^{13} = -27.1‰$

UB-155. Behy monolith, 30 to 34 cm **3630 ± 70**
1680 B.C.
$\delta C^{13} = -27.5‰$
Combined fine particulate and humic acid fractions of blanket peat.

UB-158 F. Behy monolith, 36 to 38 cm **3930 ± 105**
1980 B.C.
$\delta C^{13} = -29.1‰$
Fine particulate fraction of blanket peat.

UB-158 C. (humic acid) 3750 ± 85
$\delta C^{13} = -28.0‰$

General Comment: difference between fine-particulate and humic acid fractions of UB-153 indicates considerable movement of humic substances in profile. Result from combined sample, UB-155 is, therefore, possibly largely erroneous. Curves for conventional radiocarbon ages as a function of dendrochronologic age (Olsson, 1970; Suess, 1970) suggest UB-153 F and UB-158 F could be separated by several centuries.

Lough Neagh Antrim Bay Core series

Samples from 3 m core of nekron mud from Antrim Bay in Lough Neagh, 9.5 km SW of Antrim, Co. Antrim (54° 40′ N Lat, 6° 20′ W Long; lake surface alt. 16 m). Coll. 1970 from core taken using Makereth sampler by F. Oldfield, New Univ. Ulster. Acid pretreatment. Samples diluted with inactive methane for counting except UB-593-595. Depths recorded below top of core.

UB-593. Lough Neagh A.B. Core, 41 to 51 cm 1995 ± 85
45 B.C.
$\delta C^{13} = -28.5‰$

UB-594. Lough Neagh A.B. Core, 51 to 61 cm 1630 ± 70
A.D. 320
$\delta C^{13} = -29.0‰$

UB-595. Lough Neagh A.B. Core, 63 to 73 cm 1620 ± 70
A.D. 330
$\delta C^{13} = -28.0‰$

UB-569. Lough Neagh A.B. Core, 73 to 83 cm 1770± 70
A.D. 180
$\delta C^{13} = -27.8‰$

UB-570.	Lough Neagh A.B. Core, 98 to 108 cm	1640 ± 90 A.D. 310
UB-571.	Lough Neagh A.B. Core, 128 to 138 cm	1535 ± 80 A.D. 415 $\delta C^{13} = -27.9‰$
UB-572.	Lough Neagh A.B. Core, 168 to 178 cm	2005 ± 90 55 B.C.
UB-573.	Lough Neagh A.B. Core, 208 to 218 cm	3135 ± 105 1185 B.C. $\delta C^{13} = -29.3‰$
UB-574.	Lough Neagh A.B. Core, 248 to 258 cm	4280 ± 120 2330 B.C. $\delta C^{13} = -29.0‰$

General Comment (F.O.): lowest dates (UB-571-574) from 3 m Antrim Bay core are internally consistent, compatible with pollen evidence from core and in good general agreement with other independent indications of deposition rate and of absolute age. Upper dates (UB-569-570 and -593-595) are much older than indicated by other evidence. Most likely explanation is presence in sediment of old carbon derived from eroding soils and blanket bog areas within drainage basin. Chemical and pollen-analytic evidence so far available supports this hypothesis.

Lough Neagh Core SM VII series

Samples from core of nekron mud from Lough Neagh, ca. 9.5 km SW of Antrim, Co. Antrim (54° 42′ N Lat, 6° 18′ W Long; lake surface alt. 16 m). Core taken near Lough Neagh Antrim Bay series core, this list, using Makereth sampler. Coll. 1970 by F. Oldfield. Acid pretreatment. Samples diluted with inactive methane for counting. Depths recorded below top of core.

UB-562.	Lough Neagh Core SM VII, 22 to 32 cm	1305 ± 80 A.D. 645 $\delta C^{13} = -27.7‰$
UB-563.	Lough Neagh Core SM VII, 32 to 42 cm	2245 ± 60 295 B.C. $\delta C^{13} = -27.5‰$
UB-564.	Lough Neagh Core SM VII, 42 to 52 cm	1040 ± 130 A.D. 910 $\delta C^{13} = -27.5‰$
UB-565.	Lough Neagh Core SM VII, 52 to 62 cm	1260 ± 115 A.D. 690 $\delta C^{13} = -28.0‰$

1020 ± 155
UB-566. Lough Neagh Core SM VII, 62 to 72 cm A.D. 930
$\delta C^{13} = -27.7‰$

General Comment (F.O.): dates (UB-562-566) cannot be meaningfully interpreted at present and seem to have at least 2 sources of error.

IV. TIMBER SAMPLES

Samples from sub-fossil and other timbers taken to aid construction of floating tree-ring chronologies. Samples coll. 1968-71 by Lab. personnel.

4630 ± 60
UB-528. Derrycrow, Bog Pine 383 **2680 B.C.**
$\delta C^{13} = -22.8‰$

Bog pine from Derrycrow Td., 10.2 km N of Portadown, Co. Armagh (45° 30′ 45″ N Lat, 6° 29′ 30″ W Long; Irish Grid Ref. H 987641; alt. ca. 18 m). Sample from yr 11 to 20 of 162-yr-old tree. Tree forms part of 215-yr master sequence from site.

1785 ± 40
UB-618. Allistragh, Bog Oak 449 **A.D. 165**
$\delta C^{13} = -24.0‰$

Bog oak from pit dug in bank of R. Callan at Allistragh Td., 4.8 km N of Armagh, Co. Armagh (54° 20′ N Lat, 6° 40′ W Long; Irish Grid Ref. H 866494; alt. 30 m). Sample of 20 yr from outside of tree.

2265 ± 70
UB-619. Island MacHugh, Tree 306 **315 B.C.**
$\delta C^{13} = -24.4‰$

Oak tree or post lying at edge of lake dwelling on I. MacHugh 4.8 km SW of Newtownstewart, Co. Tyrone (54° 42′ N Lat, 7° 26′ W Long; Irish Grid Ref. H 365838; alt. 63 m). Sample from yr 119 to 139 of 154-yr-old tree.

Ballymacombs More Bog Oak series, Co. Londonderry

Bog oaks from Ballymacombs More, 13 km ESE of Ballymena, Co. Londonderry (54° 50′ N Lat, 6° 28′ W Long; Irish Grid Ref. H 985988; alt. ca. 18 m). See also UB-397, 3955 ± 80 (R., 1971, v. 13, p. 462) for bog oak sample from same site assoc. with pollen data. Samples contribute to 440-yr floating tree-ring sequence.

3835 ± 75
UB-324. Ballymacombs More, Bog Oak 560 **1885 B.C.**
Sample from yr 164 to 183 of 193-yr-old tree.

3480 ± 50
UB-596. Ballymacombs More, Bog Oak 313 **1530 B.C.**
$\delta C^{13} = -25.9‰$

Sample from yr 140 to 159 of 194-yr-old tree.

3605 ± 45
UB-597. Ballymacombs More, Bog Oak 330 **1655 B.C.**
$\delta C^{13} = -25.8‰$

Sample from yr 61 to 80 of 155-yr-old tree.

7245 ± 100
UB-621. Fallahogy, Bog Pine 442 **5295 B.C.**
$\delta C^{13} = -24.0‰$

Bog pine from raised bog at Fallahogy Td., 18.4 km WNW of Ballymena, Co. Londonderry (54° 54′ N Lat, 6° 34′ W Long; Irish Grid Ref. C 926070; alt. 36 m). Sample from yr 21 to 30 of 125-yr-old tree from lower layer of stumps.

1870 ± 45
UB-620. Balloo Cottage, Bog Oak 812 **A.D. 80**

Roof beam of bog oak from sadler's cottage in Balloo Td., 19 km SE of Belfast, Co. Down (54° 28′ N Lat, 5° 43′ W Long; Irish Grid Ref. J 486607; alt. 50 m). Sample from yr 39 to 53 of 205-yr-old tree. All roof beams from cottage were bog derived timber.

Sharvogues Bog Pine series, Co. Antrim

Bog pines from Sharvogues Td., 5.5 km N of Randalstown, Co. Antrim (54° 48′ N Lat, 6° 17′ W Long; Irish Grid Ref. D 103965; alt. ca. 45 m). Trees mostly unstratified, but probably belonging to at least 2 distinct horizons.

3795 ± 75
UB-623. Sharvogues, Bog Pine 447 **1845 B.C.**
$\delta C^{13} = -23.9‰$

Sample from yr 29 to 48 of 250-yr-old tree.

4015 ± 45
UB-624. Sharvogues, Bog Pine 446 **2065 B.C.**
$\delta C^{13} = -25.1‰$

Sample from yr 11 to 20 of 228-yr-old tree.

4670 ± 45
UB-529. Sharvogues, Bog Pine 443 **2720 B.C.**
$\delta C^{13} = -22.7‰$

Sample from yr 61 to 70 of 230-yr-old tree.

4855 ± 80
UB-611. Sharvogues, Bog Pine 448 **2905 B.C.**
$\delta C^{13} = -23.5‰$

Sample from yr 21 to 30 of 303-yr-old tree.

Sluggan Bog Pine series, Co. Antrim

Bog pines from Sluggan bog, Ballylurgan Td., 2.4 km NE of Randalstown, Co. Antrim (54° 46′ N Lat, 6° 18′ W Long; Irish Grid Ref. J 009921; alt. ca. 50 m).

UB-459. Sluggan, Bog Pine 422 — **7095 ± 115** / **5145 B.C.**

Sample from yr 11 to 20 of 272-yr-old tree, lying horizontally under stump of Tree 423 dated by UB-460.

UB-460. Sluggan, Bog Pine 423 — **6615 ± 95** / **4665 B.C.** / $\delta C^{13} = -23.4‰$

Sample from yr 11 to 20 of 139-yr-old tree from upper level.

UB-610. Sluggan, Bog Pine 412 — **6855 ± 95** / **4905 B.C.** / $\delta C^{13} = -23.1‰$

Sample from yr 1 to 25 of 180-yr-old tree.

UB-622. Sluggan, Bog Pine 810 — **7005 ± 65** / **5055 B.C.** / $\delta C^{13} = -23.9‰$

Sample from yr 61 to 70 of 300-yr-old tree.

Altnahinch, Bog Pine series, Co. Antrim

Bog pines from Altnahinch Td., 12 km SW of Cushendall, Co. Antrim (55° 3′ N Lat, 6° 15′ W Long; Irish Grid Ref. D 233125; alt. ca. 250 m). See also Altnahinch monolith series, this list, for pollen record from site.

UB-530. Altnahinch, Bog Pine 409 — **6255 ± 100** / **4305 B.C.** / $\delta C^{13} = -22.5‰$

Sample from yr 1 to 10 of 111-yr-old tree from lower layer.

UB-612. Altnahinch, Bog Pine 397 — **4510 ± 80** / **2560 B.C.** / $\delta C^{13} = -24.3‰$

Sample from yr 51 to 75 of 232-yr-old tree from upper layer.

UB-609. Altnahinch, Bog Pine 407 — **5500 ± 85** / **3550 B.C.** / $\delta C^{13} = -24.8‰$

Sample from yr 41 to 50 of 178-yr-old tree.

UB-550. Blackwater, Bog Oak 53a — **825 ± 35** / **A.D. 1125** / $\delta C^{13} = -24.4‰$

Bog oak found near Verners Bridge, R. Blackwater, Co. Tyrone (54° 29′ 30″ N Lat, 6° 38′ W Long; Irish Grid Ref. H 883615; alt. 17 m). Sample from yr 1 to 25 of tree with 140-yr heartwood.

UB-626. Derrykerran, Bog Oak 145 — **4260 ± 75** / **2310 B.C.** / $\delta C^{13} = -24.9‰$

Sample from bog oak from Derrykerran Td., Co. Armagh, 2 km W of point where motorway crosses R. Bann (54° 28′ N Lat, 6° 27′ W Long;

Irish Grid Ref. J 006588; alt. 20 m). Sample from yr 180 to 200 of 200-yr-old tree.

UB-598. Derrykeeran, Bog Oak 70 — **4655 ± 55** / **2705 B.C.** / $\delta C^{13} = -24.8‰$

Bog oak from Derrykeeran Td., 5 km N of Portadown, Co. Armagh (54° 28′ N Lat, 6° 27′ W Long; Irish Grid Ref. J. 003590; alt. 20 m). Sample from yr 188 to 207 of 217-yr-old tree.

V. GEOLOGIC SAMPLE

UB-547. Magilligan Spit, Co. Londonderry — **1535 ± 40** / **A.D. 415** / $\delta C^{13} = -26.7‰$

Wood from peat bed on L. Foyle side of Magilligan Spit, 13 km N of Limavady, Co. Londonderry (55° 11′ N Lat, 6° 57′ W Long; Irish Grid Ref. C 665385; alt. ca. 8 m). Peat bed intercalated in sands of spit, probably of postglacial age. Coll. 1971 by F. Oldfield. Subm. 1971 by N. Stephens, Geog. Dept., Queen's Univ., Belfast.

ERRATA

In R., 1971, v. 13, p. 465, UB-255 A should read UB-225 A, and p. 467, l. 4, second reference to "F fraction" should read "C fraction."

REFERENCES

Coles, J., 1969, Recent radiocarbon dates from Scotland: Antiquity, v. 43, p. 216-217.

Collins, A. E. P. and Wilson, B. C. S., 1963, The Slieve Gullion Cairns: Ulster Jour. Archaeol., v. 26, p. 19-40.

Craig, Harmon, 1961, Mass-spectrometer analyses of radiocarbon standards: Radiocarbon, v. 3, p. 1-3.

Dolley, M. and Seaby, W. A., 1971, A find of thirteenth-century pewter tokens from the National Museum excavations at Winetavern Street, Dublin: Spink's Numismatic Circ., Dec. 1971, p. 446-448.

Evans, E. E., 1939, The excavation at Carnanbane, Co. Londonderry. A Double-Horned Cairn: Royal Irish Acad. Proc., v. 45 C, p. 1-3.

Jessen, K., 1949, Studies in Late Quaternary deposits and flora-history of Ireland: Royal Irish Acad. Proc., v. 52 B, p. 85-290.

Leclant, J., 1966, Récentes recherches à la Pyramide de Téti a Saqqarah: Soc. française d'Egyptologie Bull., v. 46, p. 9-16.

May, A. McL., 1953, Neolithic habitation site, stone circles and alignments at Beaghmore, Co. Tyrone: Jour. Royal Soc. Antiq. Ireland, v. 83, p. 174-193.

Movius, H. L., 1936, A Neolithic site on the River Bann: Royal Irish Acad. Proc., v. 43 C, p. 17-40.

Olsson, I. U., 1970, Explanation of Plate IV: Nobel symposium, v. 12, p. 625-626.

Pollock, A. J. and Waterman, D. M., 1964, A Bronze age habitation site at Downpatrick: Ulster Jour. Archaeol., v. 27, p. 31-58.

Smith, A. G. and Collins, A. E., 1971, The stratigraphy, palynology and archaeology of diatomite deposits at Newferry, Co. Antrim, N. Ireland: Ulster Jour. Archaeol., v. 34, p. 3-25.

Smith, A. G. and Pilcher, J. R., 1972, Pollen analysis and radiocarbon dating of deposits at Slieve Gullion Passage Grave, Co. Armagh: Ulster Jour. Archaeol., v. 35, in press.

Suess, H. E., 1970, Bristlecone pine calibration of the radiocarbon time-scale 5200 B.C. to the present: Nobel symposium, v. 12, p. 303-311.

Waterman, D. M., 1971, A habitation site near Larne, Co. Antrim: Ulster Jour. Archaeol., v. 34, p. 65-76.

[RADIOCARBON, VOL. 15, No. 1, 1973, P. 229-239]

UNIVERSITY OF WISCONSIN RADIOCARBON DATES X

MARGARET M. BENDER, REID A. BRYSON, and
DAVID A. BAERREIS

Department of Meteorology
University of Wisconsin, Madison

Radiocarbon dates obtained since December, 1970, are summarized here. Procedures and equipment have been described previously (R., 1966, v. 8, p. 522). Wood, charcoal, and peat samples are pretreated with dilute NaOH and dilute H_3PO_4 before conversion to the counting gas, methane; marls and lake cores are treated with acid only. Very calcareous materials are treated with HCl instead of H_3PO_4.

The dates reported have been calculated using 5568 as the half-life of C^{14}, with 1950 as the reference year. The standard deviation quoted includes only 1σ of the counting statistics of background, sample, and standard counts. Methane prepared from NBS oxalic acid is used as the standard; the C^{13}/C^{12} ratios of the CO_2 prepared from this oxalic acid are measured and the activity of the standard methane is corrected for any deviation of the δC^{13} value of the CO_2 sample from the $-19‰$ value (compared to the PDB standard) reported by Craig (1961). The dated samples for which δC^{13} values are listed have been corrected to $-25‰$ (PDB standard), the "normal" value of terrestrial material.

ACKNOWLEDGMENTS

This research is supported by the National Science Foundation, Atmospheric Sciences Division, Grant GA-10651X. We thank the Chemistry Department for the use of the Nuclide RMS-660 mass spectrometer and Roger Arhart for technical assistance with the mass spectrometer.

I. ARCHAEOLOGIC SAMPLES

A. Illinois

WIS-474. Divers site (MO-28) — **1010 ± 55, A.D. 940**

Wood, Specimen 319, from Feature 36, SW wall of house, 2nd burned house from Divers site, Monroe Co., Illinois (38° 27′ 42″ N Lat, 90° 15′ 25″ W Long). Previous date, A.D. 1105, WIS-334, was reported earlier (R., 1970, v. 12, p. 340).

Cahokia series

Charcoal from E of Monks Mound, Cahokia Mounds State Park, Madison Co., Illinois (38° 40′ N Lat, 90° 04′ W Long), and from Mound 72, Cahokia Mounds State Park, St. Clair Co., Illinois (38° 39′ N Lat, 90° 04′ W Long). Coll. 1966 to 1970 by Melvin Fowler and J. B. Anderson; subm. by Melvin Fowler, Univ. Wisconsin-Milwaukee.

WIS-492. Cahokia — **900 ± 55, A.D. 1050**

UWM Sample 70-23 from Mound 72, Feature 227. Feature is large,

irregular, shallow mound pit assoc. with earliest construction activity at Mound 72.

900 ± 55

WIS-494. Cahokia **A.D. 1050**

UWM Sample 66-559 from structural timber, N199-200, E454-456, ca. 154 m E of Monks Mound. Structure preceded all phases of stockade construction E of Monks Mound. Sample directly assoc. with classic Ramey Incised pot.

850 ± 50

WIS-495. Cahokia **A.D. 1100**

UWM Sample 67-1703, timber from Structure 4, N315.80-315.90, E466.90-467.05, ca. 166 m E of Monks Mound. Sample from floor of House 4, destroyed with contents in place. Ceramic inventory includes 2 variants of Ramey Incised, weeping eye design, and 1 cord marked vessel. Structure preceded all phases of stockade construction E of Monks Mound.

810 ± 45

WIS-493. Cahokia **A.D. 1140**

$\delta C^{13} = -27.0‰$

UMW Sample 67-387, support beam for House 4, N315.38-315.48, E467.45-467.62, 166 m E of Monks Mound.

Cahokia, Monk's Mound

Charcoal from 4th terrace of Monk's Mound, Cahokia Mounds State Park, Madison Co., Illinois (38° 40′ N Lat, 90° 04′ W Long). Coll. 1970 by Univ. Washington, St. Louis, party dir. by Nelson Reed.

870 ± 55

WIS-525. Monk's Mound **A.D. 1080**

$\delta C^{13} = -28.4‰$

Sample from Feature 1B.

890 ± 60

WIS-527. Monk's Mound **A.D. 1060**

$\delta C^{13} = -26.5‰$

Sample from Feature 1H.

970 ± 65

WIS-528. Monk's Mound **A.D. 980**

$\delta C^{13} = -28.3‰$

Sample from Post 6, Feature 26.

B. Iowa

Brewster site series

Excavations conducted during the summer of 1970, sponsored by Univ. Wisconsin—Madison and Sanford Mus., Cherokee, Iowa, at the Brewster site (13CK15) (42° 49′ N Lat, 95° 36′ W Long) resulted in two-directional sectioning of the midden. Dates from charcoal specimens at various depths imply relatively thick midden was constructed in brief

time period and that excavation of house pits and features disturbed the continuity of deposition. Subm. by D. A. Baerreis.

875 ± 60

WIS-496. Brewster site (13CK15) **A.D. 1075**

Charcoal from Level 1 to 2, 15 to 25 cm depth, Sq. S30W60.

1020 ± 55

WIS-500. Brewster site (13CK15) **A.D. 930**

$\delta C^{13} = -26.5‰$

Charcoal from Level 1 and 2, Sq. S30W70, Sample 191, and Sample 182 from Sq. S50W40, 20 to 30 cm deep.

925 ± 75

WIS-468. Brewster site (13CK15) **A.D. 1025**

Sample from Level 1, 20 to 30 cm depth, Sq. S25W85.

990 ± 55

WIS-480. Brewster site (13CK15) **A.D. 960**

Charcoal from Level 1, Sq. S30W85.

750 ± 50

WIS-453. Brewster site (13CK15) **A.D. 1200**

Sample from Level 3 to 4, 30.5 to 41 cm depth, Sq. S25W85.

810 ± 70

WIS-469. Brewster site (13CK15) **A.D. 1140**

Charcoal from Level 11 to 12, 71 to 81 cm below surface, Sq. S25W90.

925 ± 55

WIS-456. Brewster site (13CK15) **A.D. 1025**

Sample from Level 15 to 16, 81 to 91 cm deep, from Sq. S25W90.

950 ± 55

WIS-463. Brewster site (13CK15) **A.D. 1000**

Sample from Level 15 to 16, Sq. S25W85.

1020 ± 55

WIS-473. Brewster site (13CK15) **A.D. 930**

Sample from Level 16 to 17, 91 to 102 cm deep, Sq. S30W90, and Level 15, 91 to 97 cm deep, Sq. S25W90.

950 ± 55

WIS-482. Brewster site (13CK15) **A.D. 1000**

Sample from Level 19 to 20, 112 to 122 cm deep, Sq. S25W85.

1015 ± 55

WIS-511. Brewster site (13CK15) **A.D. 935**

Charcoal from Level 21 to 22, 122 to 132 cm deep, Sq. S25W85.

1010 ± 55

WIS-461. Brewster site (13CK15) **A.D. 940**

Sample from Level 25 to 26, 142 to 152 cm depth, Sq. S30W85.

1000 ± 55

WIS-464. Brewster site (13CK15) **A.D. 950**

Sample from Level 25 to 26, Sq. S30W90.

910 ± 60

WIS-505. Brewster site (13CK15) **A.D. 1040**

Sample from Level 25 to 26, Sq. S25W90.

1025 ± 55

WIS-497. Brewster site (13CK15) **A.D. 925**

Sample from Level 29 to 30, 160 to 170 cm deep, Sq. S35W90.

Meehan-Schell site (13BN110)

Charcoal from Meehan-Schell site, Boone Co., Iowa (Saylorville Reservoir) (42° 2′ 0″ N Lat, 93° 56′ 50″ W Long). Coll. 1970 by David Gradwohl, Iowa State Univ.; subm. by D. A. Baerreis. Site is Great Oasis component.

870 ± 60

WIS-501. Meehan-Schell site (13BN110) **A.D. 1080**

$\delta C^{13} = -28.1‰$

Catalogue no. 2714 and 2726 from Feature 35, storage pit.

975 ± 55

WIS-502. Meehan-Schell site (13BN110) **A.D. 975**

$\delta C^{13} = -27.2‰$

Catalogue no. 2677 from Feature 32, storage pit.

950 ± 55

WIS-498. Meehan-Schell site (13BN110) **A.D. 1000**

Catalogue no. 2849 from Feature 37, storage pit.

Sparks site (13BN121)

Charcoal from Sparks site, Boone Co., Iowa (42° 2′ 0″ N Lat, 93° 56′ 30″ W Long). Coll. 1970 by David Gradwohl; subm. by D. A. Baerreis.

1600 ± 55

WIS-517. Sparks site (13BN121) **A.D. 350**

Charcoal from Feature 19 and Feature 13, storage pits or basins.

Broken Kettle West site (13PM25)

Charcoal excavated 1969, dir. by D. R. Henning, Univ. Nebraska, from site in Plymouth Co., Iowa (42° 38′ N Lat, 96° 36′ W Long). Site, of Great Oasis cultural affiliation, is on Broken Kettle Creek, opposite Broken Kettle midden (13PM1) of Mill Creek cultural affiliation. See dates of 13PM1, below, which suggest considerable overlap in the 2 occupations.

1070 ± 55

WIS-433. Broken Kettle West site (13PM25) **A.D. 880**

Sample 260 from House 3, Pit 16, Area 1.

1090 ± 55

WIS-439. Broken Kettle West site (13PM25) **A.D. 860**

Sample 89 from entrance of House 2, Area 1.

1100 ± 50

WIS-440. Broken Kettle West site (13PM25) **A.D. 850**

Sample 396 from House 3, Pit 18, Area 1.

840 ± 55

WIS-451. Broken Kettle West site (13PM25) **A.D. 1110**

Sample 168 from House 2, Pit 5, Area 1, Feature 5.

940 ± 50

WIS-455. Broken Kettle West site (13PM25) **A.D. 1010**

Sample 410 from House 3, Pit 19.

880 ± 55

WIS-452. Broken Kettle West site (13PM25) **A.D. 1070**

Sample 425 from House 3, Pit 25.

890 ± 55

WIS-488. Broken Kettle West site (13PM25) **A.D. 1060**

$\delta C^{13} = -26.4‰$

Sample 425, fresh preparation.

980 ± 55

WIS-481. Broken Kettle West site (13PM25) **A.D. 970**

$\delta C^{13} = -26.5‰$

Sample 132 from House 2 entrance.

965 ± 55

WIS-499. Broken Kettle West site (13PM25) **A.D. 985**

$\delta C^{13} = -27.7‰$

Sample 409 from House 3, Area 1, Pit 25.

Broken Kettle site, Iowa (13PM1)

Charcoal from Broken Kettle site, Plymouth Co., Iowa (42° 38′ N Lat, 96° 36′ W Long). Coll. 1969 by D. R. Henning; subm. by D. A. Baerreis. Earlier dates from this site were previously reported (R., 1968, v. 10, p. 474).

990 ± 45

WIS-478. Broken Kettle site (13PM1) **A.D. 960**

Sample from Sq. 10E10S, Level 8, 107 to 122 cm deep, Feature B.

900 ± 45

WIS-484. Broken Kettle site (13PM1) **A.D. 1050**

Specimen 8 from Sq. 10E10S, Level 10, 137 to 152 cm deep.

870 ± 50

WIS-506. Broken Kettle site (13PM1) **A.D. 1080**

Specimen 8a from Feature E, Level 10, 137 to 152 cm deep.

925 ± 55

WIS-485. Broken Kettle site (13PM1) **A.D. 1025**

Sample from Feature H, Sq. 15E5S.

950 ± 50

WIS-476. Broken Kettle site (13PM1) **A.D. 1000**

$\delta C^{13} = -27.0‰$

Charcoal from Sq. 10E10S, Level 11, 152 to 168 cm below surface, Specimen 40.

960 ± 55

WIS-479. Broken Kettle site (13PM1) **A.D. 990**

Specimen 113 from Sq. 10E10S, Level 13, 183 to 198 cm deep.

785 ± 60

WIS-531. Broken Kettle site (13PM1) **A.D. 1165**

Sample 73 from Level 16, Sq. 15E5S, Feature I, 229 to 244 cm deep.

940 ± 55

WIS-477. Broken Kettle site (13PM1) **A.D. 1010**

Specimen 97 from Sq. 10E5S, Feature K, Level 2, 231 to 279 cm deep.

910 ± 60

WIS-530. Broken Kettle site (13PM1) **A.D. 1040**

Sample 77 from Level 17, Feature H, Sq. 15E5S, 244 to 259 cm deep.

955 ± 60

WIS-503. Broken Kettle site (13PM1) **A.D. 995**

Sample 87 from Feature K, Sq. 10E5S, 279 to 287 cm deep.

C. Minnesota

McKinstry Mounds (21KC2)

Samples from McKinstry Mound 1 at mouth of Little Fork R., Koochiching Co., Minnesota (48° 31′ 30″ N Lat, 93° 35′ W Long). Coll. 1970 and subm. by J. B. Stoltman, Univ. Wisconsin—Madison. Burial mound is Middle Woodland, assigned to Laurel culture of N Minnesota.

1700 ± 55

WIS-471. McKinstry Mounds (21KC2) **A.D. 250**

Unburned wood from log floor at base of mound, Level 16 in Sq. T12.

1980 ± 45

WIS-486. McKinstry Mounds (21KC2) **30 B.C.**

Charcoal from "Basal black" level of mound, the margins of 1st stage of mound construction of Mound 1. Sample from Feature 23, Sq. S11, Level 11b. WIS-471 lay at base of this layer.

1940 ± 60

WIS-487. McKinstry Mounds (21KC2) **A.D. 10**

Charcoal from 2nd stage of mound construction, Mound A. Sample from Feature 21, Sq. T12, Level 16.

1830 ± 55

WIS-489. McKinstry Mounds (21KC2) **A.D. 120**

Charcoal from Mound B, 3rd constructional stage in mound. Combined sample from Feature 24, Sq. S12, Level 10 and Level 11, and Feature 21, Sq. T12, Level 15.

1390 ± 55

WIS-490. McKinstry Mounds (21KC2) **A.D. 560**

Charcoal from Mound C, 4th stage of mound construction, from Feature 17, Sq. S10, Level 4.

Great Oasis culture, Minnesota

Specimens coll. 1971 by Univ. Minnesota field school, supervised by D. R. Henning. Study involved a reinvestigation of Great Oasis components previously reported by L. A. Wilford, Univ. Minnesota (Wilford, 1945; 1955). Subm. by D. A. Baerreis.

1050 ± 60

WIS-522. Thompson site (21MU17) **A.D. 900**

$\delta C^{13} = -26.5‰$

Charcoal coll. 1971 from Murray Co., Minnesota (44° 5′ N Lat, 95° 55′ 30″ W Long). Sample 53 from Feature 2, Sq. 3, 61 cm deep.

975 ± 65

WIS-532. Low Village site (21MU2) **A.D. 975**

Samples 17 and 18 from Feature C, Sq. 1, 38 to 51 cm deep, in Murray Co., Minnesota (44° 5′ N Lat, 95° 53′ W Long).

D. South Dakota

Over focus series

Dating of samples from Mitchell site (39DV2), the type site of the Over focus in South Dakota, during July-August, 1971, are combined with an examination of samples from earlier work in order to clarify the temporal position of this cultural unit. The long-rectangular house assemblage is considered one of earliest sedentary village complexes of this region.

Mitchell site (39DV2), South Dakota

Excavations were made in 1971 by a Univ. Wisconsin field party, supervised by R. A. Alex at Mitchell site (43° 43′ N Lat, 98° 02′ W Long), Davison Co., South Dakota. The site contains only single cultural component and was previously tested by E. E. Meleen in 1938 (Meleen, 1938). Samples subm. by D. A. Baerreis.

825 ± 55

WIS-509. Mitchell site (39DV2) **A.D. 1125**

Charcoal from Feature 6, Sq. J, 30 to 46 cm deep.

960 ± 55

WIS-510. Mitchell site (39DV2) **A.D. 990**

$\delta C^{13} = -25.5‰$

Charcoal from Feature 5, Level 9, 122 to 142 cm deep.

965 ± 50

WIS-512. Mitchell site (39DV2) **A.D. 985**

$\delta C^{13} = -25.7‰$

Charcoal from House 3, Sq. I.

890 ± 55

WIS-514. Mitchell site (39DV2) **A.D. 1060**

$\delta C^{13} = -25.6‰$

Charcoal from House 4, Sq. U, E half, 46 to 55 cm below surface.

910 ± 55

WIS-518. Mitchell site (39DV2) **A.D. 1040**

$\delta C^{13} = -25.4‰$

Charcoal from House 4, Sq. W, E half, wall daub layer, 55 to 70 cm below surface.

950 ± 55

WIS-521. Mitchell site (39DV2) **A.D. 1000**

Charcoal from Sq. U, SE corner, wall post, 46 cm deep.

Swanson site (39BR16), South Dakota

The Swanson site (43° 54′ N Lat, 99° 20′ W Long), Brule Co., South Dakota is an Over focus component excavated 1950 by W. R. Hurt, Jr. (1951). A single date, A.D. 850 ± 250, M-839, was obtained from wood from Post C, House 2 (Crane and Griffin, 1960). A series of additional posts from the site, preserved at the W. H. Over Mus. in Vermillion, South Dakota, were obtained for dating through the courtesy of J. S. Sigstad, Univ. South Dakota and W. R. Wood, Univ. Missouri; subm. by D. A. Baerreis.

1090 ± 60

WIS-524. Swanson site (39BR16) **A.D. 860**

$\delta C^{13} = -22.8‰$

Wood from outer rings of Post D, House 2.

925 ± 55

WIS-526. Swanson site (39BR16) **A.D. 1025**

$\delta C^{13} = -23.2‰$

Wood from outer rings of Post C, House 2.

1450 ± 60

WIS-523. Swanson site (39BR16) **A.D. 500**

$\delta C^{13} = -21.9‰$

Wood from outer rings of Post 2, House 1. Date is inconsistent and

suggests sample was contaminated, perhaps by preservative, in museum storage. See WIS-529.

WIS-529. Swanson site (39BR16) **1190 ± 70**
A.D. 760
$\delta C^{13} = -22.8‰$

Sample from inner rings of Post 2, House 1.

WIS-513. Breeden site (39ST16) **730 ± 55**
A.D. 1220
$\delta C^{13} = -12.1‰$

Charred grass from the Breeden site (44° 25′ N Lat, 100° 23′ 33″ W Long) Stanley Co., South Dakota. Coll. 1955 by R. P. Wheeler; subm. by D. A. Baerreis. Date, A.D. 710 ± 150, M-608, (Crane and Griffin, 1960) was previously reported from this site.

II. GEOLOGIC SAMPLES

A. Iowa

Willard Cave

Bone from Willard Cave, 8.4 km E of Edgewood, Delaware Co., Iowa (42° 38′ 15″ N Lat, 91° 17′ 30″ W Long). Coll. 1970 by R. E. Eshelman, Univ. Iowa, Iowa City; subm. by D. A. Baerreis. Present area of sympatry of 2 id. taxa from this cave is 483 km to NW of Delaware Co., based on presence of *Clethrionomys gapperi,* the boreal red-backed vole and *Onychomys leucogaster,* the N grasshopper mouse.

WIS-483. Willard Cave **3500 ± 60**
1550 B.C.
$\delta C^{13} = -20.3‰$

Bone of small animals from 168 cm below surface of S talus from Level 6, 76 to 91 cm level.

WIS-491. Willard Cave **1255 ± 55**
A.D. 695
$\delta C^{13} = -24.1‰$

Bones (*Odocoileus virginianus*) from small cavity 259 cm below surface of S talus slope, but slumping of talus deposits may have covered younger material derived from different cave entrance.

B. Wisconsin

WIS-508. Green Bay Campus Wood **11,940 ± 110**
9990 B.C.

Small branch from trench excavated 1971, Univ. Wisconsin–Green Bay campus, Brown Co., Wisconsin (44° 32′ N Lat, 87° 55′ W Long) by Frank Byrne and Harry Guilford, Univ. Wisconsin–Green Bay. Wood, Two Creeks deposit, was 5.8 m below surface, lying beneath 4.6 m till (Valders) and above 30.5 cm brown and reddish clay above sand.

C. Canada

Southwest Keewatin series

1265 ± 55

WIS-466. Kasmere Lake **A.D. 685**

Charcoal from buried soil 15 cm below surface near base of esker. Coll. 1970 from Kasmere Lake, Manitoba, Canada (59° 40′ N Lat, 101° 14′ W Long) and subm. by C. J. Sorenson, Univ. Wisconsin–Madison.

1085 ± 45

WIS-470. Birch Bay **A.D. 865**

Charcoal from buried charcoal 30.5 cm below surface in matrix of fine sand near crest of esker near Birch Bay, N.W.T., Canada (60° 41′ N Lat, 101° 47′ W Long). Coll. 1970 and subm. by C. J. Sorenson.

1520 ± 55

WIS-472. Northwest Arm Ennadai **A.D. 430**

Charcoal from surface horizon of buried paleosol overlain by 5 to 10 cm more recent soil on S facing slope of esker on NW arm of Ennadai Lake, N.W.T., Canada (61° 05′ N Lat, 101° 37′ W Long). Coll. 1970 and subm. by C. J. Sorenson.

Roundrock Lake, N.W.T.

Samples from 3 buried charcoal horizons overlying a stone line near top of an esker at Roundrock Lake, Mackenzie Dist., N.W.T. (64° 23′ N Lat, 113° 20′ W Long). Site is in present forest/tundra ecotone and provides information on latitudinal migration of forest border during Holocene. Coll. 1971 and subm. by C. J. Sorenson and J. C. Knox, Univ. Wisconsin-Madison.

575 ± 55

WIS-519. Roundrock Lake, N.W.T. **A.D. 1375**

Wood from surface of buried paleosol, depth 102 cm. Sample denotes climatic change toward more arctic conditions with attendant S-ward depression of treeline.

1885 ± 55

WIS-515. Roundrock Lake, N.W.T. **A.D. 65**

Charcoal from buried layer of forest litter, depth 119 cm. Date identifies an early period of climatic and vegetative change.

6910 ± 85

WIS-516. Roundrock Lake, N.W.T. **4960 B.C.**

Charcoal, 152 cm deep, from buried forest remnant. Provides date for destruction by fire of a very early postglacial forest.

1580 ± 55

WIS-520. Esker near Eileen Lake, N.W.T. **A.D. 370**

Charcoal from upper horizon of buried podzol paleosol, depth 18

cm, NNW of Eileen Lake, Mackenzie Dist., N.W.T. (62° 20′ N Lat, 107° 47′ W Long). Indicates period of climatic fluctuation in which forest gave way to mixed forest and tundra. Coll. 1971 and subm. by C. J. Sorenson and J. C. Knox.

References

Bender, M. M., Bryson, R. A., and Baerreis, D. A., 1966, University of Wisconsin radiocarbon dates II: Radiocarbon, v. 8, p. 522-533.

———— 1968, University of Wisconsin radiocarbon dates V: Radiocarbon, v. 10, p. 473-478.

———— 1970, University of Wisconsin radiocarbon dates VII: Radiocarbon, v. 12, p. 335-345.

Craig, Harmon, 1961, Mass-spectrometer analyses of radiocarbon standards: Radiocarbon, v. 3, p. 1-3.

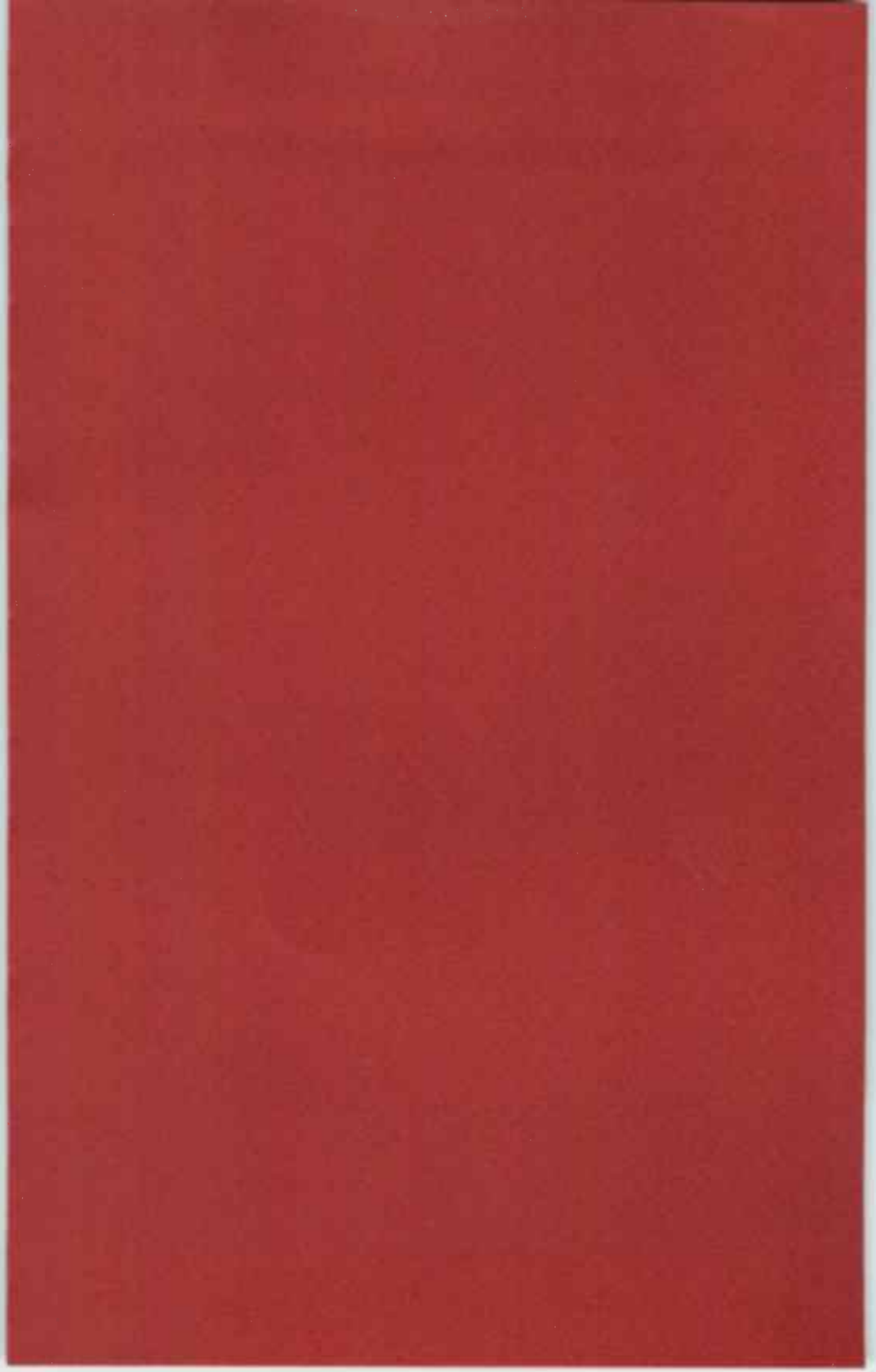
Crane, H. R. and Griffin, J. B., 1960, University of Michigan radiocarbon dates V: Am. Jour. Sci. Radiocarbon Supp., v. 2, p. 31-48.

Hurt, W. R., Jr., 1951, Report of the investigation of the Swanson site, 39BR16, Brule County, South Dakota: Archaeological Studies, Circular No. 3. Pierre, South Dakota.

Meleen, E. E., 1938, A preliminary report of Mitchell Indian village site and burial mounds on Firesteel Creek, Davison County, South Dakota: Univ. of South Dakota Mus., archaeol. studies cir., no. 2, pt. 1.

Wilford, L. A., 1945, Three village sites of the Mississippi pattern in Minnesota: Am. Antiquity, v. 11, no. 1, p. 32-40.

———— 1955, A revised classification of the prehistoric cultures of Minnesota: Am. Antiquity, v. 21, no. 2, p. 140-141.



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