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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. 14, no. 2 must be submitted in *duplicate* by August 1, 1972, and for vol. 15, no. 1 by February 1, 1973.

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. Volume 10 and subsequent volumes are published in two semi-annual issues, in Winter and in Summer. Deadlines for manuscripts have been changed to 1 August and 1 February. Because of the recent rise in the number of manuscripts and laboratories, our publication schedule may be slightly delayed in the future. 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 that has appeared hitherto at the end of each issue will now appear only once a year, in the second number of each volume.

Index. Beginning with Volume 11, all dated samples now appear in index form at the end of the second number of each volume.

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Radiocarbon

1972

ALGIERS RADIOCARBON MEASUREMENTS II

O. RAHMOUNI, C. ROUSSILLOT, and F. ARMANET
Service des Applications Nucleaires, Algiers, B.P. 1147, Algeria

The following series of dates contains most of the measurements obtained since our last list. Procedures of measurements and calculation are as previously described (R., 1970, v. 12, p. 353-357).

ACKNOWLEDGMENTS

We are grateful to S. A. Boutemine and N. Abdelmoumen for their help in routine work of chemical preparation of samples, and we thank A. Drizi for his assistance in electronics. Sample descriptions were prepared in collaboration with submitters and collectors of samples. Most of them were submitted by the Centre Algerien de Recherches Archéologiques, Préhistoriques et Ethnographiques (C.A.R.A.P.E.), the others were submitted by the Service des Antiquités d'Algérie.

SAMPLE DESCRIPTIONS

Crique des Pêcheurs series, Algeria

Various shells in archaeologic layer enclosed in sand hills at Bou Aïchem, Kristel, Willaya Oran (35° 48′ N Lat, 0° 29′ W Long), Algeria. Coll. 1968 and subm. by F. E. Roubet, C.A.R.A.P.E.

10,215 ± 400

ALG-25. Crique des Pêcheurs 136 **8265 B.C.**

Various shells, remains of food.

9700 ± 400

ALG-26. Crique des Pêcheurs 140 **7750 B.C.**

Ostrich egg shells.

General Comment: controversy over industry; some authors consider these layers Neolithic culture. Previously estimated Epipaleolithic age was confirmed (Roubet, 1947).

10,800 ± 425

ALG-27. Sidi Tosni-Columnata **8850 B.C.**

Soft water shells from Columnata, Sidi Hosni, Willaya Tiaret (35° 27′ 30″ E Long, 1° 31′ 41″ N Lat), Algeria. Coll. 1969 and subm. by C. Brahimi, C.A.R.A.P.E. *Comment*: layer presents a lateral and vertical stratigraphy for Epipaleolithic and Neolithic culture. Ibero-Maurusian culture never dated in this area (Brahimi, 1970).

8220 ± 820

ALG-28. El Haouita 1 **6270 B.C.**

Charcoal from embankment at El Haouita, in Saharian Atlas, Willaya Laghouat (37° 41′ N Lat, 0° 11′ E Long), Algeria. Coll. 1968 and subm. by G. Aumassip, C.A.R.A.P.E. *Comment*: expected age of em-

bankment: Würm period; it could have dated a new industry. Error was caused by mixing of the gas from the sample with a gas of known activity because of the small quantity of charcoal (Aumassip, 1970).

7200 ± 280

ALG-29. Guentis 146 **5250 B.C.**

Terrestrial shells (*Helix*) from upper level, 50 cm, in a snailery at Guentis, Nemenchas country (30° 0′ N Lat, 7° 18′ 15″ E Long), Algeria. Coll. 1968 and subm. by Roubet. *Comment*: in this layer were found implements comparable to Typical Capsian. This Epipaleolithic culture extending from Gafsa, Tunisia to Tebessa, Algeria had already been dated in Tunisia. First age value in Algeria (Roubet, 1968).

80 ± 110

ALG-31. Djorf Torba **A.D. 1870**

Charcoal from Djorf Torba, Béchar, Willaya Saoura (31° 30′ N Lat, 2° 10′ W Long), Algeria. Coll. 1967 by H. Lhote and subm. by G. Camps, C.A.R.A.P.E. *Comment*: this sample could have dated a pre-Islamic funeral monument. Unexpected age remains difficult to explain.

5300 ± 230

ALG-32. Assech 3 **3350 B.C.**

Charcoal from Assech, Oued Mya, Willaya Oasis (31° 0′ N Lat, 4° 40′ E Long), Algeria. Coll. 1969 and subm. by G. Aumassip. *Comment*: Neolithic culture (Aumassip, 1970).

6600 ± 250

ALG-33. Botma Si Mamar **4650 B.C.**

Terrestrial shells (*Helix*) in a deep level (80 to 100 cm) from Botma Si Mamar, Sidi Khaled, Willaya Batna (34° 22′ N Lat, 4° 53′ E Long), Algeria. Coll. 1967 and subm. by D. Grébenart, C.A.R.A.P.E. *Comment*: Neolithic culture without pottery (Grébenart, 1970).

5500 ± 125

ALG-34. Les Deux Oeufs **3350 B.C.**

Ostrich egg shells in deepest level of layer, at Les Deux Oeufs, Ouargla, Oasis area (31° 58′ N Lat, 5° 8′ E Long), Algeria. Coll. 1966 and subm. by G. Aumassip. *Comment*: Neolithic culture (Aumassip, 1970).

5550 ± 225

ALG-35. Les Deux Mamelles **3600 B.C.**

Various shells from Les Deux Mamelles near Mostaganem, Willaya Oran (36° 3′ 12″ N Lat, 0° 10′ 32″ E Long), Algeria. Coll. 1968 and subm. by F. E. Roubet. *Comment*: purpose was to date a particular aspect of Neolithic layers on sea-side of Oran Country (Roubet, 1947).

1480 ± 130

ALG-36. Tin Hinan 3 **A.D. 470**

Wood from building material of monument at Abalessa, Taman-

rasset, Oasis area (23° N Lat, 5° 0′ E Long), Algeria. Coll. 1930 and subm. by M. Mammeri and G. Camps. *Comment*: date of a protohistoric funeral monument.

Hafir series, Algeria

Charcoal from Hafir, Terni, Willaya Tlemcen (34° 45′ N Lat, 3° 40′ W Long), Algeria. Coll. 1968 and subm. by M. Couvert, C.A.R.A.P.E.

ALG-38. Hafir 6 **7530 ± 170**
5580 B.C.

Charcoal.

ALG-49. Hafir 7 **6680 ± 175**
4730 B.C.

Charcoal.

General Comment: scarce lithic, bone industry, and pottery mingled with plentiful charcoal from 7 varieties of trees. Their analysis proved past existence of species now extinct in area, such as *Cedrus atlanticus* and *Pinus nigra* (Couvert, 1970).

ALG-39. Bou Zabaouine 168 **4375 ± 145**
2425 B.C.

Charcoal from shelter in rocks at Bou Zabaouine Aïn M'lila, Willaya Constantine (36° 1′ N Lat, 6° 3′ 24″ E Long), Algeria. Coll. 1967 and subm. by C. Roubet. *Comment*: Neolithic of Capsian tradition. Excavation, teeming with arrow points, corroborates that of B. Dedieu (Dedieu, 1965; Roubet, 1968).

ALG-40. Kristel Jardins **7760 ± 190**
5810 B.C.

Sea shells, remains of food, from Sta. des Tavertins, Willaya Oran (35° 48′ 24″ N Lat, 0° 29′ W Long), Algeria. Coll. 1969 and subm. by F. E. Roubet. *Comment*: this archaeologic layer, presently mostly cultivated, is close to Criques des Pêcheurs (ALG-25); thus, date is interesting for comparisons and proves the real existence of an ancient Neolithic culture in this country (Roubet, 1947).

ALG-41. Tipasa 2 **2630 ± 105**
680 B.C.

Snail shells from Matares, Tipasa, Willaya Algiers (36° 30′ N Lat, 2° 26′ E Long), Algeria. Coll. 1969 and subm. by M. Bouchnaki, Service des Antiquités, Alger. *Comment*: sample from sand-hill near Roman tomb. Age older than expected.

ALG-42. El Hadjar Sebkra **6160 ± 150**
4210 B.C.

Ostrich egg shells from El Hadjar Sebkra, Oued Mya, Oasis area (30° 52′ N Lat, 5° 18′ E Long), Algeria. Coll. 1970 and subm. by G. Aumassip. *Comment*: Neolithic culture (Aumassip, 1970).

6460 ± 180

ALG-43. Hassi Chambi 3 **4510 B.C.**

Ostrich egg shells from Hassi Chambi, Oued Mya, Oasis area (30° 52′ N Lat, 5° 18′ E Long), Algeria. Coll. 1970 and subm. by G. Aumassip. *Comment*: Neolithic without pottery. Oldest age known for Neolithic samples in this part of Sahara (Aumassip, 1970).

5150 ± 140

ALG-44. Adrar Tioueiine 4 **3200 B.C.**

Charcoal from Adrar Tioueiine, 35 km NW of Silet Oasis area (28° 48′ N Lat, 4° 16′ E Long), Algeria. Coll. 1968 and subm. by G. Camps. *Comment*: Neolithic of Sudanese tradition with plentiful implements for grinding, stone bracelets, arrow points, and pottery.

5270 ± 140

ALG-5. Hergla **3320 B.C.**

Various terrestrial shells from Hergla, Gouvernorat de Sousse (36° 1′ N Lat, 10° 28′ E Long), Tunisia. Coll. 1970 and subm. by Harbi, Dept. de Préhistoire, Tunis. *Comment*: Neolithic culture.

7270 ± 165

ALG-46. Rabah 19 **5320 B.C.**

Fragments of ostrich egg shells from Rabah, Oued Djellal, Willaya Batna (34° 26′ N Lat, 5° 8′ E Long), Algeria. Coll. 1970 and subm. by D. Grébenart. *Comment*: sample from level, 20 to 30 cm, of Upper Capsian layer (Grébenart, 1971). This age follows our preceding date for this layer, ALG-17, -22, -23 (Grébenart, 1971).

13,330 ± 280

ALG-47. Chenoua (Rolland) **11,380 B.C.**

Various terrestrial and sea shells, remains of food, from a cave, Grotte Rolland, at Chenoua, near Tipasa, Willaya Algiers (36° 30′ N Lat, 2° 26′ E Long), Algeria. Coll. 1970 and subm. by F. E. Roubet. *Comment*: sample of upper level of archaeologic layer. Ibero-Maurusian industry: Mouilien, Abris de la Mouilah.

1870 ± 100

ALG-48. Tipasa 2 **A.D. 80**

Charcoal from Matares, Tipasa, Willaya Algiers (36° 30′ N Lat, 2° 26′ E Long), Algeria. Coll. 1969 and subm. by M. Bouchnaki. *Comment*: sample from Roman cupula tomb with an incineration urn, an oil lamp, and a Roman coin dated approx. from the end of 1st century to beginning of 2nd.

Grotte Capeletti series, Algeria

Charcoal from Neolithic layer in a cave at Khanghet Si Mohamed Tahar, Bou Ahmar, Willaya Batna (35° 20′ 21″ N Lat, 6° 26′ 5″ E Long), Algeria. Coll. 1968 and subm. by Roubet.

4340 ± 200

ALG-30. Grotte Capeletti 142 **2390 B.C.**

Charcoal from upper 35 to 40 cm in Neolithic of Capsian tradition layer of cave.

6530 ± 250

ALG-37. Grotte Capeletti 26 **4580 B.C.**

Charcoal from basal Neolithic level, 314 to 317 cm, 1st occupation of cave.

4670 ± 130

ALG-50. Grotte Capeletti B3 **2720 B.C.**

Charcoal, 40 to 45 cm deep, in Neolithic of Capsian tradition layer.

540 ± 90

ALG-51. Grotte Capeletti 143 **A.D. 1410**

Charcoal from uppermost platform in front of cave. Coll. with pottery of historic period, Berber manual trade.

General Comment: dwelling place of Neolithic of Capsian tradition searched for and excavation according to modern methods for marking and locating documents (Roubet, 1969).

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[RADIOCARBON, VOL. 14, No. 1, 1972, P. 6-110]

GRONINGEN RADIOCARBON DATES X

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INTRODUCTION

This list contains most of the unpublished radiocarbon dates measured between 1961 and 1968. Analyses of the C^{14} content of groundwater are excluded and a number of geologic dates will be included in a later list. Certain earlier analyses performed by H. de Vries and H. de Waard are included, as well as a few results obtained since W. G. Mook assumed responsibility for the laboratory in 1969, to complete series. Descriptions and comments are mainly based on information supplied by the submitters or contained in the publications cited. However, our own interpretation is often given in the comments. Sections I A to D2, II B1, and B2 were mainly prepared by the first author and the rest by the second.

Because the radiocarbon time-scale is not identical with the calendar (astronomic) time-scale (de Vries, 1959; Suess, 1970), and a calibration curve is still to be verified, we suggest that comparison of radiocarbon dates be conducted in the conventional C^{14} time-scale (years B.P.) and that chronologies based on C^{14} be clearly distinguished from calendar chronology.

Ages reported here are calculated using the "conventional" half-life of C^{14}, *i.e.*, 5568, and NBS oxalic acid as recent standard. The C^{13} content of samples are given with respect to the PDB standard. Where available, C^{13} corrections are applied to all dates on terrestrial organic material. No correction is applied to marine carbonates (sea shells) since the isotopic fractionation just compensates for the apparent age of surface ocean water. Freshwater carbonates are also not corrected for isotopic fractionation because the initial C^{14} content is variable. In general, 1300 $\pm$ 500 years are to be subtracted from such dates (Münnich and Vogel, 1959).

ACKNOWLEDGMENTS

Thanks are due to all who assisted in sample measurements, especially H. J. Streurman for his competence, and G. Pijpen and C. van der Molen-Sybolts. Ursula Vogel's assistance in preparing the manuscript is also gratefully acknowledged. W. G. Mook is thanked for the C^{13} analyses and for making available the results of those dates with GrN numbers >5680. M. Bierma and J. C. van Dijk are thanked for their competent typing of the manuscript under inevitable stress.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Canada

Missinaiba R. series, Ontario

Along Missinaibi R. in James Bay area, N Ontario, non-glacial peat of early or pre-Wisconsin age is exposed. Samples coll. 1954 by O. L. Hughes.

GrN-1435. Missinaibi peat >50,000

Peat from exposure on S bank of Missinaibi R. (50° 20′ N Lat, 82° 30′ W Long), ca. 10 km upstream from mouth of Soweska R., N Ontario. Deposit under till in silt and clay, 4.5 m below surface. Pollen analysis indicates cool climate (Terasmae, 1958; Terasmae and Hughes, 1960a). Subm. by V. K. Prest, Geol. Survey of Canada, Ottawa. *Comments*: portion of sample dated in Washington, W-241: >37,000 (Science, 1956, v. 123, p. 445). Compare also Y-269: >29,630 (Science, 1955, v. 122, p. 959). (J. Terasmae): recent geologic studies indicate Missinaibi beds probably interglacial.

GrN-1921. Missinaibi, 11 M (B) >42,000

Plant detritus from thin seam of brownmoss peat in uppermost unit in sec. at Bull's Bay on N bank of Missinaibi R. (50° 09′ N Lat, 83° 12′ W Long), N Ontario. Subm. by J. Terasmae, Dept. Geol. Sciences, Brock Univ., St. Catharines, Ontario. *Comment* (J.T.): expected to date maximum postglacial extent of Tyrrell sea, but obviously of early or pre-Wisconsin age, probably from Missinaibi beds.

65,700 ± 1300
GrN-1799. St. Pierre, Quebec (enriched) 63,750 B.C.

GrN-1713. St. Pierre, extract >47,000

In creek ca. 1.6 km SW of St. Pierre-les-Becquets (46° 31′ N Lat, 72° 10′ W Long) on S shore of St. Lawrence R., Quebec; exposed sec. of non-glacial silt, sand, and varved clay, with 4 peat layers, lying between tills. Pollen analysis of peat indicates cool Boreal climate, St. Pierre Interstadial (Terasmae, 1958; Terasmae and Hughes, 1960a); 2nd peat layer from top analyzed. Coll. and subm. 1958 by J. Terasmae. *Comment*: C^{14} in sample concentrated by isotopic enrichment by factor 11.36 ± .31 prior to measurement. C^{14} content 0.028% that of modern carbon; error given includes uncertainty of enrichment factor (Vogel, *et al.,* ms. in preparation).

66,500 ± 1600
GrN-1711. Pierreville, Quebec (enriched) 64,550 B.C.

GrN-1807. Pierreville, extract >48,000

On E bank of St. Francis R., 2.4 km SE of Pierreville (46° 04′ N Lat, 72° 49′ W Long), Quebec, same interstadial deposits as at St. Pierre, above, exposed between tills. Pollen analysis shows correlation

with upper part of St. Pierre sec. (Terasmae, 1958). Peat from 0.3 m layer near top coll. 1958 by J. Terasmae. *Comments*: C^{14} concentrated by isotopic enrichment by factor 11.04 ± .37 prior to measurement. C^{14} content 0.025% modern; error includes uncertainty of enrichment factor. (J.T.): A. Dreimanis also believes St. Pierre beds are early-Wisconsin and do not belong to last interglacial.

Scarborough series, Ontario

At Scarborough Bluffs (43° 42′ 30″ N Lat, 79° 14′ 10″ W Long), Toronto, exposure shows 30 m clay (Scarborough Formation) above Lake Ontario level (75 m alt.) followed by 13 m cross-bedded sand and 4 tills separated by sand or clay. Wood samples coll. 1959 by de Vries and Karrow and 1961 by Karrow; subm. by P. F. Karrow, Univ. of Waterloo, Waterloo, Ontario.

GrN-2555. Scarborough 1 **>52,000**

Twigs from sand at 30 to 43 m above lake level and ca. 35 m below surface; coll. 1959.

54,340 ± 500

GrN-4817. Scarborough 2 (enriched **52,390 B.C.**

Wood from same Scarborough sand coll. 1961. *Comment*: C^{14} concentrated by isotopic enrichment by factor 11.31 ± .26 prior to measurement. C^{14} content was 0.116% that of modern carbon; error includes uncertainty of enrichment factor. See Claireville, below.

GrN-4454. Markham, Ontario **24,600 ± 190**

Peat ball from 15 m depth in thick sand and gravel overlying till, covered by 2 further tills in Markham gravel pit (43° 50′ N Lat, 79° 21′ W Long), 5 km SW of Unionville, Ontario. Sands correlated with sands of Scarborough Beds (see above). Coll. 1960 and subm. by P. F. Karrow. *Comment*: pretreated with warm dilute acid, cold alkali, and acid. Insoluble fraction practically pure clay with insufficient organic material. Alkali soluble fraction measured so that date only minimum. Date should be maximum for deposition of sand layer. Compare W-194: >34,000 (Science, 1955, v. 121, p. 486) for another peat ball from same site. Date 44,600 erroneously communicated to and pub. by submitter.

GrN-4237. Clairville, Ontario **>50,800**

Peaty sand from exposure ca. 9 m from top and ca. 2 m above river level, 2.1 km SE of Clairville (43° 44′ N Lat, 79° 37′ W Long), NW of Toronto, Ontario. Sample from lens in lacustrine clay and clayey till below 2 other tills. Pollen analysis shows deposition during cool period. Clay till correlated with Early Wisconsin Sunnybrook Till at Scarborough by Karrow (see above). Coll. and subm. 1962 by A. Dreimanis, Univ. W Ontario, London, Ontario. *Comments*: pretreated with acid and cold alkali. Material disturbed by glacial action and perhaps displaced. (A.D.): peaty sand probably derived from Scarborough Formation.

Port Talbot series, Ontario

On N shore of Lake Erie, at Bradtville summer cottages (42° 37′ N Lat, 81° 23′ W Long), Dunwich Twp., 3.2 km SW of Port Talbot, Ontario, Port Talbot Interstadial beds exposed below ca. 30 m of till and lacustrine clay and silt (de Vries and Dreimanis, 1960; Dreimanis and Vogel, 1965; Dreimanis *et al.,* 1966). Pollen analysis shows Port Talbot I and II deposited in cool climate. Samples coll. and subm. by A. Dreimanis. Ages given here for samples measured by de Vries in 1958-59 are recalculated and supersede any other pub. figures. For measurements of other labs on similar material see Dreimanis *et al.,* 1966.

46,700 ± 1400

GrN-2570. Port Talbot 1, gyttja **44,750 B.C.**

Gyttja coll. 1959 from sandy silt deposit (Port Talbot II Interstadial) in cliff on shore of lake. *Comment*: pretreated with acid and alkali.

47,600 ± 400

GrN-2601. Port Talbot 2, gyttja (enriched) **45,650 B.C.**

Same as above, isotopically enriched. *Comment*: pretreated with acid and alkali. C^{14} concentrated by isotopic enrichment by factor 8.81 ± .33 before measurement. C^{14} content was 0.267% that of modern carbon; error includes uncertainty of enrichment factor.

43,400 ± 1300

GrN-4800. Port Talbot twigs, 14 **41,450 B.C.**

Twigs from 10 to 10.5 m below lake level in boring P.T. 14 at type locality, in top of Port Talbot II Interstadial beds and just below glacio-lacustrine clay and silt. Coll. by augering and subm. 1965. *Comment*: pretreated with acid and alkali.

42,700 ± 1200

GrN-4799. Port Talbot twigs, 12/13 **40,750 B.C.**

Plant remains from 10 to 10.5 m below lake level in borings P.T. 12 and 13 at type site, top of Port Talbot II Interstadial as GRN-4800. Coll. by augering and subm. 1965. *Comment*: pretreated with acid and alkali.

33,400 ± 500

GrN-4397. Port Talbot twigs, 1 **31,450 B.C.**

Larchwood splinters from 10 to 11.5 m below lake level in boring P.T. 1, 110 m SW of type site in Port Talbot Interstadial beds as GrN-4800. Coll. by wet drilling 1962; subm. 1963. *Comments*: pretreated with acid and alkali. (A.D.): since GrN-4397, -4799, and -4800 taken by drilling and augering within 1 to 2 m distance, this date must be rejected as too young.

44,400 ± 1200

GrN-2580. Port Talbot 3, wood **42,450 B.C.**

Wood fragments from Southwold Till overlying Port Talbot beds. Assoc. with fragment of mastodon or mammoth tusk. *Comment*: other

dates of same wood: S-46: >34,000 (R., 1960, v. 2, p. 74); L-440: >29,500 (R., 1959, v. 1, p. 9).

45,100 ± 1000

GrN-2619. Port Talbot 4, peat ball **43,150 B.C.**

Inner portion of peat ball from shore of Lake Erie near above exposure, 8 km SW of Port Talbot, washed up in 1958. Pollen content similar to that of Pt. Talbot gyttja, above. Although from below lake level, may still be same age as Port Talbot gyttja, since Port Talbot Interstadial deposits were disturbed by glacial over-riding and original position appears to be below lake level. Wood from another peat ball: GSC-217: 47,700 ± 1200 (R., 1965, v. 7, p. 26, 29).

General Comment (A.D.): Port Talbot II Interstadial dates, from 42,700 ± 1200 to 47,600 ± 400 B.P., agree with each other (not considering date of probably contaminated GrN-4397 material).

Plum Point series, Ontario

Exposure on N shore of Lake Erie at Plum Point (42° 36′ N Lat, 81° 24′ E Long), 1.8 km SW of Port Talbot, above, Dunwich twp., Ontario, shows Catfish Creek till down to lake surface. Test boring on shore revealed 1.5 m till followed by 18 m Port Talbot II Interstadial deposits: sand, gravel, sand and clay, on reddish Bradtville Till (Dreimanis *et al.,* 1966). Coll. and subm. by A. Dreimanis.

45,800 ± 1200

GrN-4429. Plum Point twigs **43,850 B.C.**

Twigs and leaves from ca. 10 m below lake surface just above clay and silt. Coll. and subm. 1963. *Comment*: pretreated with acid and alkali. Date suggests correlation with Port Talbot II Interstadial.

27,470 ± 130

GrN-2625. Plum Point wood **25,520 B.C.**

Larchwood from Catfish Creek till ca. 1 m above lake surface in cliff on shore. Coll. and subm. 1958. *Comments*: pretreated with acid and alkali. (A.D.): other dates of same wood: W-177: 27,500 ± 1200 (Science, 1955, v. 121, p. 485); L-185 B: 28,200 ± 1500 (Science, 1957, v. 126, p. 1325). Wood derives probably from Plum Point Interstadial deposits, overridden by Late Wisconsin glacier.

St. Thomas series, Ontario

Peat ball coll. 1961 by P. F. Karrow in Axford's gravel pit at St. Thomas (42° 45′ N Lat, 81° 11′ W Long), Ontario, 15 km NE of Port Talbot. Contains pollen indicating cool climate as analyzed by A. A. Berti. Sample from base of 7.5 m gravel underlain by Port Stanley Till. Subm. 1962 by A. Dreimanis.

34,000 ± 500

GrN-4238. St. Thomas peat **32,050 B.C.**

Inner portion of peat ball. *Comment*: pretreated with hot dilute acid and cold alkali.

38,000 ± 1500

GrN-4272. St. Thomas peat, bis **36,050 B.C.**

Same sample as above pretreated more rigorously. *Comment*: pretreated material of GrN-4238 was again extracted with 2% hot NaOH solution. Older date shows GrN-4238 was contaminated and GrN-4272 thus only minimum.

General Comment (A.D.): probably derived by varve or stream erosion from Port Talbot II Interstadial peat bed and redeposited as clasts in Late Wisconsin gravels. Porth Talbot Interstadial peat balls found along present Lake Erie beach and in beach gravels of Lake Arkona (13,000 B.P.), of an Erie Interstadial phase of Lake Erie (ca. 15,000 B.P.), and in Plum Point Interstadial beach sands (ca. 25,000 B.P.) between Plum Point and St. Thomas, Ontario.

9380 ± 60

GrN-4811. St. Fulgence, Quebec **7430 B.C.**

$\delta C^{13} = +0.4‰$

Whole shells at 0.60 to 0.80 m depth in reworked till exposed in gully at St. Fulgence (48° 27′ N Lat, 70° 48′ W Long) 162 m alt in Saguenay R. valley, near Chicoutimi, Quebec, representing marine invasion in Lake St. John dist. (Lasalle, 1966). Coll. and subm. 1965 by P. Lasalle, formerly Leiden, Netherlands. *Comments*: outer layers etched off with dilute acid and inner carbonate dated. (P.L.): age is maximum for marine invasion of Sanguenay R. area. Compare GSC-375: 9340 ± 160 B.P. and GSC-313: 8680 ± 140 B.P. (R., 1966, v. 8, p. 102) for shells from same area and GrN-1922, below.

8720 ± 80

GrN-1922. St. Adelphe Bog, Quebec **6770 B.C.**

Basal 0.10 m of peat overlying clay at 2.7 to 2.8 m depth in St. Adelphe Bog (46° 44′ N Lat, 72° 25′ W Long) 130 m alt, Quebec (Terasmae, 1960). Coll. 1957 and subm. 1958 by J. Terasmae. *Comment* (J.T.): minimum date for beginning of peat accumulation in post-Champlain Sea time in St. Lawrence lowlands.

6330 ± 85

GrN-1924. Alderdale Bog, Ontario **4380 B.C.**

Basal peat from 4.2 to 4.3 m in Alderdale Bog (46° 03′ N Lat, 79° 12′ W Long) in Fossmill Channel, 7 km SW of Fossmill near North Bay, Ontario. Pollen spectrum shows mixed hardwood phase (Terasmae and Hughes, 1960b). Coll. 1957 and subm. 1958 by J. Terasmae. *Comment* (J.T.): age assumed minimum for ice retreat from Fossmill, but pollen analysis indicates long time-gap between ice retreat and beginning of peat accumulation.

9800 ± 110

GrN-1926. High Hill Bog, Manitoulin I., Ontario **7850 B.C.**

Gyttja at 3.1 to 3.2 m depth from bottom of High Hill bog on Manitoulin I., Lake Huron (45° 53′ N Lat, 82° 05′ W Long, 260 m

alt), Ontario. Age is minimum for Early Post Lake Algonquin time (Terasmae and Hughes, 1960b). Subm. 1957 by J. Terasmae. *Comment* (J.T.): indicate early emergence of site from Glacial Lake Algonquin and ice retreat N of Lake Huron basin.

7520 ± 80

GrN-1698. Opasatika R., Ontario **5570 B.C.**

Shells from Opasatika R. (50° 05′ N Lat, 82° 30′ W Long), Ontario, near upper limit of marine submergence after glacial retreat (Terasmae and Hughes, 1960b). Subm. 1958 by J. Terasmae. *Comment*: shell carbonate dated; may be too young.

4940 ± 80

GrN-1925. Attawapiskat R., Ontario **2990 B.C.**

Basal 2 cm peat overlying marine clay in riverbank exposure along Attawapiskat R. (53° 08′ N Lat, 85° 18′ W Long), James Bay lowland, Ontario. Coll. 1957 by H. Sjörs; subm. 1958 by J. Terasmae. *Comment* (J.T.): indicates emergence of area from postglacial Tyrrell sea in James Bay lowlands.

B. U.S.A.

Otto series, New York

In Kent Moraine, glacial sediments exposed in S Branch Cattaraugus Creek (Otto High Bluff) beneath two tills at Otto (42° 21′ N Lat, 78° 50′ W Long), Cattaraugus Co., New York. Pollen analysis suggests cool to cold climate for organic zone (Muller, 1964). Coll. and subm. 1958 by Hl. de Vries, M. Rubin, and E. H. Muller.

GrN-2632. Otto 1, insoluble **>52,000**

GrN-2565. Otto 1, extract **>52,000**

Organic material from thin sand streak in 9 m gravel layer, Unit 4. *Comment*: pretreated with acid and alkali and both insoluble and alkali-soluble fraction measured.

GrN-2634. Otto 2 **>52,000**
63,900 ± 1700

GrN-3213. Otto 2 (enriched) **61,950 B.C.**

GrN-3163. Otto 2, extract **>41,000**

Peat from principal peat layer in 2 m silt layer, Unit 3, below gravel. *Comment*: pretreated with acid and alkali and C^{14} concentrated by isotopic enrichment by factor 13.46 ± 1.18 prior to measurement. C^{14} content 0.036% modern; error includes uncertainty of enrichment factor.

GrN-2633. Otto 3 **>52,000**

Peat from bottom of principal peat layer in Unit 3.

General Comment: although contamination with recent organic material appears slight, 64,000 yr B.P. may be too young. Interstadial beds, Unit

3, 4, correlate with St. Pierre Interstadial and predate Port Talbot Interstadial (see above).

GrN-5486. Clear Creek, New York >48,400

Wood fragments from ca. 13 m depth in exposure at Clear Creek near Gowanda (42° 30′ N Lat, 78° 56′ W Long), Erie Co., W New York. Coll. 1967 and subm. 1968 by P. E. Calkin, Dept. Geol. Sci., State Univ., Buffalo, New York. *Comment*: pretreated with acid and alkali. Sample apparently older than Port Talbot Interstadial and possibly equivalent to Otto organic beds (see above).

GrN-4996. Titusville, Pennsylvania 40,500 ± 1000 38,550 B.C.

$\delta C^{13} = -28.3‰$

At Strawbridge's gravel pit, Titusville (41° 37′ N Lat, 79° 39′ W Long), on Crawford-Venango Co. line, Pennsylvania, between margins of Kent Till of Wisconsin age and Titusville Till. Sequence includes till, gravel covering three thin peat layers, interbedded with thin gravel and silt layers and resting on sand. Top peat layer dated 39,900 $^{+4900}_{-2900}$ (I-1845, unpub.) and bottom layer >42,000 (I-1771, unpub.). This sample from bottom peat layer at ca. 7.5 m depth. Subm. 1966 by G. W. White, Univ. of Illinois, Urbana, Illinois. *Comment*: pretreated with acid and alkali. Date not contradictory to I-1771; peat ca. 42,000 yr old or older. See also White and Totten (1965) for date of obviously contaminated sample.

GrN-4398. Etna Township, Ohio >53,000

Wood and twigs in sandy gravel below 53 m of Late Wisconsin blue-gray till and above blue and hard brown till, washed from 20 cm drill hole, Dept. Agric. Sta., Etna Township (39° 57′ N Lat, 82° 45′ W Long), Licking Co., Ohio. Subm. 1963 by R. P. Goldthwait, Ohio State Univ., Columbus, Ohio. *Comment*: pretreated with acid and alkali Port Talbot age was expected but antedates Port Talbot Interstadial; possibly St. Pierre Interstadial age (see above). Gravel and lower till considered by earlier workers as Illinoian.

GrN-3219. Rocky Fork, Ohio 46,600 ± 2200 44,650 B.C.

Wood in top 5 m gravel outwash on 3 m till and below 10.5 m Late Wisconsin till from exposure at Rocky Fork (40° 01′ 06″ N Lat, 82° 51′ 08″ W Long), 2 km E of Gahanna Village, Jefferson Twp, Franklin Co., Ohio, 10 km from Etna Township, above (Goldthwait, 1958). Coll. 1961 and subm. by R. P. Goldthwait, Ohio State Univ., Columbus, Ohio. *Comment*: pretreated with acid and alkali. Same stratigraphic position as Etna Township sample, above. Small C^{14} content of 0.3% modern may be due to contamination; date thus only minimum. Whether drift of pre- or Early Wisconsin age, can not be determined by above 2 dates.

Upper Brush Creek series, Ohio

In Upper Brush Creek, 0.8 km E of Hwy. 25, Shelby Co. (40° 52′ N Lat, 82° 40′ W Long), Ohio, sequence includes ca. 6 m till, 0.7 m clay with fossil soil developed in upper part, 0.5 m leached sand and gravel, and basal calcareous till. Localized peat lens on top of clay (Goldthwait, 1958). Samples of peat coll. 1958 and subm. by F. Brandtner. In 1963 new samples coll. by J. L. Forsyth, Dept. Nat. Resources, Columbus, Ohio.

22,430 ± 140
GrN-1761. Upper Brush Creek 1a **20,480 B.C.**

Peat from base of lens, ca. 6.5 m depth, coll. 1958. *Comment*: pretreated with acid and alkali.

22,800 ± 200
GrN-4512. Upper Brush Creek 1b **20,850 B.C.**
$\delta C^{13} = -25.6‰$

Another portion of same sample. *Comment*: new careful pretreatment with acid and alkali.

22,400 ± 260
GrN-4513. Upper Brush Creek 2 **20,450 B.C.**

Peat from top of lens at ca. 6 m depth, coll. 1958. *Comment*: pretreated with acid and cold alkali.

GrN-4133. Upper Brush Creek 3, residue **>39,300**

GrN-4139. Upper Brush Creek 3, extract **>38,000**

New sample (1963) from top of organic rich silt layer, ca. 6.5 m depth, from different part of exposure. *Comment*: pretreated with acid and alkali; both insoluble residue and alkali soluble extract measured. Material mainly silt with low organic content.

GrN-4415. Upper Brush Creek 4 **>48,000**
$\delta C^{13} = -27.1‰$

Twigs from organic layer at same position of Sample 3. *Comment*: pretreated with acid and alkali.

General Comment: previous date for humic silt layer is W-415: >37,000 and for log in lower part of overlying till W-414: 22,000 ± 1000 (Science, 1958, v. 127, p. 1477). Suspicion that 1st date (GrN-1761) could not be correct is refuted by GrN-4512 and GrN-4513. Possible that outwash is older than 48,000 yr (GrN-4415) and that peat developed shortly before Late Wisconsin till was deposited ca. 22,000 yr ago.

21,340 ± 125
GrN-4514. Oxford, Ohio **19,390 B.C.**
$\delta C^{13} = -22.8‰$

Wood from log in "basal Wisconsin" till 0.5 m below "forest bed" underlying Late Wisconsin till in exposure at Oxford (39° 30′ N Lat, 84° 45′ W Long), Ohio. Coll. 1958 and subm. by F. Brandtner. *Comment*: pretreated with acid and alkali. Brandtner considers Oxford forest

bed same age as Upper Brush Creek peat, above, which is confirmed by dates.

GrN-4614. Grand Rapids, Michigan >51,000

Wood fragments from main peat layer at ca. 12 m depth at John Ball Park, Grand Rapids (42° 58′ N Lat, 85° 42′ W Long), Michigan. Peat overlain by silt, marl, outwash (Valparaiso) and till. Coll. and subm. 1964 by J. H. Zumberge, Grand Valley College, Allendale, Michigan. *Comments*: pretreated with acid and alkali; (J.H.Z.): pollen shows cool climate, considered post Sangamon. Compare W-1292: >40,000 (R., 1965, v. 7, p. 376) from same layer.

GrN-4132. Jones Farm, Indiana >52,000

At Jones Farm, 3.2 km SW of Dublin (39° 48′ N Lat, 85° 13′ W Long), NW Fayette Co., Indiana, sec. in creek exposes 21 m sequence of till, silt, and sand on Sangamon(?) soil (Gooding, 1963). Wood coll. 1958 by Brandtner and Gooding from lowest till (Whitewater stade) at ca. 0.2 m above Sangamon and subm. by F. Brandtner. *Comment*: pretreated with acid and alkali. Other dates from overlying New Paris Interstadial: I-478B: >40,500 (unpub.), I-587: >38,000; Fayette Stadial: I-611: >40,000; Cornersville Interstadial: I-610: 20,000 ± 500 (R., 1963, v. 5, p. 65, 66), again suggesting long period of non-deposition or hiatus prior to deposition of Late Wisconsin Till.

GrN-4408. Elburn 62-23, Illinois 32,600 ± 520 / 30,650 B.C.

Wood from 1.4 m peat bed at ca. 33 m depth in Boring NIMAPC 62 (Sample 23), Blackberry Twp (41° 52′ N Lat, 88° 25′ W Long), 11 km NW of Aurora, NW Illinois. Peat lies on silt and under 15.5 m till, 2 m outwash and 15 m till, respectively. Subm. 1964 by J. P. Kempton, Ill. State Geol. Survey, Urbana, Illinois. *Comment*: pretreated with acid and alkali. Considered stratigraphically below Farmdalian, see Farmdale, below. Compare I-1197: >40,000 (unpub.).

GrN-4468. Elgin 14-37A, Illinois 41,100 ± 1500 / 39,150 B.C.

Peat from ca. 57 m depth in Boring NIMAPC 14 (Sample 37A), Plato Twp (42° 03′ N Lat, 88° 29′ W Long), ca. 16 km W of Elgin, NW Illinois. Peat lies on silt and below ca. 42.5 m till, 1 m outwash, 5 m till and 7 m lacustrine silt, respectively. Subm. 1964 by J. P. Kempton. *Comment*: pretreated with acid and cold alkali. Considered stratigraphically older than Farmdalian, see Farmdale, below. Compare I-848: >40,000 (unpub.).

GrN-1760. Farmdale, Illinois 26,700 ± 180 / 24,750 B.C.

Wood from new exposure near type site at Farmdale R.R. Gully, NE of Farmdale, Farm Creek, 10 km E of Peoria (40° 43″ N Lat, 89° 38″ W Long), Tazewell Co., Illinois, in top of 1 m peat layer overlain

by loess and 2 clayey tills (Shelbyville and Post-Shelbyville). Coll. 1958 and subm. by F. Brandtner. *Comment*: pretreated with acid and alkali. Logs in bottom of lower till, just above loess, date: W-349: 20,340 ± 750 and W-399: 20,700 ± 650 (Science, 1958, v. 127, p. 1478), indicating Farmdale loess deposited between 26,700 and 20,700 yr ago in accordance with other dates.

GrN-4971. Double Bluff, Washington **>49,400**
$\delta C^{13} = -18.4‰$

Wood from Peat Bed C at ca. 25 m depth in sea cliff exposure at Double Bluff (47° 58′ N Lat, 112° 32′ W Long), Whidbey I., Washington. Succession shows peat interbedded in sand and silt floodplain deposits (Whidbey Formation) and overlain by till; 2nd peat bed from top dated (Easterbrook, 1969). Coll. and subm. 1965 by D. J. Easterbrook, Dept. Geol., W Wash. State College, Bellingham, Washington. *Comment*: pretreated with acid and alkali. Whidbey Formation represents warm period older than Possession Drift (see Strawberry Point, below).

Sumner series, Washington

In E valley wall of Stuck R. (47° 13′ N Lat, 122° 13′ W Long), ca. 1.6 km NE of Sumner, S Puget Lowland, Washington, glacial deposits exposed in gully. Salmon Springs drift is overlain by 10 m Vashon drift and consists of 12 m sand and gravel, 1 to 1.4 m nonglacial silt and interbedded peat layer and volcanic ash at base, 7.5 m sand and gravel (Easterbrook *et al.*, 1967; Crandell *et al.*, 1958). Sample from peat layer coll. 1963 by Dr. R. Mullineaux; subm. by D. R. Crandell, U.S.G.S., Denver, Colorado.

GrN-4074. Sumner, residue **>51,000**

GrN-4094. Sumner, extract **>49,000**
50,100 ± 400

GrN-4116. Sumner, enriched **48,150 B.C.**

Peat from below upper part of Salmon Springs drift. *Comment*: pretreated with acid and alkali. Since both alkali soluble fraction and residue were beyond normal range, C^{14} concentrated by factor 14.32 ± .43 by isotopic enrichment prior to measurement (GrN-4116). C^{14} content 0.194% modern. Error includes uncertainty of enrichment factor. 50,100 B.P. considered minimum for layer. Dates for nonglacial peat between Vashon drift and Salmon Springs drift are 27,900 to 34,700 B.P. (R., 1962, v. 4, p. 4). See also GrN-4971 and GrN-5257, below, and W-672: >38,000 B.P. (R., 1960, v. 2, p. 163) for same peat.

+3300
47,600
−1800

GrN-5257. Strawberry Point, Washington **45,650 B.C.**
$\delta C^{13} = -28.3‰$

Peat from lowest peat layer ca. 25 m below surface in sea cliff ex-

posure at Strawberry Point (48° 18′ N Lat, 122° 30′ W Long) on Whidbey I., Washington. Succession is: Whidbey Formation, Possession Drift with 2 thin peat layers overlain by till and peat (Easterbrook, 1969). Coll. and subm. 1967 by D. J. Easterbrook. *Comment*: pretreated with acid and alkali. Another date for this peat is: I-2284: >39,900 B.P. Peat layer 1 m above dates: I-1880: 34,900 $^{+\ 3000}_{-\ 2000}$ B.P. and upper (interstadial) peat dates: I-1285: 27,200 $^{+\ 1000}_{-\ \ 900}$ B.P. Possession Drift may correspond to upper part of Salmon Springs Drift (see above). See also I-1111: 26,850 ± 1700 B.P. (R., 1966, v. 8, p. 171). Cold stade lasted from before 50,000 B.P. to ca. 30,000 B.P.

Gakona series, Alaska

In Copper R. basin near Gakona (62° 18′ N Lat, 145° 19′ W Long), Alaska, last glacial is represented by 16.5 m of sediment overlain by 6 m postglacial gravel and sand (Ferrians, 1963).

GrN-4165. Gakona >46,000

GrN-4448. Gakona >49,000

43,440 ± 250

GrN-4086. Gakona (enriched) 41,490 B.C.

Wood from 15 m below surface in fine sand that grades downward into coarse fluvial gravel and upward into poorly laminated lacustrine clayey silt. Coll. 1962 by H. R. Schmoll; subm. by O. J. Ferrians, U.S.G.S., Washington, D.C. *Comment*: pretreated thoroughly with acid and alkali. GrN-4165 and GrN-4448 measured without enrichment. For GrN-4086, C^{14} concentrated by isotopic enrichment by factor 13.17 ± 0.36 before measurement. C^{14} content 0.45% modern; error includes uncertainty of enrichment factor. Since GrN-4086 younger than unenriched portions, contamination during enrichment was suspected and analysis repeated.

GrN-4744. Gakona, bis >42,000

58,600 ± 1100

GrN-4798. Gakona, bis (enriched) 56,650 B.C.

Another portion of same log as above. *Comment*: new portion (ca. 240 g) pretreated with acid and alkali. GrN-4744 measured without enrichment. For GrN-4798, C^{14} concentrated by isotopic enrichment by factor 10.20 ± .26 before measurement. C^{14} content 0.069% modern; error includes uncertainty of enrichment factor.

General Comment: 2 enriched samples prove again that contamination took place during handling in lab. where enrichment was undertaken (see also Grossweil 3, R., 1967, v. 9, p. 90). GrN-4798 indicates lower part of glacial beds date back to Early Glacial. Other dates for same horizon is W-531: >38,000 B.P. (R., 1960, v. 2, p. 170), and stratigraphically higher samples in same drift date 31,300 ± 1000 B.P. (W-843, R.,

1960, v. 2, p. 171) and 17,600 ± 400 B.P. (W-1134, R., 1964, v. 6, p. 65). Drift thus contemporary with Last Glaciation elsewhere.

GrN-2568. Omar, Delaware **>50,000**

Wood fragments washed from core at 8 m depth of drilling on sandy silt and clay at Omar (38° 31′ N Lat, 75° 12′ W Long), Sussex Co., Delaware. Pollen content shows mainly high percentages of *Pinus* with *Picea* and *Abies* down to 10 m, with *Quercus* increasing from 10 m down to 15 m. Coll. 1958; subm. 1959 by J. J. Groot, Delaware Geol. Survey, Newark, Delaware. *Comment*: compare I-747: >32,000 (R., 1966, v. 8, p. 173) for similar sample. Date suggests Early Wisconsin or Illinoian, as expected.

C. Central America

Lesser Antilles series

Lower Terrace on islands of Curaçao, Bonaire, and Aruba is youngest of terraces of marine limestone and represents high relative sea level at ca. + 10 m, once thought possibly postglacial. Completeness of shells embedded ensures contemporaneity with deposit. Coll. 1956; subm. 1965 by P. H. de Buisonjé, Dept. Geol., Univ. Amsterdam, Netherlands.

Grn-4435. Curaçao X 1181 A **36,500 ± 800**
34,550 B.C.
$\delta C^{13} = +2.5‰$

Outer ring of incomplete fossil gastropod (*Strombus gigas* L.) from surface of Lower Terrace, ca. + 10 m E of Boca Tabla (12° 22′ 15″ N Lat, 69° 06′ 48″ W Long), Curaçao.

GrN-4434. Curaçao X 588 **31,300 ± 500**
29,350 B.C.
$\delta C^{13} = +2.3‰$

Outer ring of fossil gastropod (*Strombus gigas* L.) from base of Lower Terrace, 2.4 m below top of 10 m terrace, W side of Schottegat (12° 07′ 26″ N Lat, 68° 56′ 30″ W Long), Curaçao.

Grn-4436. Aruba, X 1499 **39,500 ± 1700**
37,600 B.C.
$\delta C^{13} = +3.4‰$

Outer ring of *Strombus gigas* L. shell from 4.2 m below top of Lower Terrace, +5.6 m at Boca Andicouri (12° 32′ 26″ N Lat, 69° 57′ 16″ W Long), Aruba.

General Comment: outer portions of samples etched off with dilute acid and inner carbonate dated. Results indicate Lower Terrace not postglacial but since small amouts of recent secondary carbonate would account for C^{14} content, it is not certain that terrace is interstadial. Dates considered minimum only. Compare also other shell dates 30,000 to 40,000 B.P. for high sea level: GrN-4571: 38,100 ± 500 and GrN-4572: 35,000 ± 630 (R., 1970, v. 12, p. 450).

D. Europe

1. Pleistocene of the Netherlands

GrN-4064. Ommen X, Netherlands >42,000

Charcoal from boring in continental Eemian deposit, 15 m below surface in old Vecht R. course near Beerze (52° 31′ N Lat, 6° 39′ E Long), 7 km E of Ommen, prov. Overijssel, Netherlands (Butter, 1957). Coll. 1936 and subm. 1961 by J. Butter, Deventer. *Comment*: date as expected.

Wageningen series, Netherlands

In building pit of Phytopathology building in Wageningen (51° 58′ N Lat, 5° 40′ E Long), prov. of Gelderland, Netherlands, 2 peat layers at 5.15 m and 5.25 m depth below sand separated by cryoturbate sand and gyttja, revealed in 1964. Thought to represent Late or Pleniglacial Interstadial. Samples coll. and subm. 1964 by B. Polak, Landbouwhogeschool, Wageningen, Netherlands.

GrN-4603. Wageninger 5.25 m >50,000

Peat from lower peat layer at 5.25 m depth.

GrN-4602. Wageningen 5.15 m >52,000

Peat from upper peat layer at 5.15 m depth.

General Comment: both samples pretreated with acid and alkali. Results indicate peat predates Middle Pleniglacial.

Amersfoort series, Netherlands

Excavation for building in 1967 (Liendert) in Amersfoort (52° 09′ N Lat, 05° 24′ E Long), prov. of Utrecht, Netherlands, exposed Early Glacial overlain by Pleniglacial beds. Samples coll. by W. H. Zagwijn, Geol. Service, Haarlem, Netherlands, for palynologic and C^{14} analysis; subm. 1967.

GrN-5405. Amersfoort L II/1 >51,200

$\delta C^{13} = -28.1‰$

Peat at 6.61 to 6.69 m depth at top of Early Glacial sequence (Odderade Interstadial ?).

GrN-5404. Amersfoort L I/2 >51,000

$\delta C^{13} = -28.4‰$

Peat at 4.70 to 4.75 m depth in Pleniglacial layer.

$^{+3700}_{51,700}$ $^{-2400}$

GrN-5375. Amersfoort L I/1 49,750 B.C.

$\delta C^{13} = -28.4‰$

Peat at 4.30 to 4.33 m depth in Pleniglacial layer.

General Comment: all samples pretreated with acid and cold alkali. First Pleniglacial peat beds older than 50,000 yr recognized in the

Netherlands. For dates for Early Glacial beds at Amersfoort, see Amersfoort series (R., 1967, v. 9, p. 64-65).

GrN-5480. Nijemegen, Netherlands — **45,300 ± 2000** / **43,350 B.C.**

Cryoturbate sandy peat at De Duckenburg near Nijmegen (51° 50′ N Lat, 5° 52′ E Long), prov. of Gelderland, Netherlands, at 1.80 to 2.00 m depth below sandy loam and river banks. Pollen diagram points to cold conditions and could be Upper Dryas period if geologic situation did not indicate greater age. *Comment*: pretreated with acid and alkali. Date suggests Moershoofd Interstadial.

Peelo series, Netherlands

At bottom of erosion gully filled with fluviatile Pleniglacial deposit at Peelo (53° 01′ N Lat, 06° 34′ E Long), N of Assen, prov. of Drente, Netherlands, thin band of moss peat (*Amblistegium giganteum*) occurs. Pollen analysis shows vegetation similar to that of Moershoofd phase (van der Hammen *et al.,* 1967). Coll. 1966 and subm. 1967 by W. H. Zagwijn.

GrN-5129. Peelo, acid only — **33,610 ± 450** / **31,660 B.C.** / $\delta C^{13} = -33.7‰$

Peat at ca. 5 m depth at base of gully. *Comment*: only pretreated with dilute acid.

GrN-5141. Peelo, residue — **33,350 ± 530** / **31,400 B.C.** / $\delta C^{13} = -34.2‰$

GrN-5142. Peelo, extract — **34,050 ± 500** / **32,100 B.C.** / $\delta C^{13} = -33.3‰$

Same material as above. *Comment*: thoroughly pretreated with boiling 5% HCl and cold alkali.

General Comment: similarity of 3 dates indicates no contamination. Result places sample between Hengelo and Denekamp Interstadials, when vegetation was similar to that during Moershoofd phase.

GrN-5460. Smilde, Netherlands — **18,610 ± 800** / **16,660 B.C.** / $\delta C^{13} = -28.2‰$

Small peat lens at 3.4 m depth in depression filled with coversand at Hijkersmilde (52° 56′ N Lat, 6° 25′ E Long), 12 km SE of Assen, prov. of Drenthe, Netherlands. Pollen diagram shows up to 25% tree pollen, mainly *Betula* with some *Pinus, Picea,* and *Salix*. Similar vegetation during Denekamp Interstadial. Coll. and subm. 1968 by W. A. Casparie, Univ. Groningen, Netherlands. *Comment*: 1st organic deposit from 28,000 to 14,000 B.P. in Netherlands, suggesting slight climatic improvement.

de Hamert series, Netherlands

Two samples from Late Glacial peat bed at de Hamert (51° 30′ N Lat, 6° 11′ E Long), prov. of Limburg, Netherlands. Four dates already pub. (R., 1967, v. 9, p. 76). Coll. 1964-65 and subm. by D. Teunissen, Univ. Nijmegen, Netherlands.

GrN-5216. de Hamert 408 **12,160 ± 65**
10,210 B.C.
$\delta C^{13} = -30.5‰$

Peat from Boring 5a at 3.21 to 3.24 m depth. Just before increase of *Betula*. Last high herbaceous pollen value. *Comment*: pretreated with acid and cold alkali.

GrN-5408. de Hamert 404 **11,465 ± 50**
9515 B.C.
$\delta C^{13} = -27.8‰$

Peat from Boring 5a at 3.09 to 3.12 m depth, just below strong *Pinus* increase. *Betula* dominant. Herbaceous pollen low. *Comment*: pretreated with acid only.

General Comment: from same sec. are dates GrN-4786: 10,870 ± 100 for top of peat at depth 3.03 to 3.07 m with *Pinus* decreasing after its dominance and GrN-4787: 12,210 ± 90 for basal part of peat at depth 3.27 to 3.30 m with high value of herbaceous pollen and highest value of *Salix* in sec. Series very consistent. Comparison with dates from Usselo sec. (Science, 1958, v. 127, p. 130), after applying corrections (R., 1963, v. 5, p. 164), indicates pre-Allerød beginning of peat formation but absence of Bølling Interstadial, present in neighboring boring according to date GrN-4478: 12,760 ± 150. No clear indication in pollen diagram for colder interval after Bølling period.

GrN-4496. Spoolde, Netherlands **11,650 ± 170**
9700 B.C.

Gyttja in gully below older and younger coversand layers exposed in sluice-pit at Spoolde (52° 31′ N Lat, 6° 3′ E Long) near Zwolle, prov. of Overijssel, Netherlands. Depth 4.96 to 5.00 m below surface. Sample expected to date beginning of lower coversand formation. Expected age: 30,000 to 13,000 yr (Hamming *et al.*, 1965). Coll. and subm. 1963 by G. C. Maarleveld, Univ. Amsterdam, Netherlands. *Comment*: pretreated with acid and cold alkali. Gyttja unexpectedly Allerød, indicating unobserved stratigraphic complication.

2. Pleistocene of Other Countries

GrN-5191. Roxem, Belgium **11,740 ± 130**
9790 B.C.
$\delta C^{13} = -26.1‰$

Wood remains from compressed layer near top of 0.07 m thick sandy peat exposed in wall of sand pit at depth 2.60 at Roxem-Hoge Dijken near Brugge (51° 13′ N Lat, 3° 12′ E Long), prov. of W Flanders, Belgium. Pollen diagram of peat shows Late Glacial flora, with increas-

ing *Betula* and low *Pinus* values. Expected age Bølling. Coll. and subm. 1967 by C. Verbruggen, Seminarie voor Regionale Aardrijkskunde, Univ. Gent, Belgium. *Comment*: pretreated with acid and alkali. Date indicates Early Allerød age.

Semois valley series, Belgium

Late Glacial peat from boring, immediately below volcanic ash from Eiffel eruption at depth 2.03 to 2.06 m in Semois valley between Vance and Chantemelle (49° 46′ N Lat, 5° 40′ E Long), prov. of Luxemburg, Belgium. Coll. and subm. 1965 by P. D. Jungerius, Fys.-Geog. Lab. Univ. Amsterdam, Netherlands.

GrN-4680. Semois 1 **5400 ± 90**
3450 B.C.

GrN-4760. Semois 2 **7520 ± 110**
5570 B.C.

General Comment: pretreated with acid and alkali. Both samples from same layer. Material apparently not homogenous, and much too young. Recent roots may have been present.

GrN-4630. Leadenhall St., London, England **29,450 ± 330**
27,500 B.C.

Collagen from ulna of rhinoceros (*Coelodonta antiquitatis*) from higher flood-plain gravel found 1925 at Lloyd's building site in Leadenhall St., London (57° 30′ N Lat, 0° 10′ W Long) and subm. 1965 by K. P. Oakley, Brit. Mus. (Nat. Hist.), London. *Comment* (K.P.O.): date as expected.

GrN-5281. Aber-Mawr, Wales **>54,000**

Wood fragments from 4 to 5 m depth in natural coastal exposure at Aber-Mawr (51° 57′ 40″ N Lat, 5° 05′ 30″ W Long), St. Nicholas, Fishguard, N Pembrokeshire, Wales. Below ice-contact sand and gravel, ca. 3 m calcareous Irish Sea Till containing sample lies on solifluction sediments (John, 1965). Coll. and subm. 1967 by B. S. John, Dept. Geog., Sci. Lab., Durham City, England. *Comment*: indicates Early Würm or older. Compare also other dates for same till NPL-98: >40,300, I-1687: >36,300 (R., 1966, v. 8, p. 344; 1968, v. 10, p. 265).

Breinetsried series, Germany

In gravel quarry Breinetsried 4 km S of Penzberg (47° 45′ N Lat, 11° 23′ E Long), in Loisach Valley, Bavaria, 8 km from Grossweil (see R., 1967, v. 9, p. 89-90), peat layer underlies ca. 6 m glacial till. Between 2 gravel deposits 0.5 m *Carex-Hypnum* peat under- and overlain by 0.3 m clay contains following approx. pollen spectrum: 10% *Betula* (derived?), 18% *Picea,* 72% *Pinus* plus 110% *Cyperaceae,* 12% *Gramineae* and is considered Early Glacial Interstadial. Coll. and subm. 1958 by the late H. Gross.

GrN-4998. Breinetsried, residue **42,570 ± 1160**
40,620 B.C.
$\delta C^{13} = -26.7‰$

GrN-5011. Breinetsried, extract **42,170 ± 1400**
40,220 B.C.
$\delta C^{13} = -27.0‰$

Upper 15 cm of peat layer. *Comment*: sample pretreated with acid and alkali; both insoluble and alkali soluble fractions measured. Similarity of 2 dates suggests results trustworthy although higher age expected. Compare Signau and Glutschtal series (R., 1967, v. 9, p. 91-92) for other peat layers of this age in Alpine region.

Karrestobel series, Germany

Previous date for peat from Karrestobel, near Baindt (47° 50′ N Lat, 9° 40′ E Long), Württemberg, 8 km N of Ravensburg (GrN-1277, R., 1967, v. 9, p. 90), provoked much discussion. Additional samples, coll. Sept. 1958 by H. Gross, are reported here. Sequence uncovered in Karrestobel stream bed at 490 to 500 m alt by A. Bertsch consists of 7 humic layers (A to G) below 2 to 3.5 m thick Würm moraine. Uppermost *Carex-Hypnum* peat, Layer G, 7 cm thick, covered by 11 to 25 cm slightly layered clay. Subm. 1958 by the late H. Gross.

GrN-4999. Karrestobel G, 1 **27,750 ± 250**
25,800 B.C.
$\delta C^{13} = -26.9‰$

Peat from Layer G. *Comment*: ca. 50 g compact peat extracted at 80°C overnight with 2% HCl and 2% NaOH, respectively; insoluble portion analyzed.

GrN-5071. Karrestobel G, 2, residue **29,000 ± 450**
27,050 B.C.

GrN-5085. Karrestobel G, 2, extract **28,650 ± 300**
26,700 B.C.

Peat from same Layer G. *Comment*: material boiled with 20% HCl and extracted with 4% cold NaOH; both insoluble and alkali extractable material analyzed.

General Comment: since 2nd pretreatment gave higher date than 1st, it was more effective. Similarity of dates of 2 fractions (GrN-5071 and GrN-5085) indicates reliable result. Previous date, GrN-1277: 29,060 ± 300, was for sample from Layer E, stratigraphically slightly older than Layer G. Results clearly prove peat of Denekamp Interstadial age.

Piaseczno series, Poland

Filling of pre-Vistula Valley at Piaseczno sulphur mine near Tarnobrzeg (50° 35′ N Lat, 21° 40′ E Long), woj. Rzeszowskie, SE Poland, consists of cross-bedded gravel overlain by sandy gravel and sand with large black oak trunks in top of sand series. Ice wedges and involutions developed syngenetically with accumulation. Coll. 1965 and subm. 1966 by E. Mycielska-Dowgiallo, Inst. Geog., Univ. Warsaw, Poland.

GrN-4868. Piaseczno 1 **40,700 ± 2000**
38,750 B.C.
$\delta C^{13} = -25.5‰$

Plant detritus in Layer A at 12.5 m below present flood terrace. Pollen analysis indicates climate nearing pre-Boreal. Simultaneous occurrence of frost fissures and involutions indicates permafrost (Mycielska-Dowgiallo, 1967). *Comment*: pretreated with acid and alkali. Originally, layer ascribed to end of Late Glacial but date implies end of Lower Pleniglacial.

GrN-4867. Piaseczno 2 **9070 ± 90**
7120 B.C.
$\delta C^{13} = -29.8‰$

Peat from layer in middle of trough at ca. 5 m depth, tentatively ascribed to Atlantic period. *Comment*: pretreated with acid and alkali. Peat growth apparently started in pre-Boreal time.

GrN-5490. Dzierzby-Krzemien, Poland **11,820 ± 65**
9870 B.C.
$\delta C^{13} = -25.8‰$

Peaty sand at 1.8 to 2 m depth below peat, sand, and silt in trial trench at Krzemień-Drohiczyn (52° 30′ N Lat, 22° 30′ E Long), Sokolów Podlaski prov., Poland, related to Bug R. terraces. Coll. and subm. 1967 by M. J. Dabrowski, Inst. Material Culture Hist., Warsaw, Poland. *Comment*: pretreated with acid and alkali. Thought possibly Denekamp Interstadial, but date indicates early Allerød age.

GrN-5111. Dobra, Poland **32,600 ± 450**
30,650 B.P.
$\delta C^{13} = -22.7‰$

Piece of wood (*Pinus cembra*) from Dobra (49° 45′ N Lat, 20° 20′ E Long) 470 m alt, near Limanowa on right bank of Lososina R., W Carpathians, Poland. In exposure 10.5 m clay deposit with angular sandstone scree deposited by solifluction, overlies 1.8 m gravel, 0.5 m clay on 0.6 m gravel (Klimaszewski, 1958). Coll. at ca. 10 m depth. Pollen spectrum shows 45% tree pollen, mainly *Pinus* of which half is *Pinus cembra*. Subm. 1967 by A. Srodoń, Inst. Bot., Polish Acad. Sci., Kraków, Poland. *Comment* (A.S.): middle Pleniglacial date for flora acceptable.

GrN-4497. Gorki, Poland **3300 ± 35**
1350 B.C.

Charcoal from thin layer in parabolic dune at depth ca. 4 m at Gorki (52° 38′ N Lat, 20° 35′ E Long), Puszcza Kampinoska, NE of Warsaw, Poland. Possibly of Allerød age. Coll. 1964 by J. Kobendzina, Warsaw; subm. 1964 by G. C. Maarleveld, Univ. Amsterdam, Netherlands. *Comment*: pretreated with acid and alkali. Much younger than expected.

45,400 ± 2000

GrN-4491. Kostonjärvi no. 642, Finland **43,450 B.C.**

Peaty sand under 4 m till and 3 m gravel at Taivalkoski, Kostonjärvi (65° 45′ N Lat, 28° 29′ E Long), Finland (Korpela, 1969). Coll. and subm. 1964 by K. Korpela, Imatran Voima Oy., Helsinki, Finland. *Comment*: pretreated with hot dilute acid and cold dilute alkali.

GrN-4543. Permantokoski, Finland **>42,700**

Peaty sand under ca. 6 m till at Permantokoski (66° 30′ N Lat, 26° 10′ E Long), Rovaniemi area, Finland. Coll. 1960 and subm. 1964 by K. Korpela. *Comment*: pretreated with hot dilute acid and cold dilute alkali. With GrN-4491, above, cannot confirm that area was deglaciated between 40,000 and 50,000 B.P., but possibility exists.

26,230 ± 240

GrN-4995. Pulgary 7, Czechoslovakia **24,280 B.C.**

$\delta C^{13} = -23.2‰$

Charcoal from soil (*Braunerde*) in loess sec. in brickyard at Pulgary, 10 km S of Dolní Věstonice (48° 53′ N Lat, 16° 40′ E Long), S Moravia. Sec. similar to that of Dolní Věstonice (see R., 1967, v. 9, p. 99-101), with lower loam zone and humic bands of early and pre-Würm age, loess, sandy solifluction layer with *Braunerde* and loess, partly layered. Coll. and subm. 1959 by B. Klima, Brno. *Comment*: charcoal fragments sieved from soil, fine rootlets removed as far as possible, and pretreated with acid and alkali. Date same as for E Gravettian settlement on top of Stillfried B soil at Pavlov and Dolní Věstonice. Probably postdates soil.

Pod hradem series, Czechoslovakia

Loess samples from Pod hradem (Burghöhle) near Brno (49° 12′ N Lat, 16° 40′ E Long), Moravia, for comparison with charcoal measured previously (R., 1967, v. 9, p. 102). Coll. and subm. 1959 by K. Valoch, Moravské Mus., Brno.

28,100 ± 290

GrN-5543. Pod hradem K, humus **26,150 B.C.**

$\delta C^{13} = -28.25‰$

21,850 ± 400

GrN-5567. Pod hradem K, carbonate **19,900 B.C.**

$\delta C^{13} = -5.2‰$

Loess from 1.6 to 1.7 m depth in central passage of cave, in middle of same interstadial as Pod hradem A and C from side passage. *Comment*: carbonate removed from loess (GrN-5567), and humus extracted with 2% NaOH (GrN-5543).

30,200 ± 340

GrN-5542. Pod hradem L, humus **28,250 B.C.**

$\delta C^{13} = -28.3‰$

Humus extracted from loess at ca. 1.5 m depth in same layer as Sample K. *Comment*: carbonate removed and alkali soluble fraction measured.

General Comment: dates for humus compare satisfactorily with charcoal dates of same layer, GrN-848, -1724, -1735, -1751: 28,200 to 33,300 B.P. (R., 1967, v. 9, p. 102) and indicate contemporaneity of humus in layer. Younger date for carbonate fraction in accordance with experience (see Göttweig-Paudorf series, R., 1967, v. 9, p. 95). Interstadial (previously designated W1/2) of same age as Denekamp Interstadial.

Lunz series, Austria

Boring of lake sediment in Untersee ca. 2 km E of Lunz (47° 50′ N Lat, 15° 00′ E Long), Lower Austria, shows Late and postglacial sequence with 600 to 700 varves between 10.75 m and 7.70 m, probably formed by retreating Würm glacier. Pollen diagram covers period from Late Glacial to Sub-Atlantic (Burger, 1964). Coll. 1958 by D. Burger; subm. 1961 by Burger and T. van der Hammen.

GrN-4220. Lunzersee 9.70 m **35,150 ± 1250 / 33,200 B.C.**

Carbonate from varves at 9.70 to 9.90 m in top of Zone b correlated with beginning of Bølling (1st *Pinus* maximum). *Comment*: no pretreatment, carbonate dated. Carbonate apparently derived from old limestone sand. No precipitation of carbonate thus took place in lake in Late Glacial.

GrN-4219. Lunzersee 7.50 m **35,850 ± 700 / 33,900 B.C.**

Carbonate from uppermost varves at 7.50 to 7.70 m in top of Zone d correlated with end of Bølling (2nd *Pinus* maximum). *Comment*: no pretreatment, carbonate dated. Carbonate apparently derived.

GrN-2406. Lunzersee 5.93 m **10,940 ± 100 / 8990 B.C.**

Peaty calcareous clay from 5.93 m depth in top of Zone f with over 90% *Pinus* correlated with Allerød and "Lunzer Schwankung" of Gams, partly on basis of this date. *Comment*: pretreated with acid only. Agrees well with end of Allerød in NW Europe.

GrN-2981. Lunzersee 1.93 m **5880 ± 70 / 3930 B.C.**

Peaty calcareous clay from 1.93 m depth at top of Atlantic period sediment (Zone i) with *Picea, Quercetum mixtum,* and *Corylus* pollen predominating. *Comment*: pretreated with acid only. Agrees well with date ca. 3000 B.C. for beginning of Sub-Boreal in NW Europe.

Ljubljansko Barje series, Yugoslavia

In Ljubljansko Barje (Laibacher Moor) (46° 04′ N Lat, 14° 29′ E Long) near Ljubljana, Slovenia, ca. 135 m pollen-bearing sediment contains evidence of Middle, Upper, and Post Pleistocene vegetation (Šercelj, 1966). Pollen diagram shows Last Glacial divided into initial steppe phase, forest phase (*Pinus, Picea, Betula*), steppe and Late Glacial forest (*Pinus*), while Holocene is dominated by mixed forest (*Fagus,*

Quercus, etc.). Samples coll. and subm. 1961 by A. Šercelj, Univ. Ljubljana, Yugoslavia.

GrN-4102. Ljubljansko Barje 57 m **>51,000**

Peat from 57.70 m depth placed by Šercelj in Riss-Würm Interglacial. *Comment*: pretreated with acid and alkali. Date according to expectation.

GrN-4098. Ljubljansko Barje 40 m **>48,000**

Peat from 39.50 m depth at beginning of main forest phase of Würm Glacial. *Comment*: pretreated with acid and alkali. Compare Ioannina series, below, where middle of forest phase dates 40,000 B.P.

Adria series, Mediterranean

Several cores from N Adriatic sea, coll. 1962 by L. van Straaten for micro-malacologic and palynologic studies, contain Glacial and postglacial sediments (Bottema and van Straaten, 1966). In Core 317 at 194 m below sea level (42° 28.3′ N Lat, 16° 26.3′ E Long) deeper water mollusks decline and shallow water mollusks increase sharply at ca. 4.5 m depth. At 2.1 m reverse occurs and at ca. 1.5 m temperate and later warm pteropods appear. Pollen diagram shows vegetational changes parallel changes in distribution of mollusks. Subm. 1965 by L. van Straaten, Univ. Groningen, Netherlands.

GrN-4712. Adria 4.4 m **$\begin{matrix}+4000\\46{,}000\\-3000\end{matrix}$ B.C.**

$\delta C^{13} = +0.0‰$

Shell fragments from 4.3 to 4.5 m depth in Core 317 at onset of shallow water phase. *Comment*: cleaned carefully, etched with dilute acid and shell carbonate dated. Infinite age not excluded but result considered possible.

GrN-4807. Adria 2.9 m **19,870 ± 220 / 17,920 B.C.**

Shell fragments from 2.8 to 3.0 m depth in Core 317 in cold phase deposit. *Comment*: cleaned carefully and shell carbonate dated.

Tenagi Philippon series, Greece

The Tenagi Philippon marsh (41° 10′ N Lat, 24° 20′ E Long) in Drama basin, 15 km W of Kaválla, Macedonia, Greece, contains 120 m Quaternary sediment of which upper 30 m represents Last Glacial and Holocene (van der Hammen *et al.,* 1965; Wijmstra, 1969). In 1931 marsh was drained for cultivation. Important pollen diagram of Core II (Wijmstra, 1969) shows 3 Early Glacial interstadials between 28 and 21 m depth with oak-pine forests followed by long Pleniglacial to ca. 6 m with open vegetation and periodic *Pinus* maxima, and Late and postglacial with mainly oak forest and also *Fagus* and *Abies* above ca. 2.6 m. First boring in 1960 by Grontmij NV, Netherlands, gave material

for preliminary pollen diagram (I) and for dating (van der Hammen *et al.,* 1965) while detailed pollen analysis was performed by T. A. Wijmstra on core coll. 1964. Samples of Core I subm. 1963 by W. H. van der Molen, Grontmij NV, de Bilt, Netherlands, and those of Core II subm. 1966 by T. van der Hammen, H. de Vries Lab., Univ. Amsterdam, Netherlands.

GrN-4184. Tenagi Philippon I, 15.80 m **>40,000**

Peat from 15.80 m depth in Core I. Interval with more than 20% *Pinus* in pollen spectrum. *Comment*: pretreated with acid and alkali.

14,600 ± 200

GrN-4183. Tenagi Philippon I, 6.25 m **12,650 B.C.**

Gyttja from 6.25 m depth in Core I. Arboreal pollen at a minimum before postglacial increase. *Comment*: pretreated with acid and alkali.

7800 ± 50

GrN-4182. Tenagi Philippon I, 4.30 m **5850 B.C.**

Peat from 4.30 m depth in Core I where *Quercus* pollen percentage was increasing to last maximum. *Comment*: pretreated with acid and alkali. Date places level towards end of Boreal phase.

34,770 ± 580

GrN-4849. Tenagi Philippon II, 13.75 m **32,820 B.C.**

Gyttja from 13.50 to 14.00 m depth in Core II. Boundary of Zone P3/P4 in pollen diagram at end of Interstadial (P3) correlated with Hengelo Interstadial.

28,840 ± 300

GRN-4846. Tenagi Philippon II, 11.25 m **26,890 B.C.**

Peat from 11.00 to 11.50 m depth in Core II. Zone P7 of pollen diagram showing period of amelioration interpreted as end of Denekamp Interstadial.

22,640 ± 165

GrN-4845. Tenagi Philippon II, 9.75 m **20,690 B.C.**

Peat from 9.50 to 10.00 m depth in Core II. Zone X2 of pollen diagram with slightly more favorable conditions than immediately before or after.

General Comment: all samples pretreated with acid and alkali. Results from 2 cores show same depth-age relationship from which following dates for Pleniglacial Interstadials can be deduced: ? to ca. 44,000 B.P., 42,000 to 35,000 B.P., 33,000 to 28,500 B.P., 24,500 to 22,000 B.P., and 20,000 to 15,500 B.P. First 3 correspond well with Moershoofd, Hengelo, and Denekamp Interstadials, recognized in the Netherlands (van der Hammen *et al.,* 1967; Vogel and Zagwijn, 1967). Late Glacial boundaries of Wijmstra, however, do not correspond with C^{14} dates which would place this period between 6.4 and 5.4 m depth. Age-depth curve gives rise of *Quercus* and establishment of *Tilia* at ca. 11,200 B.P.; estab-

lishment of *Ulmus* at ca. 10,000 B.P. and *Alnus* shortly thereafter. A brief maximum (28%) of *Artemisia* at 4.6 m or 8500 B.P. is considered by Wijmstra to represent Younger Dryas period.

Ioannina series, Greece

In drained marsh 14 km NW of Ioannina (39° 46′ N Lat, 20° 44′ E Long), Epirus, Greece, 11.6 m boring by W. van Zeist and S. Bottema gave pollen diagram covering postglacial and large part of Last Glacial periods (Bottema, 1967). Pollen Zone I (bottom) shows high percentage of herbs, Zone II (11 m to 6.8 m) high tree-pollen percentage, Zone III (6.7 m to 3 m) high percentage of herbs, Zone IV (2.8 m to top) high tree-pollen percentage. Zone II reflects warmer and moister climate than Zone I and III although high percentage of *Fagus* suggests it was cooler than present (Zone IV). Samples subm. 1966 by W. van Zeist and S. Bottema, Univ. Groningen, Netherlands.

GrN-4793. Ioannina 7.90 m **40,000 ± 1000**
38,050 B.C.

Thin peat layer at 7.80 m to 8.00 m depth in top of Zone IIb (high *Pinus*). *Comment*: pretreated with acid and alkali. Sub-zone IIb preceded and followed by oak maxima. Comparison with pollen diagram of Tenagi Philippon (see above) suggests Zone II corresponds to end of Early Glacial and Lower Pleniglacial, though date places it slightly higher in sequence. Pleniglacial, though in region seems to change from cool and moist to cold and dry.

GrN-4875. Ioannina 2.67 m **10,200 ± 90**
8250 B.C.
$\delta C^{13} = -26.2‰$

Peaty clay at 2.65 m to 2.69 m depth at bottom of Zone IV. *Comment*: pretreated with acid only. Oak already predominant. Date corresponds to Late Glacial/postglacial boundary in NW Europe.

Padul series, Spain

In peat bog SE of Padul (37° 02′ N Lat, 3° 37′ W Long), prov. of Granada, Spain, >50 m pollen-bearing peat and clay represent considerable part of Pleistocene. Four cores, II, IV, V, and VI, coll. for pollen analysis in 1958-1960 and 1965, respectively. Preliminary pollen diagram of Core IV (Menéndez Amor and Florschütz, 1962, 1964) interpreted to show Last Glacial between ca. 17 m and 3.5 m with *Pinus* dominance and <5% *Quercetum mixtum* between 12.0 m and 5.3 m. Above 5.1 m *Quercetum mixtum* increases to >40% and *Pinus* decreases to ca. 15%, with a relapse between 4.4 m and 4.1 m. Between 12.7 m and 24 m up to 40% *Quercetum mixtum* occurs, but *Pinus* is mostly dominant. 10 cm portions of cores subm. by the late F. Florschütz.

GrN-850. Padul II 3 **32,830 ± 1200**
30,880 B.C.

Peat from 7.90 m depth in Core II.

10,470 ± 120
8520 B.C.

GrN-1950. Padul II 2
Peat from 3.90 m depth in Core II.

6360 ± 85
4410 B.C.

GrN-1949. Padul II 1
Peat from 1.40 m depth in Core II.

General Comment: dates of Core II incorporated in pollen diagram of Core IV in Menéndez Amor and Florschütz (1964).

GrN-2630. Padul IV 10 **>54,000**
Peat from 11.37 m depth in Core IV.

GrN-2657. Padul IV 9 **>51,000**
Peat from 10.87 m depth in Core IV.

46,440 ± 2000
44,490 B.C.

GrN-2147. Padul IV 8
Peat from 10.37 m depth in Core IV.

43,220 ± 900
41,270 B.C.

GrN-2658. Padul IV 7
Peat from 9.37 m depth in Core IV.

38,540 ± 1300
36,590 B.C.

GrN-2146. Padul IV 6
Peat from 8.37 m depth in Core IV.

34,370 ± 900
32,420 B.C.

GrN-2145. Padul IV 5
Peat from 7.37 m depth in Core IV.

30,270 ± 450
28,320 B.C.

GrN-2955. Padul V 2
Peat from 6.90 m depth in Core V.

17,000 ± 145
15,050 B.C.

GrN-2327. Padul IV 4
Peat from 5.87 m depth in Core IV.

13,000 ± 100
11,050 B.C.

GrN-2952. Padul V 1
Peat from 4.40 m depth in Core V.

10,110 ± 85
8160 B.C.

GrN-2191. Padul IV 3
Peat from 3.87 m depth in Core IV. Stratigraphically same as GrN-1950, above.

6750 ± 90
4800 B.C.

GrN-2187. Padul IV 2
Peat from 1.87 m depth in Core IV.

4980 ± 60
3030 B.C.

GrN-2185. Padul IV 1
Peat from 0.11 m depth in Core IV.

General Comment: all samples pretreated with acid only. By interpolation, *Quercetum mixtum* forest increases from a few per cent to 37% at ca. 15,000 B.P. and is below 5% between 13,000 and 11,000 B.P. when *Pinus* is dominant. After 11,000 B.P., *Quercetum mixtum* gains permanent dominance. Wide spacing of pollen samples may have caused fine structure between 13,000 and 11,000 B.P. to have been missed.

GrN-4808. Padul VI 1b **>47,000**

Peat from 12.50 to 12.55 m depth in Core VI. *Comment*: pretreated with acid and cold alkali. On basis of pollen diagram of Core IV, this and GrN-4805, below, expected to date disappearance of *Quercetum mixtum* forest in Early Glacial.

GrN-4805. Padul VI 1 **39,150 ± 920**
37,200 B.C.

Peat from 12.35 to 12.45 m depth in Core VI. *Comment*: pretreated with acid and alkali. Compared with GrN-4956, GrN-5026, and GrN-2630, this sample too young.

GrN-4943. Padul VI 2, residue **41,400 ± 1000**
39,450 B.C.

GrN-4956. Padul VI 2, extract **49,000 ± 2500**
47,050 B.C.

GrN-5026. Padul VI 2, extract (enriched) **45,000 ± 330**
43,050 B.C.

Peat from 11.87 to 12.32 m depth in Core VI. *Comment*: pretreated with acid and cold alkali, both fractions dated. Since most of the organic matter dissolved in alkali and this fraction gave higher age, 100 g of extract combusted for isotopic enrichment and enriched by factor 8.00 ± .05 before measurement. Residue appears too young, compared with extract, and all dates at this depth are too young if depths in Core VI are stratigraphically same as in Core IV. Until pollen diagram of Core VI is available, no explanation for discrepancy is possible.

3. Holocene of the Netherlands

Bourtanger Moor series, Netherlands

Peat bog development in remains of former large raised bog "Bourtanger Moor", E of Emmen (52° 48′ N Lat, 7° 0′ E Long), prov. of Drenthe, Netherlands, was studied by W. A. Casparie (in press). Series consists of 23 dates on *Pinus* stumps from 5 localities (A-E) and levels in bog, which could be grouped dendro-chronologically by A. V. Munaut into several floating tree-ring sequences, the 2 longest (groups D° and DEE°) comprising 330 and 369 yr. Dates were used by Vogel, Casparie, and Munaut (1969) for studying trends in C^{14} content of atmosphere before 6000 B.P. See also Munaut and Casparie (in press). Sample coll. by W. A. Casparie, Biol.-Archeol. Inst., Univ. Groningen, Netherlands, and A. V. Munaut, Lab. Palynol. et Phytosociol., Heverlee-Louvain, Belgium.

GrN-4267. Emmen D° 1-6 — **6910 ± 30** / **4960 B.C.** / $\delta C^{13} = -25.2‰$

Tree rings 234 to 244 from Stump D° 1.

GrN-4266. Emmen D° 1-5 — **7005 ± 35** / **5055 B.C.** / $\delta C^{13} = -24.2‰$

Tree rings 184 to 194 from Stump D° 1.

GrN-4265. Emmen D° 1-4 — **7025 ± 30** / **5075 B.C.** / $\delta C^{13} = -24.6‰$

Tree rings 134 to 144 from Stump D° 1.

GrN-4264. Emmen D° 1-3 — **7170 ± 30** / **5220 B.C.** / $\delta C^{13} = -26.3‰$

Tree rings 84 to 94 from Stump D° 1.

GrN-4263. Emmen D° 1-1 — **7130 ± 30** / **5180 B.C.** / $\delta C^{13} = -26.4‰$

Tree rings 29 to 39 from Stump D° 1.

GrN-4276. Emmen E° 1-4 — **6150 ± 30** / **4200 B.C.** / $\delta C^{13} = -25.3‰$

Tree rings 207 to 217 from Stump E° 1.

GrN-4278. Emmen E° 1-3 — **6225 ± 32** / **4275 B.C.** / $\delta C^{13} = -24.8‰$

Tree rings 157 to 167 from Stump E° 1.

GrN-4277. Emmen E° 1-2 — **6230 ± 33** / **4280 B.C.** / $\delta C^{13} = -24.8‰$

Tree rings 107 to 117 from Stump E° 1.

GrN-4279. Emmen E° 1-1 — **6290 ± 32** / **4340 B.C.** / $\delta C^{13} = -24.9‰$

Tree rings 57 to 67 from Stump E° 1.

GrN-4303. Emmen E 4-4 — **6075 ± 63** / **4125 B.C.** / $\delta C^{13} = -24.3‰$

Tree rings 172 to 182 from Stump E 4.

GrN-4302. Emmen E 4-3 — **6220 ± 63** / **4270 B.C.** / $\delta C^{13} = -24.2‰$

Tree rings 122 to 132 from Stump E 4.

GrN-4301. Emmen E 4-1 **6200 ± 65**
4250 B.C.
$\delta C^{13} = -27.3‰$

Tree rings 22 to 32 from Stump E 4.

GrN-4314. Emmen D 2-1 **6170 ± 64**
4220 B.C.
$\delta C^{13} = -24.6‰$

Tree rings 115 to 123 from Stump D 2.

GrN-4918. Emmen E° 4-6 **6160 ± 30**
4210 B.C.
$\delta C^{13} = -24.8‰$

Tree rings 180 to 190 from Stump E° 4.

GrN-4917. Emmen E° 4-5 **6365 ± 30**
4415 B.C.
$\delta C^{13} = -24.7‰$

Tree rings 150 to 160 from Stump E° 4.

GrN-4916. Emmen E° 4-4 **6310 ± 32**
4360 B.C.
$\delta C^{13} = -25.0‰$

Tree rings 120 to 129 from Stump E° 4.

GrN-4915. Emmen E° 4-3 **6410 ± 32**
4460 B.C.
$\delta C^{13} = -25.2‰$

Tree rings 90 to 100 from Stump E° 4.

GrN-4914. Emmen E° 4-2 **6440 ± 30**
4490 B.C.
$\delta C^{13} = -24.7‰$

Tree rings 61 to 68 from Stump E° 4.

GrN-4913. Emmen E° 4-1 **6325 ± 32**
4375 B.C.
$\delta C^{13} = -25.8‰$

Tree rings 31 to 39 from Stump E° 4.

GrN-4275. Emmen B 2-5 **5890 ± 65**
3940 B.C.
$\delta C^{13} = -26.1‰$

Tree rings 100 to 109 from Stump B 2.

GrN-4274. Emmen B 2-1 **6045 ± 60**
4095 B.C.
$\delta C^{13} = -26.8‰$

Tree rings 1 to 10 from Stump B 2.

GrN-4313. Emmen C 4-1 **4950 ± 40**
3000 B.C.
$\delta C^{13} = -24.6‰$

Tree rings 74 to 89 from Stump C 4.

GrN-4312. Emmen A 2-1 **4990 ± 60**
3040 B.C.
$\delta C^{13} = -24.8‰$

Tree rings 30 to 40 from Stump A 2.

General Comment: all samples pretreated with acid and alkali. For dendrochronologic correlation of stumps, see Vogel, Casparie, and Munaut (1969). Using known age differences between samples of individual stumps, mean dates of outermost samples per stump are 6945 ± 15 for D° 1, 6150 ± 15 for E° 1, 6100 ± 40 for E 4, 6260 ± 13 for E° 4, and 5920 ± 45 for B 2. Dates indicate 3 main periods of local bog desiccation and overgrowth with *Pinus* forests, roughly ending at 7000, 6000, and 5000 B.P. respectively.

GrN-4802. Klazienaveen 2 **4600 ± 90**
2650 B.C.
$\delta C^{13} = -26.3‰$

Middle 1 cm of 2-cm-thick layer of dopplerite, forming transition of iron-rich seepage peat to *Sphagnum* peat in Sec. Emmen 19 at Klazienaveen-Noord. Depth 1.90 to 2.20 m. In same stratigraphic position as *Pinus* stump Layer A, expected contemporary with GrN-4312. Coll. 1964. *Comment*: pretreated with acid only. Somewhat younger than expected.

GrN-4625. Klazienaveen 1 **4440 ± 70**
2490 B.C.

Outermost 25 to 30 tree rings of *Pinus* stump in dopplerite layer within *Sphagnum* peat at higher stratigraphic position in same sec. as preceding sample at Klazienaveen-Noord. Depth ca. 1.70 m. Expected age ca. 2500 B.C. Coll. 1964. *Comment*: later occurrence of *Pinus* than in main periods of desiccation.

GrN-4801. Splitting **4360 ± 55**
2410 B.C.
$\delta C^{13} = -23.8‰$

Outermost tree rings (50 to 60) from most E stump from Stump Layer B in Sec. Emmen 29 at Splitting, 2 km E of Bargeroosterveld. Depth 1.30 m. Expected age ca. 3000 B.C. Coll. 1964. *Comment*: younger than main stump layer at Loc. A, about same age as preceding sample.

GrN-4804. Bargercompascuum 3 **4240 ± 60**
2290 B.C.
$\delta C^{13} = -26.6‰$

Middle 1 cm of 2-cm-thick layer of dopplerite at transition of iron-rich seepage peat and highly humified *Sphagnum* peat in Sec. Emmen 31 at Bargercompascuum. Depth ca. 1.70 m. Expected age ca. 5000 B.P. Coll. 1964.

GrN-4803. Bargercompascuum 2 **4300 ± 55**
2350 B.C.
$\delta C^{13} = -28.3‰$

Upper 1 cm of lower of 2 layers of iron-poor fen peat of local occurrence within main Sphagnum peat formation. Same sec. as preceding sample. Depth ca. 1.20 m. Expected age 4500 to 3500 B.P. Coll. 1964.

GrN-4626. Bargercompascuum 1 **3870 ± 60**
1920 B.C.
$\delta C^{13} = -26.9‰$

Upper 1 cm of upper of 2 layers of iron-poor fen peat of local occurrence within main *Sphagnum* peat formation. Same sec. as preceding 2 samples. Depth ca. 0.80 m. Coll. 1964. Expected age shortly before 4000 B.P.

General Comment: GrN-4804 (dopplerite) too young.

GrN-4146. Emmererfscheidenveen GH 2 **3765 ± 40**
1815 B.C.
$\delta C^{13} = -26.6‰$

Upper 1/3 cm of highly humified *Sphagnum* peat just below "Grenzhorizont" in bog Sec. Emmen 11 at Emmererfscheidenveen. Depth 1.79 m. Coll. 1962.

GrN-4148. Emmererfscheidenveen GH 1 **3750 ± 40**
1800 B.C.
$\delta C^{13} = -26.2‰$

Lower 1/3 cm of slightly humified *Sphagnum* peat in same sec. as preceding sample, just above "Grenzhorizont." Depth 1.79 m. Coll. 1962. *General Comment*: both samples pretreated with acid only. No significant difference between samples.

GrN-4624. Emmererfscheidenveen—Groene Dijk 3 **3840 ± 60**
1890 B.C.
$\delta C^{13} = -27.3‰$

Lower cm of moderately humified *Sphagnum* peat just above highly humified peat in tussock of *Sphagnum* peat in Sec. Emmen 17 at Emmererfscheidenveen (Tweede Groene Dijk). Depth 1.15 m. Coll. 1962. *Comment*: see Casparie (1969).

GrN-4623. Emmererfscheidenveen—Groene Dijk 2 **2490 ± 60**
540 B.C.
$\delta C^{13} = -25.5‰$

Upper cm of moderately humified *Sphagnum* peat, immediately below slightly humified *Sphagnum* peat in same sec. as preceding sample. Depth ca. 0.40 m. Coll. 1962. *Comment*: see Casparie (1969).

General Comment: all samples pretreated with acid and alkali except where otherwise stated. Standard pollen sec. Emmen pub. in Science, 1958, v. 127, p. 3293. From same bog are dates Zwartemeer (*ibid.*, v. 128, p. 1552) and archaeol. dates Valthe (trackway((*ibid.*, v. 128, p. 1553), Nieuw-Dordrecht (trackway) (R., 1963, v. 5, p. 181), Bargeroosterveld (Bronze age sanctuary) (*ibid.*, p. 191) and Emmererfscheidenveen series

(2 trackways) (R., 1967, v. 9, p. 135). One trackway date, Emmererf-scheidenveen- N foot-path, GrN-4622, below.

7535 ± 50

GrN-5180. Lutterzand, Netherlands **5585 B.C.**

$\delta C^{13} = -26.6‰$

Sandy peat on top of younger coversand in Late Glacial valley exposed in sec. on shore of Dinkel R. in Lutterzand near Denekamp (52° 22′ N Lat, 7° 0′ E Long), prov. of Overijssel, Netherlands. Depth 1.10 m below surface. Peat antedates dunesand formation with many peaty intercalations. Pollen analysis points to Late Boreal (Sub-Boreal age according to submitters). Coll. and subm. 1967 by E. Brinkman and T. van der Hammen, present address H. de Vries Lab., Univ. Amsterdam, Netherlands. *Comment*: pretreated with acid and cold alkali. Date confirms Late Boreal age, indicated by pollen diagram, and suggests Atlantic age for dune formation.

Astense Peel series, Netherlands

Pollen sequences in Astense Peel peat bog near Ospel (51° 18′ N Lat, 5° 46′ E Long), prov. of Noord-Brabant, Netherlands, were studied 1957 by the late F. Florschütz and 1965 in greater detail by C. R. Jansen, Bot. Mus., Univ. Utrecht, Netherlands. The 1st sec. (Astense Peel), intended to be a standard pollen sec., was coll. and subm. 1957 by F. Florschütz. In 2nd sec. (Groote Peel), 2 prehistoric and 2 historic cultivation levels can be distinguished. Samples from this sec. coll. by C. R. Jansen from exposure down to 1.35 m and boring down to 1.60 m in 1965; subm. 1966 and 1968.

6170 ± 85

GrN-1585. Astense Peel 1 **4220 B.C.**

Peaty clay, depth 2.89 to 2.90 m, at base of sec. Boundary Boreal/Atlantic.

5350 ± 80

GrN-1595. Astense Peel 6 **3400 B.C.**

Birch stem, depth 2.00 to 2.07 m. Strong increase of *Alnus* and *Corylus*. Atlantic or Sub-Boreal.

3370 ± 60

GrN-1586. Astense Peel 3 **1420 B.C.**

Peat, depth 0.82 to 0.83 m. Beginning of strong decrease of *Corylus;* increase of *Fagus*; beginning of continuous *Carpinus* curve. Presumably Sub-Boreal.

1380 ± 55

GrN-1593. Astense Peel 4 **A.D. 570**

Older *Sphagnum* peat, 0.26 to 0.27 m. Sub-Boreal or Sub-Atlantic.

1230 ± 50

GrN-1594. Astense Peel 5 **A.D. 720**

Younger *Sphagnum* peat at 0.24 to 0.25 b. Sub-Boreal or Sub-Atlantic.

GrN-5163. Groote Peel 1 **4470 ± 30**
2520 B.C.
$\delta C^{13} = -26.4‰$

Peat from 1.29 to 1.31 m depth at 2nd prehistoric cultivation level with minimum in *Tilia* curve.

GrN-5165. Groote Peel 2 **3300 ± 50**
1350 B.C.
$\delta C^{13} = -26.3‰$

Peat from 0.72 to 0.74 m depth marking beginning of *Fagus* expansion.

GrN-5164. Groote Peel 3 **1885 ± 40**
A.D. 65
$\delta C^{13} = -26.9‰$

Peat from 0.57 to 0.59 m depth, marking 1st *Fagus* maximum and first "historic" cultivation level (*Cerealia* max.).

GrN-5166. Groote Peel 4 **1225 ± 40**
A.D. 725
$\delta C^{13} = -26.4‰$

Peat from 0.20 m depth, marking 2nd *Fagus* maximum just before 2nd "historic" cultivation level.

General Comment: Samples 2 and 3 were initially interchanged at some stage. To gain complete certainty check samples were subm. 1968.

GrN-5619. Groote Peel GRP 1 **4510 ± 85**
2560 B.C.
$\delta C^{13} = -27.4‰$

Peat from 1.57 to 1.60 m depth in boring, marking 1st occurrence of *Plantago lanceolata* (landnam) and *Ulmus* decline.

GrN-5621. Groote Peel GRP 3 **3100 ± 50**
1150 B.C.
$\delta C^{13} = -24.7‰$

Peat from 0.71 to 0.72 m depth in same profile as GrN-5165, above (check sample).

GrN-5620. Groote Peel GRP 2 **2890 ± 70**
140 B.C.
$\delta C^{13} = -27.7‰$

Peat from 0.55 to 0.58 m depth in same profile as GrN-5164, above (check sample).

General Comment: all samples pretreated with acid only. Check samples confirm dating and order of 1st Groote Peel series. *Fagus* increase is contemporeaneous in both secs. (Samples Astense Peel 3 and Groote Peel 2).

Schipluiden series, Netherlands

Alternating peat and clay layers in boring at Schipluiden (51° 58′ N Lat, 4° 42′ E Long), prov. of Zuid-Holland, Netherlands. Top of

profile is —2.80 m. Pollen diagram prepared by A. A. Hartman (1968). Absolute quantity of pollen precipitation per year calculated from analysis data (Hartman, 1968). Coll. 1966 by Geol. Survey of the Netherlands; subm. 1967 by T. van der Hammen, H. de Vries Lab., Univ. Amsterdam, Netherlands.

GrN-5143. Schipluiden 4.69 m **6020 ± 70** **4070 B.C.**

Lower peat layer at 4.69 to 4.70 m depth. Pollen zone Atlantic. Decrease of *Corylus*.

GrN-5459. Schipluiden 4.35 m **5740 ± 110** **3790 B.C.**

Thin gyttja layer on top of lower peat layer at 4.35 to 4.38 m depth. Pollen zone Atlantic. *Corylus* low.

GrN-5380. Schipluiden 3.60 m **5050 ± 45** **3100 B.C.**

$\delta C^{13} = -26.7‰$

Lower part of 2nd peat layer at 3.60 m depth. Pollen zone Sub-Boreal (after *Ulmus* decline). *Corylus* low.

GrN-5328. Schipluiden 3.10 m **4785 ± 60** **2835 B.C.**

$\delta C^{13} = -27.8‰$

Top of 2nd peat layer at 3.10 to 3.13 m depth. Pollen zone Sub-Boreal. *Corylus* high.

GrN-5379. Schipluiden 2.25 m **4430 ± 60** **2480 B.C.**

$\delta C^{13} = -26.9‰$

Base of 3rd peat layer at 2.25 m depth. Pollen zone Sub-Boreal *Corylus* low.

GrN-5378. Schipluiden 1.25 m **3220 ± 75** **1270 B.C.**

$\delta C^{13} = -27.4‰$

Middle of 3rd peat layer at 1.25 m depth. Pollen zone Sub-Boreal. First increase of *Fagus*.

GrN-5327. Schipluiden 1.23 m **3530 ± 60** **1580 B.C.**

$\delta C^{13} = -27.0‰$

Peaty gyttja intercalation in 3rd peat layer at 1.23 m depth. Pollen zone Sub-Boreal. First increase of *Fagus*; 1st occurrence of *Carpinus*.

GrN-5377. Schipluiden 1.05 m **3605 ± 50** **1655 B.C.**

$\delta C^{13} = -27.4‰$

Peat at 1.05 m depth. Pollen zone Sub-Boreal. *Fagus* absent; 1st occurrence of *Plantago lanceolata*.

GrN-5329. Schipluiden 0.57 m **3380 ± 50**
1430 B.C.
$\delta C^{13} = -27.4‰$

Top of 3rd peat layer at 0.57 to 0.60 m depth. Pollen zone Sub-Boreal. Second increase of Fagus.

General Comment: all samples pretreated with acid only. GrN-5378 and probably GrN-5327 appear too young, which, according to Hartman, may be due to contamination. Or peaty material and gyttja may have been deposited under uplifted floating peat (Troels-Smith, 1960).

GrN-5238. Vlaardingen peat, Netherlands **2960 ± 55**
1010 B.C.
$\delta C^{13} = -27.9‰$

Base of peat layer from boring at depth 1.27 to 1.30 m below surface clay deposits at Vlaardingen (51° 54′ N Lat, 4° 21′ E Long), prov. of Zuid-Holland. Lower clay layer (gully deposit) wedges out laterally into peat above which occur Early Iron age remains. Date should prove this correlation, which did not fit in with current views on geology of area. Coll. and subm. 1967 by J. D. de Jong, Geol. Dienst, Haarlem; subm. by J. F. van Regteren Altena, Rijksdienst voor het Oudheidkundig Bodemonderzoek, Amersfoort, Netherlands. *Comment*: date proves high age of underlying clay and confirms stratigraphic observation. For date of Iron age settlement in peat layer in same area see GrN-1951: 2320 ± 70 (Broekpolder, R., 1963, v. 5, p. 193).

GrN-4601. Oosterhout, Netherlands **2980 ± 70**
1030 B.C.

Charcoal pieces from thin layer of heavy clay in river at 1.05 to 1.10 m depth in boring near Oosterhout, Elst (51° 55′ N Lat, 5° 51′ E Long), prov. of Gelderland, Netherlands. Coll. 1963 by A. J. Havinga; subm. 1964 by B. Polak, Landbouwhogeschool, Wageningen, Netherlands. *Comment*: pretreated with acid and alkali.

GrN-4371. Bunnik, Netherlands **2930 ± 60**
980 B.C.
$\delta C^{13} = -24.7‰$

Charcoal pieces from continuous layer at 0.83 to 0.86 m depth between overlying river clay and underlying clayey peat and peat in pit near Bunnik (52° 4′ N Lat, 5° 12′ E Long), prov. of Utrecht. Pollen diagram of peat indicates Late Sub-Boreal. Coll. 1963 and subm. 1964 by the late K. J. Zandstra, Wageningen. *Comment*: pretreated with acid and alkali. Date was expected.

GrN-4600. Hellouw, Netherlands **2460 ± 75**
510 B.C.
$\delta C^{13} = -27.3‰$

Small charcoal pieces in dark gray, very heavy clay layer (*laklaag*), at 0.55 to 0.65 m depth, formed during interruption of clay deposition in river marsh near Hellouw, Haaften (51° 48′ N Lat, 5° 13′ E Long),

prov. of Gelderland. Expected age ca. 2000 B.P. Coll. 1963 by A. J. Havinga; subm. 1964 by B. Polak. *Comment*: pretreated with acid and cold alkali.

West-Friesland series, Netherlands

In W-Friesland, prov. of Noord-Holland between towns Alkmaar, Medemblik, Enkhuizen, and Hoorn (52° 38′ N Lat, 5° 4′ E Long), studies revealed sequence of Sub-Boreal marine intrusions, interrupted by periods of fresh-water peat formation in depressions and possible human habitation on elevated parts (Pons and Wiggers, 1960; Kwaad, 1961; Kwaad *et al.*, 1965; du Burck and Dekker, 1968). Marine deposits are called Beemster, Wieringermeer, Westfrisian I, Westfrisian II, and Westfrisian III.

4670 ± 55

GrN-1583. Zandwerven shells **2720 B.C.**

Shell bank (mainly *Cardium edule*) below sand ridge at Zandwerven, Spanbroek (52° 41′ N Lat, 4° 56′ E Long). Shells indicate marine environment. Subm. by the late J. P. Bakker, Phys. Geog. Lab., Univ. Amsterdam. *Comment*: date of Neolithic settlement (Vlaardingen culture) on ridge GrN-2221: 4000 ± 65, this list.

4760 ± 75

GrN-2386. Hoorn 2 **2810 B.C.**

Base of peat atop Beemster clay in profile at Westerblokker near Hoorn (52° 38′ N Lat, 5° 4′ E Long). Depth 4.07 to 4.12 m. Coll. and subm. by F. J. P. M. Kwaad, Phys.-Geog. Lab., Univ. Amsterdam.

3760 ± 60

GrN-2379. Hoorn 1 **1810 B.C.**

Top of same peat layer at depth 3.38 to 3.43 m, underlying Westfrisian deposits. *Comment*: thin peat layer at 1.10 to 1.20 m depth in same sec. separates Westfrisian I and II deposits.

4485 ± 85

GrN-4619. Oostmijzen **2535 B.C.**

Thin gyttja layer over clay and under peat at 0.92 to 0.95 m depth in boring at Oostmijzen (52° 36′ N Lat, 4° 56′ E Long). Coll. 1964 by P. du Burck, Stichting voor Bodemkartering, Bennekom; subm. 1965 by G. C. Maarleveld.

4420 ± 85

GrN-2389. Wadwaaij 3 **2470 B.C.**

Top of peat underlying clay, probably belonging to Wieringermeer formation at Wadwaaij, Spanbroek (52° 41′ N Lat, 4° 56′ E Long), 2 km E of Zandwerven sand ridge. Clay below peat probably Beemster deposit. Depth 2.18 to 2.23 m. This and 2 following samples subm. by the late J. P. Bakker.

GrN-2975. Wadwaaij 2 **4125 ± 75**
2175 B.C.

Base of peat overlying Wieringermeer clay, at 1.72 to 1.77 m depth in same sec. as preceding sample.

GrN-2382. Wadwaaij 1 **3935 ± 100**
1985 B.C.

Top of same peat layer as preceding sample, at 1.48 to 1.53 m depth, antedating overlying Westfrisian deposits.

GrN-2499. Berkhout **4230 ± 75**
2280 B.C.

Base of peat overlying Beemster deposit at Berkhout (52° 38′ N Lat, 4° 57′ E Long). Subm. by L. J. Pons. *Comment*: date suggests either hiatus or wrong attribution of clay deposit.

GrN-4620. Opmeer 1 **4150 ± 80**
2200 B.C.
$\delta C^{13} = -23.6‰$

Thin layer of fen-peat intercalated between clay at 1.16 to 1.18 m depth in boring at Opmeer (52° 42′ N Lat, 4° 56′ E Long). Coll. 1964 by P. du Burck; subm. 1965 by G. C. Maarleveld.

GrN-4621. Opmeer 2 **3635 ± 75**
1685 B.C.
$\delta C^{13} = -26.4‰$

Humic layer in same boring as preceding sample at 0.65 to 0.67 m depth. Deposit between both samples consists of clay and sandy clay attributed to Westfrisian I formation.

GrN-5555. Hoogwoud 2 **4160 ± 65**
2210 B.P.
$\delta C^{13} = -25.7‰$

Thin layer of humic clay between clay deposits at 0.98 to 1.02 m depth in profile pit at Hoogwoud (52° 42′ N Lat, 4° 56′ E Long). Coll. and subm. 1967 by P. du Burck.

GrN-5554. Hoogwoud 1 **3440 ± 90**
1490 B.C.
$\delta C^{13} = -26.4‰$

Thin layer of humic clay in same profile pit as preceding sample at 0.61 to 0.625 m depth. According to preliminary interpretation, lower humic layer should represent dividing line between Westfrisian I and Westfrisian II formations. *Comment*: dates suggest upper humic layer to separate Westfrisian I and II deposits (see Opmeer, above).

GrN-5553. Zuidscharwoude 2 **3800 ± 45**
1850 B.C.
$\delta C^{13} = -27.5‰$

Base of peat at 1.14 to 1.17 m depth atop heavy clay in boring at Zuidscharwoude (52° 42′ N Lat, 4° 49′ E Long). According to pre-

liminary interpretation, clay should be earlier than Westfrisian I. Coll. and subm. as samples from Hoogwoud.

3500 ± 45
GrN-5552. Zuidscharwoude 1 **1550 B.C.**

Top of same peat as preceding sample at 0.66 to 0.69 m depth. Overlying clay presumably Westfrisian. Coll. and subm. as above. *Comment*: date indicates that clay layers belong to Westfrisian I and II deposits, respectively.

3155 ± 110
GrN-611. Grootslag **2205 B.C.**

Peat in top of Westfrisian II deposits in polder Grootslag near Zwaagkdijk (52° 42′ N Lat, 5° 9′ E Long). Subm. by P. J. Ente.

2950 ± 85
GrN-823. Warmenhuizen **1000 B.C.**

Organic layer atop marine deposit, possibly Westfrisian III, at Warmenhuizen (52° 43′ N Lat, 4° 44′ E Long). Subm. 1958 by P. du Burck.

2930 ± 80
GrN-3546. Wogmeer **980 B.C.**

Lowermost 1 cm peat over tidal flat clay, SW of Zandwerven sand ridge at Wogmeer (52° 39′ N Lat, 4° 55′ E Long). Coll. 1961; subm. by W. Glasbergen, Inst. v. Pre- en Protohistorie, Univ. Amsterdam. *Comment*: all samples pretreated with acid; GrN-4621, -5552-55 also extracted with cold alkali. Date suggests prolonged tidal flat sedimentation W of Zandwerven sand ridge (van Regteren Altena *et al.,* 1963). *General Comment*: dates should be compared with those from standard sec. Hauwert (Science, 1958, v. 127, p. 131) GrN-605: 4690 ± 140 for base of peat layer between Beemster and Wieringermeer deposits, GrN-610: 4090 ± 120 for thin peat layer between Wieringermeer and Westfrisian I deposits, GrN-609: 3750 ± 120 for thin peat layer between Westfrisian I and II deposits, and GrN-617: 3240 ± 140 for shells within Westfrisian II clay. Based on peat dates, the following estimates can be made for main periods of marine clay sedimentation: Beemster ? to 4800, Wieringermeer 4400 to 4200, Westfrisian I 4000 to 3800, Westfrisian II 3400 to 3200, Westfrisian III 3100 to 3000. Settlement of Vlaardingen culture on Zandwerven sand ridge dated GrN-221: 2040 ± 65, this list. Bell Beaker culture settlement occurs on Westfrisian I deposit at Oostwoud (van Giffen, 1962). Bronze age settlements occur at various places, e.g., over Westfrisian II deposits at Zwaagdijk with date GrN-4243: 3200 ± 60 (R., 1967, v. 9, p. 134). For dates from Bronze age barrows in area, ranging from 3025 to 2965, see Wervershoof series (R., 1963, v. 4, p. 191). For dates from Bronze age barrow and Iron age settlement at Hoogkarspel, see this list.

4. Holocene of Other Countries

Niederwil bog series, Switzerland

In addition to investigation of a Neolithic settlement in bog (Egelsee) at Niederwil, Gem. Gachnang, near Frauenfeld (47° 34′ N Lat, 8° 54′ E Long), Thurgovia, Switzerland (Waterbolk and van Zeist, 1967), boring was made into deeper levels. Simplified pollen diagram by J. M. Matthews with C^{14} dates pub. by Vogel (1970) and compared with diagram for Faulenseemoos to study C^{14} trends in atmosphere before 6000 B.P. Coll. 1963 by W. van Zeist.

GrN-4951. Niederwil 6.90 to 6.99 m **12,780 ± 110**
10,830 B.C.
$\delta C^{13} = -21.1‰$

Gyttja at depth 6.90 to 6.99 m. *Betula* dominant, *Pinus* very low.

GrN-5203. Niederwil 6.00 to 6.08 m **10,680 ± 90**
8730 B.C.
$\delta C^{13} = -22.4‰$

Gyttja at depth 6.00 to 6.08 m. *Pinus* dominant, *Betula* low.

GrN-4952. Niederwil 5.60 to 5.68 m **10,310 ± 125**
8360 B.C.
$\delta C^{13} = -18.1‰$

Gyttja at depth 5.60 to 5.68 m. *Pinus* and *Betula* high, *Corylus* low, just before sharp increase.

GrN-5355. Niederwil 5.11 to 5.18 m **9000 ± 100**
7050 B.C.
$\delta C^{13} = -21.2‰$

Gyttja at depth 5.11 to 5.18 m. *Pinus* low. *Quercetum mixtum* high. *Corylus* peak.

GrN-4987. Niederwil 4.31 to 4.39 m **8170 ± 80**
6230 B.C.
$\delta C^{13} = -18.7‰$

Gyttja at depth 4.31 to 4.39 m. *Quercetum mixtum* and *Corylus* high.

GrN-5354. Niederwil 3.50 to 3.60 m **7660 ± 80**
5710 B.C.
$\delta C^{13} = -16.9‰$

Gyttja at depth 3.50 to 3.60 m. *Quercetum mixtum* and *Corylus* high. First occurrence of *Abies*. Just before appearance of *Fagus*.

GrN-4955. Niederwil 2.80 to 3.10 m **7010 ± 60**
5060 B.C.
$\delta C^{13} = -16.9‰$

Gyttja from depths 2.80 to 2.98 and 3.00 to 3.10 m. *Comment*: sample pretreated with dilute acid *and* cold alkali.

7100 ± 70
GrN-4954. Niederwil 2.90 to 2.98 m **5150 B.C.**
$\delta C^{13} = -16.3‰$

Gyttja from depth 2.90 to 2.98 m. *Quercetum mixtum* and *Corylus* high. *Fagus* increasing.

6120 ± 75
GrN-5353. Niederwil 2.51 to 2.58 m **4170 B.C.**
$\delta C^{13} = -15.3‰$

Gyttja from depth 2.51 to 2.58 m. First maximum of *Fagus*.

4960 ± 80
GrN-5202. Niederwil 2.00 to 2.09 m **3010 B.C.**
$\delta C^{13} = -22.3‰$

Gyttja from depth 2.00 to 2.09 m. *Cerealia* and other culture indicators present.

General Comment: since no significant difference between GrN-4955 on fully pretreated sample and GrN-4954 on sample pretreated with acid only, other samples were pretreated with acid only. For more dates of Swiss pollen sequences, see R., 1970, v. 12, p. 359-379. Dates from Neolithic settlement Niederwil pub. in R., 1967, v. 9, p. 132.

6825 ± 70
GrN-854. Fagne Wallone, Belgium **4875 B.C.**

Wood (*Betula*) from base of peat layer at depth 1.80 to 2.00 m in Fagne Wallone (50° 31′ N Lat, 6° 7′ E Long), Belgium. Wood overlain by 0.25 m of Atlantic *Scheuchzeria* peat and 1.50 m of Sub-Boreal *Eriophorum vaginatum* peat. Alt. 643 m. Coll. 1958 by R. Bouillenne and M. Streel, Univ. Liege, Belgium; subm. by the late F. Florschütz.

9040 ± 55
GrN-4492. Beune valley, France **7090 B.C.**
$\delta C^{13} = -24.9‰$

Dark brown silty mud from 13.40 to 13.90 m depth in Boring II in valley deposit of Beune R. (44° 56′ N Lat, 1° 42′ W Long), 3.5 km E of Les Eyzies, Périgord (Donner, 1969). Pollen diagram shows for sampled depth steep decrease of *Pinus,* increase of *Quercus* and steep increase of *Corylus,* interpreted as beginning of postglacial. Coll. 1963 and subm. 1964 by J. J. Donner, Dept. Geol. and Paleontol., Univ. Helsinki, Finland. *Comment*: pretreated with acid only. Two small samples (13.65 to 13.90 m and 13.45 to 13.65 m) taken together. Since main changes in pollen diagram occur in lower sample and relative organic content of both samples is unknown, date may apply to level after major vegetational changes and thus not contradictory to date Q-617: 9960 ± 160 for *Corylus* rise in diagram of boring La Moura near Biarritz (R., 1964, v. 6, p. 132). In this interpretation level 14.20 to 13.90 m with absence of *Quercus* and *Corylus,* and *Pinus* dominance, could be equivalent to Upper Dryas period and level 15.20 to 14.20 m with maxima for

Quercus (low) and *Corylus* (medium) would suggest Allerød period. But submitter considers presence of *Quercus* and *Corylus* pollen in these sand and silt levels due to contamination. He attributes whole sequence to postglacial (Donner, 1969).

7430 ± 100

GrN-2043. Fromentine, France **5480 B.C.**

Thin sedge peat layer from boring at 9.50 m depth below sand and clay on Atlantic coast at Fromentine, commune de la Barre-de-Monts (46° 53′ N Lat, 2° 9′ W Long), Vendée, France. Surface + 2.40 m. Pollen analysis indicates Early Atlantic age of peat (*Quercus* dominant, *Pinus* declining) (Verger and Florschütz, 1960). Coll. 1957 by F. Verger, C.N.R.S., Paris, France; subm. 1959 by the late J. P. Bakker. *Comment*: pretreated with acid only. Date as expected.

Estany series, Spain

Three samples dated from peat and clay in former volcanic crater Estany near Olot near Gerona (ca. 42° 10′ N Lat, ca. 2° 31′ E Long), Spain (Menéndez Amor, 1964). Sec. consists of clay, peat, clayey gyttja, peat, gyttja and clay. Subm. by the late F. Florschütz.

4090 ± 75

GrN-2850. Estany 4.10 to 4.23 m **2140 B.C.**

Peat at depth 4.10 to 4.23 m. *Quercus* dominant, *Corylus* low, all other trees very low.

3200 ± 65

GrN-2839. Estany 3.40 to 3.50 m **1250 B.C.**

Peat at depth 3.40 to 3.50 m. *Quercus* dominant, *Fagus, Pinus,* and *Corylus* ca. 10%.

2460 ± 50

GrN-2837. Estany 2.37 to 2.50 m **510 B.C.**

Peat at depth 2.37 to 2.50 m. *Quercus* dominant, *Fagus* and *Pinus* ca. 10%, *Corylus* very low.

E. Africa, Asia

2230 ± 55

GrN-4853. Gundumi, Nigeria **280 B.C.**

$\delta C^{13} = -27.1‰$

Charcoal particles from distinct, sloping layer in Sangiwa cover-sand at Gundumi (ca. 13° S Lat, 5° 30′ E Long), Sokoto prov., N Nigeria. Depth 0.40 to 0.80 m. Date should be approx. minimum for formation of sandy wash plain on flat surface covered by sheet erosion during "pluvial" period. Expected age Middle to Late Pleistocene. Subm. 1965 by I. S. Zonneveld, FAO, Rome, and F. A. van Baren, Koninklijk Inst. v. de Tropen, Amsterdam, Netherlands. *Comment*: pretreated with acid only. Much younger than expected.

3080 ± 115

GrN-4873. Gölbasi, Turkey **1130 B.C.**

Pollen sequence was studied in middle of 3 lakes in upper reaches

of Aksu R., near town of Gölbasi (37° 45′ N Lat, 37° 33′ E Long), Adiyaman Vilayet, Turkey. Boring reached 13.45 m depth. Sample (marl with clay bands) taken at 13.20 to 13.45 m. Alt 890 m. Pollen diagram shows high arboreal pollen values with *Quercus* dominant, prior to destruction of upland forest. *Quercus* declines at depth 12.50 m (van Zeist *et al.,* 1971). Coll. 1964 and subm. by W. van Zeist, Biol.-Archeol. Inst., Univ. Groningen, Netherlands. *Comment*: pretreated with acid only.

2590 ± 70

GrN-4874. Bozova, Turkey **640 B.C.**

Pollen sequence studied in larger of 2 small lakes (37° 21′ N Lat, 38° 31′ E Long), SW of Bozova, Urfa Vilayet, Turkey. Boring reached 4.80 m depth, but only sec. 0.85 to 1.85 m suitable for pollen analysis. Sample dated (humic clay) from 1.78 to 1.90 m. Alt ca. 600 m. Pollen diagram suggests treeless upland vegetation (van Zeist *et al.,* 1971). Coll. 1964 and subm. by W. van Zeist. *Comment*: pretreated with acid only.

Dead Sea series, Israel

In Dead Sea basin and Jordan valley extensive sediments of mainly calcium carbonate, deposited from former lake Lisan, provided material for dating by C^{14} and Uranium–Thorium. Both methods give approx. same results (Kaufman and Vogel, ms. in preparation). Two profiles analyzed. Samples from Loc. I (31° 20′ N Lat, 35° 20′ E Long) coll. 1963 by D. Neev and J. C. Vogel and those from Loc. II (31° 10′ N Lat, 35° 20′ E Long) coll. 1965 by A. Kaufman, Weizmann Inst., Rehovoth, Israel.

25,800 ± 240

GrN-4411. Lisan I, 19 m **23,850 B.C.**

Carbonate from ca. 19 m below top of Lisan Formation at Loc. I in storm water gully leading to Dead Sea.

35,000 ± 900

GrN-4401. Lisan I, 14 m **33,050 B.C.**

$\delta C^{13} = +0.6‰$

Carbonate from 14 m below top of Upper Lisan Formation and close to base, at Loc. I.

31,400 ± 310

GrN-4402. Lisan I, 10 m **29,450 B.C.**

$\delta C^{13} = +0.1‰$

Carbonate from 10 m below top of Lisan Formation at Loc. I.

16,300 ± 75

GrN-4403. Lisan I, 1 m **14,350 B.C.**

$\delta C^{13} = 0.0‰$

Carbonate from 1 m below top of Lisan Formation at Loc. I representing last carbonate precipitated from Lake Lisan before contraction of Lake.

GrN-4844. Lisan 36-VC **33,850 ± 510**
31,900 B.C.
$\delta C^{13} = +0.3‰$

GrN-4843. Lisan 36-FC **33,800 ± 530**
31,850 B.C.
$\delta C^{13} = +0.7‰$

Carbonate from 26 m below top and 8 m below base of Upper Lisan Formation. *Comment*: fraction VC and FC measured separately, as below.

GrN-4841. Lisan 35 B-VC, 12 m **29,000 ± 380**
27,050 B.C.
$\delta C^{13} = +1.7‰$

GrN-4842. Lisan 35 B-FD, 12 m **29,900 ± 530**
27,950 B.C.
$\delta C^{13} = +0.8‰$

Carbonate from 12 m below surface of Lisan Formation at Loc. II. *Comment*: Fraction VC and FD measured separately, as below.

GrN-4837. Lisan 35 D-VC, 0 m **15,150 ± 110**
13,200 B.C.
$\delta C^{13} = +1.5‰$

GrN-4838. Lisan 35 D-FD, 0 m **16,100 ± 150**
14,150 B.C.
$\delta C^{13} = +1.8‰$

Carbonate from top of Lisan Formation at Loc. II. *Comment*: layered sediment separated into very clear, fairly clear, fairly dark, and very dark fractions by Kaufman. Very clear (VC) and fairly dark (FD) fractions measured separately. Since dark fractions may contain secondary carbonate, VC fraction considered most reliable.

General Comment: no pretreatment nor correction for isotope fractionation applied. Samples from Lower Lisan Formation (GrN-4411 and GrN-4843) obviously contaminated by storm water occasionally wetting exposures near their base. Other dates show linear accumulation rate with age suggesting Upper Lisan Formation accumulated between ca. 36,000 B.P. and 15,000 B.P. Th-U ages suggest accumulation between 38,000 B.P. and 17,000 B.P.

Dacca series, Pakistan

Geologic and pedologic studies in marine and estuarine deposits of Ganges R. and Brahmaputra R. made in Dacca and Barisal dist., E Pakistan, by Food and Agric. Organization of the U.N. Deep erosion gullies in Pleistocene terrace contain clay and intercalated peat layers. Clay can be traced far outside erosion gullies into estuarine plain deposits. Subm. 1966, 1967 by L. J. Pons, Lab. Regionale Bodemkunde, Wageningen, Netherlands.

5280 ± 60

GrN-4939. Jatrabari, 3.00 m **3350 B.C.**

$\delta C^{13} = -29.6‰$

Peat (lower part of Lower Layer) from 3.00 m depth in boring at Jatrabari (25° 42′ N Lat, 90° 27′ E Long), Dacca dist. Coll. 1965 by Mr. Brinkman.

1430 ± 70

GrN-5077. Jatrabari, 2.80 m **A.D. 520**

$\delta C^{13} = -24.2‰$

Peat (upper part of Lower Layer) from 2.80 m depth, same sec. as above.

2790 ± 50

GrN-4938. Jatrabari, 2.00 m **840 B.C.**

$\delta C^{13} = -23.4‰$

Peat (Middle Layer) from 2.00 m depth, same sec.

5030 ± 70

GrN-4937. Jatrabari, 0.60 m **3080 B.C.**

$\delta C^{13} = -30.5‰$

Peat (Upper Layer) at 0.60 m depth under sand. Peat mostly at surface.

General Comment: pretreated with acid only. Dates strongly suggest interchange of samples GrN-5077 and GrN-4937.

6700 ± 210

GrN-5451. Fatulla, extract **4750 B.C.**

$\delta C^{13} = -27.7‰$

Organic acid sulphate layer at 3.60 m depth, underlying old Brahmaputra sediments at Fatulla police sta. (23° 27′ N Lat, 90° 28′ E Long), Dacca dist. Coll. 1967. *Comment*: pretreated with acid and alkali. Since all organic matter dissolved in alkali, this fraction measured.

910 ± 60

GrN-5447. Ranipur **A.D. 1040**

$\delta C^{13} = -24.0‰$

Organic material at 0.96 to 1.13 m depth buried between old Lower Meghna tidal change, at Ranipur village (22° 40′ N Lat, 90° 3′ E Long), Barisal dist. Coll. 1967. *Comment*: pretreated with acid and alkali.

805 ± 40

GrN-5448. Umerpur **A.D. 1145**

$\delta C^{13} = -26.7‰$

Basin peat at 0.74 to 0.90 m depth of type intensively occurring at junction of tidal clay and flood-plain alluvium, at Umerpur village (22° 51′ N Lat, 90° 5′ E Long), Barisal dist. Coll. 1967.

3040 ± 145

GrN-5449. Mahilara **1090 B.C.**

Organic clay buried at 0.92 to 1.02 m depth in old Lower Meghna

estuarine flood-plain at Mahilara village (22° 54′ N Lat, 90° 17′ E Long), Barisal dist. Date should be maximum for Ganges deposits, where older Brahmaputra deposits are buried in E part of delta. Coll. 1967.

GrN-5450. Gaurnadi **1790 ± 95** **A.D. 160**

$\delta C^{13} = -25.9‰$

Buried top soil at 0.72 to 0.92 m depth at boundary between old Lower Meghna and Ganges flood-plain alluvium at unnamed village near Gaurnadi police sta. (23° 0′ N Lat, 90° 12′ E Long). Same stratigraphic position as above. Coll. 1967.

General Comment: latter 3 samples pretreated with acid and cold alkali. No clear correlations between Jatrabari gully deposits and delta samples yet possible. GrN-5449 and GrN-5450 not as expected.

II. ARCHAEOLOGIC SAMPLES

A. Southwest Asia

GrN-4404. Jabrud 6, Syria **25,850 ± 410** **23,900 B.C.**

Bone from Layer 6 in Rock Shelter I at Jabrud (33° 58′ N Lat, 36° 39′ E Long), 10 km SW of Nebek and ca. 70 km NNE of Damascus, Syria, excavated ca. 1935 by A. Rust. Shelter contained 25 Middle Paleolithic layers down to 11.25 m depth. Layer 6 at ca. 1 m depth contained older Levallois or Acheulo-Mousterian and is above pre-Aurignacian layers (Rust, 1950). Obtained 1965 from Schwabedissen, Univ. Köln, Germany. *Comment*: all organic matter dissolved in dilute acid during extraction of inorganic salts. Collagen was thus partly decomposed. 4 g of organic matter from 380 g bone was separated from salts by dialysis and measured. Result obviously too young; contaminating humic substance was not removed by acid dialysis.

GrN-5576. Ein Gev, Israel **15,700 ± 415** **13,750 B.C.**

$\delta C^{13} = -22.2‰$

Charred bone coll. near burial with complete human skeleton at open-air Late Upper Paleolithic (Kebaran), site, Ein Gev (32° 46′ N Lat, 35° 39′ E Long), in Jordan valley on E shore of Lake Tiberias, 154 m below Mediterranean sea level. Depth 0.50 m. Excavated by M. Stekelis and O. Bar-Yoseph, Dept. of Prehistoric Archaeol., Hebrew Univ., Jerusalem, Israel (Stekelis and Bar-Yoseph, 1965). Coll. 1964 by O. Bar-Yoseph. *Comment*: pretreated as for charred bone and alkali soluble fraction measured. Date agrees with general cultural sequence of Palestine.

Beidha series, Jordan

3 samples from Neolithic site of Beidha (30° 22′ N Lat, 35° 26′ E Long), Ma'an Dist., Jordan (Kirkbride, 1966a; 1966b). Coll. 1964 by H. Helbaek; subm. 1965 by D. Helbaek, Helsinge, Denmark.

GrN-5063. Beidha, Level VI, E. 130 **860 ± 50**
6690 B.C.
$\delta C^{13} = -23.5‰$

Carbonized *Pistacia* nuts on floor of burnt house, sealed by plaster slag. Pre-pottery Neolithic, early phase. Sample may belong to Level V. *Comment*: pretreated with acid and alkali. Same sample as P-1379: 8546 ± 100 (R., 1969, v. 11, p. 152) and K-1082: 8710 ± 130 (R., 1968, v. 10, p. 324).

GrN-5136. Beidha, Level IV, L. 411 **8810 ± 50**
6860 B.C.
$\delta C^{13} = -22.5‰$

Carbonized *Pistacia* wood from central post in burnt house. Pre-Pottery Neolithic, early phase. *Comment*: pretreated with acid and alkali. Should be same sample as P-1380: 9128 ± 103 (R., 1969, v. 11, p. 152) and K-1083: 8640 ± 160 labelled Level V, L. 411 (R., 1968, v. 10, p. 324) and BM-111: 8790 ± 200 (R., 1968, v. 10, p. 4).

GrN-5062. Beidha, Upper Level II, F 4. 300 **9030 ± 50**
7080 B.C.
$\delta C^{13} = -20.7‰$

Carbonized wood (*Juniperus cf. phoenicia*), possibly lid of stone-lined pit in burnt house. Pre-Pottery Neolithic, early phase. *Comment*: pretreated with acid and alkali. Should be same sample as P-1382: 8892 ± 155 (R., 1969, v. 11, p. 152) and K-1085: 8550 ± 160 (R., 1968, v. 10, p. 324).

General Comment: dates do not follow stratigraphic order. *Pistacia* seed dates of 3 labs agree well, but other dates differ considerably. Some P and GrN samples may have been mislabeled. However, possibility should not be overlooked that high age of *Juniperus* and *Pistacia* trees causes wide scatter of charcoal dates.

GrN-1544. Byblos, Lebanon **7360 ± 70**
5410 B.C.

Charcoal from 0.50 m below undisturbed floor of Neolithic house in Sq. 0/6, Level XLIII at Byblos (Djebaïl) (34° 12′ N Lat, 35° 36′ E Long), Lebanon. Middle stage of *Néolithique ancien*. Coll. and subm. 1957 by M. Dunand. *Comment*: measurement by H. de Vries. Preliminary result sent to submitter in 1957 as 7000 ± 80 and pub. without GrN-number as 5043 ± 80 B.C. (Dunand, 1961; Watson, 1965). Compare W-627: 6550 ± 200 (R., 1960, v. 2, p. 183) for higher level in *Néolithique ancien*.

Elâzíg series, Turkey

Survey of Bronze Age sites, Élâzíg Vilayet (ca. 38° 40′ N Lat, 39° 30′ E Long), Turkey. Coll. and subm. 1967 by R. Whallon, Jr., Univ. Michigan, Mus. of Anthropol., Ann Arbor, Michigan.

6175 ± 50
GrN-5284. Balibey N 52/3 **4225 B.C.**
$\delta C^{13} = -24.4‰$

Charcoal (*Quercus* sp.) from disturbed hearth near surface of Mound N 52/3, Nahiye of Balibey. Assoc. with materials from earliest Bronze age. Expected age: 3000 B.C.

5370 ± 40
GrN-5286. Içme, 0.75 m **3420 B.C.**
$\delta C^{13} = -24.5‰$

Charcoal (*Populus* sp.) from face of previously exposed profile at depth 0.75 m, Mound O 55/1, Nahiye of Içme. Early Bronze age (perhaps E.B. 1). Expected age: 3000-2500 B.C.

5330 ± 40
GrN-5287. Içme, 1.00 m **3380 B.C.**
$\delta C^{13} = -21.3‰$

Charred grain (*Triticum diococcum*) from house exposed at 1.00 m depth in same profile as GrN-5286, above. Early Bronze age (perhaps E.B. I). Expected age: 3000-2500 B.C.

3980 ± 70
GrN-5285. Mollakendi **2030 B.C.**
$\delta C^{13} = -23.8‰$

Charred plant fragments from layer at depth ca. 2.00 m in previously exposed profile, Site O 54/2, Nahiye of Mollakendi. Early Bronze age (probably E.B. III). Expected age: 2200-2000 B.C.
General Comment: all samples pretreated with acid and alkali. Dates point to earlier beginning of Bronze Age sequence in area than hitherto assumed.

Gedikli series, Turkey

Bronze Age cremation necropolis at Gedikli Höyük near Islâhiye (37° 02′ N Lat, 36° 37′ E Long), prov. of Gaziantep, SE Turkey (Alkim and Alkim, 1966). Subm. 1967 by U. B. Alkim, Istanbul, Turkey, and R. Kampman, Leiden, Netherlands.

3990 ± 40
GrN-5580. Gedikli AÇ 2 **2040 B.C.**
$\delta C^{13} = -24.8‰$

Charcoal from sacrificial pit in Profile 15 at 4 m depth. Assoc. with pottery and bones of sacrificed animal. Early Bronze III-Middle Bronze age. Expected age: 2200-2000 B.C. Coll. 1967 by H. Alkim.

3820 ± 40
GrN-5581. Gedikli Km 194 **1870 B.C.**
$\delta C^{13} = -24.2‰$

Charcoal pieces from grave in Profile 13 at 4 m depth. Assoc. with bronze toggle pins and pottery. Early Bronze III-Middle Bronze age. Expected age: 2200-2000 B.C. Coll. 1967 by A. M. Dinçol.

General Comment: both samples pretreated with acid and alkali. Age as expected.

Pileh Q'aleh series, Iran

Mound of Pileh Q'aleh, Gilan (ca. 37° 35′ N Lat, 49° 45′ E Long), S of Caspian Sea, excavated 1961-62 by E. O. Negahban, Antiquities Mus., Teheran, Iran. Expected age before 12th century B.C. Subm. 1967 by R. Kampman and P. J. R. Modderman, Inst. v. Prehistorie, Leiden, Netherlands.

GrN-5199. Pileh Q'aleh, Level I — **3620 ± 40**, **1670 B.C.**, $\delta C^{13} = -24.9‰$

Charcoal from Level I, Trench TM.

GrN-5200. Pileh Q'aleh, Level II — **3670 ± 40**, **1720 B.C.**, $\delta C^{13} = -24.4‰$

Charcoal from Level II, Trench TM.

GrN-5201. Pileh Q'aleh, Level VI — **3440 ± 35**, **1490 B.C.**, $\delta C^{13} = -25.4‰$

Charcoal from Level VI, Trench TM.

General Comment: all samples pretreated with acid and alkali. Compare Marlik series, below.

Marlik series, Iran

Rich royal cemetery Marlik Tepe, adjoining mound Pileh Q'aleh, above, Gilan (ca. 37° 35′ N Lat, 49° 45′ E Long), S of Caspian Sea (Negahban, 1970). Kingdom previously unknown. Objects found suggest date 12th-9th century B.C., later than Pileh Q'aleh. Excavation 1961-2 by E. O. Negahban. Subm. 1967 by R. Kampman and P. J. R. Modderman.

GrN-5198. Marlik 3 — **3425 ± 55**, **1475 B.C.**, $\delta C^{13} = -26.2‰$

Charcoal, mixed with soil, from Tomb XV D.

GrN-5578. Marlik 5 — **2940 ± 55**, **990 B.C.**, $\delta C^{13} = -19.0‰$

Bone sample from Tomb XXIII G.

GrN-5577. Marlik 2 — **2940 ± 60**, **990 B.C.**, $\delta C^{13} = -19.1‰$

Bone sample from Tomb XXII E.

GrN-5197. Marlik 1 — **860 ± 30**, **A.D. 1090**, $\delta C^{13} = -23.2‰$

Charcoal from Tomb XII E.

General Comment: charcoal pretreated with acid and alkali. Collagen separated from bone samples for measurement. With exception of GrN-5197, dates are as expected and suggest early stage of cemetery may be contemporary with upper level of mound Pileh Q'aleh, above.

GrN-5241. Tell 'Aschtara, Syria **2885 ± 35**
935 B.C.
$\delta C^{13} = -24.4‰$

Charred grapes in storage vessel, ca. 0.60 m below surface in Tell 'Aschtara (32° 58′ N Lat, 36° 8′ E Long), 75 km S of Damascus, Syria, excavated 1966 by A. Abou Assaf, Dir. of Antiquities, Damascus, Syria. Expected age: 1000-500 B.C. Subm. 1967 by W. van Zeist, Biol.-Archeol. Inst., Univ. Groningen, Netherlands. *Comment*: pretreated with acid and alkali. Age as expected.

Deir 'Alla series, Jordan

Samples from Late Bronze and Iron age tell of Deir 'Alla (32° 15′ N Lat, 35° 30′ E Long), Jordan valley, Jordan, excavated by H. J. Franken, Univ. Leiden, Netherlands (Franken, 1969).

GrN-5283. Deir 'Alla B 433a **2690 ± 60**
740 B.C.

Charcoal from large pit, possibly a cistern, attributed to Phase M, before its destruction by an earthquake, dated by following sample. Coll. 1964 by H. T. Waterbolk.

GrN-5633. Deir 'Alla BB 303 **2600 ± 50**
650 B.C.
$\delta C^{13} = -23.3‰$

Charred grain in burnt layer of Phase M representing destruction of temple annexes and thus also dating fragments of wall plaster painted with Aramaic texts (unpub.), found in burnt layer. Expected age: 6th century B.C. Coll. 1967 by J. D. van der Waals; subm. 1967 by H. J. Franken and collector.

GrN-5634. Deir 'Alla AA 406 **2410 ± 55**
460 B.C.
$\delta C^{13} = -23.4‰$

Charred grain from small concentration in youngest burnt layer so far observed in tell. Depth 0.40 m. Level is between Building Phases N and O. Assoc. with black-glazed Greek ware. Coll. 1967 by J. D. van der Waals; subm. by H. J. Franken and collector.

General Comment: all samples pretreated with acid and alkali. Dates from stratigraphically earlier layers in tell pub. in R., 1967, v. 9, p. 140. By applying correction based on dendrochronology, true age of GrN-5633 can be estimated at ca. 800 B.C.

B. Europe, Netherlands excluded

1. Paleolithic and Mesolithic of Western Europe

Coygan series, Wales

Coygan Cave (51° 45′ N Lat, 4° 40′ W Long), 25 km SW of Carmarthen, Wales, British Isles, contained bone accumulation and Mousterian artifacts sealed by 2 calcite layers. As insufficient carbon was recovered, calcite layers were dated. Coll. and subm. 1963 by C. B. M. McBurney, Cambridge Univ., England.

GrN-4399. Coygan calcrete 2, top **3000 ± 35**
1050 B.C.
$\delta C^{13} = -8.9‰$

Top 3 cm of Upper Calcrete Layer on floor of cave. *Comment*: outer layer removed and inner carbonate dated. C^{13} content indicates pure fresh water carbonate; 1300 ± 500 yr must probably be subtracted from result to obtain actual age (Münnich and Vogel, 1959).

GrN-4423. Coygan calcite 2, bottom **5820 ± 65**
3870 B.C.
$\delta C^{13} = -9.0‰$

Bottom 2 cm of Upper Calcrete Layer in cave. *Comment*: outer layers removed with dilute acid and inner carbonate dated. C^{13} content indicates 1300 ± 500 yr should be subtracted.

GrN-4400. Coygan calcrete 1 **33,200 ± 310**
31,250 B.C.
$\delta C^{13} = -7.4‰$

Top 3 cm of Lower Calcrete Layer underlying main bone accumulation and Mousterian industry. *Comment*: outer layers removed and inner carbonate dated. C^{13} content indicates 1300 ± 500 yr should be subtracted. Date apparently too young, since Mousterian occurs above this layer.

Toirano series, Italy

Basura Cave at Toirano (44° 07′ N Lat, 8° 12′ E Long), 14 km N of Albenga, N Italy, revealed Neanderthal and Cave Bear footprints when opened in 1950 (Pales, 1960). Floor contains sediment with bones, mainly cave bear, and charcoal and soot attributed to torches used by Neanderthal man. In nearby Colombo Cave Mousterian artifacts occur below Neolithic industry in sediment (Chiapella, 1958). Bone samples coll. 1966 by T. Molleson; subm. by K. P. Oakley, Brit. Mus. (Nat. Hist.), London; charcoal sample subm. previously by the late A. C. Blanc, Rome.

GrN-5007. Basura charcoal **12,340 ± 160**
10,390 B.C.

Charcoal from floor of Basura Cave in Sala dei Misteri, apparently remains of torches used by prehistoric visitors. *Comment*: pretreated with acid and alkali.

GrN-4897. Basura bone It 67 **24,230 ± 290**
22,280 B.C.

Collagen from cave bear bones 0 to 15 cm below surface in Sala dei Misteri adjacent to human footprints. *Comment*: 4 g collagen extracted from 270 g bone for dating.

GrN-5102. Basura calcite **5160 ± 40**
3210 B.C.
$\delta C^{13} = -9.3‰$

Calcite formed on bones on floor of Basura Cave. *Comment*: outer layers removed with dilute acid and inner carbonate dated. C^{13} content indicates 1300 ± 500 yr should be subtracted from age (Münnich and Vogel, 1959). Crust thus formed in Late Atlantic and much younger than last human occupation.

GrN-5215. Colombo, calcite It 74 **32,000 ± 680**
30,050 B.C.
$\delta C^{13} = -1.9‰$

Calcite cementing bones and uppermost Mousterian artifacts in Colombo cave, Layer 4. *Comment*: since C^{13} content is so high, no correction is applied to date for disequilibrium of bicarbonate solution with atmospheric CO_2. Minimum date for fauna and artifacts.

General Comment: GrN-4897 suggests cave bear bones deposited until at least 24,000 yr ago and GrN-5007 suggests last humans visited cave ca. 12,000 yr ago. Latter date seems much too late for Neanderthal man, but no satisfactory explanation possible.

Schnurenloch series, Switzerland

Schnurenloch Cave, 1230 m alt, in Simmental near Oberwil (46° 40′ N Lat, 7° 27′ E Long), Kreis Bern, Switzerland, excavated 1931 to 1936 by D. and A. Andrist and W. Flükiger. Below ca. 3 m clay and rubble ca. 1 m layered loam, Layers 7a to d, produced bone of cave bear and Paleolithic stone artifacts (Andrist and Flükiger, 1962). Samples subm. 1965 by W. Flükiger.

GrN-4895. Schnurenloch, grün **30,020 ± 520**
28,070 B.C.
$\delta C^{13} = -21.5‰$

Collagen from cave bear bones in Layer 7c (green loam), at ca. 2.5 to 3.5 m depth. Layer said to contain Late Lower (Middle?) Paleolithic artifacts of quartzite.

GrN-4894. Schnurenloch, rot **20,100 ± 200**
18,150 B.C.
$\delta C^{13} = -21.2‰$

Collagen from cave bear bones in Layer 7a (red loam) at ca. 2 to 3 m depth. Layer contains Early Upper Paleolithic artifacts of silex.

General Comment: both samples pretreated as for unburnt bone. Similar samples measured in Bern gave: B-158: 24,000 ± 600 for Layer 7c and B-157: 14,000 ± 600 for Layer 7b (unpub.). Although older than these,

dates still young if submitter's cultural designation comparable with sequence in France. However, age of Alpine Paleolithic cultures still unknown.

Ranggiloch series, Switzerland

In Ranggiloch Cave (46° 38′ 10″ N Lat, 7° 20′ 19″ E Long, 1845 m alt) in Simmental, near Boltigen, Kreis Bern, Switzerland; ca. 3 m sediment excavated by W. Flükiger and D. Andrist between 1932 and 1946. Five layers of loam and clay with bone of cave bear, wolf, and capricorn distinguished (Andrist and Flükiger, 1962). In bottom of Layer II, 2nd from top, supposedly Paleolithic hearths found assoc. with some stone artifacts and cave bear bones. Charcoal from hearths subm. 1958 by W. Flükiger, Koppigen, and H. G. Bandi, Bernisches Hist. Mus., Bern, Switzerland.

GrN-3089. Ranggiloch 2802 **5090 ± 55**
3140 B.C.

Charcoal Sa. 2802 from Hearth b, 0.45 to 0.60 m depth, Sq. 79/80, ca. 1 m inside dripline.

GrN-3549. Ranggiloch 560 **5240 ± 100**
3290 B.C.

Charcoal Sa. 560 from Hearth a, ca. 0.55 m depth, Sq. 56, ca. 0.5 m inside dripline. Hearth a on base of loose stones.

General Comment: due to small size, samples pretreated with acid only. Another sample from Hearth b gave result B-269b: 5190 ± 100 (unpub.). Neolithic age of hearths thus certain and assoc. cave bear bones must have been redeposited.

Abri Pataud series, France

Additional samples from Abri Pataud (44° 56′ N Lat, 1° 0′ E Long) intended to clarify uncertainty in age of Couche 5, front. Coll. and subm. 1961 by H. L. Movius, Harvard Univ., Cambridge, Massachusetts.

GrN-5009. Abri Pataud 5, extract **23,350 ± 170**
21,400 B.C.
$\delta C^{13} = -22.3‰$

GrN-5012. Abri Pataud 5, residue **26,050 ± 310**
24,100 B.C.
$\delta C^{13} = -22.4‰$

Charred bone from Layer 5, front, with Perigordian IV industry (Gravette points). *Comment*: pretreated as charred bone (R., 1963, v. 5, p. 164), highest date from 2 fractions to be preferred. Previous date for front part of Layer 5, GrN-4631: 21,780 ± 215 thus definitely too young and layer probably contemporaneous with Layer 5, rear. For other Abri Pataud dates see R., 1967, v. 9, p. 113.

GrN-5499. Abri Fritsch 8d, France **19,280 ± 230**
17,330 B.C.
$\delta C^{13} = -23.2‰$

Charred bone from 2.4 m depth in Layer 8d in Abri Fritsch, Les Roches (46° 30′ N Lat, 1° 30′ E Long), Pouligny-St-Pierre, Dept. Indre, France. Just above transition from Upper Solutrean to Lower Magdalenian I (Allain and Fritsch, 1967). Coll. and subm. 1967 by J. Allain, Bourges, France. *Comment*: pretreated as for charred bone and alkali soluble fraction measured. Oldest date thus far for beginning of Magdalenian and agrees with dates for preceding Upper Solutrean at Laugerie Haute (R., 1967, v. 9, p. 116).

GrN-4677. Vilhonneur B2, residue, France **12,890 ± 140**
10,940 B.C.

GrN-4693. Vilhonneur B2, extract, France **9490 ± 90**
7540 B.C.

Charred bone from Layer B2 at ca. 1.3 m below fallen block in Abri André Ragout, Bois du Roc, Vilhonneur, near La Rochefoucauld (45° 44′ N Lat, 0.24′ E Long), Charente. Layer overlies Final Solutrean and contains Early Magdalenian Industry. Coll. and subm. 1964 by L. Balout, Inst. de Paléontol. Humaine, Paris. *Comment*: pretreated as for charred bone and both fractions measured. Both results apparently much too young (see Abri Fritsch, above).

GrN-4383. Pincevent, France **10,760 ± 60**
8810 B.C.
$\delta C^{13} = -22.5‰$

Humic clay from ca. 1.7 to 2.0 m depth in Late Magdalenian open air site at Pincevent (48° 22′ N Lat, 2° 53′ E Long), Dept. Seine et Marne, France (Leroi-Gourhan and Brezillon, 1966). Coll. and subm. 1964 by A. Leroi-Gourhan, Centre de Recherches Préhist. et Protohist., Univ. Paris. *Comment*: all carbonate removed with acid and rest combusted for analysis. Since presence of more recent humus must be expected, date only minimum. Compare also other dates on similar material from site: Lv-291: 10,920 ± 540; Lv-292: 11,610 ± 400; Lv-293: 11,310 ± 330 (R., 1969, v. 11, p. 108) and on charcoal: Gif-349: 9840 ± 350; Gif-358: 12,300 ± 400 (R., 1970, v. 12, p. 430). Present evidence is that Magdalenian did not last longer than Older Dryas period, *i.e.*, 11,800 B.P.

GrN-5393. Aveline's Hole, England **8100 ± 50**
6150 B.C.
$\delta C^{13} = -6.3‰$

Calcrete encrustation in Skull 'O' in Aveline's Hole Cave (51° 19′ N Lat, 02° 45′ W Long) on E side of Burrington Combe, Mendip Hills, Somerset, England. Skeletal remains found by Dean Buckland before 1823 in Cheddarian (Late Magdalenian) context. Subm. 1968 by K. P. Oakley, British Mus. (Nat. Hist.), London. *Comment*: C^{13} content

indicates fresh water carbonate; 1300 ± 500 yr should probably be subtracted from date (Münnich and Vogel, 1959). Minimum age for skull.

Meer series, Belgium

Two open air Upper Paleolithic (Tjongerian) sites at Meirberg near Meer (51° 27′ N Lat, 4° 45′ E Long), prov. of Antwerp, Belgium, excavated 1966, 1967 by F. van Noten, Mus. royale de l'Afrique centrale, Tervuren, Belgium (van Noten, 1967). Subm. 1966, 1968 by F. van Noten.

GrN-4960. Meer I-1 **8940 ± 85**
6990 B.C.
$\delta C^{13} = -25.1‰$

Charcoal occurring as scattered fragments below sand-covered podsol profile at site Meer I, at 0.70 m depth and 0.30 m below top of podsol. Flint artifacts occur from 0.20 to 0.80 m below top of podsol. Coll. 1966.

GrN-4961. Meer I-2 **8950 ± 80**
7000 B.C.
$\delta C^{13} = -25.3‰$

Charcoal from same site at depth 0.85 to 1.00 m below surface and 0.45 to 0.60 m below top of podsol. Coll. 1966.

GrN-5706. Meer II-1 **8740 ± 60**
6790 B.C.
$\delta C^{13} = -26.1‰$

Charcoal from Fireplace 2 at site Meer II, just below B_{2h} horizon of podsol profile, at 0.60 to 0.85 m depth. Coll. 1967.

General Comment: dates are much younger than expected Allerød age of sites. Charcoal probably of Mesolithic age. See R., 1967, v. 9, p. 120 for other instances of later admixture of Mesolithic charcoal with Paleolithic near-surface industries.

Rouffignac series, France

Three charcoal samples from Mesolithic culture layer in cave of Rouffignac (45° 3′ 11″ N Lat, 0° 58′ 30″ E Long) near Perigueux, France. Coll. 1960 by C. Barrière, Fac. Lettres et Sci. Humaines, Toulouse. Dates from 4 levels pub. in R., 1963, v. 5, p. 175 with incorrect level labels. These dates appear here with excavator's final numbering (from top downward).

GrN-5512. Rouffignac C 2 **6400 ± 40**
4450 B.C.
$\delta C^{13} = -25.2‰$

Developed Tardenoisian, assoc. with human skeleton and pottery. *Comment*: pretreated with acid and alkali.

GrN-2889. Rouffignac C 3 **7800 ± 50**
5850 B.C.

Pure Tardenoisian.

GrN-2913. Rouffignac C 4a **8370 ± 100**
6420 B.C.

Sauveterrian, upper level. *Comment*: labeled C 4b (Upper Sauveterrian) in Groningen IV.

GrN-2895. Rouffignac C 4b **8590 ± 95**
6640 B.C.

Sauveterrian, middle level. *Comment*: labeled C 4 (Middle Sauveterrian) in Groningen IV.

GrN-2880. Rouffignac C 4c **8995 ± 105**
7045 B.C.

Sauveterrian, lower level. *Comment*: labeled C $4a^1$ (Lower Sauveterrian) in Groningen IV.

GrN-5513. Rouffignac C 5a **8750 ± 75**
6780 B.C.

Lower Sauveterrian, upper level. *Comment*: pretreated with acid and alkali.

GrN-5514. Rouffignac C 5b **9150 ± 90**
7200 B.C.
$\delta C^{13} = -24.4‰$

Lower Sauveterrian, lower level. *Comment*: pretreated with acid and alkali.

General Comment: series is very consistent. Only GrN-2880 and GrN-5513 appear in the wrong order, but this may be due to statistics only (with 2σ, difference is not significant). According to excavator, pottery of Layer 2 would be of Chalcolithic age, but there were no signs of intrusions in Layer 2.

2. Paleolithic and Mesolithic of Central and Eastern Europe

Krapina series, Yugoslavia

In attempt to date Krapina man, K. P. Oakley arranged for samples from Zagreb Mus. Abri at Krapina (46° 10′ N Lat, 15° 52′ E Long), 40 km N of Zagreb, Croatia, excavated 1899-1905 by D. Gorjanović-Kramberger, revealed 9 "layers" according to excavator's field notes (courtesy M. Malez, Zagreb) with *H. sapiens* finds in Layer 4, mainly *Bos* and *Rhinoceros* in Layers 6 and 7 higher up, and *Ursus* sp. in Layer 9 at top.

GrN-4299. Krapina, burnt bone **30,700 ± 750**
28,650 B.C.

Pieces of burnt bone from mus. colln. subm. 1962 by J. S. Weimer, British Mus. (Nat. Hist.), London, Some pieces numbered 259, 260, 262, 263; entered in catalogue as from area with "many broken and burnt bones and many pieces of carbon." *Comment*: 127 g pretreated as for burnt bone and alkali soluble fraction dated; insoluble fraction too small for measurement. Material was probably assoc. with human occupation. Date appears too young for Mousterian.

3200 ± 780
GrN-4983. Krapina, bone **1250 B.C.**

Rhinoceros bone from Layer 1-2, probably from below human finds. Subm. 1966 by J. C. Vogel and T. Molleson. *Comment*: outer layer removed and pretreated as for bone. 370 g bone gave only 0.22 g carbon in form of gluey "collagen". Result suggests "collagen" was mainly glue or shellac used as preservative.

General Comment: further attempts to extract collagen from bone from Layers 7 and 8 were also unsuccessful. Since dating of Krapina man on museum material is not possible and no sediments are left at Krapina site, indirect approach of dating cultural levels in nearby sites appears more feasible way to arrive at age of this important human type (see below).

Velika Pećina series, Yugoslavia

Excavation by M. Malez in Velika Pećina near Goranec (46° 17′ N Lat, 16° 02′ E Long) on Ravna Gora, NW Croatia, 20 km NE of Krapina, revealed 16 layers (a to p) with Roman to Mousterian cultural material. Layer c, containing Mesolithic (?) industry, is cemented with calcrete; Layers d, e contain E Gravettian (or Magdalenian ?) industry with bone points; Layers f, g Aurignacian II assemblage; Layers h, i Aurignacian I assemblage with split-based bone points, and below that pre-Aurignacian and Mousterian artifacts. In top of Layer j, human skull fragment was found (Malez and Vogel, 1970). Samples coll. by M. Malez; subm. 1966 by J. C. Vogel and T. Molleson.

33,850 ± 520
GrN-4979. Velika Pećina 2, Layer i **31,900 B.C.**
$\delta C^{13} = -24.2‰$

Fine charcoal from hearth in top of Layer i at ca. 4.5 m depth (Aurignacian I). *Comment*: pretreated with acid and alkali. Date acceptable for Aurignacian. Mousterian here, and thus also at Krapina, definitely older than 34,000 B.P. Interpretation of Layer h as Interstadial corresponds to dates for Denekamp Interstadial (Vogel and Zagwijn, 1967). Interstadial Layer j may be of Hengelo age.

26,450 ± 300
GrN-4980. Velika Pećina 3, Layer e **24,500 B.C.**
$\delta C^{13} = -24.2‰$

Fine charcoal from hearth in Layer e at ca. 2.5 m depth (Gravettian). *Comment*: pretreated with acid and alkali. Oldest date thus far for post-Aurignacian industry in Yugoslavia (see Zupanov and Šjandalja, below), indicating that Aurignacian was replaced before this time.

5550 ± 40
GrN-4990. Velika Pećina 1, Layer c **3600 B.C.**
$\delta C^{13} = -4.5‰$

White calcite crust cementing coarse deposit of Layer c at ca. 1.3

m depth. *Comment*: etched with acid; carbonate dated. C^{13} content indicates freshwater limestone so that 1300 ± 500 yr should probably be subtracted from date (Münnich and Vogel, 1959). Crust thus formed in Late Atlantic.

Veternica series, Yugoslavia

Veternica Cave lies 700 m N of Gornji Sterjevec, ca. 9 km W of Zagreb (45° 48′ N Lat, 15° 58′ E Long), Croatia. Excavations in 1950 to 1955 by M. Malez revealed layers covering period since Last Interglacial, with abundant faunal remains. Layers a to g contain traces of historic and post Mousterian man; Layers h, i, j remains of Mousterian industries, where j is Interglacial deposit. Portion of human skull found in Layer h. (Malez, 1965) Samples coll. by M. Malez.

GrN-4984. Veternica i **>43,200**

Charcoal from Layer i (Stadial) at ca. 2.6 m depth subm. before 1960. *Comment*: pretreated with acid and alkali. Agrees with other Mousterian dates in R., 1967, v. 9, p. 109-120.

GrN-4989. Veternica c **13,650 ± 75**
11,700 B.C.
$\delta C^{13} = -10.1‰$

Bottom of compact crystalline calcrete forming Layer c at ca. 0.5 m depth. Subm. 1966 by J. C. Vogel. *Comment*: outer layers etched off with acid and inner carbonate dated. C^{13} content indicates freshwater limestone; 1300 ± 500 yr should be subtracted to obtain true age (Münnich and Vogel, 1959). Layer probably of Atlantic age, apparently Late Glacial (Bølling/Allerød ?).

GrN-4988. Romualdo Cave, Yugoslavia **>46,250**
$\delta C^{13} = -8.7‰$

Crystalline calcrete layer at ca. 2.3 m depth (Layer f) in Romualdo Cave at top of Lim Channel near Rovinj (45° 05′ N Lat, 13° 40′ E Long). Istria, Yugoslavia, Layer c above contains bones of cave bear, etc., and E Gravettian artifacts (Malez, 1962). Calcrete thought to date interstadial. Coll. 1962 by M. Malez and subm. 1966 by J. C. Vogel and T. Molleson. *Comment*: outer layers of calcrete etched off with acid; inner carbonate dated. Result proves calcrete older than Hengelo Interstadial (Vogel and Zagwijn, 1967).

GrN-6083. Crvena Stijena XII, Yugoslavia **40,770 ± 900**
38,820 B.C.
$\delta C^{13} = -20.6‰$

Charcoal from Layer XII at depth 8.70 m in rock shelter Crvena Stijena, near Petrovići (42° 49′ N Lat, 18° 31′ E Long), dist. Nikšić, Montenegro, Yugoslavia. Excavated strata have total depth of 11 m. Layer I is Bronze age, II, III are Neolithic, IV Mesolithic, and V-X Upper Paleolithic. They are separated from Mousterian Layers XI-XVII by heavy fallen blocks. Layers XII-XVII attributed to Würm I period, Layers X-XI to W I/II Interstadial (Brodar, 1959). Subm. 1966 by J. C.

Vogel and T. Molleson. *Comment*: date agrees well with date from Combe Grenal GrN-4304: 39,000 ± 1500 B.P. (R., 1967, v. 9, p. 112) for sample high in Mousterian sequence, before onset of warmer condition (Hengelo Interstadial).

GrN-4479. Moravany, Czechoslovakia **1275 ± 80**
A.D. 675

Charcoal fragments from fossil soil below plough soil at near-surface, Szeletian site of Moravany (48° 35′ N Lat, 17° 52′ E Long) in Waag valley near Pistyan, Slovakia. Depth 0.30 to 0.60 m, alt. 315 m. Coll. 1963; subm. 1964 by J. Barta, Archaeol. Inst., Slovakian Acad. Sci., Nitra. *Comment*: charcoal cannot be Paleolithic.

Szeleta series, Hungary

Szeleta Cave in N part of Bükk Mts. (48° 05′ N Lat, 20° 30′ E Long), near town of Hámor, co. Borsoel, N Hungary, excavated by Kadič in 1915, contains Early and Main Szeletian habitation layers. Stratigraphy also described by Vértes (1959). Coll. and subm. 1965 by the late L. Vértes.

GrN-6058. Szeleta 3 **43,000 ± 1100**
41,050 B.C.
$\delta C^{13} = -22.0‰$

Bone collagen from ca. 6 m below original surface in upper region of darkbrown layer (Layer 2 of Kadič) in Block B, slightly above lowest occurrence of Early Szeletian. *Comment*: ca. 1% carbon as collagen extracted from bone.

GrN-5130. Szeleta 2 **32,620 ± 400**
30,670 B.C.
$\delta C^{13} = -22.2‰$

Bone collagen from ca. 3 m below original surface in lightgray layer (Layer 6 of Kadič) in Block A near cave mouth representing early to middle part of Main Szeletian deposit. *Comment*: 1.1% carbon as collagen extracted from bone.

General Comment: split-based bone point in Early Szeletian deposit indicates contemporaneity with Aurignacian I in nearby Istállóskö Cave, and Main Szeletian laurel leaf point in Aurignacian II layer of latter cave proves same age for these 2 phases (Vértes, 1955b; Gábori, 1960). This is confirmed by C^{14} dates, see Istállóskö series, below. Previous sample stratigraphically between above sample gave date GX-197: >41,700 (unpub.).

Istállóskö series, Hungary

Istállóskö Cave on W side of Bükk Mts. (48° 05′ N Lat, 20° 30′ E Long), near town of Szilvás várad, N Hungary, contains 2 stratigraphically separated habitation layers (Vértes, 1955a). Upper Aurignacian II Layer already dated to ca. 31,000 (R., 1963, v. 5, p. 164). Samples of Lower Aurignacian I Layer coll. and subm. 1965 by L. Vértes.

GrN-4659. Istállóskö 4 **44,300 ± 1900**
42,350 B.C.

Bone collagen from near base of Aurignacian I Layer. *Comment*: 0.9% carbon as collagen extracted from bone.

GrN-4658. Istállóskö 3 **39,700 ± 900**
37,750 B.C.

Bone collagen from upper level of Aurignacian I Layer containing split-based bone points. *Comment*: 1.2% carbon as collagen extracted from bone.

General Comment: dates prove contemporaneity of early Aurignacian in Bükk Mts. with nearby Szeletian (see above). These old dates suggest Aurignacian in E Europe much older than in W Europe, see R., 1967, v. 9, p. 109-117. According to Vértes, GrN-1501: 31,540 ± 600 is not from Aurignacian I Layer as stated in Groningen IV (R., 1963, v. 5, p. 165) but from Aurignacian II Layer.

GrN-4950. Peskö Cave, Hungary **35,200 ± 670**
33,250 B.C.
$\delta C^{13} = -20.3‰$

Bone collagen from lowest layer in Peskö Cave on S side of Bükk Mts. (48° 05′ N Lat, 20° 30′ E Long), N Hungary, containing Aurignacian I industry (Hermann *et al.*, 1956; Vértes, 1959). Coll. 1966 and subm. by L. Vértes. *Comment*: 0.6% carbon as collagen extracted from bone. Younger than Aurignacian I dates in Istállóskö Cave (above) but still older than all dates for this industry in France.

Balla Cave series, Hungary

Balla Cave near town of Répáshuta, Bükk Mts. (48° 05′ N Lat, 20° 30′ E Long), N Hungary, excavated 1909-1913 by Hildebrand and reconsidered by Vértes (1959). In front part of cave layer with microlithic "Magdalenian" (or E. Gravettian ?) industry and child's skull, overlies base rock, while layer with Early Szeletian industry occurs in same position in back of cave. Samples coll. 1965 and subm. by L. Vértes to date Szeletian.

GrN-4660. Balla Cave, charcoal **22,300 ± 180**
20,350 B.C.

Fine charcoal mixed with sand and bone from ca. 1 m depth, supposedly from Szeletian layer. *Comment*: all carbonate removed with repeated acid treatment and humus extracted with alkali; alkali soluble fraction measured since too little insoluble charcoal remained.

GrN-4661. Balla Cave, bone **20,000 ± 190**
18,050 B.C.

Collagen from bones in same position as above sample. *Comment*: 2.2% carbon as collagen extracted from bones.

General Comment: similarity of dates suggests no considerable contamination, but they are probably too young for Szeletian and close to

E. Gravettian date for Ságvar, GrN-1783: 18,900 ± 100 (R., 1964, v. 6, p. 353), so that stratigraphic assignment may be wrong.

GrN-5181. Samuilica Cave, Bulgaria **42,780 ± 1270**
40,830 B.C.
$\delta C^{13} = -20.0‰$

Bone collagen from 0.5 m depth in Upper Layer containing blade industry (Early Aurignacian?) in Samuilica Cave near village Kunina (43° 14′ N Lat, 28° 0′ E Long), Vraca Malkijadol, Bulgaria. Underlying is Mousteroid-Szeletoid industry. Excavated 1955-60 by N. Djambasov, Sofia; subm. 1966 by L. Vértes. *Comment*: agrees well with Early Aurignacian dates from Istállóskö, above.

Mauern series, Germany

In Cave 2 at Mauern ca. 3 km N of Rennertshafen (48° 46′ N Lat, 11° 03′ E Long) on Danube R., Bavaria, Germany. Succession of Neolithic, Magdalenian, Altmühl and Mousterian cultural layers is present (Zotz, 1955). Samples coll. by L. F. Zotz; subm. 1957 by the late H. Gross.

GrN-5000. Mauern I **29,410 ± 470**
27,460 B.C.
$\delta C^{13} = -23.0‰$

Block 1 at entrance of Cave 2 at ca. 0.7 m depth, assoc. with Early Magdalenian with Gravette points and primitive bone harpoons. *Comment*: due to small sample, only acid pretreatment. Date very old for Magdalenian and admixture of older charcoal suspected.

GrN-6059. Mauern IV **28,265 ± 325**
26,315 B.C.
$\delta C^{13} = -24.1‰$

Sample from charcoal band in Layer D(=6) in interior of Cave 2 at 1.5 m depth, between Magdalenian Layer at 0.45 to 0.6 m and Altmühl at 2.5 to 2.95 m depth. *Comment*: pretreated with acid and alkali.

General Comment: similarity of dates suggest early Upper Paleolithic hunters visited site.

Vladimir series, Russia

Open air Upper Paleolithic site 7 km NE of town of Vladimir (56° 08′ N Lat, 40° 25′ E Long), E of Moscow, USSR, excavated by O. N. Bader, shows cultural layer just above uppermost fossil soil at ca. 3.5 to 4 m depth. At 5 to 5.5 m depth another soil horizon occurs and at 9 to 10 m depth lies Dnieper Moraine. Coll. 1966 by O. N. Bader and V. I. Gromov; subm. 1967 by I. K. Ivanova, Geol. Inst. Acad. Sci., Moscow.

GrN-5425. Vladimir, charcoal **25,500 ± 200**
23,550 B.C.
$\delta C^{13} = -24.1‰$

Charcoal from cultural layer at ca. 3.2 m depth. *Comment*: pretreated with acid and alkali.

GrN-5446. Vladimir, bone **24,430 ± 400**
22,480 B.C.
$\delta C^{13} = -18.2‰$

Collagen from bones (*Rangifer tarandus*) in cultural layer. *Comment*: 0.5% carbon as collagen extracted from bone. Pretreatment independently by H. J. Streurman.

General Comment: similarity of dates suggests valid result. Age corresponds to dates for E. Gravettian in Central Europe (R., 1967, v. 9, p. 101). For bones from same site compare GIN-14: 14,600 ± 600 (R., 1968, v. 10, p. 422).

Županov series, Yugoslavia

In cave Županov spodmol (45° 45′ N Lat, 14° 06′ E Long) near Sajevče, Postojna, Slovenia, F. Osole excavated rich Tardigravettian industry (Layer 2) similar to that of Ovčje Jama (Osole, 1963). Coll. 1966 and subm. 1967 by F. Osole, Univ. Ljubljana, Yugoslavia.

GrN-5288. Županov AB, charcoal **16,780 ± 150**
14,830 B.C.
$\delta C^{13} = -22.9‰$

Charcoal from lowest Gravettian layer at ca. 0.9 m depth, ca. 9 m from cave entrance. *Comment*: pretreated with acid and alkali. Date slightly younger than KN-48: 19,540 ± 500 B.P. (unpub.) for lower Gravettian industry at Ovčja Jama.

GrN-5100. Županov AB, D **13,500 ± 175**
11,550 B.C.
$\delta C^{13} = -23.4‰$

Charcoal from higher level in Gravettian layer at ca. 0.7 m depth, ca. 10 m from cave entrance. *Comment*: pretreated with acid and alkali.

GrN-5098. Županov D **12,410 ± 70**
10,460 B.C.
$\delta C^{13} = -24.3‰$

Charcoal from Late Gravettian layer at ca. 0.5 m depth, ca. 9 m from cave entrance. *Comment*: pretreated with acid and alkali. Date shows E. Gravettian lasted at least until Bølling times in region. See also Šjandalja, below.

Šandalja series, Yugoslavia

In limestone quarry Šandalja, 4 km E of Pula (44° 52′ N Lat, 13° 52′ E Long), Istria, completely filled cave was exposed in 1962. Excavation of cave filling by M. Malez and B. Bačić revealed 8 layers (a-h)

with fossil faunal bones and Upper Paleolithic implements. Layer b contained Late Gravettian industry with hearths and human calotte, Layer c some Gravettian, and Layers d-h artifacts attributed to Aurignacian. Layers e and f interpreted sedimentologically as interstadial (Malez, 1964; Malez and Vogel, 1969). Coll. by M. Malez; subm. 1966 by J. C. Vogel and T. Molleson.

GrN-4977. Šandalja 2 **25,340 ± 170** **23,390 B.C.** $\delta C^{13} = -19.5‰$

Collagen from bones at ca. 5 to 5.5 m depth in Layer f.

GrN-5013. Šandalja 3 **23,450 ± 180** **21,500 B.C.** $\delta C^{13} = -19.4‰$

Collagen from bones at ca. 4.5 to 5 m depth in Layer e.

GrN-4978. Šandalja 1 **12,320 ± 100** **10,370 B.C.** $\delta C^{13} = -23.9‰$

Charcoal from Late Gravettian hearth at ca. 2 m depth in Layer b at approx. same depth as human skull fragment. *Comment*: this Late Glacial industry is similar to that in Slovenia (Osole, 1963) and N Italy (Leonardi and Broglio, 1962).

GrN-4976. Šandalja 5 **10,830 ± 50** **8880 B.C.** $\delta C^{13} = -19.9‰$

Collagen from bones at 1 to 3 m depth in Late Gravettian Layer b. *General Comment*: dates for Layer b, accumulated towards end of Last Glacial, acceptable for Late Gravettian (see also Županov, above), but those for Layers e and f appear very young for Aurignacian, although nothing is known about duration of this type of industry in area.

GrN-5097. Kulna 6, Czechoslovakia **11,590 ± 80** **9640 B.C.** $\delta C^{13} = -25.5‰$

Charcoal from Layer 6, ca. 1.5 m deep, 39 m from entrance, in Kůlna Cave (49° 24′ 39″ N Lat, 16° 44′ 26″ E Long) near Sloup, dist. Blansko, Moravia, Czechoslovakia. Layer 6 consists of loess with Magdalenian industry, Layer 6a, stratigraphically older loess, contains nondescript artifacts and Layer 7a, Charentian industry (late Middle Paleolithic) and Neanderthal upper jawbone (Valoch, 1967). Coll. 1966 and subm. 1967 by K. Valoch, Moravské Mus., Brno, ČSSR. *Comment*: only pretreated with acid. Younger than expected but acceptable for Magdalenian.

Calovanie series, Poland

Extensive excavations by R. Schild in 1963-1969 on sand dune i. and in adjacent peat bog at Calovanie in Vistula R. valley (52° 00′ N

Lat, 21° 05′ E Long), ca. 30 km S of Warsaw, Poland, revealed succession of Late Paleolithic and Mesolithic settlements with ample charcoal for dating. Palynologic studies by M. Dabrowski established vegetation zoning from Older Dryas to modern. Samples coll. and subm. 1966, 1967 by R. Schild, Inst. Hist. Material Culture, Warsaw, Poland.

GrN-5410. Calovanie AB-1 **11,190 ± 65**
9240 B.C.
$\delta C^{13} = -25.5‰$

Charcoal from concentration in gyttja at base of Allerød peat in Tr. IX which merges into Usselo soil on adjoining sand bar. In Usselo soil, variant of evolved Epi-Magdalenian with arched, backed bladelets occurs. Coll. 1967. *Comment*: rootlets removed and pretreated with dilute acid and alkali. Places onset of peat formation in pine phase of Allerød, agreeing with palynologic evidence, and dates culture.

GrN-5253. Calovanie LG-2 **10,820 ± 90**
8870 B.C.
$\delta C^{13} = -25.4‰$

Charcoal from thin gyttja layer on Usselo soil on slope of sand bar and contemporaneous with new Final Paleolithic industry with tanged points, Tr. VII. Coll. 1966. *Comment*: pretreated with acid and alkali. Places occupation at boundary Allerød/Younger Dryas, agreeing with palynologic findings, and dates this new industry.

GrN-4966. Calovanie LG-1 **10,660 ± 100**
8710 B.C.
$\delta C^{13} = -25.2‰$

Charcoal from same gyttja as above, but 55 m W of settlement site. Coll. 1965. *Comment*: rootlets removed and pretreated with acid. Result confirms date of gyttja, above; contemporaneous with new industry, with tanged points, on top of Usselo soil.

GrN-5255. Calovanie U I-1 **9550 ± 85**
7600 B.C.
$\delta C^{13} = -23.9‰$

Charcoal at base of dune overlying Usselo soil, supposedly derived from latter. Coll. 1966 in Tr. VII. *Comment*: pretreated with acid and alkali. Date too young, admixture of Boreal-age roots thought possible.

GrN-5409. Calovanie Maz II-1 **10,455 ± 90**
8505 B.C.
$\delta C^{13} = -24.7‰$

Charcoal from upper Mazovian cultural layer in thin gyttja fingering into dune. Coll. 1967 in Tr. IX. *Comment*: rootlets removed and pretreated with acid and alkali. Agrees with advanced Younger Dryas dating by palynology and acceptable for early Mazovian.

GrN-5254. Calovanie Maz I-1 **9935 ± 110**
7985 B.C.
$\delta C^{13} = -26.5‰$

Charcoal from redeposited Mazovian cultural layer on slope of dune in Tr. III. Coll. 1965. *Comment*: pretreated with acid and alkali.

GrN-5251. Calovanie Meso I-1 **9250 ± 55**
7300 B.C.
$\delta C^{13} = -24.8‰$

Charcoal from rewashed layer at boundary of Early Mesolithic settlement palynologically dated to Preboreal or Early Boreal. Coll. 1966 in Tr. VII. *Comment*: rootlets removed and pretreated with acid and alkali. Dates 1st Mesolithic occupation.

GrN-5442. Calovanie Meso I-1 bis **9200 ± 75**
7250 B.C.
$\delta C^{13} = -25.5‰$

Same sample as above, pretreated more rigorously. *Comment*: after normal pretreatment, sample successively boiled in 40% NaOH, in chlorite solution and 72% sulphuric acid to digest rootlets. Same result indicates rootlets are not a serious source of contamination in these samples.

General Comment: dates agree well with palynologic zoning. Approx. dates for cultures at site are:

Epi-Magdalenian	9400-9000 B.C.
Mazovian	8500-8000 B.C.
Mesolithic	7300 B.C.-end Boreal.

3. Neolithic

Poland Neolithic series, Poland

Samples from various Neolithic sites in Poland coll. by J. A. Bakker, Inst. v. Pre- en Protohistorie, Univ. Amsterdam, Netherlands. Samples listed below have been described fully (Bakker *et al.*, 1969; cf. also Wislański, 1970).

GrN-5384. Olszanica 235.68a **6430 ± 75**
4480 B.C.
$\delta C^{13} = -25.24‰$

Charcoal pieces from Fire Pit 2 in Danubian I (Linear pottery) settlement at Olszanica (18° 50′ E Long, 50° 06′ N Lat), prov. of Krakow, Poland. Depth ca. 0.60 m. Pit contained one sherd of Želiezovce type and other undiagnosed sherds. Coll. 1967 by G. Johnson; subm. by S. Milisauskas, Mus. Anthropol., Univ. Michigan, Ann Arbor, Michigan. *Comment*: compare M-1986: 6020 ± 220 for Pit 1 and M-2011: 6300 ± 400 for Pits 1 and 6 (R., 1970, v. 12, p. 178) same site. Both pits contained Želiezovce and music note sherds. Agree with other dates from Linear pottery settlements in Central Europe.

GrN-5087. Strzelce **6260 ± 60**
4310 B.C.
$\delta C^{13} = -24.3‰$

Large charcoal pieces found in rubbish pit of developed Linear pottery settlement, with music note ornament, under Tumulus II (Globular Amphora culture) at Strzelce (53° 19′ N Lat, 18° 7′ E Long), Site 2, pow. Mogilno, woj. Bydgoszcz, Poland. Depth 1.00 to 1.50 m. Coll. 1952 and subm. 1966 by T. Wislański, IHKM PAN, Poznan. *Comment*: agree with other dates from Linear pottery settlements in Central Europe.

GrN-5035. Sarnowo **5570 ± 60**
3620 B.C.
$\delta C^{13} = -24.7‰$

Finely dispersed charcoal fragments in dark pit filling under Kujavian Long Barrow 8, stratigraphically older than central grave of barrow, at Sarnowo (52° 29′ 15″ N Lat, 18° 45′ E Long), Site 1, pow. Wloclawek, woj. Bydgoszcz. Depth 1.20 to 1.60 m below top of barrow. Assoc. with sherds of Sarnowo phase (Becker A/B) of TRB culture. Barrow may be assigned to Wiórek phase, though without grave gifts (Gabalówna 1969, 1968). Coll. 1966 by L. Gabalówna, Lódz. Subm. 1966. *Comment*: earliest date so far for A/B pottery; *terminus post quem* for barrow.

GrN-5045. Radziejów **4710 ± 40**
2760 B.C.
$\delta C^{13} = -22.6‰$

Charred grain (mainly *Triticum dicoccum*) at depth 1.00 to 1.50 m in Pit A, from Radziejów (52° 37′ 30″ N Lat, 18° 31′ E Long), Site 1, pow. Radziejów Kujawski, woj. Bydgoszcz. Assoc. with amphora of TRB culture (transition between Wiórek and Luboń styles). Coll. 1961 by L. Gabalówna. *Comment*: compare M-1845: 4590 ± 190 and M-1846: 4860 ± 200 (R., 1970, v. 12, p. 177) for same sample.

GrN-5044. Zarebowo **4625 ± 40**
2675 B.C.
$\delta C^{13} = -24.4‰$

Charred apples from Pit II at Zarebowo, Site 1, pow. Aleksandrów Kujawski (52° 46′ N Lat, 18° 36′ E Long). Depth 0.6 to 1.7 m. Assoc. with pottery of TRB culture (transition between Wiórek and Luboń styles, cf. GrN-5045). One unornamented sherd belonged to Globular Amphora culture. In upper part of pit (later filling?) a few other cord ornamented sherds of this culture occurred. Coll. 1960 and subm. 1966 by T. Wislański.

GrN-5088. Cmielów 231 **4615 ± 35**
2665 B.C.
$\delta C^{13} = -24.1‰$

Charcoal from Pit 231 at Cmielów-Gawroniec, pow. Opatów, woj. Kielce (50° 52′ N Lat, 21° 30′ E Long). Depth 0.8 to 1.6 m. Assoc. with

cultural remains of SE TRB group. Coll. 1961 by Z. Podkowińska, IHKM PAN, Warszawa. Subm. 1966.

GrN-5036. Cmielów 243 **4650 ± 40**
2700 B.C.
$\delta C^{13} = -24.2‰$

Charcoal from Pit 243, depth 0.6 to 1.5 m. Same provenance and assoc. as GrN-5088.

GrN-5089. Cmielów 200 **4775 ± 40**
2825 B.C.
$\delta C^{13} = -24.2‰$

Charcoal from Pit 200, depth 0.4 to 0.6 m. Same provenance and assoc. as GrN-5088. *Comment*: erroneously pub. as GrN-5087 (Bakker *et al.,* 1969).

GrN-5090. Cmielow 192 **4720 ± 40**
2770 B.C.
$\delta C^{13} = -24.3‰$

Charcoal from Pit 192, depth 0.8 to 0.9 m. Same provenance and assoc. as GrN-5088. *Comment*: GrN-5036, 5088-5090 agree well with each other and with previous Heidelberg measurement H-566/592: 4675 ± 110 for Pit 180, same site (unpub.).

GrN-5046. Klementowice **4175 ± 30**
2220 B.C.

Bark of partly charred tree from cemetery D 1, Grave 7 at Klementowice (51° 22′ N Lat, 22° 8′ E Long), pow. Pulawy, woj. Lublin. Depth 0.3 to 0.5 m. Grave goods include 3 pots and axe of Krzemionki flint, flint chips and flint objects, belonging to Wislańskis Phase II of Globular Amphora culture. Coll. 1954 and subm. 1966 by J. Kowalczyk, State Archaeol. Mus., Warsaw. Two fractions measured: volatile fraction, GrN-5046a: 4145 ± 60; non-volatile fraction, GrN-5046b: 4190 ± 40. $\delta C^{13} = -25.3‰$ and $-25.9‰$, respectively.

General Comment: all samples pretreated with acid and alkali. Series provides a 1st outline of C^{14} chronology for Neolithic period in Poland. General agreement with existing archaeologic chronologies for Poland and C^{14} dates for related finds in adjoining countries (Bakker *et al.,* 1969). More samples will be measured.

Tirpeşti series, Roumania

Two charcoal samples from Tîrpesti (ca. 47° 10′ N Lat, 26° 20′ E Long), Moldavia. Subm. 1963 by E. Condurachi, Archaeol. Inst. Roumanian Acad. Sci., Bucharest, Roumania.

GrN-4424. Tirpeşti 1 **5540 ± 85**
3590 B.C.

Charcoal from Neolithic layer, assigned to Precucuteni III, Cucuteni A_1 en A_2 (Dumitrescu, 1963).

GrN-4425. Tirpeşti 2 **2070 ± 50**
120 B.C.
$\delta C^{13} = -24.3‰$

Charcoal from more recent ditch.

General Comment: both samples pretreated with acid and alkali. Date from Neolithic layer agrees with GrN-1985: 5330 ± 80 for Habasesti (Cucuteni A_3) and GrN-1982: 4950 ± 60 for Valea Lupului (Cucuteni B_3 or B_2) (R., 1963, v. 5, p. 185). See also Berciu (1967). For further discussion of Cucuteni and Tripolje dates, see Polivanov Jar, below.

GrN-5134. Polivanov-Jar, Ukrainian SSR **5440 ± 70**
3490 B.C.
$\delta C^{13} = -22.9‰$

Charcoal from lowest layer of Tripolje settlement at Polivanov Jar (ca. 48° 30′ N Lat, 26° 48′ E Long) near Komarovo, Kelmentsy Raion, Černovtsy Oblast, Ukrainian SSR. Depth not communicated. Stratigraphy of site (Passek, 1961) is: lowest layer Tripolje B1, middle layer Tripolje B2, upper layer Tripolje γ2. Subm. by T. A. Popowa, Lvov, J. Gurba, Lublin, and J. A. Bakker, Amsterdam. *Comment* (J.A.B.): date agrees with other available C^{14} dates for Cucuteni-Tripolje culture: Bln-590: 5565 ± 100, end of Tripolje A with B1 elements, Novye-Rusešti (R., 1970, v. 12, p. 415); GrN-4424: 5540 ±85, Precucuteni, Cucuteni A1 or A2, Tîrpesti, above; GrN-1985: 5330 ± 80, Cucuteni A3, Habasesti (R., 1963, v. 5, p. 185); GrN-1982: 4950 ± 60, Cucuteni B3 or B2, Valea Lupului (R., 1963, v. 5, p. 185); Bln-631: 4870 ± 100, Tripolje C1, Čapaevka (R., 1970, v. 12, p. 413); GrN-5088: 4615 ± 35, Gorodsk-Horodistea, Tripolje C2, best of Cmielów dates, this list, for SE TRB, elsewhere assoc. to C2-Košylovce group; Bln-692: 4400 ± 100 and LE-645: 4340 ± 65, Usatovo-Foltesti I, Tripolje γ2, Majaki (R., 1970, v. 12, p. 413 and 131). Synchronization of archaeologic sequences for Tripolje (Passek) and Cucuteni (Dumitrescu) is impossible because of contradictory phase definitions, but (Dumitrescu, 1963) Tripolje A ~ Precucuteni III, Tripolje B1 ~ Cucuteni A3, Tripolje C1-γ1 ~ Cucuteni B1-3. Time gap between Habasesti and Valea Lupului corresponds to 5 subphases of Dumitrescu (1963). Gorodsk (Košylovce) does not seem to overlap much with earlier Tripolje phases and Usatovo, unexpectedly, seems younger; compare Bln-630: 4330 ±100 for Michailovka I (R., 1970, v. 12, p. 414).

GrN-5126. Majaki, Ukrainian SSR **3490 ± 35**
1540 B.C.
$\delta C^{13} = -25.8‰$

Charcoal from 3.5 m deep enclosure ditch of settlement of Late Tripolje culture (Usatovo type) at Majaki (46° 10′ N Lat, 30° 8′ E Long), Beljaevka Raion, Odessa Oblast, Ukrainian SSR. Depth 2.7 m. Expected age: 2500 to 2000 B.C. Coll. 1964 by V. G. Zbenovič, Archaeol. Inst. Acad. Sci., Ukrainian SSR, Kiev; subm. by V. G. Sbenovič, J. Gurba, Lublin, and J. A. Bakker, Amsterdam. *Comments*: pretreated

with acid and alkali, (J.A.B.): date apparently wrong. Part of probably same sample was dated Bln-692: 4400 ± 100 (R., 1970, v. 12, p. 413), which agrees with LE-645: 4340 ± 65 (R., 1970, v. 12, p. 131) for same site and phase. See comment on GrN-5134, Polivanov Jar, above.

GrN-5125. Krivina-Golovsk, Belorussian SSR **4270 ± 40**
2320 B.C.
$\delta C^{13} = -26.1‰$

Charcoal from Late Neolithic culture layer (Comb-pricked ware) at Krivina near Golovsk (ca. 54° 50′ N Lat, 29° 43′ E Long), senno Raion, Vitebsk Oblast. Depth 1.30 to 1.45 m. Should date arrival of corded ware culture in N Belorussia. Expected age end 3rd/beginning 2nd mill. B.C. Coll. 1966 by M. N. Černiavsky, Belorussian Acad. of Sciences, Minsk; subm. by J. Gurba, Lublin and J. A. Bakker, Amsterdam. *Comment*: pretreated with acid and alkali.

GrN-5604. Rosdorf 240, W Germany **5685 ± 75**
3735 B.C.
$\delta C^{13} = -25.8‰$

Scattered charcoal fragments in pit belonging to House II (Geleen type) of Early Linear Pottery settlement of Mühlengrun near Rosdorf (51° 31′ N Lat, 9° 56′ E Long), Kreis Göttingen, W Germany (Zimmermann, 1966). Depth 0.50 m. Coll. and subm. 1966 by W. H. Zimmermann, Seminar f. Ur- und Frühgeschichte, Göttingen. *Comment*: 3 samples taken together and pretreated with acid only. Compare Hv-586: 6350 ± 70 (R., 1967, v. 9, p. 205) for charcoal from pit of similar, possibly a little younger, house. GrN-5604 obviously ca. 600 yr too young, possibly caused by admixture of ca. 8% of recent carbon or of ca. 18% of carbon from Bronze age settlement, of which remains were found at same site (Rosdorf 38, GrN-5603: 3120 ± 35, below).

GrN-5601. Vallon des Vaux, Switzerland **4930 ± 40**
2980 B.C.
$\delta C^{13} = -26.0‰$

Carbonized fruit (*Malus*) from narrow sand-filled fissure in rear of rock shelter Vallon des Vaux (46° 46.5′ N Lat, 6° 46′ E Long), Chavannes le Chêne, Vaud, Switzerland. Assoc. with pottery of Chasseen type (Sitterding, ms. in preparation). Depth 1.20 m under rock surface. Expected age: ca. 3000 B.C. Coll. 1966 by M. Sitterding; subm. 1968 by M. Villaret-von Rochow, Mus. Bot., Lausanne, Switzerland. *Comment*: pretreated with acid and alkali. Age as expected.

GrN-5734. Seixas, Portugal **4900 ± 40**
2950 B.C.
$\delta C^{13} = -26.9‰$

Charcoal from lowest layer in dolmen Orca de Seixas near Moimenta da Beira (41° 0′ N Lat, 7° 43′ W Long), prov. of Beira Alta, Portugal. Coll. 1968 by C. Raposo; subm. 1968 by V. Leisner, Deutsches Arch. Inst., Madrid, Spain. Same age expected as for Carapito I, below. *Comment*: pretreated with acid and alkali.

GrN-5110. Carapito I, Portugal **4850 ± 40**
2900 B.C.
$\delta C^{13} = -24.4‰$

Scattered charcoal fragments on original floor of chamber of dolmen Carapito I, 1.5 km S of village Carapito, dist. Viseu (40° 40′ N Lat, 7° 55′ W Long), prov. of Beira Alta, Portugal. Depth 1.50 m below surface of present filling of dolmen. Assoc. with purely Neolithic inventory of microliths, silex blades without retouch, polished stone objects, big callais and amphibolite beads and small chist discs (Leisner, ms. in preparation). Coll. and subm. 1966 by V. Leisner. *Comment*: pretreated with acid and alkali. Agrees with GrN-5734 from Seixas, above. See also dates from Frágoas GrN-4924: 5060 ± 50 and GrN-4925: 4610 ± 50 (R., 1967, v. 9, p. 132-133).

GrN-5629. Bobadella, Portugal **2500 ± 40**
550 B.C.
$\delta C^{13} = -25.4‰$

Charcoal from floor of supposedly undisturbed megalithic chamber (passage grave) at Orca de Bobadella (40° 23′ N Lat, 7° 52′ W Long), near Oliveira do Hospital, prov. of Coimbra, Portugal. Depth 1.70 m below barrow rim. Should date intrusion of Bell Beakers in inner part of country. Coll. 1966 by J. de Castro Nunes; subm. 1968 by V. Leisner. *Comment*: pretreated with acid and alkali. Date is Iron age.

GrN-5628. Lapa do Bugio, Portugal **4850 ± 45**
2900 B.C.
$\delta C^{13} = -23.5‰$

Charcoal in filling of secondary Bell Beaker grave in subterranean burial cave at Lapa do Bugio (38° 38′ N Lat, 9° 5′ W Long), near Sesimbra, prov. of Setubal, Portugal. Should date Bell Beaker culture at coast of Portugal. Coll. 1967 by O. de Veiga Ferreira; subm. 1968 by V. Leisner. *Comment*: pretreated with acid and alkali. Older than expected, but charcoal may be from original cultural layer in cave, cut through by burial.

Newgrange series, Ireland

Late Neolithic passage grave at Newgrange (53° 41′ 20″ N Lat, 6° 29′ W Long), co. Meath, Ireland. Excavated by O'Kelly (1964, 1968). Coll. 1963 and subm. 1967 by M. J. O'Kelly, Dept. Archaeol., Univ. College, Cork, Ireland.

GrN-5462. Newgrange 1 **4500 ± 45**
2550 B.C.
$\delta C^{13} = -21.0‰$

Charcoal fragments in burnt soil used to pack and seal interstices at each end of Roof-Slab 3 in passage. Depth 2.20 m and 4.00 m.

GrN-5463. Newgrange 2 **4415 ± 40**
2465 B.C.
$\delta C^{13} = -24.8‰$

Charcoal fragments in burnt soil used to pack and seal interstices between roof-slabs at point where passage roof merges into corbelled roof of main chamber of tomb. Depth 3.30 m below surface of tumulus. Sample should date actual construction of tomb.

General Comment: pretreated with acid and alkali. No significant difference between dates for passage and chamber. Younger sample best date for construction of monument.

GrN-5602. Vidy, Switzerland **4330 ± 40**
2380 B.C.
$\delta C^{13} = -26.2‰$

Wood (*Abies*) from Layer M (*fumier lacustre*) containing abraded wood fragments, carbonized *Triticum dicoccum* grain, seed, of *Rubus idaeus, Vitis, Corylus,* supposed to represent ancient shore deposit at Vidy (46° 31′ N Lat, 6° 35′ E Long) near Lausanne, Lake Geneva, Switzerland. Depth 2.00 to 2.50 m. No archaeologic objects found, but pollen analysis (Villaret and Burri, 1965) favors Late Neolithic age. Coll. 1961 and subm. 1968 by M. Villaret-von Rochow, Mus. Bot., Lausanne, Switzerland. *Comment*: pretreated with acid and alkali. Age as expected. For dates from earlier levels at Vidy, see R., 1970, v. 12, p. 373.

Cerro de la Virgen series, Spain

Tell at Cerro de la Virgen (ca. 37° 40′ N Lat, 2° 30′ W Long), Orce, prov. of Granada, Spain, excavated by W. Schüle 1963-1965. Subm. 1966 by W. Schüle, Göttingen, Germany.

GrN-5593. Virgen 1/1963 **3890 ± 40**
1940 B.C.
$\delta C^{13} = -24.3‰$

Charred plant remains from basal layer at 4.50 m depth in Bell Beaker house, possibly older than house. Early Bell Beaker culture or before.

GrN-5764. Virgen 8/1965 **3800 ± 35**
1850 B.C.
$\delta C^{13} = -25.0‰$

Charred plant remains from floor of Bell Beaker house. Depth 4.00 m.

GrN-5597. Virgen 12/1965 **3920 ± 60**
1970 B.C.
$\delta C^{13} = -23.3‰$

Charcoal from burnt loom at ca. 3.30 m depth in Bell Beaker house. Early Bell Beaker culture.

GrN-5596. Virgen 4/1965 **3920 ± 35**
1970 B.C.
$\delta C^{13} = -23.4‰$

Charcoal from ashy cultural layer at ca. 2.00 m depth. Early Bell Beaker culture.

GrN-5598. Virgen 13/1965 **3835 ± 35**
1885 B.C.
$\delta C^{13} = -24.6‰$

Charcoal and charred *esparto* from Bell Beaker house at ca. 2.00 m depth. Bell Beaker culture.

GrN-5594. Virgen 2/1963 **3735 ± 55**
1785 B.C.
$\delta C^{13} = -24.1‰$

Wood from shaft grave casing at ca. 3.00 m depth. Argar A culture.

GrN-5595. Virgen 1/1965 **3865 ± 50**
1915 B.C.
$\delta C^{13} = -22.0‰$

Charred acorns and wood from house floor underlying Arabian layers. Some disturbance possible. Depth less than 1 m. Argar B culture. Expected age: ca. 1500 B.C. *Comment*: sample dissolved completely in alkali; extract measured. Early date implies admixture with material from stratigraphically deeper strata.

General Comment: Virgen 8/1965 pretreated with acid only, rest with acid and alkali. Series dates well Bell Beaker culture in S Spain.

4. Bronze age and later

GrN-5037. Leki Male I, Poland **3605 ± 35**
1655 B.C.
$\delta C^{13} = -25.5‰$

Wood from collapsed roof above double Central Grave A of Tumulus I at Leki Male (52° 09′ N Lat, 16° 33′ E Long), pow. Koscian, woj. Poznań, Poland, excavated 1953 by M. Kowiańska-Piaszykowa and S. Kurnatowski (Bakker *et al.*, 1969). Grave goods from classic phase of Unětice culture. Depth 5.00 m. Sample consists of only 5 to 10 tree rings but position in trunk unknown. Subm. 1966 by J. A. Bakker, Univ. Amsterdam, Netherlands. *Comments*: pretreated with acid and alkali; (J.A.B.): date expected, *cf.* Helmsdorf, Bln-248: 3613 ± 160 (R., 1966, v. 8, p. 29) for grave of same phase and Prasklice, Bln-475: 3845 ± 80 (R., 1970, v. 12, p. 406) for pit of earlier phase of same culture. Dates, in conventional C^{14} scale, agree well with those expected archaeologically. However, tree-ring calibration sets true age 3 to 4 centuries older.

GrN-5047. Bruszczewo 53, Poland **3320 ± 40**
1370 B.C.
$\delta C^{13} = -24.6‰$

Pieces of charcoal mainly from upper part of Pit 53 at Site 5 at

Bruszczewo (52° 2′ N Lat, 16° 35′ E Long), pow. Koscian, woj. Poznań, Poland; excavated by Z. Pieczyński, Muz. Archaeol., Poznań. Depth 0.20 to 0.60 m. Assoc. with pottery, estimated later than Únětice, but earlier than Lusatian. Coll. 1966 by J. A. Bakker; subm. by excavator and J. A. Bakker. *Comment*: pretreated with acid and alkali. Age as expected.

Glum series, W Germany

Two of 4 wooden disc wheels (*Alnus*) with inserted nave found 1880-1882 at Glum, near Wardenburg (53° 6′ N Lat, 8° 9′ E Long), Landkreis Oldenburg, W Germany, below ca. 2.50 m *Sphagnum*-peat, in E part of Vehnemoor bog. Preserved in dried condition at Staatliches Mus. f. Nat. u. Vorgeschichte, Oldenburg, W Germany. Samples from near center of wheels (diam. 0.75 m), tree rings not to be counted but maximum age of *Alnus* tree estimated at 120 yr. No assoc. finds (van der Waals, 1964). Expected age 1800-1700 B.C.: general date for start of peat formation in area. Coll. and subm. by H. Hayen, Staatliches Mus. f. Nat. u. Vorgeschichte, Oldenburg, W Germany.

GrN-5419. Glum 4 — **3445 ± 45** / **1495 B.C.** / $\delta C^{13} = -26.1‰$

GrN-5420. Glum 5 — **3480 ± 40** / **1530 B.C.**

General Comment: pretreated with acid and alkali. Indicates Early Bronze age date for wheels.

GrN-5603. Rosdorf 38, W Germany — **3120 ± 35** / **1170 B.C.** / $\delta C^{13} = -25.2‰$

Charcoal from pit with potsherds of unknown age (possibly Tumulus Bronze age), found during excavation of Bandkeramik settlement at Rosdorf (51° 3′ N Lat, 9° 56° E Long), Kreis Göttingen, W Germany at 1.10 m depth (Zimmermann, 1966). Coll. 1965 and subm. 1966 by W. H. Zimmermann, Seminar f. Ur- u. Frühgeschichte, Göttingen, W Germany. *Comment*: pretreated with acid only. Result proves supposition.

Ipwegermoor series, W Germany

3 more dates from excavations in the Ipwegermoor (ca. 53° 13′ N Lat, 8° 16′ E Long), near Oldenburg, Lower Saxony, W Germany, by H. Hayen, Staatliches Mus. f. Nat. u. Vorgeschichte, Oldenburg, W Germany. Dates from 10 other trackways in this bog range from 3650-2270 B.P. (see also Hayen, 1963; R., 1963, v. 5, p. 187-188; and R., 1967, v. 9, p. 141-142). Subm. by excavator.

GrN-5422. Ipwegermoor LVI — **3110 ± 65** / **1160 B.C.** / $\delta C^{13} = -27.5‰$

Wood (*Alnus*) from trackway ("Pfahlsteg") No. LVII, *in situ* at

depth 0.50 m below reworked peat. Coll. 1960. *Comment*: pretreated with acid and alkali.

GrN-5421. Wittemoor 1 and 2 **2420 ± 95** **470 B.C.**

$\delta C^{13} = -26.3‰$

Near trackway XLII (53° 8′ N Lat, 8° 24′ E Long) in Wittemoor near Hude, a part of Ipwegermoor, 2 unique wooden human figures (male and female) found at 1.50 m depth in 1965 (Hayen, 1965). Small splinters were taken near base from each of figures, and thus from core of trunk (*Quercus*). Breadth of figures 0.32 and 0.27 m. Stratigraphic position indicates contemporaneity with trackway, GrN-4395: 2200 ± 60 (R., 1967, v. 9, p. 142). Subm. by H. Hayen. *Comment*: because samples were small, they were combined and pretreated with acid only. Large error due to size.

GrN-5156. Streekermoor **1925 ± 35** **A.D. 25**

$\delta C^{13} = -26.0‰$

Charcoal from iron melting oven on sandy outcrop Iserbarg in Streekermoor. Depth 0.40 m. No assoc. finds, but contemporaneity expected with trackways from last centuries B.C., which run in direction of ore deposit in vicinity. Coll. 1966. *Comment*: pretreated with acid and alkali.

General Comment: GrN-5422 within range of dates of other trackways in same bog. GrN-5421 is slightly older than trackway, but age of wood can easily bridge time difference and contemporaneity of trackway and figures considered highly probable, considering also stratigraphic evidence. GrN-5156 is somewhat younger than expected and later than any trackway dated so far in area.

GrN-5250. Ivanice, Ukrainian SSR **3235 ± 35** **1285 B.C.**

$\delta C^{13} = -24.2‰$

Charcoal from pyre remains in SW quadrant in barrow of Middle Bronze age Komarowa culture at Ivanice (ca. 50° 14′ N Lat, 25° 40′ E Long), Dubno Raion, Rovne Oblast, Ukrainian SSR. Depth 1.00 m, 1 m above base of 2 m high tumulus. Coll. 1966 by I. K. Svešnikov, Univ. Lvov, USSR; subm. 1967 by I. K. Svešnikov, J. Gurba, Lublin, and J. A. Bakker. Phase of Komarowa culture not specified by collector, but expected age (13th century B.C.) points to his Phase II (with Noua culture influences in the Dubno region, see Swiesznikow, 1967 and Sulimirski, 1968, p. 97). *Comments*: pretreated with acid and alkali; (J.A.B.): agrees with expectation and with GrN-5135 for Noua culture.

GrN-5135. Magala, Ukrainian SSR **3100 ± 35** **1150 B.C.**

$\delta C^{13} = -24.6‰$

Charcoal in small pit below 0.90 m of cultural layers of Noua and Early Thracian settlement at Magala (48° 18′ N Lat, 26° 03′ E Long),

Sadgor Raion, Chernovtsy Oblast, Ukrainian SSR (Smirnova, 1957). Depth 1.1 m. Coll. 1962 and subm. by G. I. Smirnova, Inst. Archaeol. Acad. Sci., Leningrad, J. Gurba, Lublin, and J. A. Bakker, Amsterdam. Pit thought to belong to Period IV of settlement (Early Thracian); expected age: ca. 10th century B.C. *Comments*: pretreated with acid and alkali; (J.A.B.): G.I.S. reconcluded after sample was dated that pit could be assigned to Noua culture represented in lowest layers of site. Charcoal from upper, Early Thracian layers of same settlement has date LE-573: 1450 ±90 (R., 1970, v. 12, p. 131), which, apparently, is too recent.

GrN-5133. Bolčaja Andrusovka, Ukrainian SSR **2070 ± 50**
120 B.C.
$\delta C^{13} = -24.2‰$

Charcoal taken 1959 from wall remains of sunken dwelling, from early phase of Late Bronze to Early Iron age Černoles culture near Bolčaja Andrusovka (49° 10′ N Lat, 32° 55′ E Long), Georgievsk Raion, Kirowograd Oblast, Ukrainian SSR (Pokrowska and Petrowska, 1962). Depth 0.75 m. Expected age 9th to 8th century B.C. Coll. 1959; subm. by E. F. Pokrowska, E. A. Petrowska, Archaeol. Inst. Ukrainian Acad. Sci., Kiew, J. Gurba, Lublin, and J. A. Bakker. *Comment*: pretreated with acid and alkali. Much younger than expected.

GrN-5109. Cabezo Rodondo, Vil. 2, Spain **3320 ± 55**
1370 B.C.
$\delta C^{13} = -23.0‰$

Upright post in house of El Argar culture, Sec. XV of Late Bronze age settlement on hill Cabezo Rodondo near Villena (38° 40′ N Lat, 0° 52′ W Long), prov. of Alicante, Spain. Coll. 1949 by J. M. Soler García, subm. by H. Schubart, Deutsches Archäol. Inst., Madrid. *Comment*: pretreated with acid and alkali. Another charcoal sample from settlement (Sec. VIII, *pasillo norte* below stone wall) dated at Heidelberg, H-2277-1694: 3550 ± 55 (Schubart, 1965). See also GrN-5594: 3735 ± 55 from Virgen (above) for Argar culture.

GrN-5568. Monte da Penha, Gui 1, Portugal **2880 ± 65**
930 B.C.
$\delta C^{13} = -25.4‰$

Charred wooden shaft of one of pair of bronze spear-heads found by quarry workmen at depth ca. 0.50 m within range of Late Bronze age settlement Monte da Penha near Guimaraes (41° 27′ N Lat, 8° 20′ W Long), prov. of Braga, Portugal. Expected age: 1200-400 B.C. Coll. 1967 by M. Cardozo; subm. 1968 by H. Schubart. *Comment*: pretreated with acid only.

GrN-5108. El Cigarralejo, Cig. 2, Spain **2180 ± 35**
230 B.C.
$\delta C^{13} = -25.5‰$

Charcoal from very rich grave No. 200 with stone capping in cemetery of Iberian settlement and sanctuary El Cigarralejo near Mula (38° 3′ N Lat, 1° 28′ W Long), prov. of Murcia, Spain, excavated by

E. Cuadrado (Schubart, 1965). Grave goods include ornaments, weapons, horse gear, imported Greek pottery, etc., providing exact historic date at beginning of 4th century B.C. Depth ca. 1.50 m. Coll. 1963 and subm. 1964 by H. Schubart. *Comment*: pretreated with acid and alkali. Cf. H-2275-1683: 2160 ± 45 for charcoal from same grave. Both dates appear ca. 2 centuries too young. Difference too large to be explained by anomalies in original C^{14} activity. More probable that time lag existed between manufacturing of objects and deposition in grave.

GrN-5445. Satriano Vecchio, Italy **1395 ± 40** **A.D. 550**

$\delta C^{13} = -25.2‰$

Charcoal from pottery kiln at 1.35 m depth in Sec. LC-TR 19 of ancient and Medieval site of Satrianum (40° 34′ N Lat, 15° 35′ E Long), near Satriano di Lucania, prov. of Potenza (Ross Holloway, 1967). Should date from immediately before expansion of ancient town. Expected age 7th-5th century B.C. Coll. and subm. 1967 by R. Ross Holloway, Brown Univ., Archaeol. Expedition, Providence, R.I. *Comment*: pretreated with acid and alkali. Charcoal apparently Medieval.

GrN-5086. Maiden Castle, England **1880 ± 35** **A.D. 70**

$\delta C^{13} = -19.7‰$

Collagen from *femur* of male P.12 buried in Belgici War cemetery at Maiden Castle near Dorchester (50° 43′ N Lat, 2° 26′ W Long), S England, accurately dated by Roman invasion to A.D. 43. Coll. 1966 by S. Thomas; subm. 1966 by K. P. Oakley, British Mus. (Nat. Hist.), London, U.K. *Comment*: pretreated as for unburnt bone (Vogel, unpub.). Agrees well with historic date.

GrN-5612. Alt-Bennebek 107d, W Germany **1390 ± 20** **A.D. 560**

$\delta C^{13} = -27.4‰$

Wood (*Quercus*) from one-piece disc wheel KSB 107d found 1967 with 2 identical pieces near site of 4 more wheels, cart axe, etc., found in 1938, in peat-filled valley at Alt-Bennebek (54° 25′ N Lat, 9° 27′ E Long), Kreis Schleswig, W Germany. Depth 0.80 m. Sample from oldest tree rings from center of wheel, original diam. estimated at 0.60 m. Coll. 1967 at Schleswig-Holsteinisches Mus. f. Vor- u. Frühgeschichte, Schleswig, W Germany. Expected age: 2300-1500 B.C., based on finds of corresponding wheels in the Netherlands (see e.g. below, Ubbena, GrN-5069: 4185 ± 60, and van der Waals, 1964). Subm. 1967 by J. D. van der Waals, Biol.-Archaeol. Inst., Univ. Groningen, Netherlands. *Comment*: pretreated with acid and alkali. See also KI-261: 1560 ± 40 (R., 1969, v. 11, p. 429) for sample from one of Alt-Bennebek wheels.

GrN-5038. Chodlik, small fort, Poland **1140 ± 30** **A.D. 810**
$\delta C^{13} = -25.1‰$

Burnt oak beam from rampart of small ringfort, 2 km from large ringfort near Chodlik (51° 12′ N Lat, 21° 55′ E Long), pow. Opole, woj. Lublin, Poland. Depth 0.40 m. Finds date from late 8th to early 9th century A.D. Pottery is of type Chodlik C, which does not occur in large ringfort and should be later (Bakker *et al.*, 1969). Coll. 1965 by S. Hoczyk and A. Gardawski, Lublin; subm. by J. A. Bakker. *Comment*: pretreated with acid and alkali. Date from middle rampart of large ringfort GrN-4615: 1160 ± 50 in Groningen VII (R., 1967, v. 9, p. 144) indeed earlier than that of small ringfort.

GrN-5249. Biskupin 18, Pit V, Poland **1070 ± 35** **A.D. 880**
$\delta C^{13} = -26.5‰$

Burnt organic material from Pit V containing sherds of Neolithic Brzesć Kujawski Group at Biskupin, Site 18 (52° 47′ N Lat, 17° 43′ E Long), pow. Znin, woj. Bydgoszcz, Poland. Depth 0.40 to 0.50 m (below disturbance). Coll. 1937 by Z. Rajewski, kept in Muz. Archeol., Poznań; subm. 1967 by T. Wislański and J. A. Bakker. Expected age: 3rd millennium B.C. *Comments*: pretreated with acid and alkali; (J.A.B.): much younger than expected. Several 7th to 11th century A.D. remains also present at site.

GrN-4840. Corfu, Greece **175 ± 60** **A.D. 1775**
$\delta C^{13} = -25.2‰$

Wood from Venetian chest bought on isle of Corfu (39° 40′ N Lat, 18° 50′ E Long), Greece. Coll. 1963 and subm. 1966 by H. L. Visser, Scheveningen, Netherlands. *Comment*: pretreated with acid and alkali. True age after correction for de Vries-effect: mid-17th century; much younger than expected.

GrN-4233. London bone, England **330 ± 55** **A.D. 1620**
$\delta C^{13} = -18.9‰$

Collagen from rib of human buried in A.D. 1782 in London cemetery (57° 30′ N Lat, 0° 10′ W Long), England. Subm. before 1960 by K. P. Oakley. *Comment*: pretreated as for unburnt bone (Vogel, unpub.). Apparently, ca. 160 yr too old.

C. Netherlands

1. Paleolithic and Mesolithic

GrN-4180. Aardhorst **11,140 ± 70** **9190 B.C.**
$\delta C^{13} = -26.2‰$

Charcoal from fireplace in Concentration III of Mesolithic surface settlement at Aardhorst near Vessem (51° 25′ N Lat, 5° 19′ E Long),

prov. of Noord-Brabant. Ahrensburgian material occurs nearby. Coll. 1960, subm. 1961 by A. Bohmers. *Comment*: charcoal apparently Ahrensburgian. Possibility of intrusion exists.

GrN-4181. Luijksgestel 224 **9970 ± 105**
8020 B.C.

Charcoal from fireplace in Concentration II in Mesolithic surface settlement near Luijksgestel (51° 17′ N Lat, 5° 19′ E Long), prov. of Noord-Brabant. Depth ca. 0.50 m. Coll. and subm. 1961 by A. Bohmers. *Comment*: date suggests early stage of Mesolithic sequence.

GrN-5043. Waskemeer-West **7620 ± 50**
5670 B.C.

Excavation of Late Mesolithic surface settlement W of the Waskemeer (53° 02′ N Lat, 6° 15′ E Long), Ooststellingwerf, prov. of Friesland. Depth 0.30 m. A few fragmentary potsherds suggest transition to Neolithic period. Coll. and subm. 1966 by P. Houtsma, Waskemeer, Netherlands. *Comment*: date indicates sherds were intrusive.

GrN-4205. Tilburg 35[a] **4070 ± 85**
2120 B.C.
$\delta C^{13} = -26.7‰$

Charcoal with many rootlets from near-surface fireplace in settlement of Mesolithic survival group near Tilburg (51° 33′ N Lat, 5° 07′ E Long), prov. of Noord-Brabant. Subm. by A. Bohmers. *Comment*: charcoal apparently Late Neolithic. Remains from this period also occur.

GrN-4922. Willemsstad **6400 ± 85**
4450 B.C.
$\delta C^{13} = -25.3‰$

Unique wooden statuette (van Es and Casparie, 1968), from peaty layer some 8 m below sea level at bottom of building trench for dock in Volkerak dam, near Willemsstad (51° 41′ N Lat, 4° 27′ E Long), prov. of Noord-Brabant. Coll. and subm. 1966 by W. A. van Es, State Service Archaeol. Research, Amersfoort. Mesolithic age expected. *Comment*: according to R. R. Newell (unpub.), Mesolithic survival groups were present in S Netherlands in 5th millennium B.C.

2. Neolithic

Oostelijk Flevoland series, Netherlands

Geologic, palynologic, and archaeologic studies were made in new Zuyderzee polder, Oostelijk Flevoland, by P. J. Ente, W. H. Zagwijn, and G. D. van der Heide. Under younger clay deposits a syystem of gullies, river banks, and Pleistocene river dunes occur, forming part of former lower course of river IJssel. At levels $>$ 5 m below present sea level, ca. 1 m below former Zuyderzee bottom, Early Neolithic habitation sites were found at 7 places in ditches and borings ("Swifterbant culture"). Trial excavations made on Plots H46 and G42 (van der Heide, 1966; van der Waals, in press). A series of marine clay deposits (Calais-

stages) were recorded in valleys and depressions, alternating with peat layers. Samples subm. by P. J. Ente, Rijksdienst v. IJsselmeerpolders, Kampen, Netherlands.

GrN-5067. Swifterbant H46 **5610 ± 60** **3660 B.C.**

$\delta C^{13} = -26.9‰$

Peat layer exposed in pit on Plot H46 (52° 34′ N Lat, 5° 38′ E Long) at depth —6.15 m (1.94 m below surface) on slope of Pleistocene river dune with human habitation, consisting of settlement pits, fireplaces, and graves. Pottery ornamentation includes vertical rows of paired finger-tip impressions, horizontal rows of vertical nail impressions, etc. Pottery differs considerably from that of Site G42. Sample dates overgrowing of dune. Date should be minimum for settlement. Coll. 1966 by P. J. Ente. *Comment*: pretreated with acid and cold alkali.

GrN-5443. Swifterbant G42[a] **5300 ± 40** **3350 B.C.**

Charcoal from dark gray humic cultural layer (0.20 m thick) on Plot G42 (52° 34′ N Lat, 5° 35′ E Long), on clayey river bank at —5.30 m. Assoc. with flint tools and pottery, including such with pointed bases and rim sherds with inside ornamentation. Coll. 1967 by G. D. van der Heide. *Comment*: pretreated with acid and alkali.

GrN-5606. Swifterbant G42[b] **5540 ± 65** **3590 B.C.**

$\delta C^{13} = -22.6‰$

Collagen from human skeleton in 1 of 4 graves below cultural layer on Plot G42 (see GrN-5443 above). Coll. 1967 by G. D. van der Heide. *Comment*: pretreated as for unburnt bone.

GrN-5082. Lelystad II **6150 ± 130** **4200 B.C.**

$\delta C^{13} = -26.0‰$

Basal part of peat layer between marine clay deposits at depth 4.66 to 4.71 m below surface on Plot A70 (52° 33′ N Lat, 5° 30′ E Long). Pollen analysis points to Calais II age of lower clay and Calais III age of upper clay deposit. Expected age: 5400 B.P. Coll. 1966 in boring by P. J. Ente and W. H. Zagwijn. *Comment*: pretreated with acid and alkali.

GrN-5081. Lelystad I **5330 ± 60** **3380 B.C.**

$\delta C^{13} = -27.2‰$

Same sec. as Lelystad II, above. Basal part of peat layer on top of upper clay deposit. Sample taken immediately above *Ulnus* decline in pollen diagram. Below this decline a few *Cerealia* pollen occur. Expected age 4800: B.P. Coll. 1966 by P. J. Ente and W. H. Zagwijn. *Comment*: pretreated with acid and alkali.

GrN-5348. Lelystad I[b], residue **5265 ± 75**
3315 B.C.
$\delta C^{13} = -26.8‰$

GrN-5390. Lelystad I[b], extract **5315 ± 65**
3365 B.C.
$\delta C^{13} = -27.2‰$

To check preceding date, a new core sample was taken 10 m away at depth 3.63 to 3.65 m in same sec. Coll. 1967 by P. J. Ente. *Comment*: pretreated with acid and cold alkali; both alkali soluble and insoluble fractions measured. Similar results indicate no contamination.

GrN-5349. Tollebeek I, residue **4630 ± 90**
2680 B.C.
$\delta C^{13} = -26.3‰$

GrN-5391. Tollebeek I, extract **4370 ± 40**
2420 B.C.
$\delta C^{13} = -27.9‰$

Base of peat layer on marine clay deposit, representing either Calais III or IV stage, on Plot D8/9 in neighboring Noordoostpolder at Tollebeek (52° 41′ N Lat, 5° 41′ E Long). Coll. 1967 by P. J. Ente. *Comment*: pretreated with acid and cold alkali; both alkali soluble and insoluble fractions measured. Older date most reliable.

General Comment: dates indicate interesting possibilities for further archaeologic research and prove earlier intrusion of marine influence in area than was expected on basis of Elm decline, which seems very early in this area. Check measurements of alkali soluble fractions indicate reliability of peat dates. GrN-5443 and 5606 first dates between 5100 and 5800 B.P. for archaeologic finds in Netherlands. Contemporaneity with Rössen and Michelsberg cultures indicated.

GrN-5549. Rijckholt R 9, Netherlands **5000 ± 40**
3050 B.C.
$\delta C^{13} = -25.2‰$

Charcoal from basal filling of Shaft R 9 in flint mine, dist. Rijckholt (50° 48′ N Lat, 5° 44′ E Long), prov. of Limburg. Coll. 1966 by W. M. Felder and collaborators; subm. by H. T. Waterbolk. *Comment*: pretreated with acid and alkali. See GrN-4544: 5070 ± 60 (R., 1967, v. 9, p. 124) for other date from same flint mining area.

Angelsloo series, Netherlands

Three more samples were dated from Neolithic contexts in excavation at Angelsloo (52° 47′ N Lat, 6° 57′ E Long), Emmen, prov. of Drenthe (Bakker and van der Waals, in press). For Bronze age dates from site see below. Subm. by J. D. van der Waals, Biol.-Archaeol. Inst. State Univ., Groningen, Netherlands.

GrN-5103. Angelsloo 455 **4355 ± 45**
2405 B.C.
$\delta C^{13} = -25.1‰$

Scattered pieces of charcoal in settlement pit with abundant pottery of late-Drouwen stage of TRB culture. Depth 0.5 to 1.0 m. Coll. 1965 by A. Meijer and G. Delger. Subm. 1967. *Comment*: pretreated with acid and alkali.

GrN-5767. Angelsloo 90 **4315 ± 60**
2365 B.C.
$\delta C^{13} = -26.0‰$

Scattered pieces of charcoal from settlement pit with pottery from last stage of TRB culture. Depth > 0.45 m. Coll. 1961 by G. Delger and J. D. van der Waals. Subm. 1967. *Comment*: pretreated with acid only.

GrN-5070. Angelsloo 464 **4100 ± 30**
2150 B.C.
$\delta C^{13} = -24.7‰$

Charcoal from pyre in flat grave with cremation. Grave goods belong to last stage of TRB culture. Depth 0.4 to 0.9 m. Coll. 1965 by J. D. van der Waals. Subm. 1967. *Comment*: pretreated with acid and alkali.

GrN-5139. Angelsloo 535 **2750 ± 35**
800 B.C.
$\delta C^{13} = -24.8‰$

Large charcoal pieces from concentration at 0.40 to 0.90 m depth in oval settlement pit with remains of TRB culture. Coll. 1966 by H. Praamstra. *Comment*: pretreated with acid and alkali. Charcoal apparently much younger than sherds and dating from Late Bronze age. *General Comment*: present series confirms dates GrN-2370: 4145 ± 100 (R., 1963, v. 5, p. 179) for charcoal from a flat grave and GrN-4201: 4380 ± 75 (R., 1967, v. 9, p. 126) for charcoal from a settlement pit. Together they suggest a duration for last (late Havelte) stage of TRB culture from ca. 4300 to 4100 B.P. For early Havelte stage there is a date GrN-1824: 4420 ± 55 at Anlo (R., 1963, v. 5, p. 180). In this connection GrN-5103, Angelsloo 455, from preceding late-Drouwen stage appears a little late. Further dates are needed for more precise dating of TRB cultural stages.

Vlaardingen series, Netherlands

Two more dates from Neolithic site at Vlaardingen (51° 54′ N Lat, 4° 19′ E Long), prov. of Zuid-Holland. For main series, see R., 1963, v. 5, p. 177.

GrN-4114. Vlaardingen N 8 **4420 ± 120**
2470 B.C.

Outermost 10 tree rings of post. Coll. 1960; subm. by W. Glasbergen, Inst. v. Pre- en Protohistorie, Univ. Amsterdam, Netherlands. *Comment*: pretreated with acid only. Same sample as GrN-2304: 4205 ± 75 (R., 1963, v. 5, p. 177).

GrN-4948. Vlaardingen, bone **4130 ± 40**
2180 B.C.
$\delta C^{13} = -21.1‰$

Animal bone from upper refuse layer in Neolithic creek. Subm. 1966 by W. Groenman-van Waateringe, Inst. v. Pre- en Protohistorie, Univ. Amsterdam, Netherlands. *Comment*: pretreated as for unburnt bone. Date agrees well with charcoal date GrN-2480: 4190 ± 70 for upper part of refuse layer in creek bed.

GrN-5175. Hazendonk, Netherlands **4290 ± 40**
2340 B.C.
$\delta C^{13} = -27.9‰$

Peaty occupation layer (drill core) in clay-covered peat adjacent to Early Holocene river dune at Hazendonk (51° 52′ N Lat, 4° 50′ E Long), Molenaarsgraaf, prov. of Zuid-Holland. Remains of Vlaardingen culture, various Beaker cultures, and Early Bronze age were found on dune. Depth 1.95 to 1.20 m. Coll. 1966 and subm. 1967 by L. P. Louwe Kooijmans, Rijksmus. van Oudheden, Leiden. Sample should date active period of gully, which after being filled, became stream ridge of Schoonrewoerd, with occupation from Bell Beaker and Bronze age periods (see Molenaarsgraaf series, below). Expected age: 2400 to 2000 B.C. (Vlaardingen culture). *Comment*: pretreated with acid and alkali. Age as expected.

GrN-5031. Voorschoten 2, Netherlands **4030 ± 40**
2080 B.C.
$\delta C^{13} = -26.8‰$

In addition to 4 samples from Voorschoten (52° 8′ N Lat, 4° 25′ E Long) (R., 1967, v. 9, p. 125) another sample from one of basal layers, no. 4-5, with remains of early stage of Vlaardingen culture (Vl 1), was dated. Depth 1.00 m (Glasbergen *et al.,* 1967). Coll. and subm. 1965 by W. H. Metz, Inst. v. Pre- en Protohistorie, Univ. Amsterdam, Netherlands. *Comment*: pretreated with acid only. Confirms earlier dates (e.g., GrN-4906: 4090 ± 50), placing Vlaardingen culture at Voorschoten about a century later than at Vlaardingen itself (see above).

GrN-2221. Zandwerven, Netherlands **4000 ± 65**
2050 B.C.

Re-excavation 1958 by Inst. v. Pre- en Protohistorie, Univ. Amsterdam, of Late Neolithic settlement, now assigned to Vlaardingen and PFB cultures, at Zandwerven (52° 41′ N Lat, 4° 56′ E Long), Spanbroek, prov. of Noord-Holland (van Regteren Altena *et al.,* 1963). Charcoal piece from pit, containing settlement refuse, with shells and fish bones. Depth ca. 0.80 m. *Comment*: date later than Vlaardingen series, but contemporary with dates from Vlaardingen culture at Voorschoten (R., 1967, v. 9, p. 125 and this list, below).

Leidschendam series, Netherlands

At Leidschendam (52° 10′ N Lat, 4° 20′ E Long), prov. of Zuid-

Holland, settlement of Late Neolithic Vlaardingen and PFB cultures excavated 1963 and 1964 by Inst. v. Pre- en Protohistorie, Univ. Amsterdam, Netherlands, which submitted samples 1966. Settlement occurs on narrow sand ridge. Unstratified occupation layer was 0.20 m thick covered by ca. 0.15 m peat (Glasbergen *et al.,* 1967). Samples coll. by W. Groenman-van Waateringe.

GrN-5027. Leidschendam 23 **3660 ± 60**
1710 B.C.
$\delta C^{13} = -30.5‰$

Charcoal from occupation layer in Cutting 1. Coll. 1963.

GrN-5029. Leidschendam A 5 **3660 ± 80**
1710 B.C.
$\delta C^{13} = -25.9‰$

Charcoal from occupation layer in Cutting 4. Coll. 1964.

GrN-5028. Leidschendam 191 **3810 ± 60**
1860 B.C.
$\delta C^{13} = -28.0‰$

Charcoal from occupation layer in Cutting 4. Coll. 1964.

General Comment: due to their size, all samples pretreated with acid only. Dates a few centuries younger than upper layers at nearby Voorschoten, with which archaeologic finds are comparable. To explain difference, one would have to assume a contamination or admixture amounting to nearly 10% of recent carbon, which does not seem probable. No explanation of anomaly can be given.

GrN-5069. Ubbena, Netherlands **4185 ± 60**
2235 B.C.
$\delta C^{13} = -25.3‰$

Wood (*Quercus*) from one of pair of disc wheels (ritual deposit) found in small peat-filled depression near Ubbena (53° 3′ N Lat, 6° 35′ E Long), Vries, prov. of Drenthe. Depth ca. 1 m below surface. Sample consists of outermost tree rings. Coll. 1966, subm. 1967 by J. D. van der Waals. *Comment*: pretreated with acid and alkali. Minimum date for dates for disc wheels in area (van der Waals, 1964).

GrN-5068. Eeserveld, Netherlands **3955 ± 50**
2005 B.C.
$\delta C^{13} = -24.4‰$

Charred grain from 0.40 to 1.00 m depth in horse-shoe shaped pit under barrow at Eeserveld near Odoorn (52° 51′ N Lat, 6° 51′ E Long), prov. of Drenthe. Pit stratigraphically situated between 1st period of barrow of Late Neolithic PFB culture and secondary capping from Middle Bronze age Elp culture. Coll. 1966 and subm. 1967 by J. D. van der Waas. *Comment*: pretreated with acid and alkali. Minimum date for PFB grave and proves Late Neolithic age of horse-shoe shaped pit. At Schipborg, similar pit gave GrN-2445: 3780 ± 60 (R., 1963, v. 5, p. 182).

GrN-5295. Bornwird, Netherlands **3930 ± 50**
1980 B.C.
$\delta C^{13} = -28.2‰$

Sandy peat at 1.50 m depth overlying plough soil with Late Neolithic finds and clear traces of ploughing at Bornwird (53° 20′ N Lat, 6° 0′ E Long), Westdongeradeel, prov. of Friesland. Marly clay covers peat. Coll. and subm. 1967 by W. A. Casparie and W. van Zeist, Biol.-Archaeol. Inst., Univ. Groningen, Netherlands. Date should be minimum for Late Neolithic occupation at site, which probably belongs to PFB culture. *Comment*: pretreated with acid and alkali.

Molenaarsgraaf series, Netherlands

At Molenaarsgraaf (51° 52′ N Lat, 4° 50′ E Long), prov. of Zuid-Holland, settlement was excavated on sandy stream ridge cut through by a gully. Phase 1 of occupation is characterized by Bell Beakers of Veluwe type, Phase 2 by pottery ornamented by so-called barbed-wire stamps, Phase 3 by related but unornamented ware. Coll. 1966 and subm. 1967 by L. P. Louwe Kooijmans.

GrN-5131. Molenaarsgraaf, Grave I **3635 ± 40**
1675 B.C.
$\delta C^{13} = -21.6‰$

Collagen from *femur* of 15-yr-old child in Grave I assoc. with typologically late Bell Beaker of Veluwe type. Depth 1.00 m. *Comment*: pretreated as for unburnt bone.

GrN-5566. Molenaarsgraaf, Grave II **3630 ± 40**
1680 B.C.
$\delta C^{13} = -22.6‰$

Collagen from *femur* of ca. 30-yr-old male in Grave II assoc. with antler pic, 3 bone fish hooks, and 4 pieces of flint. Depth 0.80 m. *Comment*: pretreated as for unburnt bone.

GrN-5705. Molenaarsgraaf 210 **3635 ± 60**
1685 B.C.
$\delta C^{13} = -27.7‰$

Large quantity of charcoal from 0.50 to 1.00 m depth in Pit 210 at head end of Grave II and, supposedly, contemporary with it. In pit sherd of Veluwe Bell Beaker was found. *Comment*: pretreated with acid and rigorously boiled with alkali.

GrN-5132. Molenaarsgraaf 199 **3780 ± 55**
1830 B.C.
$\delta C^{13} = -27.0‰$

Charcoal from 0.70 to 1.00 m depth in Pit V, dug shortly after Grave II. *Comment*: pretreated with acid and alkali.

GrN-5176. Molenaarsgraaf 58 **3640 ± 30**
1690 B.C.
$\delta C^{13} = -27.4‰$

Charcoal from 0.40 to 0.80 m depth in small area (2 × 2 m^2) of

peat with cultural remains, including large pot, related to pottery with barbed-wire stamp ornamentation and Bentheim-type Beakers. *Comment*: pretreated with acid and alkali.

GrN-5177. Molenaarsgraaf 29 **3350 ± 35**
1400 B.C.
$\delta C^{13} = -25.8‰$

Charcoal from shallow pit with many pieces of burnt loam and pottery of Middle Bronze age character. Depth 0.40 m. *Comment*: pretreated with acid and alkali.

GrN-5264. Molenaarsgraaf, Trench C 8 **2710 ± 35**
760 B.C.
$\delta C^{13} = -28.0‰$

Peat from 0.58 m depth in deposit in gully from level where all human influence on vegetation had ceased. *Comment*: pretreated with acid only.

General Comment: dates agree well with archaeologic estimates. GrN-5132 appears a little early but charcoal is not necessarily contemporary with moment the pit was dug. Series provides good dating of late phase of Veluwe Bell Beakers at ca. 3630 B.P.

GrN-4635. Haarlem, Netherlands **3685 ± 40**
1735 B.C.

Thin peat layer merging into humic layer, containing sherds of Pot Beakers (Bell Beaker culture) in excavation made for construction of sewer at Schoterweg, Haarlem (52° 22′ N Lat, 4° 39′ E Long). Depth 1.75 to 1.78 m below surface (−1.25 to −1.28 m). For general description of area see Coastal Dunes series (this list) and Jelgersma *et al.* (1970). Coll. 1963 by J. de Jong; subm. by W. H. Zagwijn, Geol. Dienst, Haarlem, Netherlands. *Comment*: pretreated with acid and alkali. First date for Pot Beakers (Lehmann, 1965) in the Netherlands, proving contemporaneity with Veluwe stage of Bell Beaker culture (see Molenaarsgraaf series, above).

3. Bronze and Iron ages

Vaassen series, Netherlands

Samples from excavation of a large heather-overgrown prehistoric field complex ("Celtic field") near Vaassen (52° 18′ N Lat, 5° 56′ E Long) Epe, prov. of Gelderland. Coll. by A. Bruin and subm. 1968 by J. A. Brongers, Rijksdienst v. het Oudheidkundig Bodemonderzoek, Amersfoort, Netherlands.

GrN-5496. Vaassen 3 **3560 ± 40**
1610 B.C.
$\delta C^{13} = -25.0‰$

Charcoal from ca. 1 m depth in pit with Early Bronze age pottery ("barbed-wire" decoration), stratigraphically below arable soil of "Celtic field." Coll. 1967.

GrN-5497. Vaassen 4 **3915 ± 45**
1965 B.C.
$\delta C^{13} = -24.1‰$

Charcoal from 0.75 m depth at base of light gray arable soil below bank of "Celtic field." Coll. 1968.

GrN-5895. Vaassen 6 **3020 ± 55**
1070 B.C.
$\delta C^{13} = -27.0‰$

Charcoal particles at 0.70 to 0.90 m depth in fill of post hole of granary, preceding layer of arable soil below bank of "Celtic field" system. Granary should be Early Iron age. Coll. 1968.

GrN-5498. Vaassen 5 **2420 ± 65**
470 B.C.

Charcoal from 0.40 m depth in cultural layer with Early Iron age pottery (Harpstedt-type) and house remains below arable soil of "Celtic field." Coll. 1967.

GrN-5495. Vaassen 2 **1800 ± 35**
A.D. 150
$\delta C^{13} = -25.2‰$

Charcoal from pit with Iron age pottery. Pit supposed to antedate "Celtic field." Depth 0.55 to 0.85 m. Coll. 1967.

GrN-5494. Vaassen 1 **1290 ± 30**
A.D. 660
$\delta C^{13} = -25.2‰$

Charcoal from 0.35 m depth in small pit dug into "Celtic field" wall. Coll. 1967.

General Comment: all samples pretreated with acid and alkali. Dates indicate Late Neolithic and Early Bronze age occupation at site. preceding the "Celtic field" which must have been in use shortly after 2420 B.P. (GrN-5498). Vaassen 2 much younger than expected, but pit may be younger than acre. GrN-5494 points to Early Medieval human activity at site.

GrN-5034. Renkum, Netherlands **3460 ± 40**
1510 B.C.
$\delta C^{13} = -24.6‰$

Charcoal pieces from remains of cremation pile at base of Period II of 2-period tumulus near Renkum (51° 58′ N Lat, 5° 43′ E Long), prov. of Gelderland. Primary barrow belongs to Bell Beaker culture. Depth 0.50 m. Coll. 1958 by A. E. van Giffen; subm. 1966 by G. Elzinga, Biol.-Archaeol. Inst., Univ. Groningen. *Comment*: pretreated with acid and alkali. Indicates Early Bronze age date for cremation.

GrN-5350. Eersel, Netherlands **3460 ± 35**
1510 B.C.
$\delta C^{13} = -24.1‰$

Charcoal patch on old land surface near central grave with crema-

tion remains in Drakenstein urn under barrow with ditch and bank at Eersel (51° 22′ N Lat, 5° 19′ E Long), prov. of Noord-Brabant (van Zeist, 1967). Depth 0.65 to 0.70 m. Coll. 1966 and subm. 1967 by J. F. van Regteren Altena, Rijksdienst v. het Oudheidkundig Bodemonderzoek, Amersfoort. *Comment*: pretreated with acid and alkali. Agrees with dates from similar monuments at Toterfout-Halve Mijl, see GrN-1828: 3420 ± 45 (R., 1963, v. 5, p. 188).

Angelsloo-Emmerhout series, Netherlands

From 1964 to 1968 a large Bronze age settlement was excavated in contiguous suburbs Angelsloo and Emmerhout (52° 47′ N Lat, 6° 56′ E Long) of Emmen, prov. of Drenthe (Butler, 1969). Occupation traces consisted of post holes, forming plans of long houses and pits of various kinds. Widely spaced houses made order difficult to establish. Barrows and urnfields interspersed with settlement remains. Neolithic remains also present (see Angelsloo series above). Subm. by J. D. van der Waals, Univ. Groningen, Netherlands.

GrN-5183. Angelsloo 163 **3405 ± 35**
1455 B.C.
$\delta C^{13} = -25.2‰$

Scattered charcoal pieces at 0.93 m depth in filling of tangential secondary grave in Barrow 8 of Middle Bronze age Elp culture. Coll. 1965 by A. Meijer and G. Delger.

GrN-5184. Angelsloo 338 **3010 ± 40**
1060 B.C.
$\delta C^{13} = -25.5‰$

Charcoal from concentrations in filling of tangential secondary grave in Barrow 9 of Middle Bronze age Elp culture. Depth 0.17 to 0.20 m below present surface; original depth unknown; barrow was destroyed. Coll. 1965 by A. Meijer and G. Delger.

GrN-5187. Angelsloo 31 **3485 ± 35**
1525 B.C.
$\delta C^{13} = -25.5‰$

Charcoal pieces at 0.70 m depth from 1 m deep circular settlement pit. Assoc. with Early Bronze age pottery, with so-called barbed-wire decoration. Pit adjacent to House 1. Coll. 1964 by H. Praamstra.

GrN-5186. Angelsloo 39 **2830 ± 35**
880 B.C.
$\delta C^{13} = -26.7‰$

Charcoal pieces at 0.50 m depth from 0.80 m deep circular settlement pit (depth 0.80 m), adjacent to House 1. Early and Middle Bronze age pottery in immediate vicinity. Coll. 1964 by H. Praamstra.

GrN-5185. Angelsloo 418 **2870 ± 30**
920 B.C.
$\delta C^{13} = -25.7‰$

Charcoal pieces from 0.40 to 0.50 m depth in post hole of House 1. Coll. 1965 by J. D. van der Waals.

GrN-5105. Angelsloo 235 **2910 ± 35**
960 B.C.
$\delta C^{13} = -25.3‰$

Charcoal pieces from 0.40 to 1.00 m depth in irregular pit complex with Middle or Late Bronze age pottery adjacent to House 7. Coll. 1965 by A. Meijer and G. Delger.

GrN-5265. Angelsloo 84 **2570 ± 55**
620 B.C.

Charred grain, mainly hulled barley, further naked barley and emmer wheat, from isolated pit without diagnostic finds. In Netherlands hulled barley replaces naked barley in Early Iron age. Should permit more precise dating of transition. Coll. 1964. Subm. by W. van Zeist. *Comment*: see also GrN-5266, Elp, below.

GrN-5588. Emmerhout 215 **3320 ± 60**
1370 B.C.
$\delta C^{13} = -24.0‰$

Charred grain at 0.40 to 0.90 m depth from pit in House 7. Both Early Bronze age and TRB pottery occur in vicinity. House plan differs considerably from that of most Bronze age houses in Angelsloo and Emmerhout (Elp type). Coll. 1968 by S. Bottema; subm. by J. D. van der Waals and W. van Zeist.

GrN-5862. Emmerhout 26 **2890 ± 35**
940 B.C.
$\delta C^{13} = -25.5‰$

Charcoal pieces at 0.65 to 0.85 m depth from fireplace depression in center of Elp type House 1. A Late Bronze age or Early Iron age sand dune covers house. Coll. 1966 by A. Meijer and G. Delger.

GrN-5861. Emmerhout 304 **2905 ± 35**
955 B.C.
$\delta C^{13} = -26.0‰$

Small charcoal pieces from pit filling in central aisle of Elp type House 2. Coll. 1967 by S. Bottema.

GrN-5777. Emmerhout 308 **2895 ± 35**
945 B.C.
$\delta C^{13} = -25.8‰$

Scattered charcoal pieces from another pit in Elp type House 2. Coll. 1967 by S. Bottema.

GrN-5776. Emmerhout 135 **2965 ± 35**
1015 B.C.
$\delta C^{13} = -26.2‰$

Charcoal pieces at ca. 0.70 m depth from fireplace depression in central aisle of Elp type House 5. Coll. 1967 by G. Delger and A. Meijer.

GrN-5775. Emmerhout 267 **3090 ± 60**
1140 B.C.
$\delta C^{13} = -25.9‰$

Charcoal at 0.80 to 1.00 m depth from small fire pit in side aisle of House 13, which, because of cattle stall boxes, was expected to be younger than other houses. Coll. 1967 by G. Delger and A. Meijer.

General Comment: Samples 31, 39, 215, 135, and 267 pretreated with acid only, rest pretreated with acid and alkali. GrN-5183 is older than expected. Early Bronze age habitation proved by GrN-5187, though not dating adjacent House 1 (see GrN-5185) and by GrN-5588, possibly dating new house type. Most houses appear to date from Middle Bronze age; dates range from 3090 ± 60 (GrN-5776) to 2830 ± 35 (GrN-5186). Grain sample GrN-5265 proves later habitation at site, which is also archaeologically evident.

Zijderveld series, Netherlands

Excavation of prehistoric settlement and adjacent gully deposits in river marsh area near Zijderveld (51° 57′ N Lat, 5° 09′ E Long), prov. of Zuid-Holland. Habitation remains, houses, fences, etc., from Middle Bronze age Hilversum culture and from Early pre-Roman Iron age. Cultural layers separated only locally. Medieval clay covers settlement. Subm. 1967 by J. F. van Regteren Altena.

GrN-5376. Zijderveld B **3370 ± 80**
1420 B.C.
$\delta C^{13} = -27.7‰$

Outermost tree rings of post stump in post hole of Middle Bronze age round house. Coll. 1965 by R. S. Hulst. Depth 1.56 m.

GrN-5574. Zijderveld D **2665 ± 80**
715 B.C.
$\delta C^{13} = -31.0‰$

Stump of small post from wattle and daub wall of Iron age rectangular house. Depth 0.75 to 0.90 m. Coll. 1966 by R. S. Hulst.

GrN-5351. Zijderveld E **2565 ± 100**
665 B.C.
$\delta C^{13} = -27.1‰$

Stump of Iron age granary post at 0.80 to 1.00 m depth. Coll. 1966 by R. S. Hulst.

GrN-5573. Zijderveld C **2390 ± 65**
450 B.C.
$\delta C^{13} = -27.9‰$

Base of roof-bearing post of Iron age house. Sample taken between 10th and 20th tree ring from outside. Depth 0.75 to 1.00 m. Coll. 1966 by R. S. Hulst.

GrN-5352. Zijderveld F **2150 ± 90**
200 B.C.
$\delta C^{13} = -26.8‰$

Twigs from trackway at 1.65 m depth. Expected age either Bronze age or Iron age. Subm. 1965 by R. S. Hulst.

GrN-5221. Zijderveld II/2 **4620 ± 60**
2670 B.C.
$\delta C^{13} = -29.9‰$

Gyttja-containing peat intercalation at 1.20 to 1.28 m depth, in clay deposits of gully adjacent to settlement. No indication yet of human influence on vegetation at this depth in pollen diagram. Coll. 1965 by J. de Jong.

GrN-5220. Zijderveld II/1 **3265 ± 60**
1315 B.C.

Humic clay at 0.50 to 0.55 m depth in same Sec. II as Zijderveld II/2. High *Cerealia* values in pollen diagram indicate contemporaneity with Middle Bronze age settlement. Coll. 1965 by J. de Jong.

GrN-5219. Zijderveld I/3 **2880 ± 35**
930 B.C.
$\delta C^{13} = -27.9‰$

Base of lower peat deposit in Sec. I, stratigraphically above clay deposit of Sample II/1. Depth 1.14 to 1.19 m. Coll. 1965 by J. de Jong.

GrN-5218. Zijderveld I/1 **2260 ± 30**
310 B.C.
$\delta C^{13} = -27.4‰$

Base of upper peat deposit in Sec. I. Early Sub-Atlantic.

General Comment: Zijderveld B pretreated with acid only, rest pretreated with acid and alkali. Dates from settlement as expected, GrN-5352, which dates occupation of area at Late pre-Roman Iron age. Dates of highly differentiated gully deposits help to establish correlation of sedimentary phases with stages of human habitation. Pollen evidence from Sec. II suggests habitation prior to Middle Bronze age (shortly after GrN-5221: 4620 ± 60); no archaeologic evidence yet. Bronze age remains mentioned by Beex and Hulst (1968).

Putten series, Netherlands

Excavation of heavily damaged prehistoric barrow at Putten (52° 15′ N Lat, 5° 48′ E Long), prov. of Gelderland. Subm. 1965 by R. S.

Hulst, Rijksdienst v. het Oudheidkundig Bodemonderzoek, Amersfoort, Netherlands.

3320 ± 85

GrN-4957. Putten 45 **1370 B.C.**

Charcoal pieces at ca. 1.75 m depth from post hole in single widely spaced timber circle belonging to Period 3 of barrow. Coll. 1965 by submitter. *Comment*: pretreated with acid only.

3060 ± 35

GrN-4958. Putten 10 **1110 B.C.**

$\delta C^{13} = -24.8‰$

Charcoal from secondary grave (*Brandskelettgrab*). Later than Period 2 (and also Period 3?). Coll. 1964 by submitter. *Comment*: pretreated with acid and alkali.
General Comment: ages as expected.

3105 ± 65

GrN-5266. Elp 98, Netherlands **1155 B.C.**

$\delta C^{13} = -19.6‰$

Charred grain, mainly emmer wheat and naked barley, some hulled barley, from settlement pit at Elp (52° 54′ N Lat, 6° 38′ E Long), Westerbork, prov. of Drenthe (Waterbolk, 1964). Other dates from same settlement in R., 1967, v. 9, p. 134. Sample subm. 1967 by W. van Zeist to obtain more accurate date for replacement of naked barley by hulled variety (van Zeist, 1971). *Comment*: pretreated with acid and alkali. GrN-5266 (Elp 98), GrN-1553 and GrN-2392 (Gees, mean value 2420 ± 35; R., 1963, v. 5, p. 193, hulled barley with some emmer wheat) and GrN-5265 (Angelsloo 84, this list) suggest that N Netherlands naked barley was replaced by hulled variety in Early Iron age.

2960 ± 60

GrN-5356. Benschop, Netherlands **1010 B.C.**

$\delta C^{13} = -26.2‰$

Charcoal from concentration in clay covered cultural layer with small pottery fragments of supposed Late Neolithic character at Benschop (52° 0′ N Lat, 4° 59′ E Long), prov. of Utrecht. Depth 0.60 to 0.80 m. Coll. and subm. 1967 by L. P. Louwe Kooijmans. *Comment*: pretreated with acid and alkali. Date later than expected but within period of dense human habitation.

3125 ± 40

GrN-5357. Biesheuvel, Netherlands **1175 B.C.**

$\delta C^{13} = -26.0‰$

Scattered charcoal pieces at 0.60 to 0.95 m depth in small pit with pottery of supposed Late Neolithic character on stream ridge near Biesheuvel (51° 45′ N Lat, 5° 4′ E Long), mun. of Wijk en Aalburg, prov. of Noord-Brabant. Coll. and subm. 1967 by L. P. Louwe Kooijmans. *Comment*: pretreated with acid and alkali. Date later than expected but within period of dense human habitation.

Wychen series, Netherlands

Sandy peat layer at 1.68 to 2.00 m depth (lake bottom?) with supposedly Iron age potsherds under sand dune at de Pas, near Wychen (51° 48′ N Lat, 5° 44′ E Long), prov. of Gelderland. Coll. and subm. 1967 by D. Teunissen, Geol. Afdeling, Univ. Nijmegen, Netherlands.

GrN-5482. Wychen 511 **3480 ± 40**
1530 B.C.
$\delta C^{13} = -28.5‰$

Sandy peat at 1.90 to 1.93 m depth.

GrN-5481. Wychen 510 **3110 ± 40**
1160 B.C.
$\delta C^{13} = -28.7‰$

Sandy peat at 1.70 to 1.73 m depth.

General Comment: both samples pretreated with acid and alkali. Peat dates from Bronze age. Late Bronze age sand dunes are known from various places in Netherlands (Waterbolk, 1962).

GrN-5217. Alkmaar-de Heul, Netherlands **3140 ± 50**
1190 B.C.
$\delta C^{13} = -28.1‰$

Base of peat layer of 0.50 m thickness, intercalated between sand deposits at de Heul, near Alkmaar (52° 38′ N Lat, 4° 45′ E Long), prov. of Noord-Holland. Depth 1.40 to 1.44 m below surface. Peat contains archaeologic remains of probable Early Iron age. Coll. 1964 by J. de Jong; subm. by J. F. van Regteren Altena. *Comment*: pretreated with acid and alkali. Age as expected.

Hoogkarspel series, Netherlands

Barrows and settlement from Late Bronze age were excavated in 1965 at Hoogkarspel (52° 4′ N Lat, 5° 10′ E Long), prov. of Noord-Holland, by J. A. Bakker, Inst. v. Pre- en Protohistorie, Amsterdam, Netherlands (Bakker and Brandt, 1966). Subm. by excavator.

GrN-5050. Hoogkarspel 1 **3020 ± 40**
1070 B.C.
$\delta C^{13} = -24.9‰$

Big lumps of charcoal from secondary grave with human cremation in Tumulus II, Sq. H 19, depth 0.70 m. Coll. by W. J. Manssen.

GrN-5051. Hoogkarspel 2 **2680 ± 50**
730 B.C.
$\delta C^{13} = -26.2‰$

Charcoal fragments from layer in ring ditch of Tumulus II, Sq. M 14, depth 0.45 m. Coll. by J. A. Bakker.

GrN-5048. Hoogkarspel 4 **2650 ± 45**
700 B.C.
$\delta C^{13} = -25.6‰$

Charcoal and ash from settlement ditch, which cuts through ring ditch of Barrow II, Sq. M 19, depth 1.00 m. Coll. by R. W. Brandt.

GrN-5030. Hoogkarspel 5 **2235 ± 60**
285 B.C.
$\delta C^{13} = -26.0‰$

Black soil with some charcoal from ditch with rich settlement remains from late stage of settlement. Sq. Y 8, depth ca. 1.00 m. Coll. by J. A. Bakker.

General Comment: all samples pretreated with acid and alkali. Date for barrow agrees with other dates for Bronze age barrows in area, see Oostwoud and Wervershoof (R., 1963, v. 5, p. 191). GrN-5051 and GrN-5048 are acceptable dates for settlement. GrN-5030 appears too young, which may be due to bad quality of sample.

GrN-4959. Berghem II[s], Netherlands **2630 ± 65**
680 B.C.
$\delta C^{13} = -27.5‰$

Scattered charcoal fragments from filling of oval ditch below Tumulus II at Berghem (51° 45′ N Lat, 5° 35′ E Long), prov. of Noord-Brabant. Depth 0.60 m. Early Iron age date expected for this burial type. Coll. 1965 and subm. 1966 by G. J. Verwers, Inst. v. Prehistorie, Univ. Leiden, Netherlands. *Comment*: pretreated with acid and alkali. Age as expected.

Culemborg series, Netherlands

Excavation in 1966 of Early Iron age settlement in river marsh area near Culemborg (51° 57′ N Lat, 5° 13′ E Long), prov. of Gelderland. Coll. and subm. 1966 by L. P. Louwe Kooijmans.

GrN-4946. Culemborg 93 **2620 ± 50**
670 B.C.
$\delta C^{13} = -27.3‰$

Charcoal from Pit 6 B with fragments of human skull. Pit from 1st stage of settlement (Hallstatt D) and intersected by trench forming part of house plan. Depth 0.30 to 0.60 m.

GrN-4945. Culemborg 101 **2600 ± 70**
650 B.C.
$\delta C^{13} = -26.7‰$

Charcoal from bottom of settlement pit from 1st stage of habitation. Depth 0.50 to 0.55 m.

GrN-4947. Culemborg 210-214 **2360 ± 75**
410 B.C.
$\delta C^{13} = -25.6‰$

Charcoal from settlement Pit 2 A, from concentration at base and scattered in fill. Pit rich in sherds, including Early La Tène (Marne) types. Depth 0.30 to 0.75 m.

GrN-5001. Culemborg, Post 8 **2210 ± 50**
260 B.C.
$\delta C^{13} = -27.2‰$

Worked wooden Post 8 (*Alnus*) in gully deposit, assoc. with iron dagger and potsherds including Early La Tène types. Sample dates last stage of settlement. Depth 0.80 to 1.00 m.

General Comment: dates suggest continuous habitation from ca. 2600 to 2200 B.P.

GrN-4622. Emmererfscheidenveen, N foot path, Netherlands **2480 ± 40**
530 B.C.
$\delta C^{13} = -28.2‰$

Outer 10 to 15 tree rings of plank of N foot path in bog sec. Emmen 15 near Tweede Groene Dijk at Emmererfscheidenveen (52° 47′ N Lat, 6° 59′ E Long), Emmen, prov. of Drenthe. Depth 0.40 to 1.30 m. Pollen diagram in van Zeist (1955). Coll. 1963 and subm. by W. A. Casparie, Biol.-Archaeol. Inst., Univ. Groningen, Netherlands. Expected age 0 to 500 B.C. or ca. 1150 B.C. *Comment*: pretreated with acid and alkali. Sample from same area as GrN-4624 and GrN-4623, Emmererfscheidenveen-Groene Dijk (Bourtanger Moor series, above). Compare dates from S foot path in sec. Emmen 16 in same area GrN-4149: 3120 ± 50 and GrN-4342: 3145 ± 55 (R., 1967, v. 9, p. 135). See also Casparie (in press).

Coastal dunes series, Netherlands

Many radiocarbon measurements were made during geologic, palynologic, and archaeologic studies of coastal dunes in W Netherlands (Jelgersma, *et al.*, 1970). Two systems occur: the Older Dunes on a system of parallel coastal barriers in which they originated, and the Younger Dunes, which often reveal several series with parabolic forms. Wet phases, indicated by soil horizons, and dry phases of active dune building alternate synchronously over area. This cyclic development runs parallel to a series of transgressions and regressions. Human occupation was continuous from Late Neolithic Vlaardingen culture up to 12th century A.D. when Upper Dunes made area uninhabitable. No dune formation of any importance occurred from ca. A.D. 1 to 1200. Only dates of Iron age and Roman archaeologic material are listed here. For Neolithic and Bronze age dates, see R., 1963, v. 5, p. 163-202 (Haamstede, the Hague, Vogelenzang), R., 1967, v. 9, p. 107-155 (Voorschoten, Leidschendam, Heemstede), and this list (Leidschendam, Zandwerven, Haarlem). Dates of mainly geologic importance will be included in a future date list.

GrN-4665. Vogelenzang-AWL XIV/1 **2510 ± 55**
560 B.C.
$\delta C^{13} = -26.9‰$

Charcoal from occupation soil in Sec. XIV in Amsterdam "Waterleiding" dunes near Vogelenzang (52° 19′ N Lat, 4° 34′ E Long). Depth 4.00 to 4.30 m below surface. In overlying sand near its base, a pot of type Ruinen-Wommels I (Zeijen culture) was found, for which date is *terminus post quem*. Coll. 1963 by J. de Jong, Geol. Dienst, Haarlem. *Comment*: pretreated with acid only.

GrN-5505. Velzen VIII **2210 ± 70**
260 B.C.
$\delta C^{13} = -28.5‰$

Outer tree rings of stump in post hole of 6-post shed in excavated settlement with pottery of Ruinen-Wommels III type (Protofrisian culture) at Dutch Steelworks at Velzen (52° 29′ N Lat, 4° 38′ E Long), prov. of Noord-Holland. Expected age 2300 B.P. Depth 8 m. Coll. 1965 by R. E. Lutter; subm. 1967 by J. F. van Regteren Altena. *Comment*: pretreated with acid and alkali.

GrN-5485. Velzen IX **2275 ± 65**
325 B.C.
$\delta C^{13} = -20.4‰$

Collagen from human *femur* in inhumation grave in pit adjacent to shed described above. Depth 8 m. Coll. 1965 by R. E. Lutter; subm. 1967 by J. F. van Regteren Altena. *Comment*: pretreated as for unburnt bone.

GrN-5195. Velzen II **2140 ± 60**
190 B.C.
$\delta C^{13} = -25.3‰$

Post of Farm House I excavated 1963 at Dutch Steelworks near Velzen (52° 29′ N Lat, 4° 38′ E Long) by J. F. van Regteren, Altena. From ca. 40 tree rings from outside of stem. Depth 6.5 m. House is 2nd of 3 successive buildings at site. Roman pottery dates 1st stage of settlement to middle of 1st century A.D. Coll. and subm. 1966 by excavator. *Comment*: pretreated with acid only. In comparison with 2 following dates, date appears too old, which may be due to re-use of old wood.

GrN-5196. Velzen III **2020 ± 55**
70 B.C.
$\delta C^{13} = -24.9‰$

Post from same house as GrN-5195, ca. 30 to 35 tree rings from outside of stem. *Comment*: pretreated with acid only.

GrN-4833. Velzen I **1940 ± 50**
A.D. 10
$\delta C^{13} = -23.9‰$

Third post from same house, at ca. 30 to 35 tree rings from outside of stem. *Comment*: pretreated with acid and alkali.

General Comment: series includes 1st date in Netherlands for Ruinen-Wommels III stage. For further comments, see Jelgersma *et al.*, 1970.

Paddepoel III series, Netherlands

Clay covered Iron age settlement (terp mound) No. III in former sea marsh area in new suburb Paddepoel of town of Groningen (53° 13′ N Lat, 6° 34′ E Long), prov. of Groningen, excavated 1964 by W. A. van Es, formerly Biol.-Archaeol. Inst., Univ. Groningen; present address Rijksdienst v. het Oudheidkundig Bodemonderzoek, Amersfoort, Netherlands (van Es, 1971). Coll. and subm. by excavator.

GrN-5592. Paddepoel 332 **2125 ± 35**
175 B.C.
$\delta C^{13} = -24.0‰$

Wood from post in post hole of house, belonging to Stage II of settlement. Depth 1.50 m. Expected age: ca. 100 B.C. to A.D. 100.

GrN-5591. Paddepoel 331 **1970 ± 95**
20 B.C.
$\delta C^{13} = -25.1‰$

Wood from post in post hole of granary, belonging to later stage of settlement. Depth 1.00 m. Expected age: ca. A.D. 1 to 200.

General Comment: both samples pretreated with acid and alkali. Earlier than expected.

4. Roman and later

GrN-5491. Lathum, Netherlands **2000 ± 65**
50 B.C.
$\delta C^{13} = -28.8‰$

Top of peat layer at 1.06 to 1.08 m depth below single levee clay deposit of IJssel R. in sec. near Lathum, Angerlo (51° 59′ N Lat, 6° 8′ E Long), prov. of Gelderland (Poelman and Harbers, 1966) between Arnhem and Doesburg. Possibility exists that this narrow part of IJssel R. was not original but dug by Romans under Drusus. Coll. 1967 by J. N. B. Poelman; subm. by G. C. Maarleveld, Univ. of Amsterdam. *Comment*: pretreated with acid and alkali. Date agrees with suggested Roman origin of river section.

Ouddorp series, Netherlands

Settlement from Roman period at Ouddorp (51° 49′ N Lat, 3° 59′ E Long), Goedereede I., prov. of Zeeland, excavated 1959 by J. A. Trimpe Burger, Rijksdienst v. het Oudheidkundig Bodemonderzoek (Trimpe Burger, 1961). Subm. 1966 by excavator.

GrN-4968. Ouddorp I **1870 ± 35**
A.D. 80
$\delta C^{13} = -22.6‰$

Charred grain (*Hordeum vulgare*) in thick layer in corner of burnt house or shed. Depth 0.50 m. Assoc. with abundant pottery dating from ca. A.D. 125 to 150.

GrN-4969. Ouddorp II **1970 ± 40**
20 B.C.
$\delta C^{13} = -25.1‰$

Charcoal from last stage of settlement from layer of Roman roof tiles and burnt wood. Depth 0.50 m. Date of underlying broken pottery supposedly ca. A.D. 200, but a later age (after A.D. 250) considered possible. *General Comment*: both samples pretreated with acid and alkali. GrN-4968 as expected, but GrN-4969 is 2 or 3 centuries too high, which may be due to re-use of timber and/or to high age of wood when cut.

GrN-4967. Aardenburg, Netherlands **1835 ± 35**
A.D. 115
$\delta C^{13} = -25.3‰$

Charcoal from burnt Roman temple at Quataert near Aardenburg (51° 16′ N Lat, 3° 27′ E Long), prov. of Zeeland (Trimpe Burger, 1963). Excavated 1962 by J. A. Trimpe Burger. Depth 1.70 m. Coins date temple destruction shortly after A.D. 270. Subm. 1966 by excavator. *Comment*: pretreated with acid and alkali. Slightly older than expected, perhaps may be due to age of wood.

GrN-5646. Kapel Avezaath, Netherlands **1820 ± 30**
A.D. 130
$\delta C^{13} = -26.5‰$

Wood from bottom of 30 m long supposedly Roman ship from 6 m depth in former bed of Linge R. at Kapel Avezaath (51° 52′ N Lat, 5° 23′ E Long), Zoelen, prov. of Gelderland. Small scale rescue excavation 1968 by L. P. Louwe Kooijmans. A few finds in vicinity date from early 3rd century A.D., but of no certain assoc. with ship. Coll. and subm. 1968 by excavator. *Comment*: pretreated with acid and alkali. Date proves Roman age of ship.

GrN-5382. Bennekom-de Kooi, Netherlands **5055 ± 40**
3105 B.C.
$\delta C^{13} = -24.7‰$

Remains of ca. 40 trees found ca. 1930 at depth 0.70 m in peat near farm de Kooi at Bennekom (52° 0′ N Lat, 5° 41′ E Long), prov. of Gelderland. Supposedly from a raft of Roman or Carolingian age. Coll. 1966 and subm. 1967 by J. J. Dijkveld Stol, Inst. v. Rassenonderzoek van Landbouwgewassen, Bennekom, Netherlands. *Comment*: pretreated with acid and alkali. Sample consisted of outer ca. 70 tree rings of trunk. Trees probably buried by natural causes.

Maastricht series, Netherlands

Fragment of bone (femur) preserved with other human skeletal remains in relic shrine in church of St. Servatius in Maastricht (50° 51′ N Lat, 5° 41′ E Long), prov. of Limburg. Bones traditionally ascribed to St. Martinus of Tongeren, who died some time before A.D. 350 and was closely assoc. with St. Servatius (+ 384) over whose grave a memorial chapel was built, that later became a famous Romanesque church.

Shrine manufactured A.D. 1160 and only opened once per century. Coll. and subm. 1963 by dean Msgr. Jennekens.

GrN-4211. Maastricht, St. Martinus, bone collagen **1530 ± 50**
A.D. 400
$\delta C^{13} = -19.0‰$

GrN-4212. Maastricht, St. Martinus, bone carbonate **850 ± 340**
A.D. 1100

General Comment: pretreated as for unburnt bone, carbonate fraction measured separately. GrN-4212 apparently too young due to exchange with atmospheric CO_2. GrN-4211 proves antiquity of bone.

Paddepoel IV series, Netherlands

Early Medieval raised cemetery below *terp* settlement at Paddepoel IV, N of Groningen (53° 15′ N Lat, 6° 34′ E Long), excavated 1964 by W. A. van Es (1971). Top layers of *terp* were removed before excavation. Subm. by excavator.

GrN-5461. Paddepoel IV-344 **1415 ± 30**
A.D. 535
$\delta C^{13} = -25.6‰$

Charcoal (*Quercus*) from incomplete cremation of very young child found in circular pit, near inhumation graves. If same age as graves, cemetery would be of mixed type, 7th to 9th century A.D. Coll. by W. A. van Es and H. Praamstra.

GrN-5590. Paddepoel IV-298 **1205 ± 45**
A.D. 745
$\delta C^{13} = -27.2‰$

Wood from post in post hole of later building, expected to date from 12th to 13th century A.D. Coll. by W. A. van Es.

General Comment: both samples pretreated with acid and alkali. After correction for de Vries effect, dates are ca. A.D. 600 and A.D. 700 to 870, respectively. Latter date much older than expected, which may be due to stratigraphic complications, not observed during rescue excavation.

GrN-5489. Stapelen, Netherlands **1350 ± 30**
A.D. 600
$\delta C^{13} = -25.2‰$

Wood from joist, forming part of unique early wooden building incorporated in later stone hall of castle Stapelen (51° 35′ N Lat, 5° 22′ E Long), near Boxtel, prov. of Noord-Brabant. Found during restoration of castle. Sample from outer part of beam. First mention of castle in A.D. 1173. Expected age A.D. 1100-1400. Coll. and subm. 1968 by architect A. van Abeelen, Boxtel, Netherlands. *Comment*: pretreated with acid and alkali. Much older than expected.

945 ± 45

GrN-4476. Arnhem, Netherlands **A.D. 1005**

$\delta C^{13} = -18.8‰$

Collagen from human skeleton under foundation of St. Eusebius church at Arnhem (51° 59′ N Lat, 5° 55′ E Long), prov. of Gelderland, with remains of buildings and sarcophagi made from tuff, and indicating earlier occupation of site than hitherto assumed. Coll. and subm. 1960 by K. Schaap, Town Archivarian, Arnhem, Netherlands. *Comment*: pretreated as for unburnt bone. Date agrees with main period of use of tuff as building stone in the low countries.

Utrecht series, Netherlands

Wood from house Drakenburg at Utrecht (52° 05′ N Lat, 5° 8′ E Long), prov. of Utrecht. Expected age either 17th century A.D., or Medieval; in latter case very early instance of use of *Abies*-wood in Netherlands. Coll. 1967 by H. van der Waal, Rijksdienst v. de Monumentenzorg, The Hague; subm. 1968 by J. A. Brongers, Rijksdienst v. het Oudheidkundig Bodemonderzoek, Amersfoort, Netherlands.

770 ± 40

GrN-5626. Utrecht 1 **A.D. 1180**

$\delta C^{13} = -24.3‰$

Wood from beam above 1st floor.

800 ± 30

GrN-5627. Utrecht 4 **A.D. 1150**

$\delta C^{13} = -25.1‰$

Wood from rafter.

General Comment: both samples pretreated with acid and alkali. Dates prove Medieval age of wood. Comparison with *Bristlecone* chronology leads to 13th century as probable historical date of use of *Abies*-wood for building of house.

Dokkum series, Netherlands

Excavation in 1966 during restoration of St. Boniface church at Dokkum (53° 20′ N Lat, 6° 0′ E Long), prov. of Friesland. On artificial mound, built ca. A.D. 760, 2 or 3 wooden churches were built successively, replaced ca. 1050 by tuff stone church (Halbertsma, 1961). Coll. 1966 by W. A. Casparie; subm. by H. Halbertsma, Rijksdienst v. het Oudheidkundig Bodemonderzoek, Amersfoort, Netherlands.

1160 ± 30

GrN-5157. Dokkum 1966 C **A.D. 790**

$\delta C^{13} = -25.6‰$

Outer 20 tree rings of oak coffin, from oldest group of graves dug into mound. Coffin partly destroyed to provide space for poles of wooden church. Depth 2.50 m.

GrN-5158. Dokkum 1966 B **1045 ± 50**
A.D. 905
$\delta C^{13} = -25.9‰$

Outer 20 to 30 tree rings of post of wooden church. Depth 2.50 m. *General Comment*: both samples pretreated with acid and alkali. Measurement of other post of wooden church: GrN-4713: 960 ± 50 (A.D. 990) (R., 1967, v. 9, p. 138). Correction for de Vries effect would make dates 40 to 100 yr younger. They remain within expected time range.

Rijnsburg series, Netherlands

Excavations in 1949 and 1951 at Rijnsburg (52° 11′ N Lat, 4° 27′ E Long), prov. of Zuid-Holland, yielded remains of 12th century church and other buildings of Medieval Benedictine abbey of Rijnsburg. In transept of church 8 graves were found, supposedly from members of Holland line of counts, buried in abbey up to A.D. 1299. One countess (Ada + 1258) historically known to have been buried before high altar. One of skeletons showed sword-inflicted damages, corresponding in detail to description of violent death of Count Floris V in A.D. 1296. Graves and foundation trenches were dug into cultural layers of Carolingian and Merovingian age. Outside church, but within abbey buildings, graves were found supposedly belonging to noble abbesses or possibly young female members of House of Holland. Many graves of latter group were destroyed. For details of excavations see Glasbergen (1950, 1954) and Glasbergen and van Regteren Altena (1964). Anthropologic studies by B. K. S. Dijkstra are in progress. Three measurements by H. de Vries pub. (Science, 1958, v. 128, p. 1555). Samples coll. by W. Glasbergen; subm. by W. Glasbergen and B. K. S. Dijkstra.

GrN-677. Rijnsburg 92 **945 ± 100**
A.D. 1005

GrN-680. **900 ± 70**
A.D. 1050

Organic matter from bones, probably of Count Floris V (A.D. 1254 to 1296). Two measurements of same sample already pub. (*op. cit.*, above). Mean value: 915 ± 60 (A.D. 1035).

GrN-1111. Rijnsburg 93 **1210 ± 40**
A.D. 740

Organic matter from bones possibly of Floris, brother of Count Willem I (+ ca. 1210). Date pub. (*op. cit.*, above).

GrN-4235. Rijnsburg 93[a] **1225 ± 50**
A.D. 725
$\delta C^{13} = -19.0‰$

New analysis of same sample as GrN-1111. *Comment*: pretreated as for unburnt bone (Vogel, unpub.).

1120 ± 65

GrN-3040. Rijnsburg 93[b] **A.D. 830**

New sample from same skeleton as GrN-1111. *Comment*: pretreated as Rijnsburg 98, below, and unprecipitable fraction of acid solution measured.

1100 ± 25

GrN-3026. Rijnsburg 97 **A.D. 850**

Organic matter from bones, possibly of Floris IV (A.D. 1210 to 1234). *Comment*: pretreated as Rijnsburg 93[b], above.

1460 ± 150

GrN-836. Rijnsburg 98, residue **A.D. 490**

1050 ± 50

GrN-1894. Rijnsburg 98[a], extract a **A.D. 900**

960 ± 40

GrN-1895. Rijnsburg 98[b], extract b **A.D. 990**

Bones, possibly of Ada (+ 1258). *Comment*: pretreatment procedure used by de Vries, for this sample as follows: bone dissolved in strong hydrochloric acid, insoluble fraction measured (GrN-836). Organic matter and salts precipitated from acid solution by increasing the pH. Fraction precipitated at pH 4 measured (GrN-1894). Fraction not precipitated at pH 8, dried and measured (GrN-1895). According to de Vries, pH 4 fraction gave best result, *i.e.*, A.D. 900.

1280 ± 50

GrN-3029. Rijnsburg 102 **A.D. 670**

Organic matter from bones, possibly of Godevaert (ca. A.D. 1190). *Comment*: pretreated as Rijnsburg 93[b], above.

1025 ± 45

GrN-2968. Rijnsburg, ambulatory **A.D. 925**

Organic matter from skeleton found in ambulatory, presumably younger than other skeletons. *Comment*: pretreated as Rijnsburg 93[b], above.

860 ± 55

GrN-4232. Rijnsburg 174 **A.D. 1090**

$\delta C^{13} = -20.2‰$

Collagen from skeleton found in ambulatory, possibly of Beatrix, married to Floris V. *Comment*: pretreated as for unburnt bone (Vogel, unpub.).

1215 ± 50

GrN-6097. Rijnsburg-Willem I **A.D. 735**

$\delta C^{13} = -19.9‰$

Collagen from skeleton, possibly of Count Willem I (+ A.D. 1223). *Comment*: pretreated as for unburnt bone (Vogel, unpub.).

General Comment: C13/12 correction applied in 3 instances only. Since C^{13} for human bones is, in general, ca. −20‰, other samples would

become ca. 80 yr older when corrected. Fluctuation in atmospheric C^{14} concentration will cause dates to be too old by, at most, 150 yr, which is not enough to bridge difference with expected historic ages. Historic data strongly support archaeologic dating of graves. Yet earlier cemetery at site is quite possible in view of local continuity of habitation since 7th century and probability of earlier church or chapel. No explanation for radiocarbon age discrepancy of 3 centuries or more for most samples. Results are internally consistent and similar results for different methods of pretreatment increase their reliability. Further analyses of well dated bones are needed.

Ginkel series, Netherlands

Two charcoal samples from sec. in old arable soil (*enk*) at Ginkel (52° 2 ′ N Lat, 5° 44′ E Long), Ede, prov. of Gelderland. Coll. 1962 by J. C. Pape; subm. 1963 by G. C. Maarleveld.

GrN-5168. Ginkel 1 **1950 ± 50**
A.D. 1
$\delta C^{13} = -26.3‰$

Charcoal from 0.60 to 0.75 m depth in upper layer of natural soil profile below arable soil. Expected age ca. A.D. 150.

GrN-5167. Ginkel 2 **2570 ± 50**
620 B.C.
$\delta C^{13} = -27.0‰$

Charcoal from 0.40 to 0.55 m depth in lower part of arable soil. Expected age ca. A.D. 150.

General Comment: both samples pretreated with acid only. Can only be used as *terminus post quem* for arable soil. Large difference between dates indicates heterogeneity of charcoal at site. See also dates from Rekken and Eibergen, below.

GrN-5169. Rekken, Netherlands **1265 ± 50**
A.D. 685
$\delta C^{13} = -26.2‰$

Charcoal in upper layer of natural soil profile below arable soil (*enk*) at Rekken (52° 6′ N Lat, 6° 44′ E Long), prov. of Gelderland. Depth 0.90 to 1.05 m. Expected age ca. A.D. 150. Coll. 1962 by J. C. Pape; subm. by G. C. Maarleveld. *Comment*: pretreated with acid only. Younger than expected, but still only a *terminus post quem* for *enk*.

Eibergen series, Netherlands

Two charcoal samples from sec. in old arable soil at Beltrum, Eibergen (52° 06′ N Lat, 6° 49′ E Long), prov. of Gelderland (Pape, 1966). Coll. and subm. 1968 by J. C. Pape.

GrN-2940. Eibergen 1 **1685 ± 65**
A.D. 265

Charcoal from upper 0.20 m of old land surface below arable soil.

1345 ± 65

GrN-2943. Eibergen 2 **A.D. 605**

Charcoal from lower 0.20 m of arable soil.

General Comment: pretreated with acid only. See also dates from Ginkel and Rekken, above.

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GLASGOW UNIVERSITY RADIOCARBON MEASUREMENTS IV

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INTRODUCTION

The following list and data presented previously (R., 1970, v. 12, p. 494-495) were obtained to investigate the transport of carbon between man and his environment (Harkness, 1970). These data constitute a study of contemporary variations of C^{14} concentrations *viz.*, Suess effect and bomb effect, as reflected in the tissues and food chain of the population of the United Kingdom (Harkness and Walton, 1969).

Operation of counting systems and preparation of results remain as described by Ergin *et al.* (1970).

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SAMPLE DESCRIPTIONS

I. HUMAN C^{14} CONCENTRATIONS

A. Blood protein samples

The following C^{14} activities complete the series reported previously (R., 1970, v. 12, p. 494-495).

Blood protein, S Scotland

Sample no.	Sample date	δC^{14}‰	δC^{13}‰	Δ‰
GU-300	Oct. 1953	−2.9 ± 0.6	−27.7	−2.3 ± 0.7
GU-301	May 1954	−1.5 ± 0.6	−29.4	−1.4 ± 0.7
GU-302	Dec. 1955	−1.2 ± 0.5	−26.2	−0.9 ± 0.6
GU-303	June 1958	−2.0 ± 0.6	−28.5	−1.3 ± 0.6
GU-304	June 1969	52.4 ± 0.7	−31.5	54.4 ± 0.8

Comment: C^{14} concentrations in blood protein show a marked decrease from maximum values after 1968, correlating with the decline in atmospheric C^{14} concentrations.

B. Human tissue samples

An attempt has been made to investigate the distribution of bomb C^{14} in the human body. Apart from a composite sample of testes coll.

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in S England in 1969, the data relate to tissue obtained from a 37-year-old female inhabitant of Glasgow who died from coronary artery disease in September 1969.

Sample no.	Tissue	$\delta C^{14}‰$	$\delta C^{13}‰$	$\Delta‰$
GU-305	Testes	46.1 ± 0.7	−29.3	47.3 ± 0.8
GU-306	Brain	58.3 ± 0.7	−22.4	57.5 ± 0.8
GU-307	Liver	50.3 ± 0.8	−27.9	51.2 ± 0.8
GU-308	Kidney	52.9 ± 0.7	−20.5	51.5 ± 0.8
GU-309	Ovaries	53.5 ± 1.3	−28.2	54.5 ± 1.4
GU-310	Uterus	45.9 ± 0.7	−27.4	46.7 ± 0.7
GU-311	Muscle	55.5 ± 0.7	−26.6	56.0 ± 0.8
GU-312	Fat	48.2 ± 0.8	−30.4	49.8 ± 0.8
GU-313	Bone marrow	41.3 ± 0.8	−34.2	43.9 ± 0.8
GU-314	Bone collagen	25.7 ± 0.7	−27.6	26.4 ± 0.8
GU-315	Bone mineral	22.4 ± 0.7	−17.1	20.5 ± 0.8

Comment: carbon in the adult skeleton appears to be several years older than that in soft tissues. Results suggest the possible application of contemporary C^{14} concentrations in investigations of tissue renewal rates.

II. DIETARY C^{14} CONCENTRATIONS

A. Terrestrial food chain

Samples were selected from unpreserved foods produced in S Scotland.

Sample no.	Sample	Coll. date	$\delta C^{14}‰$	$\delta C^{13}‰$	$\Delta‰$
GU-316	Milk	July 1967	62.9 ± 0.8	−23.7	62.4 ± 0.9
GU-317	Milk	Sept. 1967	60.9 ± 0.8	−24.2	60.8 ± 0.8
GU-318	Beef	Aug. 1967	59.2 ± 0.7	−27.2	59.7 ± 0.8
GU-319	Milk	Aug. 1968	55.3 ± 1.2	−23.7	54.9 ± 1.2
GU-320	Potatoes	Sept. 1968	55.4 ± 1.1	−23.6	54.9 ± 1.1
GU-321	Beef	Aug. 1968	56.8 ± 0.8	−26.0	57.0 ± 0.9
GU-322	Cheese	July 1969	52.6 ± 1.2	−24.0	52.5 ± 0.9
GU-323	Beef	Nov. 1969	54.1 ± 0.7	−33.1	56.5 ± 0.8

Comment: results agree with contemporary tropospheric C^{14} concentrations monitored in this region (Walton *et al.* 1970).

B. Marine food chain

Zooplankton samples coll. in May 1969 using a conical net (26 mesh per linear in.). Hauls were oblique from 100 m depth to the surface. Fish samples were selected from a trawl made in Dec. 1968.

Sample, site	$\delta C^{14}‰$	$\delta C^{13}‰$	$\Delta‰$
GU-324. Zooplankton (61° 03′ N Lat, 02° 46′ E Long)	7.4 ± 0.6	−31.6	8.8 ± 0.7
GU-325. Zooplankton (61° 03′ N Lat, 02° 46′ E Long)	7.8 ± 0.6	−27.2	8.2 ± 0.6
GU-326. Zooplankton (57° 25′ N Lat, 07° 00′ E Long)	11.3 ± 1.0	−27.0	11.8 ± 1.1
GU-327. Zooplankton (59° 15′ N Lat, 01° 45′ E Long)	9.5 ± 1.0	−27.2	10.0 ± 1.1
GU-328. Zooplankton (57° 00′ N Lat, 00° 00′ Long)	2.6 ± 0.7	−34.2	4.4 ± 0.8
GU-329. Zooplankton (60° 30′ N Lat, 00° 30′ W Long)	4.4 ± 0.6	−29.0	5.2 ± 0.7
GU-330. Zooplankton (58° 00′ N Lat, 03° 00′ E Long)	5.8 ± 1.0	−36.8	8.3 ± 1.1
GU-331. Cod muscle (57° 10′ N Lat, 1° 50′ W Long)	7.0 ± 0.4	−24.4	6.8 ± 0.5
GU-332. Skate muscle (57° 10′ N Lat, 1° 50′ W Long)	1.6 ± 0.5	−23.5	1.3 ± 0.6
GU-333. Whiting muscle (57° 10′ N Lat, 1° 50′ W Long)	10.8 ± 0.6	−22.1	10.2 ± 0.7

Comment: low C^{14} concentration in skate flesh probably reflects bottom feeding habits of this species.

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ISOTOPES' RADIOCARBON MEASUREMENTS IX

JAMES BUCKLEY and ERIC H. WILLIS*

TELEDYNE ISOTOPES, Westwood, New Jersey

INTRODUCTION

The measurements presented in this date list were made in the Radiocarbon Dating Laboratory at Teledyne Isotopes during 1969-70. Samples were analyzed by techniques described in R., 1968, v. 10, p. 246. Methods and references to sample pretreatment are provided in R., 1970, v. 12, p. 87. Errors associated with the age determinations are calculated by combining standard deviations from oxalic acid standard, background, and actual sample data. Samples which approach modern or background are reported with at least 2σ limits. Counting time for calculation of errors of background and standard is the same as that used for the sample. The error associated with the De Vries effect and the uncertainty of the half-life are not included.

ACKNOWLEDGMENTS

We wish to thank our clients who have consented to have their data published in this date list and who have supplied us with the sample descriptions and informative comments. Technical support in the laboratory was supplied by Mr. J. Bonicos. Our thanks are also extended to Mrs. J. Buckley and Mrs. M. Mandel for preparation of the manuscript.

I. GEOLOGIC SAMPLES

A. Western United States

Thom Watershed series, Tama County, Iowa

Wood and charcoal fragments from alluvium in side valley of tributary of Four Mile Creek in SE ¼, Sec. 28, T.86N, R.15W (42° 13′ N Lat, 92° 34′ W Long), Tama Co., Iowa. Alluvium overlain by 2.4 m oxidized and leached silt. Coll. 1967 by W. J. Vreeken; subm. by R. V. Ruhe, Water Resources Res. Ctr., Indiana Univ., Bloomington, Indiana.

I-3056. Thom Watershed, 2.4 to 2.6 m — **6200 ± 125 / 4250 B.C.**

I-3057. Thom Watershed, 3.1 to 3.3 m — **7710 ± 130 / 5760 B.C.**

Comment (R.V.R.): dates major valley fill that correlates with beginning of prairie environment (W-235, Rubin and Suess, 1956).

I-3677. Sumner, Bremer County, Iowa — **23,750 ± 650 / 21,800 B.C.**

Organic carbon and wood fragments from silt interbedded with alluvium next to Little Wapsipinicon R. in SE ¼ NE ¼, Sec. 14, T.93N,

* Present address: NMRO, Advanced Research Projects Agency, 1400 Wilson Boulevard, Arlington, Virginia 22209.

R.11W (42° 51′ N Lat, 92° 05′ W Long), Bremer Co., Iowa. Sample depth 1.0 m beneath interbedded clay, sand, and silt (I-1860-1862, R., 1969, v. 11, p. 58). Coll. 1968 by H. J. Kleiss and N. E. Helzer; subm. by R. V. Ruhe. *Comment* (R.V.R.): dates terrace alluvium on which Sumner Bog formed.

I-3656. Lone Tree, Johnson County, Iowa **24,900 ± 750 / 22,950 B.C.**

Organic carbon from silt interbedded with alluvium on high terrace of Quaternary Lake Calvin in SW ¼ NW ¼, Sec. 25, T.77N, R.5W (41° 21′ N Lat, 91° 23′ W Long), Johnson Co., Iowa. Sample horizon beneath 3.7 m leached loess and bedded sand (OWU-167, R., 1967, v. 9, p. 319; I-1865, R., 1969, v. 11, p. 58). Coll. 1968 by W. H. Allen and W. J. Vreeken; subm. by R. V. Ruhe. *Comment* (R.V.R.): date refutes Illinoian age of terrace (Schoewe, 1920).

I-3654. Nichols, Muscatine County, Iowa **11,800 ± 200 / 9850 B.C.**

Conifer wood from alluvium on intermediate terrace of Quaternary Lake Calvin in SW ¼, Sec. 9, T.77N, R.4N (41° 28′ N Lat, 91° 20′ W Long), Muscatine Co., Iowa. Sample horizon beneath 3.2 m loess and alluvium. Coll. 1968 by Jean Prior; subm. by R. V. Ruhe.

I-4409. Hogup Spring, Utah **26,700 ± 900 / 24,750 B.C.**

Oolitic carbonate from Hogup Spring (36° 29′ N Lat, 113° 15′ W Long), Box Elder Co., Utah. Core I, 3.84 to 4.02 m depth. Coll. 1968 and subm. 1969 by P. J. Mehringer, Jr., Dept. Anthropol., Univ. of Utah. *Comment* (P.J.M.): dates pluvial-lake sediment and pollen profile from Great Salt Lake, Utah.

B. Eastern United States

I-4910. Mastodon bone, Florida **21,150 ± 400 / 19,200 B.C.**

Rib bone (*Mammut americanum*) from W half Tract 17, Block 1, Plat. 9 of Palm Beach Farms, Sec. 28, T-43-5, R-42-E (26° 40′ 03″ N Lat, 80° 04′ 05″ W Long), Palm Beach Co., Florida. Bone level 3 m depth from area 14 m by 26 m (Olsen, 1959). Coll. 1969 and subm. 1970 by H. H. Converse, Jr., Sci. Mus. and Planetarium of Palm Beach Co., Inc. *Comment* (H.H.C.): most S site in U.S. for major paleontol. excavation. Sample assoc. with bones from various animals including mammoth, bison, horse, camel, tapir sloth, capybara, etc.

I-4163. Guy Wilson Cave, Tennessee **19,700 ± 600 / 17,750 B.C.**

Bone collagen of extinct peccary (*Platygonus compressus*) from Guy Wilson Cave, S Fork Holston R. (36° 27′ N Lat, 82° 13′ W Long), 4 km SE of Bluff City, Sullivan Co., Tennessee. From talus at base of extinct sink (entirely closed by flowstone), exposed in inner chamber of Guy Wilson Cave. Coll. and subm. 1969 by Carnegie Mus., Sec. of

Vertebrate Fossils field party. *Comment* (J.E.G.): meager assoc. fauna includes *Synaptomys borealis, Phenacomys,* and *Citellus tridecemlineatus,* indicating cooler climate than at present.

12,950 ± 550
I-2982. Welsh Cave, Kentucky, Peccaries **11,000 B.C.**

Bone collagen (*Platygonus compressus*) from Welsh Cave (37° 52′ N Lat, 84° 45′ W Long), Woodford Co., Kentucky. Collapsed sink, samples from fill in cave passages (Guilday, 1968b). Coll. 1966 by Carnegie Mus., Sec. of Vertebrate Fossils field party; subm. 1967 by J. E. Guilday. *Comment* (J.E.G.): assoc. fauna includes mammoth, grizzly bear, badger, 13-lined ground squirrel, many boreal rodents including *Microtus xanthognathus,* and dire wolf.

Great Marshes series, Massachusetts

High marsh peat from Great Marshes, 360 m E of Navigation Rd., 250 m S of Spring Creek, 60 m from Upland (41° 42′ 51″ N Lat, 70° 21′ 52″ W Long), W Barnstable, Massachusetts. Peat is 6.1 m deep, overlies blue clay (I-4648, this list), contains 85 to 90% water (Kaye and Barghoorn, 1964; Redfield, 1965). Coll. 1969 by A. C. Redfield and K. O. Emery; subm. 1970 by A. C. Redfield, Woods Hole Oceanog. Inst., Woods Hole, Massachusetts.

1280 ± 95
I-4212. From 1.8 to 2.0 m depth **A.D. 670**

1760 ± 95
I-4213. From 2.5 to 2.7 m depth **A.D. 190**

2100 ± 100
I-4214. From 3.4 to 3.5 m depth **150 B.C.**

2400 ± 105
I-4215. From 4.0 to 4.2 m depth **450 B.C.**

2730 ± 100
I-4647. From 4.7 to 4.8 m depth **780 B.C.**

General Comment (A.C.R.): to determine degree of compaction of tidal-marsh peat in response to overload, comparisons of age depth relationships between samples from mid-depth in a deep peat layer and those collected immediately over the substratum (Redfield and Rubin, 1962) were made. At depth of 3 m, peat ca. 2100 yr old lies 1 m below level of formation indicating underlying column was reduced in length by 25%.

13,200 ± 220
I-4648. Barnstable Blue Clay, Massachusetts **11,250 B.C.**

Barnstable blue clay from Great Marshes (41° 42′ 51″ N Lat, 70° 21′ 52″ W Long), W Barnstable, Massachusetts. Core sample depth 6.5 to 6.6 m, clay underlies tidal-marsh peat. Sample composition: water 36.1%, ash 60.4%, organic matter 3.5% (Woodworth and Wigglesworth, 1934; Prest, 1969). Coll. 1969 and subm. 1970 by A. C. Redfield and

K. O. Emery. *Comment* (A.C.R.): clay probably was deposited in meltwater lake between retreating ice front and Sandwich Moraine; date indicates early stage.

Plattville series, Illinois

Organic carbon assoc. with soil clay (<2 micron particle size) from middle terrace above Kankakee R. floodplain, Kankakee Co. (41° 12′ N Lat, 88° 01′ W Long), Illinois. Underlain by nonfractured Niagaran limestone. Coll. and subm. 1968 by T. Ballagh and E. Runge, Univ. of Illinois, Urbana.

I-3770. Plattville 86-95 — **3070 ± 105** / **1120 B.C.**

From B 31 horizon, 86 to 95 cm depth.

I-3771. Plattville 95-102 — **3090 ± 105** / **1140 B.C.**

From B 32 horizon, 95 to 102 cm depth (Bartelli and Odell, 1960).

Wea soil series, Illinois

Organic carbon complexed with soil clay (<2 micron particle size) from high terrace above Kankakee R. floodplain, Kankakee Co. (41° 12′ N Lat, 88° 01′ W Long), Illinois. Underlain by coarse limestone. Coll. and subm. 1968 by T. Ballagh and E. Runge.

I-3772. Wea soil, 88-101 — **2935 ± 105** / **985 B.C.**

From II B 31 horizon, 88 to 101 cm depth.

I-3773. Wea soil, 101-110 — **2500 ± 105** / **550 B.C.**

From II B 32 horizon, 101 to 110 cm depth.

Ashdale soil series, Illinois

Organic carbon complexed with soil clay (<2 micron particle size) from Stephenson Co. (42° 22′ N Lat, 88° 35′ W Long), Illinois. Site underlain by fractured Wise Lake Formation of the Galena dolomite at 116 cm depth. Coll. and subm. 1968 by T. Ballagh and E. Runge.

I-3971. Ashdale soil, 104-105 — **9330 ± 190** / **7380 B.C.**

From middle of residuum, 84% clay, II B 31 horizon, 104 to 105 cm depth.

I-3972. Ashdale soil, 115-116 — **4270 ± 95** / **2320 B.C.**

From base of clay-rich zone, II B 32 horizon, 115 to 116 cm depth.

General Comment (E.R.): average organic carbon assoc. with clay increases in age 1000 yr per 15 cm depth (Sharpenseel, Pietig, and Tamers, 1968). Clay-rich horizons overlying limestone may be product of illuviation of clay from higher horizons and flocculation at the limestone contact by high calcium-ion concentration, resulting in younger age with

increasing depth. Clay mineralogy, particle-size studies, and carbon dating support this concept (Ballagh and Runge, 1970).

I-4900. Grand Rapids-1, Michigan **>39,900**

Wood and other plant remains from SE ¼ NW ¼, Sec. 34, T.7N, R.12W (43° 57′ 08″ N Lat, 85° 43′ 13″ W Long), Kent Co., Michigan. Sample horizon below 10 to 14 m sand and till and believed to be stratum below organic zone at John Ball Park (Zumberge and Benninghoff, 1969; Leverett and Taylor, 1915). Coll. 1969 by D. F. Eschman; subm. 1970 by W. R. Farrand, Quaternary Res. Lab., Univ. of Michigan, Ann Arbor, Michigan.

33,300 ± 1800

I-5078. GR-3, Grand Rapids **31,350 B.C.**

Decayed wood fragments from gravel pit in Grand Rapids area, SE ¼ NW ¼, Sec. 31, T.8N, R.11W, W of interchange of W River Dr. and U.S. 131, Kent Co. (43° 23′ N Lat, 85° 39′ 50″ W Long), Michigan. From near top of thick complex interbedded sand, gravel, and till showing evidence of overriding. Sequence believed stratigraphically younger than John Ball Park organic zone (Zumberge and Benninghoff, 1969). Coll. 1969 by W. Farrand and D. Eschman; subm. 1970 by W. R. Farrand. *Comment* (W.R.F.): wood somewhat contaminated with modern mold and fungus. Sample may represent part of late Port Talbot complex which is not well known in Michigan. *Laboratory Comment*: sample very soluble in NaOH solution; 15 min. treatment resulted in 80% material loss.

28,800 ± 1050

I-5079. GR-4, Grand Rapids **26,850 B.C.**

Plant remains including *Ranunculus, Salix, Dryas integrifolia,* and abraded wood fragments from Grand Rapids area SE ¼ SE ¼, Sec. 19, T.6N, R.11W, Kent Co. (42° 53′ 08″ N Lat, 85° 39′ W Long), Michigan. From many small lenses of organic-rich material in sand at 222 m surface of Ross Channel (Bretz, 1953). Coll. by R. Rhodes and D. Eschman; subm. 1970 by W. R. Farrand. *Comment* (W.R.F.): Ross Channel lies between inner and outer Valparaiso morainic ridges and is interpreted as a drainage connection between Glacial Grand R. and Kalamazoo R. at Lake Border time (Eschman and Farrand, 1970). Date unexpected but falls into Farmdalian Interstade widely recognized in Great Lakes area. Thus, organic matter may be reworked from an older deposit.

13,770 ± 210

I-4899. Weaver Drain, Michigan **11,820 B.C.**

Plant remains, mostly leaves and twigs (*Dryas integrifolia, Salix herbacea, Salix* sp., and *Vaccinium uliginosum*) from SE ¼ SE ¼, Sec. 15, T.19N, R.12E, Weaver Drain, Lapeer Co. (43° 12′ N Lat, 83° 02′ 30″ W Long), Michigan. From unoxidized beds of sand, silt, clay, and organic matter 35.6 to 43.2 cm above poorly sorted coarse sand overlying unoxidized till in outwash channel. Fossiliferous zone overlain by

medium to coarse sand (Leverett and Taylor, 1915). Coll. 1969 by W. A. Burgis and subm. 1970 by W. R. Farrand. *Comment* (W.R.F.): although organic matter is post-till in age, modern ecology and range of species suggest time lag between deposition of till and plant material was short; date represents ice retreat during life of Glacial Lake Maumee III.

Kuhl Mastodon site series, Michigan

Samples from Lima Township, SW ¼ NE ¼, Sec. 33, T.2S, R.4E, Washtenaw Co. (42° 15′ 24″ N Lat, 85° 57′ 30″ W Long), Michigan, E edge of depression outside Fort Wayne Moraine. Interbedded peat, shell-rich marls and calcareous, organic sand overlie sample horizons (Russell and Leverett, 1915). Coll. 1969 by R. S. Rhodes; subm. 1970 by W. R. Farrand.

I-5080. KM-5a **11,050 ± 160 / 9100 B.C.**

Organic debris washed from calcareous, organic sand, 200 cm depth, directly below a mastodon vertebra. *Comment* (W.R.F.): should date earliest organic deposition, establish minimum age for deglaciation outside Fort Wayne Moraine, and maximum age for assoc. mastodon remains. Age agrees well with others of mastodons from Michigan (Wilson, 1967). Other samples being dated by Univ. of Michigan.

I-5081. KM-29a **9590 ± 160 / 7640 B.C.**

Wood from peat, 130 cm depth. *Comment* (W.R.F.): date is minimum for mastodon remains and is similar to younger ages for mastodons in this area (Skeels, 1962; Wilson, 1967).

I-5082. Saxon, Wisconsin **9730 ± 140 / 7780 B.C.**

Wood (*Tsuga canadensis*) with 250 growth rings from NW ¼ NE ¼, Sec. 3, T.46N, R.1W, Iron Co. (46° 30′ N Lat, 90° 29′ 30″ W Long), Wisconsin. One of several logs including spruce and tamarack in large sand lens enclosed by red clay till. Elev. ca. 332 m which approximates upper limit of Glacial Lake Duluth in this area (Leverett, 1929). Coll. 1968 by G. E. Lindsay; subm. 1970 by W. R. Farrand. *Comment* (W.R.F.): site seems assoc. with last ice advance before Glacial Lake Duluth. But date is too young to fit usual late-glacial history (Farrand, 1969; Black, 1969). Spruce wood from this site was dated at 10,100 ± 100 B.P. (WIS-409, unpub.). These dates fall into a group (Black, 1969) and are considered anomalous at present. They are 1000 to 2000 yr too young, implying much later glaciation on S shore of Lake Superior than generally admitted.

C. Europe

Fiano Romano series, Italy

Wood from 3 m depth in alluvial fill, maximum thickness 8.50 m, right bank Tiber R. (42° 11′ 55″ N Lat, 12° 36′ 27″ E Long), near Fiano Romano, Italy. Coll. 1969 and subm. 1970 by C. Vita-Finzi.

I-4801. Fiano 2 **1670 ± 95 A.D. 280**

I-4802. Fiano 1 **1350 ± 100 A.D. 600**

General Comment (C.V-F.): dates support contention (Vita-Finzi, 1966) that youngest fill in Tiber valley corresponds with historic deposit of Mediterranean valleys (Vita-Finzi, 1969). Similar deposit was reported from S. Etruria by Judson (1963).

I-4963. Shortalstown Td., Ireland **12,160 ± 180 10,210 B.C.**

Brown, laminated, late-glacial mud from kettle 8 km S-SW of Wexford town, Shortalstown Td. (52° 16′ N Lat, 06° 30′ W Long), Ireland. Coll. 1968 and subm. 1970 by G. F. Mitchell, Univ. of Dublin, Ireland. *Comment* (G.F.M.): one of a late-glacial series of deposits resting in kettle; it contained remains of *Cervus giganteus*, the Giant Irish deer; date agrees well with other similar deposits (Colhoun and Mitchell, ms. in preparation).

I-4730. Corrie Brochain, Cairngorm Mountains, Scotland **1905 ± 95 A.D. 45**

Peat from floor of cirque basin in central Cairngorm Mts. (57° 06′ N Lat, 03° 40′ W Long), Scotland. From peat overlain by gravel, alt ca. 1000 m. Coll. and subm. 1969 by D. E. Sugden, Dept. Geog., Univ. of Aberdeen, Scotland. *Comment* (D.E.S.): building of cirque moraines antedates formation of peat; hence cirque does not date 17th to 19th centuries little ice age.

I-5070. W Newbie Cottage, Dumfriesshire **4290 ± 100 2340 B.C.**

Peat from near top of low cliff N shore Solway Firth, 290 m W of Newbie Cottages, Nat. Grid Ref. NY 167 649 (54° 58′ N Lat, 03° 18′ W Long), Dumfriesshire, Scotland. From basal 7 cm of 40 cm thick peat, overlying Carse Deposits of Flandrian marine transgression. Coll. 1966 and subm. 1970 by W. G. Jardine. *Comment* (W.G.J.): dates local commencement of peat growth, and minimum age for end of Flandrian marine transgression along N shore of Solway Firth (Godwin and Willis, 1962; Godwin *et al.*, 1965).

D. Africa

Lake Elmenteita series, Kenya

Gyttja core samples from Lake Elmenteita (0° 25′ S Lat, 36° 15′ E Long), E Rift Valley, Kenya. Coll. 1969 and subm. 1970 by A. E. Richardson and J. L. Richardson, Dept. Biol., Franklin and Marshall College, Lancaster, Pennsylvania (Washbourn, 1967; Washbourn and Kamar, 1970).

I-5177. Lake Elmenteita, 2038 to 2081 **29,320 ± 1100 27,370 B.C.**

2038 to 2081 cm below mud-water interface, water depth 187 cm.

Comment (J.L.R.): lowest organic sediments obtained, underlying several m volcanic ash and pumice. Microfossils suggest small, fresh lake rapidly developing into alkaline lake.

I-5178. Lake Elmenteita, 974 to 1020.5 **12,200 ± 180**
10,250 B.C.

974 to 1020.5 cm below mud-water interface. *Comment* (J.L.R.): level lies just below S band of volcanic ash, alkaline water conditions indicated.

I-5179. Lake Elmenteita, 636 to 672 **8740 ± 190**
6790 B.C.

636 to 672 cm below mud-water interface. *Comment* (J.L.R.): level indicates highest and freshest phase of now-alkaline lake in last 29,000 yr.

E. Australia

Lake Gnotuk series, Victoria

Necron mud, composed entirely of decayed plankton, from Lake Gnotuk (38° 13′ S Lat, 143° 06′ E Long), Camperdown, Victoria. Coll. 1967 and subm. 1969 by D. M. Churchill, Monash Univ., Victoria, Australia.

I-3977. Sample 1, 0 to 7 cm **625 ± 95**
A.D. 1325

From topmost 7 cm of organic peat overlying ash in Lake Gnotuk at water depth 20 m. *Comment* (D.M.C.): C^{13}/C^{12} ratio is —23.2 relative to PDB standard, indicating carbon is from normal autotrophic plants with no fractionation. True age of sample < 15 yr, as pollen below this level marks introduction of European plants into area. Close examination revealed some old necron mud eroded from crater walls incorporated into sample.

I-4101. Sample 2, Core 2 **9030 ± 145**
7080 B.C.

From contact of organic necron mud with underlying inorganic volcanic ash, 310 to 340 cm depth from surface of mud. *Comment* (D.M.C.): date indicates age of last volcanic eruption in Camperdown area.

I-4102. Sample 3, Core 2 **6310 ± 115**
4360 B.C.

From freshwater phase of lake's history, 210 to 230 cm depth. *Comment* (D.M.C.): dates change of volcanic crater lake water from highly saline to fresh. Water became resalinified and is presently 55‰ saline.

I-4103. Lake Bullenmerri, Victoria **3610 ± 90**
1660 B.C.

Necron mud, composed entirely of decayed plankton, from Lake Bullenmerri (38° 14′ S Lat, 143° 06′ E Long), Camperdown, Victoria. Sample 1, Core 1, 210 to 230 cm depth in lake mud, 61 m below water surface. Coll. 1967 and subm. 1969 by D. M. Churchill. *Comment*

(D.M.C.): date indicates much younger fresh-water phase than adjacent Lake Gnotuk (I-4102, this list). From evidence of fossil phytoplankton, this freshwater phase was preceded and succeeded by long phase of brackish water conditions. Present salinity of lake is 8‰.

7580 ± 135

I-4104. Cobrico Swamp, Victoria **5630 B.C.**

Calcareous necron mud from Cobrico Swamp (38° 18′ S Lat, 143° 02′ E Long), Camperdown, Victoria. Sample 1, 350 to 400 cm depth, from level characterized by onset of open water conditions and marked increase in organic matter, expressed on dry weight basis. Coll. 1966 and subm. 1969 by D. M. Churchill. *Comment* (D.M.C.): dates onset of normal lake succession.

F. Canada

Lake Joncas series, Canada

Peat and silty clay from bog of Lake Joncas outlet, Forêt Expérimentale Montmorency de l'Univ. Laval, Quebec, ca. 80.5 km N of Quebec City, Map no. 21M/6E (47° 15′ 30″ N Lat, 71° 09′ 45″ W Long), Canada.

4710 ± 170

I-4756. JON 1 **2760 B.C.**

Holocene peat. Coll. 1969 and subm. 1970 by Pierre Richard, Lab. Palynol. Fac. Sci., Montpellier, France. *Comment* (P.R.): date refers to pine *pollen* maximum for region. Interpretation of pollen diagram implies balsam fir forest as regional vegetation.

7140 ± 130

I-5083. JON 2 **5190 B.C.**

Peat and silty clay from limit between Late and postglacial for region, beginning of organogenic sediments. Coll. and subm. 1970 by M. Grandtner. *Comment* (P.R.): date refers to limit between tundra and open forests of N birches and black spruce. These phytogeographic units were very typically identified by pollen analysis and lead to new interpretation for vegetational history in region.

II. ARCHAEOLOGIC SAMPLES

A. Western United States

5250 ± 120

I-4782. Menlo Baths site, LMA1-191451 **3300 B.C.**

Mammal bones from Menlo Baths site, lower Surprise Valley, Modoc Co., (41° 16′ N Lat, 120° 05′ W Long), California. From occupation surface 117 cm below surface, assoc. with large side-notched projectile points (Gruhn, 1961). Coll. 1967 by J. F. O'Connell and C. R. Corson; subm. 1970 by J. F. O'Connell, Dept. Anthropol., Univ. of California, Berkeley. *Comment* (J.F. O'C): date consistent with time of similar material from Columbia Plateau (Warren, 1968). Date on another portion of sample was 13,750 ± 250; rejected as inconsistent.

1265 ± 95

I-4528. Buchanan Archaeol. Project, Sample 3 **A.D. 685**

Charcoal from Buchanan Reservoir locality of Chowchilla R. (37° 13′ 25″ N Lat, 119° 59′ 02″ W Long), Madera Co., California. Site CA-Mad-107, Unit G-96, depth 100 to 110 cm below surface. From large ash lens assoc. with several projectile points. Coll. and subm. 1969 by M. J. Moratto, San Francisco State College, California. *Comment* (M.J.M.): dates terminal portion of lower component occupation in Buchanan Reservoir region and initial part of upper component.

1060 ± 95

I-4798. Golden Gate National Cemetery, SMa-100 **A.D. 890**

Charcoal from .4 km E of Golden Gate Natl. Cemetery near Sneath Lane and Hwy. 280, San Mateo Co. (37° 37′ N Lat, 122° 25′ W Long), California. From rim of house floor 55 cm below surface, assoc. with artifacts of Phase I, Late horizon (Van Dyke, 1969). Coll. 1969 and subm. 1970 by S. Van Dyke and R. Schenk, San Francisco State College, California. *Comment* (S.V.D.): date indicates middle part of Phase I, Late horizon.

Lovelock Cave series, Nevada

Organic material from Lovelock Cave, SE ¼ SW ¼ NE ¼, Sec. 12, T.24N, R.30E (39° 57′ 42″ N Lat, 118° 33′ 24″ W Long), Nevada. Coll. and subm. 1968 by R. F. Heizer and L. K. Napton, Dept. Anthropol., Univ. of California, Berkeley.

4690 ± 110

I-3962. AN-16 **2740 B.C.**

Bat guano and tule rushes from occupation layer 200 cm below datum plane, Test Unit AN (Loud and Harrington, 1929; Grosscup, 1960).

1470 ± 90

I-3963. LX-10 **A.D. 480**

Coprolite from 143 cm below datum plane, Test Unit LX (Napton, 1969).

B. Eastern United States

Caxambus Point, Marco Island series, Florida

Charcoal from Caxambus Point, Marco I. (25° 54′ 56″ N Lat, 81° 42′ 55″ W Long), Collier Co., Florida. Coll. 1968 and subm. 1969 by L. R. Morrell, Florida Bur. Hist. Sites and Properties, Dept. of State, Tallahassee, Florida.

1995 ± 160

I-4568. Caxambus 1 **45 B.C.**

8 Cr 107 × 1 Test 2, Sq. 100, Level 3, 0.40 to 0.60 m below surface. Contained mostly fiber-tempered Orange Incised and Plain ceramics with some sand-tempered plain. *Comment* (L.R.M.): sample considered intrusive from a surface Glades I occupation.

3155 ± 100

I-4569. Caxambus 2 **1205 B.C.**

8 Cr 107 × 1 Test 2, Sq. 100, Level 4, 0.60 to 0.80 m below surface. Mostly fiber-tempered Orange Incised and Plain ceramics with minor sand-tempered plain. *Comment* (L.R.M.): this and Level 7 date (I-4570, this list) suggest a later occupation for Test 2 area than Test 3 area, but still represent late Orange decorated period.

3060 ± 105

I-4570. Caxambus 3 **1110 B.C.**

8 Cr. 107 × 1 Test 2, Sq. 100, Level 7, 1.20 to 1.40 m. Level 7 contained little cultural material attributable to an intrusion from Levels 4 and 5. *Comment* (L.R.M.): Test 2 and 3 areas were small midden deposits, suggesting single family residence. The ca. 200 yr separation of Test 2 and 3 dates suggests a later holdover of late Orange ceramics than previously considered.

3375 ± 105

I-4571. Caxambus 4 **1425 B.C.**

8 Cr 107 × 1 Test 3, Sq. 109, Level 2, 0.20 to 0.40 m. Mostly fiber-tempered Orange Incised and Plain ceramics with minor sand-tempered plain. *Comment* (L.R.M.): this date with I-4572 and I-4573 (this list) represent a single occupation. Caxambus site extends known area of Orange influence 241 km S.

3315 ± 105

I-4572. Caxambus 5 **1365 B.C.**

8 Cr 107 × 1 Test 3, Sq. 109, Level 3, 0.40 to 0.60 m.

3400 ± 100

I-4573. Caxambus 6 **1450 B.C.**

8 Cr 107 × 1 Test 3, Sq. 109, Level 4, 0.60 to 0.80 m. Deepest level for sand-tempered ceramics.

Monocacy site series, Maryland

Charcoal from Monacacy site on point at junction W bank of Monocacy and N bank of Potomac Rivers, site 18 FR 100, approx. middle of Potomac Piedmont (39° 13′ 28″ N Lat, 77° 27′ 14″ W Long), Frederick Co., Maryland. Coll. 1969 and subm. 1970 by W. M. Gardner and C. W. McNett, Jr., Dept. Anthropol., Catholic Univ., Washington, D.C.

285 ± 90

I-5088. Monocacy 1 **A.D. 1665**

From top of 1st of 3 prehistoric levels separated by sterile strata. Assoc. pottery is heavily quartz-tempered, some shell- and limestone-tempered from Late Woodland occupation.

715 ± 90

I-5089. Monocacy 2 **A.D. 1235**

From base of 1st cultural level. Assoc. pottery is Late Woodland, mostly quartz-tempered.

2495 ± 95

I-5090. Monocacy 3 **545 B.C.**

From top of 2nd cultural level, with transition of steatite-tempered to fine sand-tempered cordmarked pottery, Early Woodland.

2900 ± 95

I-5091. Monocacy 4 **950 B.C.**

From base of 2nd cultural level. *Comment* (W.M.G.): dates directly assoc. with heavily-tempered, plain steatite-tempered pottery, 1st pottery in Potomac valley. Cultural assoc.: Early Woodland.

Macauley complex series, New York

Charcoal from Geneseo, Livingston Co. (42° 45′ 22″ N Lat, 77° 50′ 20″ W Long), New York. From Site 4 on postglacial river terrace uncomformably overlying proglacial lake varves and till. Thin persistent oxidized zones, sedimentary structures and undisturbed features assoc. with artifacts. Coll. and subm. 1969 by W. J. Wells and W. D. Rhodes, Dept. Anthropol., State Univ. New York, Geneseo.

3670 ± 110

I-4267. Macauley I **1720 B.C.**

Firepit from Test Block 1, 114 cm depth. First glacial varve at 153 cm.

3300 ± 105

I-4364. Macauley II **1350 B.C.**

Storage pit from Loc. 3, 38 cm depth. Pit starts at 23 cm depth; contained charred bones and acorns.

2890 ± 200

I-4515. Macauley III **940 B.C.**

Hearth from Loc. 2, 46 cm depth. Hearth contained flint chips, bone, and projectile point; extended to 59 cm depth.

2670 ± 115

I-4558. Macauley IV **720 B.C.**

From burnt area between 1st and 2nd oxide layers, 25 cm depth, Test Block 2, Loc. 2. Assoc. with 3 adzes of varying form.

Susquehanna series, New York

Charcoal from A(dequentaga) site (42° 26′ 45″ N Lat, 75° 01′ 15″ W Long), New York. Subm. 1970 by B. E. Raemsch, Dept. Anthropol., Hartwick Coll., Oneonta, N.Y.

4090 ± 125

I-4455. A(dequentaga) 90-a **2140 B.C.**

From old erosional surface on glacial till, overlain by river gravel, 230 cm below surface. Coll. 1969 by B. Raemsch and A. Moyer. *Comment* (B.E.R.): sample was attempt to date large percussion-flaked tool industry; represents intrusion or was washed into position from a higher terrace.

3980 ± 180

I-4444. A(dequentaga) 90-b **2030 B.C.**

Duplicate of I-4455.

3420 ± 140

I-4446. A(dequentaga) 31 **1470 B.C.**

Taken at 79 cm depth. Charcoal intruded into river gravel to 135 cm depth, from hearth containing Susquehanna cultural artifacts. Coll. 1969 by D. Roper. *Comment* (B.E.R.): date agrees with another from Susquehanna culture (I-3974, R., 1970, v. 12, p. 120) but both are somewhat earlier than Ritchie's for same culture.

1630 ± 95

I-4367. A(dequentaga) 23-26 **A.D. 320**

From hearth 59 to 66 cm below surface, assoc. with artifacts of Steubenville culture. Agrees with similar sample (I-3731, R., 1970, v. 12, p. 120) and correlates black line horizon-1 with occupation throughout Steubenville site (Raemsch, 1970). Coll. 1970 by B. E. Raemsch.

1345 ± 95

I-4557. A(dequentaga) 15 **A.D. 605**

From 38 cm depth between Steubenville and Iroquois horizons. Coll. 1969 by D. Laist. *Comment* (B.E.R.): dates occupation by Jack's Reef people; agrees with point typology and pottery.

1080 ± 95

I-4445. A(dequentaga) 15-a **A.D. 870**

From ca. 38 cm below surface between Steubenville and Iroquois horizons. Coll. 1969 by D. Roper and J. Biesemeyer.

470 ± 90

I-4378. A(dequentaga) 12 **A.D. 1480**

From large hearth 31 to 48 cm depth just below plow line. Iroquois rim sherd and triangular Madison-type points assoc. with sample. Coll. 1969 by J. Biesemeyer and B. Raemsch.

330 ± 90

I-4366. A(dequentaga) 10 **A.D. 1620**

From hearth 25 to 41 cm depth. Type Iroquois pottery; Madison points and dog bones assoc. Coll. 1969 by B. Raemsch.

Coffin site series, New York

Charcoal from Coffin site, Washington Co. (43° 05′ 47″ N Lat, 73° 34′ 24″ W Long), New York. Coll. 1969 and subm. 1970 by R. E. Funk, New York State Mus. and Sci. Service, Albany, N.Y.

2820 ± 110

I-4835. Coffin W50N10 **870 B.C.**

From a hearth, Feature 4, upper portion of St. 4, Sec. W50N10. Assoc. with Orient Fishtail points and a soapstone sherd. *Comment* (R.E.F.): date agrees with estimate for artifact assemblage; shows close affiliation with Orient culture of Long Island (Ritchie, 1965).

3040 ± 95

I-4836. Coffin W5N0 **1090 B.C.**

From general midden in upper portion of St. 4, Sec. W5N0.

4450 ± 130

I-4837. Ten Mile River Rock Shelter, New York **2500 B.C.**

Bone from Ten Mile R. Rock Shelter, Tusten Township, Sullivan Co. (41° 33′ N Lat, 75° 01′ W Long), New York. From black midden of lowest occupation zone, Sec. EON20. Assoc. side-notched, corner-notched, and triangular points appear to represent Vosburg Laurentian component (Funk, ms. in preparation). Coll. 1969 and subm. 1970 by R. E. Funk. *Comment* (R.E.F.): date consistent for Vosburg complex in E New York and Connecticut.

1625 ± 95

I-4838. Davenport Creamery site, New York **A.D. 325**

Charcoal from Davenport Creamery site, Delaware Co. (42° 26′ 44″ N Lat, 74° 55′ 30″ W Long), New York. From Feature 1, Sec. E5N25 in upper occupation zone, assoc. with thin side-notched points and rocker-stamped pottery. Coll. 1969 and subm. 1970 by R. E. Funk. *Comment* (R.E.F.): date close to early Middle Woodland manifestation.

12,530 ± 270

I-4137. Dutchess Quarry Cave, New York **10,580 B.C.**

Bone collagen of Woodland Caribou (*Rangifer tarandus*) from Florida (41° 21′ 42″ N Lat, 74° 21′ 48″ W Long), Orange Co., New York. From St. 2, with a fluted point and a few intrusive bones of elk and deer (Funk *et al.*, 1970; 1969a; 1969b; Guilday, 1968a, 1969). Coll. 1965 by members of Orange Co. Chap. N.Y.S. Archeol. Assoc., subm. 1968 by E. M. Reilly, Jr., N.Y.S. Mus. and Sci. Service. *Comment* (E.M.R.): date confirms late Wisconsin age of caribou bones probably brought to cave by man. They occur in same level as fluted point and presumably pertain to Paleo-Indian occupation of cave. But date indicates greater age for fluted point tradition than generally accepted by archaeologists.

3850 ± 95

I-5236. Frontenac Island site, Cat. AP648 **1900 B.C.**

Human bone collagen from Frontenac I. (42° 50′ 30″ N Lat, 76° 42′ 30″ W Long), Cayuga Co., New York. From burial 78 of young adult male with rich assortment of grave goods pertaining to Archaic Frontenac phase (Ritchie, 1945; 1965). Coll. 1939; subm. 1970 by W. A. Ritchie, N.Y.S. Mus. and Sci. Service. *Comment* (W.A.R.): date agrees with 2 charcoal dates from separate hearth features of same level (3970 ± 80 B.P., Y-459, R., v. 1, 1959, p. 161 and 3680 ± 250 B.P., W-545, R., v. 2, 1960, p. 180).

Parker site series, Pennsylvania

Charcoal from Parker site, 36 Lu 14 (41° 17′ N Lat, 75° 51′ 42″ W Long), Luzerne Co., Pennsylvania. Coll. 1968 and subm. 1970 by

I. F. Smith III, William Penn Mem. Mus., Harrisburg, Pennsylvania (Smith, 1968).

250 ± 90

I-4879. Feature 45 a **A.D. 1700**

From Sq. N40E70, Feature 45 a. Feature is part of or intrusive into nearby semi-subterranean living structure. *Comment* (I.F.S.): Parker site is prehistoric, date is too recent.

480 ± 90

I-4880. Feature 45 **A.D. 1470**

From Sq. N40E60, Feature 45. Semi-subterranean living structure with burned grasses covering floor and burned logs or saplings collapsed onto grass. Artifacts include: Susquehannock and Proto-Mohawk-like pottery, cobble choppers, chipped stone, hammerstones, grinding slab. *Comment* (I.F.S.): date agrees with estimated age of village.

350 ± 90

I-4881. Feature 54 **A.D. 1600**

From Sq. N30E50, Feature 54, a semi-subterranean living structure. Artifacts found in stone hearth within structure: Proto-Mohawk-like pottery, net sinker, and carbonized cultigens.

C. Canada

Rose Island series, N Labrador

Wood charcoal from W shore Rose I., Saglek Bay, N Labrador. Subm. 1970 by J. A. Tuck, Dept. Sociol. and Anthropol., Mem. Univ. of Newfoundland, Canada.

4530 ± 105

I-5249. Site Q, Feature 10 **2580 B.C.**

From large stone hearth in Band 7A (58° 31′ 51″ N Lat, 62° 58′ 27″ W Long), Site Q, Feature 10. Coll. by J. A. Tuck. *Comment* (J.A.T.): dates earliest occupation discovered at Saglek Bay. Assoc. large crude "stemmed flake" tools, fragments of ground slate points and inferred sea mammal hunting economy, suggest Maritime Archaic affiliations (Tuck, ms. in preparation).

3890 ± 110

I-5251. Site Q, Feature 13 **1940 B.C.**

From stone hearth in Band 4A (58° 31′ 51″ N Lat, 62° 58′ 27″ W Long), Site Q, Feature 13. Coll. by D. O. Bowden, III. *Comment* (J.A.T.): dates terminal Maritime Archaic occupation at this station. Proximity of time to overlying Archaic Small Tool tradition (1880 B.C., I-5250, this list) suggests contact between the 2 cultures.

3830 ± 115

I-5250. Site Q, Feature 2 **1880 B.C.**

From stone hearth in Band 4 (58° 31′ 51″ N Lat, 62° 58′ 27″ W Long), Site Q, Feature 2. Coll. by J. A. Tuck. *Comment* (J.A.T.): dates earliest pre-Dorset Arctic Small Tool tradition occupation at Site Q.

2715 ± 130

I-5252. Site E, Stratum 2 **765 B.C.**

From concentration of charcoal in Stratum 2 (58° 30′ 58″ N Lat, 62° 57′ 25″ W Long), Site E. Coll. by J. A. Tuck. *Comment* (J.A.T.): date is probably slightly late but not unreasonable for late pre-Dorset assemblage.

1850 ± 100

I-5253. Site W, Loc. III **A.D. 100**

Scattered charcoal from cultural layer 8 cm to 13 cm deep (58° 31′ 12″ N Lat, 62° 58′ 50″ W Long), Site W, Loc. III. Coll. by D. O. Bowden, III. *Comment* (J.A.T.): date acceptable for terminal Dorset Eskimo occupation.

275 ± 90

I-5254. Ikkusik site, House 21 **A.D. 1675**

Preserved wood from floor of House 21 (58° 30′ N Lat, 62° 58′ W Long), a prehistoric Thule Eskimo sod house, Ikkusik site. Coll. by P. Schledermann. *Comment* (J.A.T.): date corrected to ca. A.D. 1520 by Suess curve is close to supposed date of 1st Thule Eskimo penetration of Labrador coast.

I-4375. Observation site (KeNw-4), Great Slave Lake, Canada **<185**

Charcoal from promontory at mouth of MacKinlay R., McLeod Bay, Great Slave Lake (62° 42′ 35″ N Lat, 111° 24′ 48″ W Long), Canada. From hearth 13 cm deep, assoc. with small side-notched points alongside silicious shale lanceolates, bifaces, wedges, and ground stone. Coll. 1968 and subm. 1969 by W. C. Noble, McMaster Univ., Hamilton, Ontario. *Comment* (W.C.N): site represents late prehistoric component of Taltheilei Shale tradition which terminated with Yellowknife Indians.

I-4376. Deception Point (L6Pf-5), Snare Lake, Canada **5070 ± 140**
3120 B.C.

Charcoal from N shore Snare Lake, N.W.T. (64° 14′ 20″ N Lat, 113° 56′ 50″ W Long), Canada. Lens 3 cm thick from depth 46 cm, overlying podsol on fine white esker sand. Above are 2 zones of aeolian sand 15 to 25 cm thick separated by 5 to 8 cm cultural layer. Coll. 1967 and subm. 1969 by W. C. Noble. *Comment* (W.C.N.): date and burned soil horizon represents earliest evidence for forest burning in tundra-taiga region of central dist. of MacKenzie, N.W.T.

540 ± 95

I-4550. Hennessey site (KfNm-3), Canada **A.D. 1410**

Charred caribou bone from 13 cm depth in circular pit structure at extreme S end Hennessey site, E shore Artillery Lake directly opposite narrows at Timber Bay (62° 55′ 55″ N Lat, 108° 13′ W Long), Canada. Site 11 m above present lake level on tundra-covered terrace. Coll. and subm. 1969 by W. C. Noble. *Comment* (W.C.N.): does not date main

archaeol. complex represented at Hennessey, but late Frank Channel phase.

1125 ± 100

I-4972. Porteous site, Canada **A.D. 825**

Charcoal from W side of Oxbow in Grand R. (43° 07′ 50″ N Lat, 80° 13′ 30″ W Long), SE end of town of Brantford, Brant Co., Ontario, Canada. From base of Pit 2 within center of incompletely excavated longhouse structure. Coll. 1969 and subm. 1970 by W. C. Noble. *Comment* (W.C.N.): date helps establish history and development of longhouses and corn horticulture in SW Ontario. Cord-marked and incised pottery sherds of Porteous site fall transitionally between earlier Princess Point complex and later Glen Meyer branch of Early Ontario Iroquois tradition.

220 ± 90

I-4684. St. James Mound, Manitoba **A.D. 1730**

Wood from St. James mound (49° 53′ 45″ N Lat, 97° 16′ 45″ W Long), St. James-Assiniboia, Manitoba, Canada. Part of pole near bottom of central burial pit. Coll. and subm. 1969 by R. J. Nash, Manitoba Mus. of Man and Nature, Winnipeg, Manitoba. *Comment* (R.J.N.): date agrees with artifactual ages and indicates mound building in Manitoba continued into early historic times.

St. Mungo Cannery site series, Canada

Charcoal from St. Mungo Cannery site, S bank of S arm of Fraser R., opposite New Westminster on Fraser Delta (49° 09′ 25″ N Lat, 122° 56′ 30″ W Long), British Columbia, Canada. Coll. 1969 by G. Calvert, L. Calvert, S. Davidson, and R. Munro; subm. 1969 by G. Calvert, Vancouver Centennial Mus.

3970 ± 105

I-4685. Dg Rr 2: C 5 **2020 B.C.**

Excavation Unit C 1, Level 14, in matrix of gray-brown earth, mussel, clam, and burnt shell. From 1.5 m below datum plane, 1.2 m below surface, assoc. with series of hearth structures in middle layers of site.

390 ± 95

I-4686. Dg Rr 2: C 10 **A.D. 1560**

Excavation Unit C 1, Level 2, in matrix of dark soil, crushed shell, ash, and fire-cracked rock. From 37 cm below datum plane. *Comment* (G.C.): dates most recent layer of site.

800 ± 95

I-4687. Dg Rr 2: C 11 **A.D. 1150**

Excavation Unit C 2, in matrix of red, hard-baked ash, Hearth Feature 2. From 62 to 64 cm below datum plane. *Comment* (G.C.): dates Marpole phase material.

4240 ± 105

I-4688. Dg Rr 2: C 17 **2290 B.C.**

Excavation Unit C 2, Level 27, in matrix of mussel, shell, clay, and

gray-brown earth. From 2.1 m below Datum Plane A. *Comment* (G.C.): dates earliest level of site.

1120 ± 95

I-4869. Dg Rr 2: C 20 **A.D. 830**

Excavation Unit D 2, Level 5A, in pit of red-brown sandy soil. From 79 cm below datum plane.

General Comment (G.C.): St. Mungo's is oldest shell midden site on Fraser Delta. Artifact assemblage suggests link between Eayem phase of Fraser Canyon and perhaps an early manifestation of Marpole phase of Fraser Delta (Calvert, ms. in preparation).

Trout Lake series, Canada

Charcoal from N shore of small lake ca. 1.6 km NE of Trout Lake (68° 50′ N Lat, 138° 42′ W Long), Arctic Yukon coast, Canada. Coll. and subm. 1968 to 1970 by B. C. Gordon, Archaeol. Dept., Univ. of Calgary, Alberta, and B. Yorga.

260 ± 90

I-3911. Eskimo housepit, Sample 1 **A.D. 1690**

From hearth excavated in Eskimo housepit, Site NfVi-2, on SW sloping ridge. *Comment* (B.C.G.): date verifies estimate of late prehistoric Eskimo campsite. Assoc. artifacts: antler rakes, picks, ground slate knives and points, bone awls, etc.

4590 ± 110

I-4447. 'Y' pit, Sample 1 **2640 B.C.**

Disseminated charcoal in soil from top of 'Y' pit hearth. Assoc. with British Mountain artifacts. *Lab. Comment*: carbon content 1.9%, no NaOH pretreatment.

5380 ± 125

I-4985-A. 'Y' pit, Sample 2a **3430 B.C.**

Disseminated charcoal and willow twigs from intermediate and lower levels of large British Mountain hearth at NeVi-1.

5490 ± 125

I-4985-B. 'Y' pit, Sample 2b **3540 B.C.**

Samples I-4985 A and B were taken from homogenized sample concentration immediately below I-4447 by flotation in double-distilled ion exchange water and subsequent rootlet removal.

General Comment (B.C.G.): pollen analysis and discovery of caribou bone and seven hearths in infilled natural bedrock depression substantiates belief that people bearing British Mountain tool kits were hunters frequenting Trout Lake region in autumn hunts.

D. Africa

1130 ± 95

I-4862. Leopard's Kopje Main Kraal **A.D. 820**

Charcoal from 24 km NE of Bulawayo (20° 07′ S Lat, 28° 26′ E Long), Rhodesia. From storage pit of the Zhizo phase of Rhodesian

Iron age (Robinson, 1959; 1966). Coll. and subm. 1970 by T. N. Huffman, Natl. Mus. of Rhodesia, Bulawayo, Rhodesia. *Comment* (T.N.H.): dates end of Zhizo phase at site.

E. Europe

Gibbins' Brook series, Stanford, Kent, England

Sedge peat from valley bog at Stanford (51° 06′ 38″ N Lat, 01° 00′ 94″ E Long), Kent, England. Coll. and subm. 1969 by A. Thorley, Dept. Geol. and Geog., Sir John Cass College, London.

I-4513. Gibbins' Brook I — **6260 ± 125 / 4310 B.C.**

From 195 to 210 cm below surface. Peat cutting for fuel below this level.

I-4514. Gibbins' Brook II — **8070 ± 200 / 6120 B.C.**

From 400 cm depth.

General Comment (A.T.): dates correlate with pollen evidence. Archaeol. evidence agrees with dates and suggests earlier human clearance of vegetation in SE England than in most parts of country.

I-4542. Castle Hill, England — **2505 ± 100 / 555 B.C.**

Carbonized oak beam from multivallate Iron-age hill-fort, Castle Hill, 25 km S of Huddersfield (53° 40′ N Lat, 01° 46′ W Long), Almondbury, Yorks, England. From uppermost of series of successive rampart structures (Varley, 1967). Coll. 1969 by Adrian Hovercroft and W. J. Varley; subm. 1969 by W. J. Varley for Rolson Mem. Mus., Ravensknowle, Huddersfield, Yorks. *Comment* (W.J.V.): date connects timber-braced hill fort rampart structures of Central England chronologically with Scottish series, particularly Dun Lagaidh.

I-4234. Lough Derravaragh, Ireland — **5360 ± 110 / 3410 B.C.**

Charcoal from fen-peat deposit, Clonava Townland, Lough Derravaragh (53° 40′ N Lat, 07° 22′ W Long), Co. Westmeath, Ireland. Assoc. with chert implements, debitage of Larnian (Mesolithic) type and burned stone (R., 1961, v. 3, p. 32). Coll. 1968 and subm. 1969 by G. F. Mitchell, Univ. of Dublin, Dublin, Ireland. *Comment* (G.F.M.): Mesolithic type chert implements were found on several lake shores in Irish Midlands. At some sites they seem assoc. with Neolithic type polished stone axes. Clonava Td. is the only site where they are in primary position stratified in fen-peat. Date corresponds with Newferry, Bann flakes (Mesolithic) and polished stone axes 5290 ± 170 (D-36) and Dalkey I. transition 5300 ± 170 (D-38).

F. Hawaii

Makaha Valley series I, Oahu, Hawaii

Charcoal from Lower Makaha Valley (21° 29′ N Lat, 158° 12′ 30″

W Long), Oahu, Hawaii. From Archaeol. Zone 1. Subm. 1969 by R. C. Green (except as noted), Bernice P. Bishop Mus., Honolulu, Hawaii (Green, 1969; 1970).

I-4199. MVP Ca 36 **730 ± 100** **A.D. 1220**

From Site C4-17, Fireplace 3. Coll. 1969 by J. Takayama. *Comment* (R.C.G.): dates 1 of 2 pit or oven type fireplaces. Date is one of earliest for Makaha Valley (I-4201, this list).

I-4200. MVP Ca 37 **370 ± 100** **A.D. 1580**

From Site C4-17a, Fireplace 2. Coll. 1969 by J. Takayama. *Comment* (R.C.G.): date is one of earliest for perimeter fireplace assoc. with C-shaped field shelter (I-4121, this list). A later occupation of same shelter is dated by I-4306, this list.

I-4201. MVP Ca 38 **720 ± 105** **A.D. 1230**

From Site C4-18a, Fireplace 2. Coll. 1969 by J. Takayama. *Comment* (R.C.G.): date is one of earliest for Makaha Valley and is from 1 of 2 pit or oven type fireplaces (I-4199, this list).

I-4121. MVP Ca 2 **370 ± 90** **A.D. 1580**

From Site C4-39, rectangular fireplace. Coll. 1969 by J. Takayama. *Comment* (R.C.G.): Sample I-4200 and this one from similar context, indicate time depth of 400 to 500 yr for perimeter fireplaces and C-shaped shelters.

I-4122. MVP Ca 7 **270 ± 90** **A.D. 1680**

From Site C4-38, Fireplace 3. Coll. 1969 by J. Takayama. *Comment* (R.C.G.): sample stratigraphically earlier than existing C-shaped shelter at Site C4-38, and 1 of 3 dated samples from that site (see I-4311 and I-4310).

I-4311. MVP Ca 54 **250 ± 90** **A.D. 1700**

From Site C4-38, Fireplace 2. Coll. 1969 by J. Rasor. *Comment* (R.C.G.): sample probably assoc. with remnants of C-shaped shelter earlier than existing one at Site C4-38.

I-4310. MVP Ca 53 **230 ± 95** **A.D. 1720**

From Site C4-38, Fireplace 1. Coll. 1969 by J. Rasor. *Comment* (R.C.G.): sample dates existing C-shaped field shelter at C4-38. Dates suggest relatively short time for occupational sequence of site.

I-4120. MVP Ca 1 **<210**

From Site C4-37, NW firepit in G-1. Coll. 1968 by K. Ishizuki. *Comment* (R.C.G.): sample from fireplace outside wall, and perhaps earlier than L-shaped shelter at C4-37.

I-4306. MVP Ca 43 **<205**

From Site C4-17a, Fireplace 1. Coll. 1969 by J. Takayama. *Comment* (R.C.G.): dates late occupation at C4-17a.

615 ± 140

I-4961. Storage Pit, MVP-63 **A.D. 1335**

From 30 cm depth in small rock enclosure. Coll. 1970 by E. Ladd; subm. by Y. H. Sinoto. *Comment* (Y.H.S.): dates age of structure believed to be storage pit.

Makaha Valley series II, Oahu, Hawaii

Charcoal from Makaha Valley (23° 30′ N Lat, 158° 11′ W Long), Oahu, Hawaii (Green, 1969; 1970).

380 ± 120

I-4718. Kaneaki Heiau **A.D. 1570**

From temple 60 cm depth, Survey area 8, Lower Makaha Valley. Coll. 1969 by E. Ladd; subm. by Y. H. Sinoto, B. P. Bishop Mus., Honolulu, Hawaii. *Comment* (Y.H.S.): dates early limit of construction of heiau (temple).

200 ± 95

I-4823. Terrace, 60 cm **A.D. 1750**

From walled agricultural terrace 60 cm depth, Survey area 17, Upper Makaha Valley. Coll. 1970 by P. Rosendahl and T. Riley; subm. by D. E. Yen. *Comment* (Y.H.S.): dates later of 2 strata believed to be "cultivation layers" in which wet-land taro was planted.

445 ± 95

I-4824. Terrace, 1.15 to 1.42 m **A.D. 1505**

From walled agricultural terrace 1.15 to 1.42 m depth, Survey area 17, Upper Makaha Valley. Coll. 1970 by P. Rosendahl and T. Riley; subm. by D. E. Yen. *Comment* (Y.H.S.): dates earlier of 2 strata believed to be "cultivation layers" in which wet-land taro was grown.

565 ± 110

I-4825. Terrace, 37 to 93 cm **A.D. 1385**

From behind wall of terrace 37 to 93 cm depth, Survey area 17, Upper Makaha Valley. Coll. 1970 by N. Carter; subm. by D. E. Yen. *Comment* (Y.H.S.): dates possible construction time of agricultural terrace wall.

I-4826. Terrace, 30 to 45 cm **<185**

From below terraced platform 30 to 45 cm depth, Survey area 17, Upper Makaha Valley. Coll. 1970 by T. Riley and P. Rosendahl; subm. by D. E. Yen. *Comment* (Y.H.S.): dates structure after initial construction.

405 ± 90

I-4827. Terrace, 85 to 111 cm **A.D. 1545**

From walled agricultural terrace 85 to 111 cm depth, Survey area 17, Upper Makaha Valley. Coll. and subm. 1970 by D. E. Yen. *Com-*

ment (Y.H.S.): dates lower portion of stratum believed to be "cultivation layer" for wet-land taro.

I-4926. Maui, Hawaiian Islands, Site MA-B11-2/3 **295 ± 90** **A.D. 1655**

Hardwood housepost from Palauea (20° 40′ 30″ N Lat, 156° 26′ 30″ W Long), Maui, Hawaiian Is. Housepost found *in situ* in stone wall house foundation. Coll. and subm. 1970 by P. V. Kirch, B. P. Bishop Mus., Honolulu, Hawaii. *Comment* (P.V.K.): dates main feature of small hamlet occupied by people with maritime economy (Kirch, 1970).

G. Mexico

Becan, Campeche series, Mexico

Charcoal mixed with gravel and plaster from Becan, Campeche (18° 30′ 36″ N Lat, 89° 28′ 24″ W Long), Mexico. Samples securely sealed under floors of 2 rooms of Structure IV, a "Rio Bec" style construction. Coll. 1969 by P. Thomas and subm. 1969 by E. W. Andrews, Middle Am. Research Inst., Yucatan, Mexico.

I-4286. Becan, Campeche, 1 **1230 ± 95** **A.D. 720**

From top (last) floor, Rm. 9.

I-4287. Becan, Campeche, 2 **1295 ± 95** **A.D. 655**

From top floor, Rm. 8.

General Comment: (E.W.A.): 1st dates in previously unexcavated part of Maya Lowlands. Helps date architectural construction, define chronologic position of pottery and artifacts sealed below floors and extensive midden deposits overlying floors.

Tlapacoya series, Basin of Mexico

Samples from Tlapacoya, once an island in Chalco Lake, Basin of Mexico (19° 18′ N Lat, 98° 55′ W Long), Mexico. Subm. 1969 by J. L. Lorenzo, Inst. Nac. Antropol. e Historia, Moneda, Mexico.

I-4406. Tlapacoya IV, Layer XIII **3310 ± 110** **1360 B.C.**

Peaty material mixed with pumice from Riparian zone in Tlapacoya (Niederberger, 1969). Coll. 1969 by C. Niederberger and J. Lorenzo. *Comment* (J.L.L.): dates base of Ceramic Formative occupation.

I-4404. Tlapacoya IV, Layer XVII-A 28 **4250 ± 110** **2300 B.C.**

Charcoal from 2.57 m depth preceramic horizon termed Zohapilco II. Coll. 1969 by C. Niederberger and J. Lorenzo.

I-4405. Tlapacoya IV, Layer XXIII bis-A 17 **7040 ± 115** **5090 B.C.**

Wood from 2.84 m depth preceramic horizon termed lower Zohapilco I. Coll. 1969 by C. Niederberger and J. Lorenzo.

21,700 ± 500

I-4449. Tlapacoya I, Alfa 2 **19,750 B.C.**

Charcoal from Hearth III on Pleistocene beach of Chalco Lake, assoc. with animal bones with no anatomic relation and lithic industry. Coll. 1969 by Raul Arana. *Comment* (J.L.L.): date clusters with A-790A (22,400 B.P., R., 1971, v. 13, p. 15; and GX-0959, 23,150 B.P.) from same area.

H. Australia

Puntutjarpa Rock-shelter series, Australia

Charcoal and ash samples from Puntutjarpa Rock shelter, 4.8 km S of Warburton Ranges Mission (26° S Lat, 127° E Long), Western Australia. Coll. 1967 and subm. 1970 by R. A. Gould, Dept. Anthropol., American Mus. Nat. History, New York, N.Y. (Gould, 1968).

10,170 ± 230

I-5319. Trench 2, Square 14 **8220 B.C.**

From well-defined hearth directly above cave floor, 117 to 122 cm below ground surface. *Comment* (R.A.G.): earliest radiocarbon date for cultural materials in W desert of Australia, assoc. with earliest human occupation of Puntutjarpa Rock shelter. Assoc. materials include remains of modern desert fauna, horsehoof cores, large flake scrapers, and small-hafted micro-adzes. The micro-adzes are earliest examples of small-hafted stone tools discovered in Australia.

435 ± 90

I-5320. Trench 2, Square 11 **A.D. 1515**

Combined sample from 2 nearby hearths, 43 to 48 cm below ground surface. *Comment* (R.A.G.): the 2 hearths represent limits of an excavated campsite. Assoc. artifacts included surral-backed blades and a large horsehoof core.

3840 ± 105

I-5321. Trench 3, Square 49 **1890 B.C.**

From large hearth 28 to 38 cm below ground surface. *Comment* (R.A.G.): furnishes final date for a presumed well, used to secure drinking water from localized water table within W cave.

6710 ± 125

I-5475. Trench 2, Square 11 **4760 B.C.**

From 78 cm below ground surface. *Comment* (R.A.G.): sample checks dates of same level from nearby Trench I (I-3387 and I-3388, R., 1969, v. 11, p. 87).

4010 ± 105

I-5476. Trench 2, Square 46 **2060 B.C.**

From well-defined hearth, 105 to 112 cm below ground surface. *Comment* (R.A.G.): sample stratigraphically above I-5475, assoc. with earliest appearance of well-made backed blades.

I-5318. Winpuly (Winburn Rocks) site, Australia **835 ± 145 A.D. 1115**

Charcoal from Winburn Rocks, 107 km E of Warburton Ranges Mission (26° S Lat, 127° E Long), Western Australia. From well-defined hearth in Tr. 1, Sq. 7, 15 to 31 cm below ground surface. Coll. and subm. 1970 by R. A. Gould. *Comment* (R.A.G.): site is shallow remnant of extensive open air camp. Stone artifacts closely resemble those from upper levels of Puntutjarpa (Gould, 1968).

I-5477. Nyawar (Ranford Hill site), Australia **2190 ± 95 240 B.C.**

Charcoal from Ranford Hill, 72 km E of Warburton Ranges Mission (26° S Lat, 127° E Long), Western Australia. From small hearth inside E rock shelter, 76 to 92 cm below ground surface. Stone flakes and scrapers assoc. with hearth; a single-backed blade stratigraphically above hearth. Coll. and subm. 1970 by R. A. Gould.

I. Asia

Chansen series, Thailand

Main occupation of Chansen (15° 07′ N Lat, 100° 27′ E Long), Takli Dist., Nakhon Sawan Prov., Thailand, belongs to Dvaravati period (ca. 6th to 10th century A.D.), earliest historic period of Thailand. Coll. and subm. 1969 by G. F. Dales, Univ. Mus., Univ. of Pennsylvania, Philadelphia. Samples supplement 1968 series of Univ. of Pennsylvania (R., 1970, v. 12, p. 587). Dates cited were calculated by the Univ. of Pennsylvania lab. from Isotopes' raw data using 5568 yr half-life.

I-4368. Phase IV Late Funan **1416 ± 84 A.D. 534**

Charcoal, Sample 69-2, from Operation Dg, Lot 16, St. 16, 100 cm beneath surface. Mixed with shells, rootlets, and limestone fragments. *Comment* (G.F.D.): only Phase IV sample, agrees with traditional historic dating of this pre-Dvaravati phase.

I-4369. Phase V or early VI, Late Dvaravati **948 ± 78 A.D. 1002**

Charcoal, Sample 69-3, bamboo or reed, some matting, from Operation Eb, Lot 7, St. 3, 48 to 50 cm beneath ground surface. *Comment* (G.F.D.): assoc. pottery sherds resemble material from late Dvaravati sites in central Thailand.

I-4370. Phase II, Pre-Funan **1644 ± 85 A.D. 306**

Charcoal, Sample 69-10, of hardwood and bamboo, Operation Dg, Lot 43, Pit 1, 230 cm below ground level. *Comment* (G.F.D.): from good context that dates end of pre-Funan Indianized cultural phase.

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[RADIOCARBON, VOL. 14, NO. 1, 1972, P. 140-144]

INSTITUTE OF GEOLOGICAL SCIENCES RADIOCARBON DATES II

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This date list was compiled by the Institute of Geological Sciences (U.K.) incorporating data supplied under contract by E. Welin, Radioactive Dating Laboratory, Stockholm. Unless otherwise stated, age figures are in C^{14} years before A.D. 1950. The half-life of C^{14} is taken as 5568 and the standard error is given as a standard deviation of 1σ. Correction for C^{13}/C^{12} has not been made.

South Shian series

Shells from glacially disturbed marine clay in low cliff at S Shian, Argyllshire (56° 32′ N Lat, 5° 24′ W Long, Grid Ref. NM 909 422), exposed about high-tide level beneath glacial sand. Coll. 1969 by J. D. Peacock, D. Mottershead, and J. C. C. Romans; subm. by J. D. Peacock, Inst. of Geol. Sci.

IGS-C14/16. (St 3262/3332)

a) Valves of pelecypod *Chlamys islandica.*

Outer 11,300 ± 300
9350 B.C.
Inner 11,530 ± 210
9580 B.C.

IGS-C14/17. (St 3263)

b) Valves of pelecypod *Astarte elliptica.*

11,805 ± 180
9855 B.C.

IGS-C14/18. (St 3266/3306)

c) Mixed shell debris.

Outer 6705 ± 130
4755 B.C.
Inner 11,430 ± 220
9480 B.C.

General Comment (J.D.P.): results confirm that marine clay is of Allerød age and that overlying glacial deposit was laid down during the Loch Lomond Readvance. Difference of dates on the 2 mollusk species is only slightly greater than statistical error, and is probably not significant. Poor results of determinations on mixed shell debris underlines value of unbroken shell valves for radiocarbon dating.

IGS-C14/19. (St 3267) Dumbarton Distillery Borehole — **11,805 ± 205**, **9855 B.C.**

Valves of pelecypod *Chlamys islandica* from marine horizon between alt —24.7 and —41.8 m in borehole at Dumbarton (55° 57′ N Lat, 4° 34′ W Long, Grid Ref. NS 396 752). Coll. 1938. Subm. by J. D.

* Published by permission of the Director, Institute of Geological Sciences, Exhibition Road, London, S.W.7. The Institute is a contracting agency, not a dating laboratory, yet IGS at London is the "author" when needed for interlaboratory communication.

Peacock. *Comment* (J.D.P.): date shows that much of the deposit, which is in the buried channel of R. Leven, is of Allerød and later age.

IGS-C14/20. (St 3269/3333) Gallowhill, Paisley

Outer 12,930 ± 160
10,980 B.C.
Inner 15,625 ± 240
13,675 B.C.

Valves of pelecypod *Arctica islandica* from marine clay exposed in temporary excavation, top of excavation 11 m O.D., at Gallowhill, Paisley, (55° 52′ N Lat, 4° 25′ W Long, Grid Ref. NS 491 657). Coll. 1938. Subm. by J. D. Peacock. *Comment* (J.D.P.): age greater than anticipated; additional specimen subm. for dating (see below).

IGS-C14/68. (St 3480/3481) Gallowhill, Paisley

Outer 12,125 ± 210
10,175 B.C.
Inner 12,615 ± 230
10,665 B.C.

Comment (J.D.P.): revised dates agree with present knowledge of local geology.

IGS-C14/21. (St 3270/3334) Ralston, Paisley

Outer 12,890 ± 360
10,940 B.C.
Inner 12,610 ± 210
10,660 B.C.

Valves of pelecypod *Arctica islandica* from marine clay exposed in temporary excavation, top of excavation ca. 16 m O.D., at Ralston, Paisley (55° 51′ N Lat, 4° 23′ W Long, Grid Ref. NS 510 641). Coll. 1938. Subm. by J. D. Peacock. *Comment* (J.D.P.): date compares with that at Wester Fulwood (R., 1970, v. 12, p. 391) and indicates age of higher late-glacial marine sediments in Paisley area.

IGS-C14/26. (St 3274) Bathampton, Somerset

8690 ± 180
6740 B.C.

Peat from Borehole 11 on line of proposed Batheaston By-Pass rd. (51° 24′ N Lat, 2° 18′ W Long, Grid Ref. ST 7850 6711) ca. 0.7 m above base of alluvium resting on Jurassic (Lower Lias) clay. Ground alt 20.25 m. Borehole is on S margin of alluvial plain of R. Avon above Bath. Presence of peat bed suggests valley floor was partly occupied by swamps and marshes at postglacial climatic optimum. Deposits overlying peat consist primarily of silty clay. Material presented by Le Grand Sutcliffe and Gell. Coll. 1965 and subm. by G. A. Kellaway, Inst. of Geol. Sci.

Severnside series, Gloucestershire

Peat and reworked organic silt from excavation for reservoir at Severnside, Avonmouth (51° 33′ N Lat, 2° 39′ W Long, Grid Ref. ST 5461 8334). Coll. 1969 and subm. by A. B. Hawkins, Univ. of Bristol.

3110 ± 100

IGS-C14/27. (St. 3257) **1160 B.C.**

Peat layer at +3.96 m, between 2 estuarine clays.

3905 ± 100

IGS-C14/28. (St 3275) **1955 B.C.**

Peat layer at +3.35 m, between 2 estuarine clays.

IGS-C14/25. (St 3273) Sandbach, Cheshire **>40,000**

Wood from organic horizon brought up by suction-dredging from beneath Congleton Sand in Arclid Wood Quarry (53° 09′ N Lat, 2° 20′ W Long, Grid Ref. SJ 7767 6203). Coll. 1969 and subm. by W. B. Evans, Inst. of Geol. Sci. Nearby, boreholes show that horizon lies at ca. 48 m O.D., in white sands overlain in turn by Congleton Sand and late Devensian (Weichselian) till, and underlain by thin patches of sandy gravel and stony till. *Comment*: date consistent with suggestion (Evans *et al.*, 1968, p. 213) that organic deposit is broadly comparable in age with that at Farm Wood Quarry, Chelford (R., 1970, v. 12, p. 385).

5100 ± 100

IGS-C14/29. (St 3276) **3150 B.C.**

Reworked organic silt at 1.73 m O.D.

General Comment (A.B.H.): forms part of Flandrian coastal sequence. There is no stratigraphic break above horizon of C14/27 as would be expected if area had been a land surface prior to inundation by the 'Romano British Transgression.' Upper 5 m of organic silt is bioturbated and contains *Hydrobia* sp.; bottom contact is irregular.

Avonmouth Bridge series, Somerset

Samples from bridge excavations.

4305 ± 100

IGS-C14/30. (St 3277) Avonmouth Bridge **2355 B.C.**

Wood in peat band 0.56 m thick, at 3.45 m O.D., in excavation for pier (51° 30′ N Lat, 2° 41′ W Long, Grid Ref. ST 5234 7752). Peat rests on eroded surface of Keuper Marl and is overlain by Flandrian clay. Coll. 1969 and subm. by D. D. Gilbertson and A. B. Hawkins.

4105 ± 100

IGS-C14/31. (St 3278) Avonmouth Bridge **2155 B.C.**

Roots in frost wedge within Keuper Marl, overlain by Flandrian clay, from excavation for pier, at 3.66 m O.D. (51° 30′ N Lat, 2° 41′ W Long, Grid Ref. ST 5228 7738). Coll. 1969 and subm. by D. D. Gilbertson and A. B. Hawkins. *Comment* (A.B.H.): date indicates roots are contemporary with peat band (cf. IGS C14/30) and not with infilling of frost wedge.

IGS-C14/32. (St 3279) Undy Wharf, Monmouthshire **3485 ± 100 1535 B.C.**

Wood in peat band, overlain by recent clay, exposed on foreshore (51° 34′ N Lat, 2° 48′ W Long, Grid Ref. ST 4441 8531). Part of submerged forest. Coll. 1969 and subm. by A. B. Hawkins.

IGS-C14/33. (St 3281) East Brent, Somerset **7280 ± 130 5330 B.C.**

Peat at —7.77 m O.D. in borehole (51° 16′ N Lat, 2° 55′ W Long, Grid Ref. ST 3581 5283). Peat bed overlain by estuarine clay. Presented by Soil Mechanics Ltd. Coll. 1967 and subm. by A. B. Hawkins.

IGS-C14/34. (St 3292) Clevedon Pill, Somerset **5815 ± 115 3865 B.C.**

Peat at —0.9 m O.D. in creek (51° 26′ N Lat, 2° 53′ W Long, Grid Ref. ST 3878 7039). Peat interbedded with estuarine clays. Coll. 1969 by D. D. Gilbertson. Subm. by A. B. Hawkins.

IGS-C14/35. (St 3293) Clevedon, Somerset **5360 ± 120 3410 B.C.**

Peat at 0.23 m O.D. overlain by 6.1 m of estuarine clay in excavation for sewer trench (51° 26′ N Lat, 2° 52′ W Long, Grid Ref. ST 3957 7029). Coll. 1969 by D. D. Gilbertson. Subm. by A. B. Hawkins. *Comment* (A.B.H.): no indication of stratigraphic break above dated horizon.

Kenn Pier series, Somerset

Peat and wood in excavations for pumping sta. at Kenn Pier (51° 25′ N Lat, 2° 49′ W Long, Grid Ref. ST 4335 6978). Coll. 1968 by D. D. Gilbertson. Subm. by A. B. Hawkins.

IGS-C14/36. (St 3294) **3510 ± 100 1560 B.C.**

Peat band 0.15 m thick, in estuarine clay, at 2.69 m O.D.

IGS-C14/37. (St 3295) **3410 ± 100 1460 B.C.**

Peat band 0.1 m thick, in estuarine clay, at 2.24 m O.D.

IGS-C14/38. (St 3280) **4145 ± 100 2195 B.C.**

Wood from top of peat band, 1.09 m thick, at —0.41 m O.D.

IGS-C14/39. (St 3282) **6100 ± 120 4150 B.C.**

Peat from bottom of same peat band is IGS C14/38 at —1.50 m O.D.

General Comment (A.B.H.): series of peat beds in Flandrian deposits of Kenn Moor. No stratigraphic break above horizon at C14/36.

Weston-super-Mare series, Somerset

Peat from Flandrian deposits from excavation for sewer trench at Weston-super-Mare (51° 21′ N Long, 2° 57′ W Long, Grid Ref. ST 3457 6194). Coll. 1969 by D. D. Gilbertson. Subm. by A. B. Hawkins.

IGS-C14/40. (St 3296) **3675 ± 100**
1725 B.C.

Peat from top of peat band, 1.22 m thick, in estuarine clay, at 1.60 m O.D.

IGS-C14/41. (St. 3297) **4530 ± 105**
2580 B.C.

Peat from near base of same peat band at IGS C14/40, at 0.51 m O.D.

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[RADIOCARBON, VOL. 14, NO. 1, 1972, P. 145-148]

INSTITUT ROYAL DU PATRIMOINE ARTISTIQUE RADIOCARBON DATES III

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INTRODUCTION

This list includes the results of datings made during 1969-70. The method is essentially the same as described in R., 1968, v. 10, p. 29-35; 1971, v. 13, p. 29-31.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

IRPA-66. St. Joris ten Distel — **29,900 ± 700 / 27,950 B.C.**

Peat from St. Joris ten Distel, W Flanders, Belgium (51° 07′ 40″ N Lat, 3° 19′ 50″ E Long), at 10 m alt. Coll. 1969 by W. De Breuck, Lab. Geol., Univ. of Ghent, Belgium. No NaOH pretreatment. *Comment*: control of palynologic dates.

IRPA-67. St. Baafs Vijve — **13,090 ± 440 / 11,140 B.C.**

Shells from St. Baafs Vijve, W Flanders, Belgium (50° 54′ 40″ N Lat, 3° 23′ 45″ E Long), at 10 m alt. Coll. 1969 by G. De Moor, Lab. Geol., Univ. of Ghent, Belgium; subm. by W. De Breuck. Pretreatment with HCl 1% until 15 to 20% weight loss. *Comment*: date elucidates unconfirmed data.

IRPA-68. St. Baafs Vijve — **29,955 ± 790 / 28,005 B.C.**

Peat from St. Baafs Vijve, W Flanders, Belgium (50° 54′ 40″ N Lat, 3° 23′ 45″ E Long), at 1.5 m alt. Coll. by G. De Moor; subm. by W. De Breuck. No NaOH pretreatment. *Comment*: sample was taken from peat layer, at 7 to 8 m depth, between sablon upper layer and loam under layer.

IRPA-69. Zandvoorde — **3365 ± 190 / 1415 B.C.**

Peat from Zandvoorde, W Flanders, Belgium (51° 12′ 30″ N Lat, 2° 57′ 30″ E Long), at 1.8 m alt and 15 cm depth. Coll. 1969 by G. De Moor; subm. by W. De Breuck. No NaOH pretreatment. *Comment*: sample belongs to IRPA-39-42 series, R., 1971, v. 13, p. 29. See general comment to series.

Meetkerke series

Samples from W Flanders, Belgium (51° 13′ 32″ N Lat, 3° 9′ 43″ E Long). Coll. 1969 to 1970 by W. De Breuck and G. De Moor.

19,560 ± 540
IRPA-76. Meetkerke 1 **17,610 B.C.**

Shells (*Scrobicularia*), at —5 m alt; pretreated with HCl 1% until 15 to 20% weight loss.

21,440 ± 670
IRPA-77. Meetkerke 2 **19,490 B.C.**

Shells (*Ostrea*), at —5 m alt; pretreated as above.

17,430 ± 460
IRPA-78. Meetkerke 3 **15,480 B.C.**

Shells (*Hydrobia*), at —4 m; pretreated as above.

22,875 ± 620
IRPA-79. Meetkerke 4 **20,925 B.C.**

Shells (*Cardium*), at 0 m alt; pretreated as above.

34,160 ± 850
IRPA-86. Meetkerke 5 **32,210 B.C.**

Shells (*Cardium, Venerupis, Nasso, Scrobicularia*), at —5 m alt; pretreated as above.

IRPA-85. St. Pieters Brugge **>35,000**

Wood of calcined trunk, at —3 m alt. (51° 13′ 32″ N Lat, 3° 11′ 38″ E Long).

General Comment (W. De B.): dates are used for stratigraphic study of upper Pleistocene in coastal area. Samples were from sediments and were not handled again.

Pajara series

Calcareous rock from Pajara, Canary Is., Spain (28° 24′ N Lat, 10° 27′ W Long), at 75 m alt. Coll. 1969 by P. De Paepe and R. Vermeire, Univ. of Ghent, Belgium; subm. by W. De Breuck. Pretreatment with HCl 1% until 15 to 20% weight loss.

25,850 ± 560
IRPA-80. Pajara 1 **23,900 B.C.**

7080 ± 300
IRPA-81. Pajara 2 **5130 B.C.**

19,405 ± 540
IRPA-84. Pajara 3 **17,455 B.C.**

General Comment (P. De P.): dates beginning (IRPA-80) and end (IRPA-81) of calcareous rock formation. IRPA-84 is sample of intermediate layer.

1630 ± 90
IRPA-87. Uitkerke **A.D. 320**

Shells (*Cardium*) from Uitkerke, W Flanders, Belgium (51° 17′ 35″ N Lat, 1° 13′ 13″ E Long), at 0 m alt. Coll. 1969 by W. De Breuck. Pretreatment HCl 1% until 15 to 20% weight loss. *Comment*: shells from well at 2.5 m depth; date confirms previous data.

IPJA-88. Izenberge **>30,000**

Shells (*Cardium*) from Izenberge, W Flanders, Belgium (50° 1′ 18″ N Lat, 2° 43′ 36″ E Long), at 11 m alt. Coll. 1970 by M. De Dapper, Lab. Geol., Univ. of Ghent, Belgium. Pretreatment HCl 1% until 15 to 20% weight loss.

IRPA-89. Ghent **30,005 ± 735**
28,055 B.C.

Shells from Ghent, E Flanders, Belgium (51° 06′ 05″ N Lat, 3° 45′ 30″ E Long), at —10 m alt. Coll. 1965 by G. De Moor. Pretreated as above.

II. ARCHAEOLOGIC SAMPLES

Weelde series

Charcoal from Weelde excavations, Flanders, Belgium (51° 25′ 18″ N Lat, 5° 2′ 12″ E Long). Coll. 1965 by H. Roosens, Service Nat. des Fouilles, Brussels, Belgium. *Comment* (H.R.): dates agree with archaeologic date: Bronze age.

IRPA-49. Weelde 1 **2880 ± 130**
930 B.C.

IRPA-51. Weelde 2 **2915 ± 160**
965 B.C.

IRPA-52. Weelde 3 **3155 ± 160**
1205 B.C.

Jemdet Nasr series

Coal from Jemdet Nasr; Mesopotamia (32° 24′ N Lat, 44° 43′ E Long). Coll. 1967 by L. De Meyer, Univ. of Ghent, Belgium. *Comment* (L. De M.): before excavation, level was 12 m above ground level.

IRPA-70. Jemdet A **4470 ± 220**
2820 B.C.

Coal near mud brick wall, 1 m under present level. Archaeologic date: ca. 2700 B.C.

IRPA-71. Jemdet B **3640 ± 175**
1690 B.C.

Coal among ashes and burned bones, at 40 cm under present level. Also found was a painted vase dated at end of archaic dynasty or beginning of Agade age: ca. 2400 B.C.

IRPA-72. Jemdet C **2140 ± 130**
190 B.C.

Coal from same site as IRPA-71, at 40 cm depth. Possibility of contamination.

4220 ± 140

IRPA-73. Jemdet D **2270 B.C.**

Coal from filling of ground and stones near a brick pipe, at 60 cm under present level. Filling is probably contemporary with pipe: ca. 2400 B.C.

3470 ± 190

IRPA-74. Jemdet E **1520 B.C.**

Coal from brick well, between 1.5 m and 1.6 m of present margin, with ceramics dated at end of Ur III age or beginning of Isin-Larsa age: ca. 2000 B.C.

3830 ± 215

IRPA-75. Jemdet F **1880 B.C.**

Coal from ground, near oven, at 50 cm under present level.

REFERENCE

Dauchot-Dehon, M. and Heylen, J., 1971, Institut royal du Patrimoine artistique radiocarbon dates II: Radiocarbon, v. 13, p. 23-31.

[RADIOCARBON, VOL. 14, No. 1, 1972, P. 149-154]

ILLINOIS STATE GEOLOGICAL SURVEY RADIOCARBON DATES III

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The following date list includes all samples processed from December 1969 through November 1970 at the Illinois State Geological Survey Radiocarbon Dating Laboratory. The benzene liquid scintillation technique was used, following the method of Noakes, Kim, and Stipp (1965), and Noakes, Kim, and Akers (1967). Detailed sample preparation procedures used in this laboratory have been reported by Kim and Ruch (1969), and Kim, Ruch, and Kempton (1969).

All ages are calculated using a C^{14} half-life of 5568 years and the NBS oxalic acid standard as reference. Errors (1σ) reported account only for uncertainties in activity measurements of the sample, standard, and backgrounds. If the calculated error is less than 200 years, a minimum error of ± 200 years is assigned. No corrections have been made for isotopic fractionation or atmospheric C^{14} fluctuations.

Samples ISGS-33 through ISGS-38 were dated by S. M. Kim and the remainder by the author. Chao Li Liu assisted in sample preparation. All samples submitted were screened prior to acceptance by an Isotopic Analysis Committee consisting of J. P. Kempton (chairman), Charles Collinson, R. E. Bergstrom, D. D. Coleman, and J. C. Frye.

I. GEOLOGIC SAMPLES

A. United States

ISGS-33. Lake Michigan Core 146-2 — **6920 ± 200 / 4970 B.C.**

Varved lake sediment from core sample 32 km E of Waukegan, Illinois (42° 21′ 48″ N Lat, 87° 25′ 0″ W Long). Organic-rich layers from 26 to 106 cm depth were combined. Coll. 1969 by D. L. Gross, J. A. Lineback, and H. V. Leland; subm. by D. L. Gross, Illinois State Geol. Survey.

ISGS-36. Lake Michigan Cores 143-2 and 144-2 — **7050 ± 200 / 5100 B.C.**

Organic-rich clay from 2 cores 52 and 45 km E of Waukegan, Illinois (42° 21′ 48″ N Lat, 87° 10′ 48″ W Long, and 42° 21′ 48″ N Lat, 87° 15′ 36″ W Long). Organic-rich layers from 35 to 65 cm depth in 2 adjacent cores. Coll. 1969 by D. L. Gross, J. A. Lineback, and H. V. Leland; subm. by D. L. Gross.

General Comment (D.L.G.): samples date top of lacustrine sediment sequence (Lake Michigan Formation) in S Lake Michigan, indicating that most of Lake Michigan Formation was deposited late in Wisconsinan stage during glacial melting, and that there is relatively little Holocene sediment in this part of lake. See Gross *et al.* (1970) and Lineback, Ayer, and Gross (1970).

30,700 ± 500
ISGS-37. Tuscola Borrow Pit section 28,750 B.C.

Peaty silt from upper 8 cm of 30 cm unit in Douglas Co., NE¼ SE¼ SW¼ Sec. 26, T.16N, R.8E, 1.6 km NE of center of Tuscola, Illinois (39° 48′ 32″ N Lat, 88° 16′ 1″ W Long). From peaty silt unit at 8 m depth, below Woodfordian gray silty till. Coll. 1969 by D. L. Gross and W. H. Johnson; subm. by D. L. Gross. *Comment* (D.L.G.): from stratigraphic position of Robein Silt. Most organic silt underlying Woodfordian tills in E-central Illinois date 20,000 to 27,000 yr B.P.

Edwardsville Section series

20,000 ± 500
ISGS-39. ED-1, wood fragments 18,050 B.C.

21,350 ± 320
ISGS-45. ED-2, gastropod shells 19,400 B.C.

Both samples from same horizon in Madison Co., NW¼ NE¼ SE¼ Sec. 29, T.4N, R.8W, 7.7 km SW of Edwardsville, Illinois (38° 46′ 10″ N Lat, 90° 00′ 30″ W Long). From organic silt (Robein Silt?) below Peoria Loess and above Roxana Silt. Coll. 1969 and subm. by A. M. Jacobs, Illinois State Geol. Survey. *Comment* (A.M.J.): from stratigraphic position of Robein Silt; dates deposit during early Woodfordian substage. Wood and shell dates agree.

21,400 ± 1000
ISGS-46. Shelby County Moraine section 19,450 B.C.

Peat and wood fragments in accretion-gley from Shelby Co., NE¼ SE¼ SW¼ Sec. 8, T.11N, R.4E, 1.6 km E of center of Shelbyville, Illinois (39° 24′ 36″ N Lat, 88° 46′ 54″W Long). From upper 30 cm of 1.5 m thick accretion-gley. Three separate fractions dated: acid-soluble, base-soluble, and insoluble fractions. As all 3 dates were in statistical agreement, an average value is reported. Coll. 1969 by D. L. Gross and W. H. Johnson; subm. by D. L. Gross. *Comment* (W.H.J.): dates uppermost portion of accretion-gley (Berry Clay Member of Glasford Formation) overlying Vandalia Till Member of Glasford Formation and indicates that deposition of Berry Clay Member continued into early Woodfordian. ISGS-26, 20,000 ± 200, and ISGS-32, 21,300 ± 500 (R., 1970, v. 12, p. 507), from top and bottom, respectively, of overlying Robein Silt, indicate no time break between Berry Clay Member and Robein Silt deposits (Johnson *et al.,* 1971).

Vandalia Core series, Pittsburg Basin

21,370 ± 810
ISGS-47. J-1, 200 to 210 cm depth 19,420 B.C.

24,200 ± 1900
ISGS-53. J-2, 225 to 230 cm depth 22,250 B.C.

Core samples of gray silty clay 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; see Jacobs and Lineback (1969), Jacobs (1970), and Grüger (1969). Coll. 1969 by A. M. Jacobs and H. E. Wright; subm. by A. M. Jacobs. *Comment* (A.M.J.): interval dated by ISGS-47 marks appearance of spruce in local pollen rain and increase in relative abundance of expandable clay minerals in response to encroachment of Woodfordian ice front. Interval dated by ISGS-53 marks maximum of pine in local pollen rain and maximum of illite and kaolinite in clay fraction. Related to previously pub. Vandalia Core series (R., 1970, v. 12, p. 505).

Volo Bog series

Site is in Lake Co., SW¼ SE¼ NE¼ Sec. 28, T.45N, R.9E, 2.4 km N of Volo, Illinois (42° 20′ N Lat, 88° 11′ W Long). Coll. 1970 by M. R. McComas; subm. by J. P. Kempton, Illinois State Geol. Survey.

ISGS-49. Volo Bog #1 **2100 ± 200**
150 B.C.

Reed and sedge peat from edge of bog at base of peat overlying sand and gravel, 1.5 m below surface. *Comment* (J.P.K.): from local and regional data, date implies peat accumulated along edge of bog in response to rising water levels.

ISGS-50. Volo Bog #2 **460 ± 310**
A.D. 1490

Decayed *Sphagnum* peat from base of floating mat, ca. 1.5 m below surface. *Comment* (J.P.K.): sample dated to show development rate of floating mat, but small size prevents definite conclusions.

ISGS-52. Clear Creek section **>32,800**

Wood fragments in till from Putnam Co., NW¼ NW¼ NE¼ Sec. 19, T.31N, R.1W, 8 km ENE of Henry, Illinois (41° 09′ N Lat, 89° 16′ W Long). From base of 7.3 m sec. of blue-gray till overlying organic silt. Coll. 1964 by J. C. Frye and H. B. Willman; subm. by J. C. Frye, Illinois State Geol. Survey. *Comment* (J.C.F.): dates assoc. fossil snail fauna and underlying till as Altonian or older.

Hughes Peat Bed series

Site in Linn Co., SW¼ SW¼ SW¼ Sec. 2, T.83N, R.6W, 5 km E of Marion, Iowa (42° 01′ N Lat, 91° 31′ W Long).

ISGS-38. Hughes Peat Bed #1 **4940 ± 200**
2990 B.C.

Peat from brain case of *Bison occidentalis,* overlain by 1 to 1.5 m peat; underlain by ca. 1.5 m peat. Coll. 1969 by H. A. Semken, Jr.; subm. by S. A. Hall, Univ. of Iowa. *Comment* (S.A.H.): dates Hughes bison as youngest *Bison occidentalis.*

N Lat, 89° 11′ 30″ W Long). From Equality Formation, 4 to 5 m above Hagarstown Member of Glasford Formation; see Jacobs and Lineback (1969), Jacobs (1970), and Grüger (1969). Coll. 1969 by A. M. Jacobs and H. E. Wright; subm. by A. M. Jacobs. *Comment* (A.M.J.): interval dated by ISGS-47 marks appearance of spruce in local pollen rain and increase in relative abundance of expandable clay minerals in response to encroachment of Woodfordian ice front. Interval dated by ISGS-53 marks maximum of pine in local pollen rain and maximum of illite and kaolinite in clay fraction. Related to previously pub. Vandalia Core series (R., 1970, v. 12, p. 505).

Volo Bog series

Site is in Lake Co., SW¼ SE¼ NE¼ Sec. 28, T.45N, R.9E, 2.4 km N of Volo, Illinois (42° 20′ N Lat, 88° 11′ W Long). Coll. 1970 by M. R. McComas; subm. by J. P. Kempton, Illinois State Geol. Survey.

ISGS-49. Volo Bog #1 **2100 ± 200**
150 B.C.

Reed and sedge peat from edge of bog at base of peat overlying sand and gravel, 1.5 m below surface. *Comment* (J.P.K.): from local and regional data, date implies peat accumulated along edge of bog in response to rising water levels.

ISGS-50. Volo Bog #2 **460 ± 310**
A.D. 1490

Decayed *Sphagnum* peat from base of floating mat, ca. 1.5 m below surface. *Comment* (J.P.K.): sample dated to show development rate of floating mat, but small size prevents definite conclusions.

ISGS-52. Clear Creek section **>32,800**

Wood fragments in till from Putnam Co., NW¼ NW¼ NE¼ Sec. 19, T.31N, R.1W, 8 km ENE of Henry, Illinois (41° 09′ N Lat, 89° 16′ W Long). From base of 7.3 m sec. of blue-gray till overlying organic silt. Coll. 1964 by J. C. Frye and H. B. Willman; subm. by J. C. Frye, Illinois State Geol. Survey. *Comment* (J.C.F.): dates assoc. fossil snail fauna and underlying till as Altonian or older.

Hughes Peat Bed series

Site in Linn Co., SW¼ SW¼ SW¼ Sec. 2, T.83N, R.6W, 5 km E of Marion, Iowa (42° 01′ N Lat, 91° 31′ W Long).

ISGS-38. Hughes Peat Bed #1 **4940 ± 200**
2990 B.C.

Peat from brain case of *Bison occidentalis,* overlain by 1 to 1.5 m peat; underlain by ca. 1.5 m peat. Coll. 1969 by H. A. Semken, Jr.; subm. by S. A. Hall, Univ. of Iowa. *Comment* (S.A.H.): dates Hughes bison as youngest *Bison occidentalis.*

11,000 ± 200
ISGS-41. Hughes Peat Bed #2 **9050 B.C.**

Wood from *Picea* stump, id. by B. F. Kukachka and R. C. Koeppen, Forest Products Lab., Madison, Wisconsin. Coll. 1969 and subm. by S. A. Hall. *Comment* (S.A.H.): date is possibly minimum for *Picea*-dominated arboreal vegetation indicated by pollen analysis of core segments stratigraphically beneath dated stump. Base of *Picea-Cyperaceae* pollen zone dated 11,880 ± 250 yr B.P. (I-5102, unpub.).

9340 ± 200
ISGS-55. Hughes Peat Bed #3 **7390 B.C.**

Peat from basal 5 cm of peat bed. Coll. 1970 and subm. by S. A. Hall. *Comment* (S.A.H.): date is minimum for beginning of peat formation in Hughes deposit. Analysis of same horizon 25 m E of dated sample indicates *Quercus-Ulmus* pollen zone.

5640 ± 540
ISGS-56. Hughes Peat Bed #4 **3690 B.C.**

Bone collagen from *Bison occidentalis*, 0.6 to 1 m from present surface of peat bed. Coll. 1969 by H. A. Semken, Jr.; subm. by S. A. Hall. *Comment* (S.A.H.): confirms ISGS-38 and supports Hughes bison as youngest *Bison occidentalis* reported.

Rocky Fork Cut series

Wood in gravel from Franklin Co., SW¼ SE¼ Sec. 2, T.1N, R.16W, 1.6 km E of Gahanna, Ohio (40° 1′ 6″ N Lat, 82° 51′ 9″ W Long). Coll. and subm. by R. P. Goldthwait, Ohio State Univ.

ISGS-40. 68-9-14A **>50,000**

From Lockborne Gravel, at bottom edge of upper oxidized zone. Coll. 1968.

ISGS-57. 70-4-4 **>36,050**

From Lockborne Gravel, at bottom of coarse boulder gravel just above contact with Rocky Fork Till. Sample believed contaminated in lab.; therefore minimum age is assigned. Coll. 1970.

General Comment (R.P.G.): dates indicate Altonian or older for early interstadial deposits.

21,080 ± 200
ISGS-42. Olive Moraine, C-47 **19,130 B.C.**

Wood from till in Highland Co., 5 km NNE of Hillsboro, Ohio (39° 14′ 56″ N Lat, 83° 34′ 52″ W Long). From Boston till at 5 m depth, 1.2 m below yellow oxidized zone, underlain by paleosol in Illinoian gravel. Coll. 1969 by T. E. Rosengreen; subm. by R. P. Goldthwait. *Comment* (T.E.R.): date establishes age of Mt. Olive Moraine and time when late Wisconsinan glacier of Scioto Lobe first reached terminal position of initial advance into S Ohio.

ISGS-44. Fall Creek, D-36 **20,910 ± 240 18,960 B.C.**

Wood from till in Highland Co., 10 km NNE of Hillsboro, Ohio (39° 15′ 44″ N Lat, 83° 32′ 52″ W Long). From lower, unoxidized portion of Boston till; overlain by Darby Till bearing modern soil and underlain by Sangamon paleosol in silt. Coll. 1969 by T. E. Rosengreen; subm. by R. P. Goldthwait. *Comment* (T.E.R.): identifies Boston till as late Wisconsinan, not early Wisconsinan as hypothesized on basis of soil development.

ISGS-59. Blinco Branch, C-58 **>37,770**

Wood from till in Highland Co., 4.3 km E of Rainsboro, Ohio (39° 12′ 51″ N Lat, 83° 28′ 27″ W Long). From Danville Till. Sample believed contaminated in ISGS lab., therefore minimum age is assigned. Coll. 1970 by T. E. Rosengreen; subm. by R. P. Goldthwait. *Comment* (T.E.R.): date indicates that Danville Till is older than late Wisconsinan and rectifies a former age of 25,300 ± 600 B.P. (I-4797, unpub.) for wood believed contaminated in field.

B. Other Countries

Sao Paulo Basin series

ISGS-34. Sao Paulo City site, RP-2 **>43,500**

ISGS-43. Sao Paulo City site, RP-1 **>44,600**

Wood from alluvium of Tietê and Pinheiros Rivers, within Sao Paulo City, Brazil (23° 35′ 00″ S Lat, 47° 42′ 00″ W Long). From continental sediments near SW border of Sao Paulo Basin. Coll. 1969 by Kenitiro Suguio; subm. by J. C. Mendes, Univ. of Sao Paulo. *Comment* (K.S.): wood-bearing alluvium represents phase of fluvial sedimentation in tectonically active area. Dates indicate site was still tectonically unstable 44,600 yr B.P.

ISGS-54. Vietnam 48-6 **2700 ± 200 750 B.C.**

Organic-rich soil from Long An Prov., 10 km S of Long An, Vietnam (10° 30′ N Lat, 106° 22′ E Long). Sample from buried soil horizon, 90+ cm depth. Coll. 1963 by T. D. Phu; subm. by E. H. Tyner, Univ. of Illinois. *Comment* (E.H.T.): from humic paleosol horizon very high in total sulfur compared to sulfur content of overlying soil horizons; indicative of very brackish environment during formative period. May represent soil formation in period between Crane Key and Pelham Bay periods of emergence (Fairbridge, 1961) when sea stands were 2 to 3 m below present datum.

II. ARCHAEOLOGIC SAMPLES

Rodgers Shelter series

From Benton Co., SW¼ SW¼ NE¼ Sec. 33, T.39N, R.22W, 19 km N of Wheatland, Missouri (30° 5′ 30″ N Lat, 93° 20′ 40″ W Long).

Coll. 1968 by R. B. McMillan, Illinois State Mus., Springfield, Illinois; subm. by M. D. Thompson.

6300 ± 590

ISGS-35. Rodgers Shelter, 5315 **4350 B.C.**

Carbonized wood from colluvial cultural layer designated Stratum 2 in Rodgers sequence. *Comment* (R.B.M.): dates end of deposition of Stratum 2.

10,530 ± 650

ISGS-48. Rodgers Shelter, 7799 and 8259 **8580 B.C.**

Carbonized wood from alluvial clay near base of Stratum 1 in Rodgers sequence. *Comment* (R.B.M.): dates Dalton complex occupation early in terrace-building sequence.

1400 ± 200

ISGS-51. Brynjulfson Cave #1 **A.D. 550**

Charcoal particles in soil from Boone Co., SW¼ NE¼ SW¼ Sec. 16, T.47N, R.12W, 19 km S of Columbia, Missouri (38° 51′ 7″ N Lat, 92° 16′ 50″ W Long). Between 3 and 5 m from cave entrance, ca. 1 m above floor, mixed with soil and bone debris. Coll. 1969 by P. W. Parmalee and R. D. Oesch; subm. by P. W. Parmalee, Illinois State Mus., Springfield, Illinois. *Comment* (P.W.P.): date younger than estimated age of faunal material, but correlates with time when cave was infrequently used by Indians of Late Woodland (Boone focus) culture; charcoal particles may be residue of their fires.

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[RADIOCARBON, VOL. 14, NO. 1, 1972, P. 155-194]

UNIVERSITY OF MICHIGAN RADIOCARBON DATES XIV

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The following is a list of dates obtained since the compilation of List XIII (R., 1970, v. 12, p. 161-180). The method is essentially the same. Two CO_2–CS_2 Geiger counter systems were used. Equipment and counting techniques have been described elsewhere (Crane, 1961). Dates and estimates of error in this list follow the practice recommended by the International Radiocarbon Dating Conferences of 1962 and 1965, in that (a) dates are computed on the basis of the Libby half-life, 5570 yr; (b) A.D. 1950 is used as the zero of the age scale; and (c) the errors quoted are the standard deviations obtained from the number of counts only. In Michigan date lists up to and including VII, we quoted errors at least twice as great as the statistical errors of counting in order to take into account other errors in the over-all process.

We wish to acknowledge the help of Patricia Dahlstrom in preparing chemical samples and John D. Speth, Roberta Pennypacker, Steve Plog, Robert M. Schacht, R. Ingrid Christensen, and Dale D. Brodkey in preparing the descriptions.

I. GEOLOGIC SAMPLES

M-2147. Mud Lake site, Michigan **11,550 ± 400 / 9600 B.C.**

Calcareous marl from Mud Lake (43° 23′ 30″ N Lat, 85° 40′ 30″ W Long), Newaygo Co., Michigan. Sample P-56, 730 to 770 cm below water surface (430 to 470 cm below sediment surface) tentatively correlated with Valders stadial. Sample from core 3 m underwater near middle of Mud Lake. Coll. 1968 and subm. by R. O. Kapp, Alma College, Alma, Michigan. *Comment* (R.O.K.): pollen diagrams show strong oscillation in *Picea* and *Pinus* at this level. Oscillation believed to be vegetational response to late glacial warming of Two Creeks Interstadial and subsequent cooling to Valders Stadial. Valders maximum lobe within 50 km of site. Date corroborates interpretation of late glacial section of Mud Lake pollen diagram. The dated sample is from sediments interpreted to be correlative with the Valders Stadial.

M-2186. Marl Pond, Michigan **10,300 ± 340 / 8350 B.C.**

Organic gyttja with intercalated snails (43° 28′ N Lat, 85° 42′ W Long), Newaygo Co., Michigan. Sample from 15 cm band, lowest of 3 bands of similar dense gyttja, 317.5 to 325 cm deep. In upper coniferous pollen zone of late glacial time, date should permit correlation with Mud Lake (M-2147) and help stabilize late glacial pollen stratigraphy. Coll. 1968 by R. O. Kapp and Joseph Leach; subm. by R. O. Kapp. *Comment* (R.O.K.): date corresponds very well with same episode in other pollen diagrams; it is at point at which spruce pollen percentages

have dropped sharply and pine pollen percentages begin to dominate the record. Dates beginning of postglacial time in W central Michigan.

330 ± 100

M-2208. Pittsfield Horse, Michigan **A.D. 1620**

Toe bone (*Equus*) from Pittsfield Twp. (42° 14′ N Lat, 83° 45′ W Long), Washtenaw Co., Michigan. Sample from N bank of ditch along NE side of Interstate 94, W edge of Defiance moraine. Skeleton in depression filled by fine material worked from moraine and surrounding area. Overburden below soil .761 m. Coll. 1968 by W. R. Farrand and C. W. Hibbard, Univ. of Michigan; subm. by C. W. Hibbard. *Comments* (C.W.H.): although it looked quite recent, we thought skeleton should be dated since it directly overlay the moraine and since no fossil horse had been reported from Michigan. There was ca. 2.54 cm zone of burned peat just below soil zone and above bone. (W.R.F.): obviously a horse from historic period.

13,700 ± 600

M-2211. Boney Springs Mammoth site, Missouri **11,750 B.C.**

Organic silt, twigs, seeds, mosses, and other plant debris from tusk cavity of *Mammut americanum* (38° 06′ N Lat, 93° 22′ W Long), Breton Co., Missouri. Coll. 1968 and subm. by Peter Mehringer, Univ. of Arizona, Tucson, Arizona. *Comment* (P.M.): date agrees with I-3922—16,580 ± 220 B.P. (R., 1970, v. 12, p. 90)—in establishing a late Wisconsin age for the bone bed.

Bailer Mammoth site, Michigan

Bone and carbonized wood fragments from Bailer Mammoth site (43° 40′ 35″ N Lat, 84° 20′ 45″ W Long), Midland Co., Michigan.

24,000 ± 4000

M-2145. Bailer Mammoth site **22,050 B.C.**

Bone of Jefferson Mammoth (id. by Marion Whitney and R. O. Kapp) 2.44 m below soil surface in basal sandy and gravelly horizon overlain by ca. 1.22 m organic sediments. Remains were cranial bones, one molar, one fragment of molar, and part of mandible. Assoc. with plant remains, M-2361. Mammoth specimen near N limits of species. Coll. 1967 and subm. by R. O. Kapp.

3310 ± 160

M-2361. Bailer Mammoth site **360 B.C.**

Cores of *Larix laricina, Pinus strobus,* and possibly *Picea mariana* in stratigraphic assoc. with Jefferson Mammoth remains (M-2145).

General Comment (R.O.K.): ancient date of M-2145 indicates that Jefferson Mammoth occupied E Michigan during Mid-Wisconsin interval. Date suggests fossil remains should be assigned to Plum Point Interstadial (late Port Talbot Interstadial, *s.l.*) described in Ontario by Dreimanis (Goldthwait, *et al.,* 1965). Stratigraphy, alluvial sand and gravel, indicates, and widely disparate dates confirm, that plant remains

(M-2361) are not synchronous with mammoth bones. This date (M-2361) probably indicates the reworking of Bluff Creek alluvium and burial of bones at recovery point.

II. ARCHAEOLOGIC SAMPLES

A. Upper Mississippi Valley

White site series, Indiana

Charcoal from White site (40° 56′ N Lat, 85° 22′ 45″ W Long), T.17N, R.10E, SE¼, NW¼, Sec. 15, Henry Co., Indiana. Woodland site. Coll. 1967 by John Shrader and Mike Dixon; subm. by B. K. Swartz, Jr., Ball State Univ., Muncie, Indiana.

1860 ± 200

M-2015. White site **A.D. 90**

Pit N 22, W 2, 86.4 cm N and 71.1 cm E, 45.7 to 60.9 cm deep. Small sample.

1740 ± 140

M-2016. White site **A.D. 210**

Pit N 2, W 3, 43.2 cm N and 127 cm E.

1910 ± 140

M-2017. White site **A.D. 40**

Pit S 1, W 5, 48.3 cm N and 12.7 cm E, 15.2 to 30.4 cm deep.

1920 ± 140

M-2018. White site **A.D. 30**

Pit N 2, W 3, 48.3 cm N and 45.7 cm E, 0 to 15.2 cm deep.

1490 ± 130

M-2019. White site **A.D. 460**

Pit S 1, W 5, 129.5 cm N and 66 cm E, 15.2 to 30.4 cm deep.

1550 ± 150

M-2020. White site **A.D. 400**

Feature 3, pit S 1, W 3, 13.95 cm deep.

1400 ± 130

M-2021. White site **A.D. 550**

Feature 2.

General Comment (B.K.S.): M-2017 and M-2018 from S limit of surviving mound are bark from deposit containing indistinctive Woodland sherds and broken lithic remains. M-2015 is from isolated timber assoc. with burials NW of excavation. M-2016 is from log tomb assoc. with burials with red ocher, copperwork, expanded bar gorget, pendant, and stone slate celt at N edge of mound. M-2021 is from log timber in SE portion of mound with no assoc. artifacts. M-2019 and M-2020 may represent an intrusive component in that they are from isolated timbers not assoc. with artifacts. These timbers are centrally located in relation to the defined components. M-2019–2021 seem late for Adena occupation.

Possibly there was late survival in the W periphery. In this series, the earliest dates come from the margins of the surviving mound area.

720 ± 130

M-2131. Divers site series, Illinois **A.D. 1230**

Charcoal from Divers site (MO-28) (Otten site, 11-MO-3, Univ. of Mich. files, ISA: MO-4) (38° 27′ 30″ N Lat, 90° 15′ 30″ W Long), Monroe Co., Illinois. Post in W wall of Feature 15, S 56.9, E 46.57, 56 cm BAD 124.915. In 1950 J. B. Griffin called site Late Woodland of Pulcher complex. Coll. 1968 and subm. by James Porter, Marshall, Wisc. *Comments* (J.W.P.): date not out of line; it fits observed sequence of building at site. (J.B.G.): date may fit building sequence, but it is much too late for Pulcher complex.

1170 ± 150

M-2179. Butcher site, Missouri **A.D. 780**

Charcoal from Butcher site (23 Cl 118) (39° 27′ 05″ N Lat, 94° 32′ 10″ W Long), Clay Co., Missouri. Sample from Feature 301, shallow, basin-shaped pit. Artifact remains show similarities to materials of Steed-Kisker site and Doniphan phase of Nebraska tradition. Coll. 1968 by F. A. Calabrese; subm. by W. R. Wood, Univ. of Missouri, Columbia, Missouri. *Comment* (W.R.W.): date pertains to one of a series of several sites considered a Kansas City variant of Mississippian tradition. Date seems a bit early, but the wide sigma factor precludes any definite assessment at this time.

475 ± 100

M-2024. Woodpecker site, Missouri **A.D. 1475**

Charcoal from Woodpecker site (37° 38′ 41″ N Lat, 93° 44′ 23″ W Long), Cedar Co., Missouri. Sample from Sq. 100 NW 90, Feature 63 (pit fill) dug into occupational level. Probable single component, nonceramic site, perhaps Late Archaic. Coll. 1967 by R. E. Pangborn; subm. by W. R. Wood. *Comment* (W.R.W.): date is later than suggested by cultural remains.

Perrin's Lodge Crematory site series, Illinois

Wood charcoal from Perrin's Lodge Crematory site (39° 20′ 00″ N Lat, 90° 37′ 05″ W Long), Calhoun Co., Illinois. From beneath large limestone slab, obviously *in situ* and part of crematory structure. Possibility that charcoal is intrusive is remote. *In situ* fire remnants, Jersey Bluff phase, Late Woodland. Jersey Bluff elbow pipe and sherds in assoc. Coll. 1968 and subm. by Stuart Struever, Northwestern Univ., Evanston, Illinois.

950 ± 150

M-2253. Sq. 15, Subsquare 1 **A.D. 1000**

1380 ± 130

M-2254. Sq. 8, Subsquare 15 **A.D. 570**

All charcoal from one piece which was at least 7.62 cm in diam.

General Comment (S.S.): pottery sherds scattered throughout crematory feature are all "classic" Jersey Bluff ware; expectable dates between A.D. 800 and 1100. Therefore M-2253 is about expected age; M-2254 is a little earlier than expected from ceramic evidence.

Rodgers Shelter series, Missouri

Carbonized wood from Rodgers Shelter (23 BE 125) (38° 05′ 30″ N Lat, 93° 20′ 40″ W Long), Benton Co., Missouri. Samples pretreated by C. Vance Haynes, Univ. of Arizona.

5200 ± 200

M-2281. Rodgers Shelter **3250 B.C.**

Charcoal from a small trash pit, Feature 5418, that originated and terminated in Stratum III, D.D. 1.22 m to 1.53 m, Sq. 260 NW 70, 96.5 to 114.4 cm NW 145 cm to 152.4 cm. Coll. 1968 by S. A. Ahler; subm. by W. R. Wood. *Comment* (R.B. McMillan): date is satisfactory since age estimated for Stratum III was 3500 B.P. (top) to 5500 B.P. (bottom), based on cultural materials above and below unit. Stratum III originally thought to be culturally sterile, but small trash pit from which M-2281 came indicates infrequent occupation of shelter as Stratum III was being deposited.

5100 ± 400

M-2332. Rodgers Shelter **3150 B.C.**

Charcoal from small shallow basin-shaped pit, Feature 5418, containing some refuse within Stratum III; Sq. 260 NW 70, 44-55 NW 76.3 to 119.3 cm; D.D. 1.22 to 1.37 m. Coll. 1968 by S. A. Ahler and R. B. McMillan; subm. by W. R. Wood. *Comment* (R.B.McM.): during deposition period of Stratum III there was only infrequent occupation. This virtually sterile stratum divided an Early Archaic zone from a later Archaic horizon. Date is satisfactory and generally corroborates date of M-2281 from same feature.

10,200 ± 330

M-2333. Rodgers Shelter **8250 B.C.**

Carbonized wood from deepest hearth discovered at site, Stratum I, Sq. 225 NW 95, 20.3 cm NW 43.2 cm, D.D. 9 m. Coll. 1968 by R. B. McMillan and Gerald Berry; subm. by W. R. Wood. *Comment* (R.B.McM.): cultural debris was scattered around hearth (chert, bone) with no diagnostic artifacts. Hearths just above this location contained Dalton cultural materials; this hearth probably represents initial Dalton occupation. Date is satisfactory.

1740 ± 140

M-2238. Wright Mound, Kentucky **A.D. 210**

Wood charcoal (*Gleditsia triacantros* or *Gymnocladus diocica*) id. by Suzanne Harris, Univ. of Michigan, from Wright Mound (38° 05′ 10″ N Lat, 83° 57′ 45″ W Long), Montgomery Co., Kentucky (Webb, 1940). Sample from Adena mound Burial 13, Mm6, Feature 19, Sq. 100

R 8, 5.7 m deep, apparently in secondary mound. Coll. 1939 by J. L. Buckner; subm. by O. C. Shane, Kent State Univ., Kent, Ohio. *Comment* (O.C.S.): sample dates construction of log tomb intrusive from secondary mound into primary mound. Charred logs covering primary mound dated at 1900 ± 50 B.P. by Nuclear Science and Engineering, Inc., Pittsburgh, Pa. (unpub.). Date is consistent with internal stratigraphy of mound and contained cultural material. It is acceptable for late Adena.

2260 ± 140

M-2239. Dover Mound, Kentucky **310 B.C.**

Wood charcoal from Dover Mound (38° 45′ 20″ N Lat, 83° 53′ 00″ W Long), Mason Co., Kentucky (Webb and Snow, 1959). Sample from Adena mound Burial 9, Ms 27, from over legs of burial. Coll. 1950 by R. W. Woodbury; subm. by O. C. Shane. *Comment* (O.C.S.): sample dates bark-covered extended burial in Zone 2 or Zone 3. Sample appears to be stratigraphically older than the 2 previously dated samples, C-759 and C-860 (Science, 1954, v. 119, p. 137), which came from tops of Zone 3 and Zone 4, respectively. C-759 (2650 ± 170) is suspect, as it is much too early. But C-760, an average of 2 determinations of same sample, is stratigraphically consistent with M-2239. Date is acceptable.

2100 ± 140

M-2240. Morgan Stone Mound, Kentucky **150 B.C.**

Bark charcoal, probably *Betula Sp.*, id. by Suzanne Harris from Morgan Stone Mound (38° 13′ 30″ N Lat, 83° 51′ 30″ W Long), Bath Co., Kentucky (Webb, 1941). Sample assoc. with Burial 6 in Adena mound. Coll. 1939 by Claude Johnston; subm. by O. C. Shane. *Comment* (O.C.S.): dates initial use of site for burial purposes; structure was burned soon after placement of central burial. Adena Plain and Montgomery Incised vessels grave goods with Burial 6. Date is satisfactory although slightly early for Montgomery Incised pottery, consistently dated to 1st century A.D.

2400 ± 150

M-2241. Hartman Mound, Kentucky **450 B.C.**

Wood charcoal of *Quercus*, id. by Suzanne Harris from Hartman Mound (39° 06′ 00″ N Lat, 84° 49′ 35″ W Long), Boone Co., Kentucky. Sample from Burial 7 or 8 of Adena mound (Webb, 1943; Webb and Snow, 1959). Coll. by J. B. Elliot; subm. by O. C. Shane. *Comment* (O.C.S.): sample from centrally located burial pit over which mound was constructed. This sub-floor pit also contained charred material which, upon analysis, proved to be ". . . some bituminous substance, probably cannel coal" (Webb, 1943, p. 540). While possibility exists that M-2241 was contaminated during combustion, it is important that only Fayette Thick sherds occurred in mound fill, and this date is consistent with other dates for Fayette Thick pottery. Date is acceptable.

2100 ± 140

M-2242. Robbins Mound, Kentucky **150 B.C.**

Wood charcoal, (*Quercus*) id. by Suzanne Harris from Robbins Mound (38° 54′ 50″ N Lat, 84° 46′ 50″ W Long), Boone Co., Kentucky (Webb and Elliot, 1942). Sample from Feature 26, 24.4 m to 25.9 m sec. E of Curbing and 27.4 to 29 m sec. of E Curbing, gleaned from unclean cremation on house floor of Adena mound. Coll. 1941 by J. B. Elliot; subm. by O. C. Shane. *Comment* (O.C.S.): sample obtained from Feature 26, burned house structure below primary mound at base of accretional Robbins tumulus. Dates initial stage of mound construction and Adena Plain sherds occurring in the ash deposits of Feature 26. Date is acceptable.

5220 ± 200

Miller site series, Indiana **3270 B.C.**

Charcoal, both wood and hickory nut, from Miller site (38° 01′ 00″ N Lat 86° 11′ W Long), Mauckport, Ind.-Ky. quad., Sec. 3, T.6S, R.3E, NW quarter, to W of Buck Creek, Harrison Co., Indiana. Midden from which samples were taken was a distinctive zone resting on a stratum of mussel shells. Samples combined. Coll. 1970 and subm. by D. E. Janzen, Beloit College, Beloit, Wisconsin.

M-2389. Miller site

Test Pit A, 15.2 to 22.8 cm below datum, from midden area; no assoc. features.

M-2390. Miller site

Test Pit A, 22.8 to 30.4 cm below datum, from midden; no assoc. features.

M-2391. Miller site

Test Pit A, 30.4 to 38.1 cm below datum, from midden area; no assoc. features.

General Comment (D.E.J.): date based on 3 samples ranging from 15.2 to 38.1 cm at Miller site and is composite date from 3 levels. It represents an Archaic horizon and fits with dates from the Hornung site, Kentucky (M-2460: 4900 ± 200; M-2461: 5220 ± 230; M-2464: 5000 ± 200).

Hornung site series, Kentucky

Charred nuts from Hornung site (38° 00′ 00″ N Lat, 85° 56′ 15″ W Long), USGS Fort Knox, Kentucky, knoll N of confluence of Pond Creek and Salt R. Coll. 1970 and subm. by D. E. Janzen.

4900 ± 200

M-2460. Hornung site **2950 B.C.**

Charred nuts, possibly hickory, from Unit 3, Level 10, from midden.

5220 ± 230

M-2461. Hornung site **3270 B.C.**

Charred nuts, possibly hickory, from Unit 3, Level 13. Small sample.

5000 ± 200

M-2464. Hornung site **3050 B.C.**

Unit 8, Level 4.

General Comment (D.E.J.): M-2460 and M-2461 date earliest Archaic horizons at Hornung site. Dates agree with expectations. M-2464 should date Early Woodland component; 3050 B.C. is erroneous.

Riverwood Rock Shelter, Kentucky

Charred wood and nuts from Riverwood Rock Shelter (38° 00′ 20″ N Lat, 85° 40′ 30″ W Long), USGS Brooks, Kentucky, on N bank of Salt R. Coll. 1970 and subm. by D. E. Janzen.

2870 ± 150

M-2462. Riverwood Rock Shelter **920 B.C.**

Charred wood and nuts, hickory definitely present, from 495 E 545, Level 5.

2450 ± 140

M-2463. Riverwood Rock Shelter **500 B.C.**

Charred nuts, hickory definitely present, from 500 E 590, Feature 3, a small pit.

General Comment (D.E.J.): M-2462 and M-2463 date Early Woodland component. Assoc. ceramics were thick grit-tempered ware characteristic of Early Woodland.

B. Great Lakes

Indian Hills site series, Ohio

Charred wood from Indian Hills site (41° 36′ N Lat, 83° 32′ W Long), Wood Co., Ohio. Coll. 1967 and subm. by E. J. Prahl, Univ. of Toledo, Toledo, Ohio.

840 ± 100

M-2042. Indian Hills site **A.D. 1110**

T.P. O-E-3, SE ¼, .275 m deep. Dates pottery at this level.

1240 ± 120

M-2043. Indian Hills site **A.D. 710**

T.P. O-E-2, .489 to .55 m deep.

1060 ± 130

M-2044. Indian Hills site **A.D. 890**

C Doze area. House No. 1, Burial 1, Trench A, .702 to .794 m deep. Dates house.

340 ± 100

M-2268. Indian Hills site **A.D. 1610**

Charcoal from Pit 6, Feature 1, 1.28 to 1.31 m level. Dates ceramics from pit.

General Comment (E.J.P.): dates for M-2042 to M-2044 seem too early for the shell-tempered pottery and other artifacts; M-2268 seems too late.

880 ± 110

M-2087. Morrin site, Michigan **A.D. 1070**

Charcoal from Morrin site (20 MO 40) (41° 44′ N Lat, 83° 29′ W Long), Monroe Co., Michigan. Sample from Test Pit 1, NW ¼ of .61 m floor, assoc. with Glen Meyer-like pottery of Ontario (Wright, 1966). Coll. 1967 and subm. by E. J. Prahl. *Comment* (E.J.P.): good date for material recovered. Ceramics appear similar to Glen Meyer focus ceramics.

610 ± 150

M-2310. Gladieux site, Ohio **A.D. 1340**

Charcoal from Gladieux site (33 Lu 7) (41° 35′ 45″ N Lat, 83° 36′ 00″ W Long), Adams Twp., Sec. 28, Lucas Co., Ohio, from Test Pit 1, Feature 1. Dates ceramics assoc. with Feature 1, firepit. Coll. 1969 and subm. by E. J. Prahl. *Comment* (E.J.P.): lithic artifacts are Middle Woodland. Date is too late.

Ekdahl-Goudreau site series, Michigan

Charcoal from Ekdahl-Goudreau site (45° 55′ N Lat, 85° 55′ W Long), Sec. 21, Mueller Twp. (T41N-R13W), Schoolcraft Co., Michigan. Coll. 1968 and subm. by E. J. Prahl.

870 ± 120

M-2311. Ekdahl-Goudreau site **A.D. 1080**

Test Pit O-SW, NE ¼, S. S. 4-5 .24 m. Dates Late Woodland level. *Comment* (E.J.P.): dates top level of this 2-component site and is assoc. with Juntunen-like ceramics. Would compare favorably with A.D. 1060 ± 75 date from Juntunen dating Bois Blanc ware (M-1140: R., 1961, v. 3, p. 110).

1290 ± 130

M-2312. Ekdahl-Goudreau site **A.D. 660**

Test Pit O-SW, NE ¼, S. S. 9-10, .55 to .58 m. Dates Laurel level of site. *Comment* (E.J.P.): should date Middle Woodland ceramics from base. Date is late, compared to Middle Woodland dates by Brose at Summer I. on somewhat comparable material (R., 1970, v. 12, p. 171-172).

1120 ± 120

M-2313. Cufr site, Ohio **A.D. 830**

Charcoal from Cufr site (33 FU 2) (41° 37′ 34″ N Lat, 83° 55′ 29″ W Long), Sec. 10, Fulton Twp. (R4E-T9S), Fulton Co., Ohio. Pit 12 .52 to .61 m level. Coll. and subm. by E. J. Prahl. *Comment* (E.J.P.): dates Late Woodland ceramics with high collar and fabric-impressed surface. Date is early for this material within Younge tradition but consonant with Wayne ware found elsewhere in site.

Allegan Dam site series, Michigan

Charcoal from Allegan Dam site (42° 34′ N Lat, 85° 57′ 30″ W Long), Allegan Co., Michigan. Site is Late Woodland camp with many

storage pits containing grit- and shell-tempered ceramics. Coll. 1968 and subm. by E. E. Baldwin, Western Michigan Univ., Kalamazoo, Michigan.

740 ± 100

M-2230. Allegan Dam site **A.D. 1210**

Feature 19, Level 3. Material dated is charcoal from stone-lined fire pit.

640 ± 100

M-2231. Allegan Dam site **A.D. 1310**

Feature 17, 60.9 to 89 cm below surface. Sample is burned wood from a storage pit.

General Comment (E.E.B.): dates are acceptable for shell tempering in SW Michigan and suggest that this is a single component site.

46th Street site series, Michigan

Charcoal and charred wood from 46th Street site (42° 37′ N Lat, 86° 00′ W Long), Allegan Co., Michigan, a Late Woodland camp site. Ceramics are grit-tempered, with stylistic relationship to Wayne ware as described at Michigan sites of Riviere au Vase and Spring Creek. Coll. 1968 and subm. by E. E. Baldwin.

810 ± 100

M-2232. 46th Street site **A.D. 1140**

Charcoal from Feature 4, Level 5, hearth.

910 ± 100

M-2233. 46th Street site **A.D. 1040**

Charred wood from a storage pit, Feature 6, 104.3 to 137 cm below surface.

240 ± 100

M-2236. 46th Street site **A.D. 1710**

Burned wood from burial pit in Mound 1. Burial removed by previous excavator (unknown).

General Comment (E.E.B.): M-2232 and M-2233 are in expected time range. M-2236 is surprisingly late, perhaps due to disturbance. Relationship of this and several similar mounds to adjacent Late Woodland village site (M-2232, M-2233) remains problematic.

Nordhof site series, Michigan

Charcoal and burned wood from Nordhof site (20 Al 13) (42° 38′ 30″ N Lat, 86° 07′ 30″ W Long), Allegan Co., Michigan. Coll. 1968 and subm. by E. E. Baldwin.

910 ± 110

M-2234. Nordhof site **A.D. 1040**

Charcoal from small fire pit, Feature 26, 50.8 to 73.7 cm below surface. Shell-tempered pottery and some grit-tempered ware overlay feature, presumably assoc. *Comment* (E.E.B.): date is somewhat early

but is in acceptable range for appearance of shell-tempered pottery in SW Michigan.

M-2235. Nordhof site **410 ± 100** **A.D. 1540**

Burned wood from storage pit, Feature 25, 66 to 76.3 cm below surface. *Comment* (E.E.B.): this date and M-2234 confirm suspected multiple component nature of this extensive site.

M-2237. Brainerd site, Michigan **1510 ± 130** **A.D. 440**

Human bone from Brainerd site (42° 32′ 30″ N Lat, 85° 58′ W Long), Allegan Co., Michigan. Trench A, 73.7 to 152.4 cm below surface. No cultural remains assoc. Ossuary, low mound with remains of > 30 individuals. Coll. 1968 and subm. by E. E. Baldwin. *Comment* (E.E.B.): skeletal remains entirely disarticulated and very fragmentary due, in part, to prior disturbance.

Holtz site series, Michigan

Charcoal from Holtz site (44° 58′ 45″ N Lat, 85° 11′ 23″ W Long), Antrim Co., Michigan. Coll. 1967 and subm. by C. E. Cleland, Michigan State Univ. Mus., East Lansing, Michigan.

M-2061. Holtz site **580 ± 140** **A.D. 1370** **A.D. 1380 N**

Charcoal from Unit S20 W10, between 0 and .092 m deep, assoc. with pottery.

M-2062. Holtz site **770 ± 100** **A.D. 1180** **A.D. 1210 N**

Charcoal from Unit S20 W10, Level 2, .76 to 1.02 cm depth.

General Comment (C.E.C.): Holtz site is late Middle Woodland occupation in zone covered by charred peat. Samples M-2061 and M-2062 do not date occupation but may correspond to surface burnings after occupation.

Wycamp Creek site series, Michigan

Charcoal from Wycamp Creek site (45° 39′ N Lat, 85° 00′ 45″ W Long), Emmet Co., Michigan. Coll. 1967 and subm. by C. E. Cleland.

M-2059. Wycamp Creek site **730 ± 110** **A.D. 1220** **A.D. 1220 N**

Charcoal from hearth, Feature 2, from S ½ of Unit N30 E190, at depth .366 to .458 m below surface.

M-2060. Wycamp Creek site **240 ± 100** **A.D. 1710** **A.D. 1650 N**

Charcoal from Unit Test 2, at depth .825 m below surface.

1320 ± 120

M-2065. Wycamp Creek site **A.D. 630**

Charcoal seeds from depth .275 m in Unit S150 E40, assoc. with a flint concentration.

General Comment (C.E.C.): this series indicates occupation from late Middle Woodland to Early Historic periods. M-2065 may be slightly late for Laurel occupation of Wycamp beach. M-2059 probably dates Bois Blanc phase occupation of Late Woodland component, while M-2060 dates ceramics thought to represent an historic Ottawa occupation.

500 ± 100

M-2063. Henderson-Lamb site, Michigan **A.D. 1450**
A.D. 1420 N

Charcoal from Henderson-Lamb site (44° 55′ 10″ N Lat, 85° 12′ 20″ W Long), Antrim Co., Michigan. Sample from Level 3, .183 to .275 m below surface, of Unit N80 E60. Coll. 1967 and subm. by C. E. Cleland. *Comment* (C.E.C.): similarities in ceramic styles from Skegemog Point site, Fauver site, and Henderson-Lamb site indicate similar temporal placements for these occupations. Fauver site date A.D. 1495 ± 100 (R., 1968, v. 10, p. 83) and Skegemog Point site date A.D. 1310 ± 110 (*ibid.*) agree with A.D. 1420 ± 100 date for Henderson-Lamb and this is probably accurate for this occupation.

O'Neill site series, Michigan

Charcoal from O'Neill site (45° 17′ N Lat, 85° 21′ W Long), NE ¼ Sec. 1, T.33N R.9W, NW ¼ of SW ¼ of T.33N R.8W, Charlevoix, Emmet Co., Michigan. Coll. 1969 and subm. by C. E. Cleland.

430 ± 100

M-2398. O'Neill site **A.D. 1520**
A.D. 1455 N

Charcoal from hearth in 3rd level .275 m of Unit N350 W40.

1000 ± 140

M-2401. O'Neill site **A.D. 950**
A.D. 1000 N

Charcoal from hearth in N340 W40 (small sample).

670 ± 100

M-2405. O'Neill site **A.D. 1280**
A.D. 1290 N

Charcoal from hearth at .732 m below surface, Unit N380 W50.

740 ± 100

M-2406. O'Neill site **A.D. 1210**
A.D. 1210 N

Charcoal from hearth in Occupation Zone 2, ca. .671 m below surface, in Unit N390 W60.

General Comment (C.E.C.): this series indicates site was occupied from ca. A.D. 1000 to 1500. M-2398 probably dates a late Juntunen phase house. M-2405 and M-2406 date an early Juntunen phase occupation. M-2401 might possibly date a Skegemog occupation.

Eagle Island site series, Michigan

Charcoal from Eagle Island site (45° 17′ 30″ N Lat, 85° 01′ 00″ W Long), SE ¼ of SE ¼, Sec. 34, T.34N R.6W, Walloon Lake, Emmet Co., Michigan. Coll. 1969 and subm. by C. E. Cleland.

2270 ± 140

M-2400. Eagle Island site **320 B.C.**

Charcoal from hearth, from SW corner of Level 4 in Unit N30 E50.

2140 ± 140

M-2404. Eagle Island site **190 B.C.**

Charcoal from hearth, Feature 3, Units N30 E40 and N30 E50.

General Comment (C.E.C.): both samples are clearly too early to date occupation of Eagle Island site. Ceramics from site indicate a Late Woodland temporal placement.

3030 ± 200

M-2402. North Manitou #3 site, Michigan **1080 B.C.**

Charcoal from North Manitou #3 site (45° 08′ N Lat, 85° 58′ W Long), NE ¼ of SE ¼, Sec. 27, T.32N R.14W, North Manitou I., Leelanau Co., Michigan. Charcoal from hearth in the N ½ of Test No. 1, Level 2; small sample. Coll. 1968 and subm. by C. E. Cleland. *Comment* (C.E.C.): site is on a Nipissing beach terrace with Late Woodland and Archaic occupations. M-2402 seems to date Archaic component.

950 ± 110

M-2403. Scott site, Michigan **A.D. 1000**

A.D. 1060 N

Charcoal from Scott site (43° 56′ 15″ N Lat, 86° 15′ 38″ W Long), NE ¼ of SE ¼, Sec. 19, and NW ¼ of SW ¼, Sec. 20, Custer Twp., Ludington, Mason Co., Michigan. Charcoal from hearth, S1 E1-S3 E1, Pit H, St. I-IV. Coll. 1969 and subm. by C. E. Cleland. *Comment* (C.E.C.): dates Late Woodland component.

Ponshewaing Point site series, Michigan

Charcoal from Ponshewaing Point site (45° 25′ 01″ N Lat, 84° 48′ 00″ W Long), SW ¼ of SE ¼, Sec. 16, Littlefield Twp., Emmet Co., Michigan.

1760 ± 130

M-2064. Ponshewaing Point site **A.D. 190**

Charcoal from hearth, Feature 1 in Unit S140 W60. Coll. 1967 and subm. by C. E. Cleland.

1600 ± 130

M-2399. Ponshewaing Point site **A.D. 350**

Charcoal from Level 4 of S370 EO. Coll. 1969 and subm. by C. E. Cleland.

General Comment (C.E.C.): site is a Late Woodland occupation with ceramics indicating time span between A.D. 1000 and 1400. M-2399 and M-2064 do not date occupation.

Wood site series, Michigan

Charcoal from Wood site (45° 22′ 12″ N Lat, 85° 07′ 00″ W Long), Charlevoix Co., Michigan. Coll. 1967 and subm. by C. E. Cleland.

990 ± 120

M-2057. Wood site **A.D. 960**
A.D. 1020 N

Charcoal from black area, with pottery, Level 4 of NE ¼ of N65 W85, along N wall.

320 ± 100

M-2058. Wood site **A.D. 1630**
A.D. 1580 N
A.D. 1630 N
A.D. 1510 N

Charcoal from hearth in Level 4 of Unit S10 E140.

General Comment (C.E.C.): normalized dates for M-2058 provide 3 alternatives of which the earliest, A.D. 1510 ± 100, is the preferred choice to date castellated cord-impressed Juntunen-type pottery. Date agrees with M-2398 from O'Neill site which dates a late Juntunen-phase house. M-2057 supposedly dates earlier Juntunen pottery with stab-drag impressions; A.D. 1020 ± 120 seems too early for wares of this variety.

Fort Michilimackinac series, Michigan

Charcoal from Fort Michilimackinac (45° 49′ 50″ N Lat, 84° 43′ 50″ W Long), Mackinaw City, Emmet Co., Michigan. Middle Woodland component. Samples from Feature 169, Laurel tradition fire pit. Laurel tradition indicated by pottery and flint tool assoc. Coll. 1970 and subm. by L. M. Stone, The Museum, Michigan State Univ., East Lansing, Michigan.

1500 ± 120

M-2489. Sample MS²-5388-1 **A.D. 450**

Sample possibly contaminated with recent charcoal. *Comment* (L.M.S.): date is consistent with field interpretation and comparative dating of Late Laurel tradition sites.

1300 ± 130

M-2490. Sample MS²-5388-2 **A.D. 650**

Comment (L.M.S.): date of Laurel component is acceptable but between 100 and 200 yr later than anticipated in reviewing previously dated sites.

C. Northeastern United States

Kinzua site series, Pennsylvania

Wood charcoal from Kinzua site (36 Wa 53) (41° 53′ 06″ N Lat, 78° 57′ 05″ W Long), Warren Co., Pennsylvania. Samples from inside rectangular Proto-Iroquoian house. Coll. 1965 and subm. by D. W. Dragoo, Carnegie Mus., Pittsburgh, Pa.

750 ± 100

M-2192. Kinzua site F. C. 4856 **A.D. 1200**

From small, circular fire pit inside house.

600 ± 100

M-2193. Kinzua site F. C. 4866 **A.D. 1350**

From large storage pit inside house.

General Comment (D.W.D.): M-2192 appears reasonably close to early occupation of site. Ceramics would conform to this time period in early Proto-Iroquoian. M-2193 seems a little late; it should be similar to M-2192.

Cornplanter site series, Pennsylvania

Wood charcoal from Cornplanter site (36 Wa 83) (41° 55′ 36″ N Lat, 78° 55′ 59″ W Long), Warren Co., Pennsylvania.

970 ± 100

M-2194. Cornplanter site, Grant No. 1 **A.D. 980**

Sample from fire hearth in midden zone, 53.4 to 60.9 cm below surface from Early Proto-Iroquoian site. Coll. 1965 and subm. by D. W. Dragoo.

690 ± 100

M-2195. Cornplanter site, Grant No. 2 **A.D. 1260**

Sample from refuse pit containing transitional or Late Archaic material. Coll. 1966 by Stanley Lantz; subm. by D. W. Dragoo.

General Comment (D.W.D.): M-2194 is extremely close to our estimate of A.D. 1000 for this early Proto-Iroquoian site. M-2195 is reasonable for Proto-Iroquoian occupation but does not date Archaic items in feature, which may have been brought by Proto-Iroquoian peoples.

Onoville Bridge site series, New York

Wood charcoal from Onoville Bridge site (30 Ca 5) (42° 01′ 40″ N Lat, 78° 56′ 55″ W Long), Cattaraugus Co., New York. Coll. 1966 and subm. by D. W. Dragoo.

180 ± 100

M-2196. Onoville site, F. C. 5292 **A.D. 1770**

From W end of trench surrounding stockaded Proto-Iroquoian village site.

520 ± 100

M-2197. Onoville site, F. C. 5295 **A.D. 1430**

From Feature 103, S portion of trench surrounding village.

General Comment (D.W.D.): M-2196 is completely out of line with contents of feature. On basis of pottery types, site was estimated at ca. A.D. 1400. M-2197 is close to this estimate.

590 ± 100

M-2198. Drew site, Pennsylvania **A.D. 1360**

Charred corn kernels from Drew site (36 Al 62) (40° 22′ 04″ N Lat, 80° 07′ 08″ W Long), Alleghany Co., Pennsylvania. From large, irregular refuse pit of Late Prehistoric Monongahela site. Coll. 1965 by William Buker; subm. by D. W. Dragoo. *Comment* (D.W.D.): date seems a little late for an early Monongahela site.

600 ± 100

M-2200. Bunola site, Pennsylvania **A.D. 1350**

Charcoal from Bunola site (36 Al 4) (40° 14′ 12″ N Lat, 79° 57′ 36″ W Long), Alleghany Co., Pennsylvania. Sample from Feature 1, large but shallow basin-shaped pit of Late Prehistoric village. Coll. 1966 by D. P. Tanner; subm. by D. W. Dragoo. *Comment* (D.W.D.): date seems quite good for this Monongahela site.

620 ± 100

M-2201. McKees Rocks site, Pennsylvania **A.D. 1330**

Charcoal from McKees Rock site (36 Al 16) (40° 28′ 20″ N Lat, 80° 02′ 59″ W Long), Alleghany Co., Pennsylvania. Charcoal from Feature 39, pit in Late Prehistoric Monongahela site. Coll. 1960 by William Buker; subm. by D. W. Dragoo. *Comment* (D.W.D.): date is close to our estimate based on pottery types at this site.

390 ± 100

M-2202. Anderson Mound, Pennsylvania **A.D. 1560**

Charcoal from Anderson Mound (36 Al 96) (40° 30′ 56″ N Lat, 79° 50′ 49″ W Long), Alleghany Co., Pennsylvania. Wood charcoal assoc. with Burial No. 1, cremated burial in Middle Woodland stone mound. Coll. 1964 by R. L. George; subm. by D. W. Dragoo. *Comment* (D.W.D.): sample cannot be considered Middle Woodland mound; it must have been contaminated or was recent, since mound was disturbed in historic times. Sample appeared undisturbed.

740 ± 100

M-2203. Portman site, Pennsylvania **A.D. 1210**

Wood charcoal from Portman site (36 Al 39) (40° 19′ 06″ N Lat, 80° 06′ 47″ W Long), Alleghany Co., Pennsylvania. From base of Feature 2, medium-sized fire pit from Late Prehistoric village site. Coll. by D. P. Tanner; subm. by D. W. Dragoo. *Comment* (D.W.D.): date is close to expected for this early Monongahela site.

520 ± 100

M-2204. Campbell site, Pennsylvania **A.D. 1430**

Wood charcoal from Campbell site (36 Fa 26) (40° 00′ 32″ N Lat, 79° 51′ 04″ W Long), Fayette Co., Pennsylvania. Sample from Feature 1, refuse pit of Late Prehistoric Monongahela site. Coll. 1965 and subm.

by D. W. Dragoo. *Comment* (D.W.D.): date appears good for this Middle Monongahela site.

250 ± 100

M-2205. Hartly site, Pennsylvania A.D. 1700

Wood charcoal from Hartly site (39° 55′ 10″ N Lat, 79° 58′ 02″ W Long), Green Co., Pennsylvania. Sample from Feature 6, refuse pit of Late Prehistoric Monongahela (Early phase) site. Coll. 1964 and subm. by D. W. Dragoo. *Comment* (D.W.D.): pottery types invalidate date for site, which is early Monongahela. Date should be close to A.D. 1360.

Chambers Mound series, Pennsylvania

Wood charcoal from Chambers Mound (36 Lr 11) (41° 00′ 48″ N Lat, 80° 25′ 52″ W Long), Lawrence Co., Pennsylvania. Coll. 1960 by John Zakucia; subm. by D. W. Dragoo.

120 ± 100

M-2206. Chambers Mound F. C. 3674 A.D. 1830

Wood charcoal from fill of Middle Woodland stone mound.

3070 ± 150

M-2207. Chambers Mound F. C. 3729 1120 B.C.

Wood charcoal from small fire pit in transitional zone beneath mound.

General Comment (D.W.D.): M-2206 is unsatisfactory. Since this Early Woodland–Middle Woodland mound was disturbed in historic times, it is possible that charcoal came from a disturbed zone. Sample should have been close to 1120 B.C. M-2207 date seems good for Transitional Archaic zone under Chambers Mound.

M-2247. Cornplanter Grant No. 3 site, 240 ± 100
M-2248. Pennsylvania A.D. 1710

Wood charcoal from Cornplanter Grant No. 3 site (36 Wa 81) (41° 58′ 10″ N Lat, 78° 55′ 50″ W Long), Warren Co., Pennsylvania. Sample from upper and lower levels of large oval-shaped cremation pit containing 3 large "turkey tail" blades and tubular pipe fragments. Samples combined. Coll. 1966 by Stanley Lantz; subm. by D. W. Dragoo. *Comment* (D.W.D.): this date for Red Ocher culture feature does not seem to fit with any previous dates for period. It seems ca. 2500 yr too late.

3330 ± 160

M-2255. Harlan Mill steatite quarry, Maryland 1380 B.C.

Twigs of charcoal (*Populus,* maybe *Salix* 9, *Juglans* 3, *Quercus* 4, *Fraxinus* 5, and *Picea* 1) id. by Suzanne Harris, from Harlan Mill steatite quarry (39° 39′ 38″ N Lat, 75° 52′ 40″ W Long), Cecil Co., Maryland. Sample from hearth in E end of excavation, approx. 1.37 m below ground surface (Wilkins, 1962, p. 1-22). Coll. and subm. by E. S. Wilkins, Jr., R 2, Newark, Delaware. *Comment* (E.S.W.): date indicates quarry-

ing of material for carved stone bowls during Transitional stage at horizon of Perkiomen and Orient points.

D. Lower Mississippi Valley and Southeastern U. S.

410 ± 100

M-1968. Dupree site, Arkansas **A.D. 1540**

Charcoal from Dupree site (3 PH 1) (34° 11′ N Lat, 91° 00′ W Long), NE ¼, SW ¼, Sec. 10, Twp. 65, Rge. 1 E, Phillips Co., Arkansas. From base of Level 2, approx. 30.4 cm deep, from refuse cover assoc. with shell-tempered pottery, Wallace Incised (Moselage, 1965). Coll. 1967 and subm. by John Moselage, Memphis, Tennessee. *Comment* (J.M.): pottery from this site is being considered as possibly made by Quapaw people; date fits with site and is reasonable for historical date of 1673. Sample was from a lower level; possibly from early phase of development of Quapaw tribe which eventually became historical. Site was occupied for a considerable period of time.

420 ± 100

M-2088. Beckwith's Fort site, Missouri **A.D. 1530**

Wood charcoal from Beckwith's Fort site (36° 43′ N Lat, 89° 15′ W Long), Mississippi Co., Missouri. Sample from floor of burned house (House I, 23 MI 2), Sq. 2480 R 2330, AE 99.6, at basal .153 m of house fill. Directly assoc. with vessels of Mississippian form, but grog and grog-shell tempering, with paste like Baytown ware. Date will place ceramic style in area as well as fortified village-ceremonial center (Smith, 1967; Thomas, 1894; Williams, 1954). Coll. 1967 by J. W. Clark; subm. by G. P. Smith, Univ. of Missouri. *Comment* (G.P.S.): at first, date seemed nearly 200 yr too late. Ref. to Table 1 in Stuiver and Suess (1966, p. 537) suggests calendar equivalent of A.D. 1460 ± 100. Actual date is probably in 1st half of indicated range. The Bryant phase is currently considered to mark the ceramic transition from grog-tempered Beckwith phase ceramics to shell-tempered ceramics of the Cairo Lowland phase. Date emphasizes contrast between ceramic tradition of N end of Mississippi Alluvial Valley and those to S where shift to shell tempering occurred much earlier.

Hyneman site series, Arkansas

Charred nut shell and wood from Hyneman site (3 PO 54) (35° 03′ 33″ N Lat, 90° 34′ 30″ W Long), Poinsett Co., Arkansas. Should date early part of Hyneman phase, ca. A.D. 900 to 1100. Coll. 1967 and subm. by D. F. Morse, State Univ., Arkansas.

1330 ± 130

M-2112. Hyneman site **A.D. 620**

Feature 6, refuse pit, charred hickory nut shell.

1210 ± 130

M-2113. Hyneman site **A.D. 740**

Feature 6, refuse pit, wood charcoal of hickory or persimmon.

General Comment (D.F.M.): dates are acceptable; they place Late Woodland (Baytown) assemblage shortly before change to Mississippian.

M-2212. **1310 ± 130**

M-2213. Hoecake site, Missouri **A.D. 640**

Wood charcoal from Hoecake site (23 Mi 8) (36° 45′ N Lat, 89° 15′ W Long), Mississippi Co., Missouri. From partially charred log in tombs of Story Mound, subsurface, log-lined tomb (1 of 3) below large, conical mound. No direct assoc. with burials in tomb, but some unintentional debris was found in tomb. Assoc. with Mulberry Creek Cord-Marked, Baytown Plain, clay- and shell-tempered sherds, and a shell-tempered loop handle. Will date tombs and materials with them. Samples combined; M-2212 from Tomb A and M-2213 from Tomb B. Coll. 1963 by R. A. Marshall; subm. by Ray Williams, Univ. of Missouri. *Comment* (R.W.): date is about what was expected. Site is later than originally suspected.

730 ± 100

M-2214. Harryette site, Missouri **A.D. 1220**

Wood charcoal from Harryette site (23 NM 269) (36° 37′ N Lat, 89° 40′ W Long), New Madrid Co., Missouri. Sample from Feature 14, area of concentration of ash, fired clay, and bone, Sq. 1070 N, 980 E, Level 1, S.D. 7.62 cm. Site seems to be Middle Baytown. Will help date certain ceramic type combinations in Little River lowland and their assoc. with burial patterns. Coll. 1968 by Fred Schneider; subm. by Ray Williams. *Comment* (R.W.): feature belonged to an early Mississippian component; date is satisfactory.

Potato Patch site series, Missouri

Wood charcoal from Potato Patch site (23 NM 217) (36° 46′ N Lat, 89° 30′ W Long), New Madrid Co., Missouri. Site seems to be Early Baytown. Will date pre-shell-tempered ceramic site in SE Missouri. Coll. 1968 and subm. by Ray Williams.

200 ± 100

M-2215. Potato Patch site **A.D. 1750**

Sq. 1010 N, 990 E, Level 2, S.D. 43.2 cm.

910 ± 120

M-2216. Potato Patch site **A.D. 1040**

Sq. 1010 N, 990 E, Level 5, S.D. 76.3 cm.

General Comment (R.W.): M-2215 was expected to date Early Baytown or ca. 1500 yr earlier; M-2216 was expected to date Early Baytown or ca. 800 yr earlier.

660 ± 100

M-2217. Denton Mound site, Missouri **A.D. 1290**

Wood charcoal from Denton Mound site (23 Pm 549) (36° 06′ N Lat, 89° 54′ W Long), Pemiscot Co., Missouri. Sample from Excavation Area I, Sq. 2490 N, 2530 E, S.D. 43.2 cm, large center post in probable funeral

house. Coll. 1968 by Fred Schneider; subm. by Ray Williams. *Comment* (R.W.): site is thought to belong to early part of Late Mississippian Nodena phase. Date is perhaps slightly early.

670 ± 100

M-2257. Powell Bayou site, Mississippi A.D. 1280

Charcoal (*Fraxinus* sp.) id. by Suzanne Harris from Powell Bayou site (33° 49′ 40″ N Lat, 98° 30′ 28″ W Long), Sunflower Co., Mississippi. Coll. by R. A. Marshall; subm. by John Connaway, Box 367, Helena, Arkansas. *Comment* (R.A.M.): date fits interpretation of ceramic complex that it is primarily a Middle to late Middle Mississippian site. (J.B.G): this is site 17-0-9 of Lower Mississippi Valley Survey report (Phillips, Ford, and Griffin, 1951, Fig. 19).

Salts Cave site series, Kentucky

Human tissue from Salts Cave (37° 11′ N Lat, 86° 03′ W Long), Hart and Edmondson Cos., Kentucky. From male child ca. 9 yr old. Body appears to have been in flexed position on left side on floor or ledge, well-preserved except for bones of left hand and both feet. Tissue of entire left side torn away (Watson and Yarnell, 1966). Coll. and subm. by L. M. Robbins, Univ. of Kentucky, Lexington, Kentucky.

1960 ± 160

M-2258. Salts Cave site 10 B.C.

20 g size.

1920 ± 160

M-2259. Salts Cave site A.D. 30

Two 10 g sizes.

General Comment (L.M.R.): satisfactory dates; they are closer than expected since tissue was taken from different parts of body. Dates agree with upper temporal range of the fecal specimens recovered from Salts Cave, *i.e.*, 290 ± 200 B.C. (M-1573: R., 1968, v. 10, p. 71) and 320 ± 140 B.C. (M-1771: R. *ibid.*), and they are only slightly more recent than one of dates from Mammoth Cave (420 ± 60 B.C.; Benington, Melton, and Watson, 1962). Earliest date suggests man's presence in Salts in 1190 ± 150 B.C. (M-1589: R., 1968, v. 10, p. 72) for prehistoric soot from cave ceiling. Late Archaic and Early Woodland people probably occupied or visited the cave over a long period of time.

1230 ± 120

M-2382. Buck site, Midden Sample No. 1, Florida A.D. 720

Charred wood, probably pine, from Buck site, Midden Sample No. 1 (8 Ok 11) (30° 24′ 00″ N Lat, 86° 37′ 00″ W Long), Okaloosa Co., Florida. From lowest level of midden deposit directly S of burial mound, a pure deposit of Weeden Island phase. Coll. 1969 and subm. by D. S. Phelps, East Carolina Univ., Greenville, N.C. *Comment* (D.S.P.): dates earlier range of site occupation, Weeden Island phase, and provides minimum time limit for mound construction. It falls within estimated age.

Buck site series, Florida

Charcoal from Buck site (8 Ok 11) (30° 24′ 00″ N Lat, 86° 37′ 00″ W Long), Okaloosa Co., Florida.

1170 ± 140

M-2383. Buck site **A.D. 780**

Charcoal from Level 2, 20.3 to 35.6 cm, in perimeter of mound. Coll. 1966 and subm. by Y. W. Lazarus, Temple Mound Mus., Fort Walton Beach, Florida.

1470 ± 130

M-2384. Buck site **A.D. 480**

Charcoal from N sec. of Pit 7-1966, 15.2 cm depth. Coll. 1966 by D. W. Sharon; subm. by Y. W. Lazarus.

General Comment (Y.W.L.): should date material of Weeden Island pottery. Previous date yielded A.D. 815 ± 150 (FSU, AC 30) for another Weeden Island Mound with comparable material, Basin Bayou West (8 WL 13). M-2383 is more valid and satisfactory. Dates provide better estimate of time of Buck Mound people. The 3 previously tested dates for this site were unsatisfactory: 2515 ± 140 B.C. (GX-215), < 180 yr B.P. (FSU-172), and n.d. (GX-154).

1380 ± 130

M-2385. Grayton Beach, Florida **A.D. 570**

Charcoal from Grayton Beach (30° 20′ 10″ N Lat, 86° 12′ 08″ W Long), Walton Co., Florida. From Pit 4, 30.4 cm level, N edge of site area. Should date late Deptford or Swift Creek, but nothing more recent than very early Weeden Island I. Coll. 1961 by W. C. Lazarus; subm. by Y. W. Lazarus. *Comment* (Y.W.L.): date is much more valid and satisfactory than previous date, A.D. 980 ± 130 (FSU, AC 35; Lazarus, 1965).

Bonds Village site series, Mississippi

Charcoal from Bonds Village site (22 TU 530) (34° 32′ 30″ N Lat, 90° 27′ 30″ W Long), Tunica Co., Mississippi. Coll. 1968 and subm. by John Connaway.

880 ± 110

M-2163. House 2 **A.D. 1070**

Sample 10 from SW wall trench of House 2 and Sample 11 from NW wall trench of same house from varying depths below plow zone.

690 ± 100

M-2164. House 4 **A.D. 1260**

Sample 12 ca. 1.83 m W of SW corner of House 4 in area of abundant charcoal covering fired house floor. May be more of House 4 floor or different house. .31 m deep.

780 ± 130

M-2175. House 4 **A.D. 1170**

Sample 14 and 19 from S wall trench of House 4.

680 ± 110

M-2177. House 4 **A.D. 1270**

Sample 16 from W wall trench of House 4.

910 ± 120

M-2178. House 5 **A.D. 1040**

Samples 17 and 18 from W and E wall trenches, House 5.

General Comment (J.C.): dates are satisfactory and agree with results from preliminary analysis of site, with generally consistent overall picture. Margin of error is large enough on all of them to afford a common date of A.D. 1160 as well as a range of 460 yr from A.D. 920 to 1380. The 3 houses will probably fit within this period.

Teoc Creek site series, Mississippi

Charcoal from Teoc Creek site (22 Cr 504) (33° 36′ 30″ N Lat, 90° 06′ 05″ W Long), W ¼, SW ¼, Sec. 9, T.20N, R.2E, Greenwood quad., Carroll Co., Mississippi. Coll. 1970 by John Connaway and Sam McGahey; subm. by John Connaway.

3400 ± 160

M-2393. Teoc Creek site **1450 B.C.**

Sq. 0-10E, Level 2, .305 to .427 m below surface.

3020 ± 150

M-2394. Teoc Creek site **1070 B.C.**

Sq. 10S-10E, Level 2, .305 to .427 m below surface.

3650 ± 160

M-2395. Teoc Creek site **1700 B.C.**

From deep midden at W end of profile trench, excavation area 3, ca. 2.22 m below surface; 3 Poverty Point objects in midden.

3600 ± 160

M-2412. Teoc Creek site **1650 B.C.**

Sq. 10S-10E, Level 4, .55 to .67 m below surface.

3210 ± 250

M-2413. Teoc Creek site **1260 B.C.**

Sq. 10S-10E, Level 5, .67 to .794 m below surface.

3270 ± 200

M-2414. Teoc Creek site **1320 B.C.**

Sq. 10S-10E, Level 6, .794 to .915 m below surface. Small sample.

3080 ± 150

M-2415. Teoc Creek site **1130 B.C.**

Sq. 0-10E, Level 3, .427 to .55 m below surface.

3470 ± 160

M-2416. Teoc Creek site **1520 B.C.**

Sq. 0-10E, Level 4, .55 to .67 m below surface.

3380 ± 160

M-2417. Teoc Creek site **1430 B.C.**

Sq. 0-10E, Level 5, .67 to .794 m below surface.

General Comment (J.C.): dates seem remarkably consistent. Compared to other Poverty Point sites, they are quite acceptable. Lack of pottery in all levels of 37.2 m^2 excavation area, except on the surface, indicates dates relate to pre-pottery occupation. All except earliest, M-2395, are from this excavation area. M-2395 is from an occupation zone ca. 22.2 m below surface of natural levee of site. Zone is probably continuous with lower levels of excavated midden on the levee backslope. Date is not much earlier than the 2 from Level 4 of the excavation.

Snodgrass site series, Missouri

Charcoal from Snodgrass site (23 BU 21-B) (36° 33′ N Lat, 90° 33′ W Long), Butler Co., Missouri.

470 ± 100

M-2133. Snodgrass site **A.D. 1480**

Quercus, red oak group, from Str. 14, F.S. No. 106, Sq. 998.5 E, 224.1 S, D.D. 3.32 m. Coll. 1968 by J. E. Price; subm. by J. B. Griffin.

560 ± 150

M-2134. Snodgrass site **A.D. 1390**

Hickory (*Carya* sp.) from Str. 14, F.S. No. 162, Sq. 989.05 E, 225.45 S, D.D. 3.4 m. Coll. 1968 by J. E. Price; subm. by J. B. Griffin.

630 ± 100

M-2135. Snodgrass site **A.D. 1320**

White oak from Str. 7, Sq. 938.9 E, 231.0 S, D.D. 2.83 m. Coll. 1968 by J. E. Price; subm. by J. B. Griffin.

430 ± 100

M-2136. Snodgrass site **A.D. 1520**

Hickory or pecan (*Carya* sp.) from Str. 7, Sq. 947.0 E, 228.5 S, D.D. 3.36 m. Coll. 1968 by J. E. Price; subm. by J. B. Griffin.

520 ± 100

M-2137. Snodgrass site **A.D. 1430**

Charcoal, (probably *Fraxinus* sp.) ash, Extra Ed., Pit No. 10, NE Quad. Coll. 1968 by J. E. Price; subm. by J. B. Griffin.

400 ± 100

M-2180. Snodgrass site **A.D. 1550**

Quercus, white, from Str. 3, F.S. No. 324, 154.9 S, 880.3 E, D.D. 2.46 m, Post No. 5. Coll. 1967 and subm. by J. E. Price, Univ. of Michigan.

620 ± 100

M-2181. Snodgrass site **A.D. 1330**

Quercus, red, from Str. 3, F.S., 292, 153.5 S, 883.9 E. Coll. 1967 and subm. by J. E. Price.

620 ± 100

M-2182. Snodgrass site **A.D. 1330**

730 ± 110

A.D. 1220

Quercus, red, from Str. 4, F.S. 299, 191.0 S, 929.0 E, D.D. 2.33 m. Two runs made. Coll. 1967 and subm. by J. E. Price.

560 ± 100

M-2183. Snodgrass site **A.D. 1390**

Fraxinus sp. from Str. 4, 187.85 S, 929.3 E, D.D. 2.4 m. Coll. 1967 and subm. by J. E. Price.

410 ± 100

M-2184. Snodgrass site **A.D. 1540**

Carya sp. from Str. 10, 151.70 S, 99.160 E, D.D. 2.46 m. Coll. 1967 and subm. by J. E. Price.

810 ± 110

M-2185. Snodgrass site **A.D. 1140**

Quercus, red, from Str. 10, 150.60 S, 991.70 E, D.D. 2.5 m. Coll. 1967 and subm. by J. E. Price.

560 ± 100

M-2274. Snodgrass site **A.D. 1390**

Str. 15, F.S. 272, 755.8 E, 301.3 S. Coll. 1969 by J. E. Price; subm. by J. B. Griffin.

620 ± 100

M-2275. Snodgrass site **A.D. 1330**

Str. 24, S ½ of F.S. 1, 808.5 E, 152.05 S to 804.0 E, 152.65 S. Coll. 1969 by J. E. Price; subm. by J. B. Griffin.

790 ± 100

M-2430. Snodgrass site **A.D. 1160**

Str. 17, F.S. 89, 793.45 E, 230.56 S. Coll. 1970 by Pamela Mears and Michael Jochim; subm. by J. B. Griffin.

3800 ± 160

M-2431. Snodgrass site **1850 B.C.**

Str. 17, F.S. 141, 228.4 S, 798.7 E, D.D. 2.36 m. Coll. 1970 by N. L. Hamblin and John Greene; subm. by J. B. Griffin.

660 ± 100

M-2432. Snodgrass site **A.D. 1290**

Str. 25, F.S. 246, 173.0 S, 779.5 E, D.D. 2.14 m. Coll. 1970 by Terence D'Altroy and C. M. S. Price; subm. by J. B. Griffin.

540 ± 100

M-2433. Snodgrass site **A.D. 1410**

Str. 25, F.S. 246, 173 S, 799.5 E, D.D. 2.14 m. Coll. 1970 by Gary Mono, Vida Goldstein, Terence D'Altroy, and C. M. S. Price; subm. by J. B. Griffin.

General Comment (J.E.P. and J.B.G.): with exception of M-2431, dates are acceptable. Again, all specimens dated came from structures that burned the same day. Snodgrass site was very short lived, probably not > 10 to 20 yr. Mean for all Snodgrass dates, except M-2431, is A.D. 1364, an acceptable date for Powers phase. Range of dates, however, indicates difficulty of establishing priority of one site over another on the basis of radiocarbon dates.

Powers Fort series, Missouri

Charcoal from Powers Fort (23 BU 10) (36° 33′ N Lat, 90° 33′ W Long), Butler Co., Missouri. Coll. 1969 by John Walthall; subm. by J. B. Griffin.

M-2276. Powers Fort — **540 ± 100** (A.D. 1410)
Str. 1, F.S. 1, 10.6 E, 13.7 N, D.D. .305 m.

M-2277. Powers Fort — **660 ± 100** (A.D. 1290)
Str. 1, F.S. 44, 15.1 E, 7.5 N, D.D. .259 m.

M-2278. Powers Fort — **590 ± 100** (A.D. 1360)
Str. 1, F.S. 41, 16 E, 6.7 N, D.D. .259 m.

M-2279. Powers Fort — **660 ± 200** (A.D. 1290)
Str. 1, F.S. 40, 16.9 E, 5.6 N, D.D. .214 m. Small sample.

M-2280. Powers Fort — **650 ± 100** (A.D. 1300)
Str. 1, F.S. 47, 16.2 E, 9.2 N, D.D. .229 m.

General Comment (J.E.P.): dates are from charcoal of burned structure and should date the same. Some range in dates but they cluster better than any others run on other sites of Powers phase. Mean of Powers Fort dates is A.D. 1330, within reason for assoc. material remains.

M-2434. Neil Flurry site, Missouri — **380 ± 100** (A.D. 1570)

Charcoal from Neil Flurry site (23 BU 69) (36° 33′ N Lat, 90° 33′ W Long), Butler Co., Missouri. Str. 8, F.S. 119, 53.6 N, 82.2 E, E.D. 2.44 m. Coll. 1970 by Timothy Hubert and Terence D'Altroy; subm. by Barbara Luedtke, Univ. of Michigan. *Comment* (J.E.P. and J.B.G.): date is the only one on this site and appears too recent. It does not differ greatly from some dates for other sites of the phase where > 1 sample were run and then averaged. Date is usable but is almost certainly some 200 radiocarbon yr later than occupation.

E. Great Plains

Havens site series, North Dakota

Charcoal, small twigs, from Havens site (32 EM 1) (46° 01′ N Lat,

100° 33′ W Long), Emmons Co., North Dakota. Coll. 1967 by J. E. Sperry; subm. by W. R. Wood.

730 ± 100

M-2362. Havens site, 101-A **A.D. 1220**

From fill of Feature 164, oval pit, in NE corner of House 1.

720 ± 100

M-2363. Havens site, 101-B **A.D. 1230**

From fill of Feature 164, oval pit, in NE corner of House 1.

General Comment (W.R.W.): dates are well within apparent time range of Fort Yates phase complex of extended Missouri Valley variant and are nearly the same as one from another component of phase, Fire Heart Creek (A.D. 1230 ± 80: SI-213, R., 1966, v. 8, p. 416).

Paul Brave site series, North Dakota

Charcoal, twigs, and small branches from Paul Brave site (32 Si 4) (46° 01′ N Lat, 100° 35′ W Long), Sioux Co., North Dakota. Coll. 1955 by W. R. Wood and A. R. Woolworth; subm. by W. R. Wood.

920 ± 100

M-2364. Paul Brave site, 918-A **A.D. 1030**

From Excavation 2, Feature 42, fill of bell-shaped pit in front of House 2.

850 ± 100

M-2365. Paul Brave site, 918-B **A.D. 1100**

From Excavation 2, Feature 42, fill of bell-shaped pit in front of House 2.

General Comment (W.R.W.): dates are well within apparent time range of Fort Yates phase complex.

Clark's Creek site series, North Dakota

Charcoal, outer rings of an oak log, from Clark's Creek site (32 ME 1) (47° 14′ 30″ N Lat, 101° 16′ W Long), Mercer Co., North Dakota. Should date one of most N components of Extended Middle Missouri variant. Coll. 1968 and subm. by W. R. Wood.

670 ± 100

M-2366. Clark's Creek, Fl-A **A.D. 1280**

In fill of Feature 1, undercut pit in Test No. 1.

770 ± 110

M-2367. Clark's Creek, Fl-B **A.D. 1180**

In fill of Feature 1, undercut pit in Test No. 1.

General Comment (W.R.W.): either date is acceptable, although it seems unlikely that site was occupied long enough for both to apply.

Cross Ranch site series, North Dakota

Charcoal and wood from Cross Ranch site (32 OL 14) (47° 11′ N Lat, 101° 00′ W Long), Oliver Co., North Dakota. Should date one of

most N components of Extended Middle Missouri variant. Coll. 1969 by F. A. Calabrese; subm. by W. R. Wood.

M-2368. Cross Ranch site, Sample No. 1 **420 ± 100** **A.D. 1530**

Charcoal from Feature 105, pit in floor of House 3, Level 2.

M-2369. Cross Ranch site, Sample No. 2 **590 ± 100** **A.D. 1360**

Wood from wooden brace between center supports, Features 158 and 159, House 3.

General Comment (W.R.W.): either date is acceptable, although it seems unlikely that site was occupied long enough for both to apply.

Taylor Mound site series, Kansas

Charcoal from Taylor Mound site (14 DP 3) (39° 56′ 45″ N Lat, 95° 15′ 30″ W Long) NW ¼, NW ¼, Sec. 26, T.1S, R.39W, Doniphan Co., Kansas. Coll. and subm. by P. J. O'Brien, Kansas State Univ., Manhattan, Kansas.

M-2343. Taylor Mound site **1940 ± 140** **A.D. 10**

Feature 7, Burial 2; charcoal from cremation within cremation layer of mound.

M-2344. Taylor Mound site **1660 ± 140** **A.D. 290**

Feature 9; wood charcoal within cremation layer of mound ca. .61 m higher than cist. Cremation layer was laid down as part of ceremony covering cist, the cremation fire itself.

M-2345. Taylor Mound site **1940 ± 140** **A.D. 10**

Feature 9; wood charcoal from cremation layer.

General Comment (P.J.O.): dates are expected for Valley focus Woodland.

Pridey site series, Missouri

Charcoal from Pridey site (23 PL 4) (39° 12′ N Lat, 94° 45′ 30″ W Long), SW ¼, SE ¼, Sec. 30, T.51N, R.34W, Platte Co., Missouri. Coll. and subm. by P. J. O'Brien.

M-2346. Pridey site **660 ± 100** **A.D. 1290**

Charcoal from Feature 11 in House 1; from an interior support post of house.

M-2347. Pridey site **880 ± 110** **A.D. 1070**

Wood charcoal from S wall, Sq. 10S-25W, directly above floor of house. Probably an exterior support post of House 1.

General Comment (P.J.O.): dates are in range for Steed-Kisker focus of Middle Mississippian, but since house was probably used for 200 yr, I favor later date for house, with earlier date probably belonging to a re-used post or the like.

F. Western United States

1800 ± 140

M-2348. Ruby site, Wyoming **A.D. 150**

Sample from Ruby site (48 CA 302) (43° 40′ 58″ N Lat, 105° 54′ 16″ W Long), Campbell Co., Wyoming. From fire pit ca. 6.1 m deep in profile cut by an arroyo. Coll. and subm. by G. C. Frison, Univ. of Wyoming, Laramie, Wyoming. *Comment* (G.C.F.): excellent date; it fits very well with both geologic and another carbon date from same area. C^{14} date, 1670 ± 135 yr (GX-1157: Frison, 1971), was obtained 3.05 m higher in same depositional sequence, giving an idea of depositional rates for alluvium in area.

Glenrock Buffalo Jump series, Wyoming

Samples from Glenrock Buffalo Jump (48 CO 304) (42° 51′ 41″ N Lat, 105° 55′ 58″ W Long), Converse Co., Wyoming. Coll. and subm. by G. C. Frison.

280 ± 100

M-2349. Glenrock Buffalo Jump **A.D. 1670**

From fire hearth 1.295 m deep. Late Prehistoric period.

210 ± 100

M-2350. Glenrock Buffalo Jump **A.D. 1740**

From fire hearth 1.95 m deep. Late Prehistoric period.

General Comment (G.C.F.): excellent dates; they fit with other archaeologic evidence, suggesting that site was probably used until historic period, *i.e.*, ca. A.D. 1750.

790 ± 110

M-2373. Hermanas Ruin, New Mexico **A.D. 1160**

Charcoal, mesquite, from Hermanas Ruin (31° 47′ N Lat, 108° 12′ W Long), Luna Co., New Mexico. Sample from Unit 490 E 500, Feature No. 1, stone lined fire pit .305 to .55 m below surface. Coll. 1970 and subm. by J. E. Fitting, Case Western Reserve Univ., Cleveland, Ohio. *Comment* (J.E.F.): from very homogeneous site, probably occupied during middle of Mimbres development. Abundant Mimbres Bold Face ceramics and no Mimbres Polychrome. I now believe entire Polychrome period postdates A.D. 1160.

1330 ± 130

M-2374. Burro Cienaga, site No. 40, New Mexico **A.D. 620**

Charcoal, cedar from Burro Cienaga, Site No. 40 (32° 25′ N Lat, 108° 18′ W Long), Grant Co., New Mexico. From burned roofing material just above floor in House No. 1. House contains Three Circles Red on White and Mimbres Bold Faced ceramics on floor. Coll. 1970 and subm.

by J. E. Fitting. *Comment* (J.E.F.): earlier than dates on comparable ceramics in San Francisco drainage to N and suggests that Gila and Mimbres drainages will prove to be core areas for Mogollon cultural developments.

G. Mexico

M-2249. Rancho del Escritorio, Mexico **2350 ± 140 / 400 B.C.**

Shell pendant from Rancho del Escritorio, Tuxpan, Jalisco, Mexico. Heavy shell pendant in poor condition, purchased, but allegedly from burial; apparently, of Comala complex. From vendor's statements and one pottery vessel still in his possession, Comala assoc. was assumed. Coll. and subm. by Isabel Kelly, Tepepan (z.23) D.F., Mexico. *Comment* (I.K.): date ca. ½ millennium earlier than expected. Whole ceramic series in Colima area may have to be pushed back in time. More likely is that rifled tomb (?) in question may have had pre-Colima use, which was not clear from limited ceramic evidence. Neither in this case nor for other dates based on shell has any adjustment for "upwelling" been applied.

Cerro del Zapote series, Mexico

Shell bracelet fragments from rifled tomb, Cerro del Zapote, Colima, Mexico. Specimen purchased from unknown vendor. Chiefly Zapote complex, but some vessels of San Miguel horizon, evidently formal part of burial furniture. Coll. and subm. by Isabel Kelly.

M-2251. Cerro del Zapote **2320 ± 140 / 370 B.C.**

Assoc. with large number of discarded pottery vessels of both San Miguel and Zapote complexes.

M-2252. Cerro del Zapote **2060 ± 140 / 110 B.C.**

Sample from rifled tomb, ca. 15 m from that which produced M-2251. Specimens purchased; assoc. with either San Miguel or Zapote complex.

General Comment (I.K.): unpub. date based on a sherd sample (Geochron: GX-1785) was reported as 3080 ± 190 or 1130 B.C. for Zapote complex. Latter date considered too early; as yet, no secure date exists for San Miguel horizon. Zapote and San Miguel, now considered separate complexes, may be 2 aspects of a single phase; ceramically, relationship is close.

El Chanal site series, Mexico

Charcoal from El Chanal (19° 16′ N Lat, 103° 41′ W Long), Colima, Mexico. Ceramically, site does not fit into regular Colima series, because relationships seem to be with Jalisco (Autlan and Tuxcacuesco) and Michoacan. Coll. and subm. by Isabel Kelly.

M-2334. El Chanal West, Pot. Edificios Chicos **490 ± 100 A.D. 1460**

Charcoal from Test #1.

M-2338. El Chanal, East, Cenicero **660 ± 100 A.D. 1290**

Charcoal from Test 3:5 (80 to 100 cm), 2 pieces found close together.

General Comment (I.K.): both dates comparatively late and confirm impression that El Chanal was occupied in centuries immediately prior to the Conquest.

M-2339. El Bajadero, Las Borregas, Mexico **1260 ± 130 A.D. 690**

Marine shell from Burial 11, El Bajadero, Las Borregas, Acatitlan (19° 06′ N Lat, 104° 45′ W Long), Colima, Mexico. Coll. and subm. by Isabel Kelly. *Comment* (I.K.): 1st date for Armeria complex; somewhat earlier than estimated, not leaving much room for Comala and Colima complexes, which are thought to precede Armeria during 1st centuries A.D. More carbon dates are needed.

M-2340. Parcela de Jacinte Avila, Mexico **1810 ± 140 A.D. 140**

Two fragments of marine shell, from surface of a cluster of rifled burials, Parcela de Jacinte Avila, Coahuayana Valley (18° 46′ N Lat, 103° 40′ W Long), Michoacan, Mexico. Coll. and subm. by Isabel Kelly. *Comment* (I.K.): present date should help establish some order among ill-defined complexes of E Colima and adjacent Michoacan. Burials accompanied by some specimens, tentatively assignable to Chanchopa phase, but certain key wares were lacking. More data are necessary.

M-2341. Loma del Volantin, Alcusahue, Mexico

Worked marine shell from rifled tomb, Loma del Volantin, Alcusahue (18° 56′ N Lat, 103° 47′ W Long), Colima, Mexico. Coll. and subm. by Isabel Kelly.

M-2341a. Loma del Volantin **1690 ± 140 A.D. 260**

M-2341b. Loma del Volantin **2230 ± 140 280 B.C.**

General Comment (I.K.): sherd material salvaged from tomb establishes presence of at least 2 Ortices vessels, evidently grave furniture; earlier date may refer to these. Some sherd material not yet identifiable. Nearly 550 yr spread from one tomb > expected. Usual reservations as to utility of shell for C^{14} dating may apply. But, from other evidence, it is patent that tombs were used and re-used, which present dates reinforce, although somewhat extravagantly. These 2 dates emphasize perils of lumping discrete samples presumed contemporaneous. Compare

with M-2396, based on good charcoal sample, which places a presumably Ortices deposit from Coahuayana Valley at 160 B.C.

M-2396. La Paranera, San Vicente, Mexico **2110 ± 140 / 160 B.C.**

Charcoal from La Paranera, San Vicente, Coahuayana Valley (18° 44′ N Lat, 103° 41′ W Long), Michoacan, Mexico. Sample from Test #1, East pit, 340 cm below surface. Coll. 1970 and subm. by Isabel Kelly. *Comment* (I.K.): material from this test not yet tabulated but believed to be a local variety of Ortices, quite close to that recognized many years ago in Salado drainage and presumably its contemporary. Only charcoal sample so far attributable to Ortices phase; dates based on shell are M-2341a and M-2341b.

San Jose Mogote site series, Mexico

Charcoal from San Jose Mogote site (17° 11′ N Lat, 96° 48′ W Long), Oaxaca, Mexico. Sample should date Early Formative deposit with zoned, rocker-stamped sherds and abundant worked marine shell (Flannery *et al.*, 1967). Coll. 1966 and subm. by K. V. Flannery, Mus. Anthropol., Univ. of Michigan.

M-2104. Sample OS-62, I10 and OS-62, K11, Zone D3 **2670 ± 200 / 720 B.C.**

From bottom of ashy midden layer overlying ignimbrite. Est. date: 900 to 1200 B.C. *Comment* (K.V.F.): expected dates for San Jose phase are 850 to 1150 B.C. Date falls within one standard deviation of range.

M-2330. Area C, Feature 23 **3280 ± 180 / 1330 B.C.**

Pit is bedrock below Zone G. Tierras Largas phase. *Comment* (K.V.F.): acceptable.

M-2331. Area C, Sq. S33A **3120 ± 150 / 1170 B.C.**

Carbonized post in bedrock below stratigraphic Zone G. Tierras Largas phase. *Comment* (K.V.F.): acceptable.

M-2354. Area C, Sample OS-62-C/F.24 **2840 ± 150 / 890 B.C.**

Feature 24, pit in bedrock, from flotation sample. San Jose phase. *Comment* (K.V.F.): acceptable.

M-2355. Area C, Sq. S24A, Zone E **2610 ± 150 / 660 B.C.**

Sherd layer above Platform 3 and below House 5. San Jose phase. *Comment* (K.V.F.): too young.

M-2372. Area C, Code: OS-62-C **3270 ± 160 / 1320 B.C.**

Charcoal from fill of Platform 5 (Zone F). Tierras Largas phase. *Comment* (K.V.F.): acceptable.

Tierras Largas site series, Oaxaca, Mexico

Charcoal from Tierras Largas site (17° 05′ N Lat, 96° 46′ W Long), Oaxaca, Mexico. Coll. 1969 and subm. by K. V. Flannery.

M-2351. Sq. 1995, Sample 1 — **2960 ± 150 / 1010 B.C.**

Tierras Largas phase.

M-2352. Sq. 1005, from below metate No. 2 — **3020 ± 150 / 1070 B.C.**

Charcoal. Tierras Largas phase.

M-2353. Feature 116 — **3030 ± 150 / 1080 B.C.**

80 cm below top of bedrock. Tierras Largas phase.

General Comment (K.V.F.): expected date for Tierras Largas phase is 1400 to 1150 B.C. Dates are within one standard deviation of above range.

San Sebastian Abasolo site series, Oaxaca, Mexico

Charcoal from San Sebastian Abasolo (16° 58′ N Lat, 96° 32′ W Long), Oaxaca, Mexico. Coll. 1969 and subm. by K. V. Flannery.

M-2358. Test A, Sq. E 13, Feature 3 — **2600 ± 150 / 650 B.C.**

From Pre-Columbian well. *Comment* (K.V.F.): well is San Jose phase (1150 to 850 B.C.). Date is therefore too recent. Sample was from below ground water level in bottom of well and may be contaminated.

M-2357. Test A, Sq. D 13, Zone D2 — **2680 ± 200 / 730 B.C.**

Depth of 220 cm. *Comment* (K.V.F.): expected date is 900 B.C. Date is within one standard deviation.

M-2360. Test B — **2330 ± 180 / 380 B.C.**

Depth of 120 cm below surface. Monte Alban I. *Comment* (K.V.F.): perfect.

M-2371. Feature 3-fill — **2730 ± 150 / 780 B.C.**

Charcoal from San Jose phase well. *Comment* (K.V.F.): date is within one standard deviation of expected date of 900 B.C.

Barrio del Rosario Huitzo, Mexico

Charcoal from Barrio del Rosario Huitzo (17° 17′ N Lat, 96° 54′ W Long), Oaxaca, Mexico. Coll. 1967 and subm. by K. V. Flannery.

M-2102. Sample B46A, Zone F3 — **2800 ± 150 / 850 B.C.**

Charcoal from burned post embedded in sterile soil at base of stratigraphic column, 7.5 m below surface. Should date Early Formative. Geochron date from same log: 1400 ± 140 B.C. (Flannery *et al.*, 1967). *Comment* (K.V.F.): acceptable date.

2440 ± 140

M-2386. Area B46C (V-W site), Zone D2 **490 B.C.**

Midden charcoal. *Comment* (K.V.F.): within one standard deviation of expected date ca. 600 B.C.

2960 ± 150

M-2387. Area B46A (control), House 7 **1010 B.C.**

Charcoal (fuel) from floor of House 7, Guadalupe phase. *Comment* (K.V.F.): expected date is ca. 850 B.C.; sample is roughly within one standard deviation of it.

H. Africa, Europe, Near East, and Asia

Ita Yemoo site series, Nigeria

Charcoal from Ita Yemoo site (07° 28′ N Lat, 04° 32′ E Long), Ife, Nigeria. Coll. and subm. by Frank Willett, Northwestern Univ., Evanston, Illinois.

480 ± 100

M-2117. Ita Yemoo 1397 **A.D. 1470**

From Layers 4 and 5, very small trench cutting entirely sealed by potsherd pavement No. 1 and overlain by stone pavement No. 15. Sample from 3.81 m to .854 m below top pavement and immediately below stone pavement. BM-261, directly above, dated A.D. 960 ± 130 (R., 1969, v. 11, p. 291).

M-2119. Ita Yemoo Unnumbered, 1072 and 1187 **800 ± 200 A.D. 1150**

Combined sample from Layer 2 over pavement and beside terra cotta. Unnumbered: Sq. 7D, Layer 2. Corresponds to BM-262: A.D. 1060 ± 130 (R., 1969, v. 11, p. 291); IY 1072, Sq. 4E, Layer 2 of reddish-brown earth.

600 ± 100

M-2120. Ita Yemoo 1066 **A.D. 1350**

Layer 13A, Trench XIII. Two sections: lower part of fill of Feature 9, deep pit outside town wall, 2.31 m below surface. Upper: deep pit, obscure but cut by Feature 10, pit dug from old land surface. Trench XIII sectioned town wall and revealed pavement, various pits, and old wells beneath and beyond wall.

1100 ± 120

M-2121. Ita Yemoo 863 **A.D. 850**

Trench XIII, Feature 1, pit filling of Layer 7A, 1.98 m below surface. Old well excavated to 4.6 m below top of natural bedrock, dug from old land surface; buried below material cleaned out of town ditch. *Terminus post quem* for building town wall.

General Comment (F.W.): pottery from well (M-2121) is oldest so far excavated for Ita Yemoo; older rubbish must have filled it for it is stratigraphically later than BM-259: A.D. 1160 ± 130 (R., 1969, v. 11, p. 291) and M-2119 which corresponds well with BM-262 from same

layer. M-2117 comes from below a pavement which corresponds stratigraphically to that below M-2119 and BM-262; it exactly overlays BM-261 in Layer 11 and must be contaminated, probably from organic material accumulated in a deep hollow in overlying pavement. *Cire perdue* brasscastings were found and appear to have come from a corresponding situation and to be from 11th and 12th centuries, when nearly life-size naturalistic terra cotta sculptures were being made.

Orun Oba Ado site series, Nigeria

Charcoal from Orun Oba Ado site (07° 28′ N Lat, 04° 32′ E Long), Ife, Nigeria. Site of burial of heads of kings of Benin in Ife. Coll. and subm. by Frank Willett.

1150 ± 120

M-2114. Pit III sample **A.D. 800**

Depth of .764 m in Pit III, Sq. C3 adjacent to D in dark brown earth Layer 4; large, irregular, non-gravel pit.

1150 ± 120

M-2115. Pit V sample **A.D. 800**

Combination of small samples 112, 113, 114, 138, 142, 152 from 2.44 to 2.75 m below surface.

1010 ± 150

M-2116. Pit VI sample **A.D. 940**

Combination of very small charcoal samples 32, 83, 96, 117, 118, 119, 123, 139, 144, 149 at depths of .812 m to 2.14 m.

General Comment (F.W.): taken together, these dates confirm that site of Ife itself was occupied during latter part of 1st millennium A.D., earlier than some scholars would expect and earlier than generally accepted date for beginning of Yoruba Dynasty in Benin. Pottery from Orun Oba Ado appears less evolved than main series from Ita Yemoo; that Orun Oba Ado dates should mostly precede those from Ita Yemoo is satisfactory (cf. BM-265: A.D. 560 ± 130 and BM-264: A.D. 990 ± 130 from Orun Oba Ado: R., 1969, v. 11, p. 292).

3900 ± 150

M-1325. Mound 1, Leki Male, Poland **1950 B.C.**

Wood from Mound 1 at Leki Male (52° 11′ N Lat, 16° 33′ E Long), Koscian dist., Poland. Piece of wood from Burial A in Mound (Barrow) 1, 3rd layer of stone construction, Bronze age Unetice culture (Kowianska-Piaszykowa and Kurnatowski, 1954). Coll. 1953 by Mieczyslawa Kowianska-Piaszykowa; subm. by J. B. Griffin. *Comment* (S.R. Milisauskas): with relative chronology, excavators date mound ca. 1700 to 1500 B.C. C^{14} date is earlier than expected for Early Bronze age Unetice culture in Poland. Same mound dated by Groningen, GrN-5037 at 3605 ± 40 (Bakker *et al.*, 1969, p. 1516). Considering standard deviation, however, date is probably acceptable.

Olszanica site series, Poland

Charcoal from Olszanica site (50° 06′ N Lat, 18° 50′ E Long) near Stalinograd and Gliwice, S Poland. Coll. 1968 by Janusz Kruk; subm. by Sarunas Milisauskas, New York State Univ. at Buffalo.

M-2165. Olszanica **6150 ± 210**
4200 B.C.

Charcoal from Feature No. 1, 57 to 59 cm depth. Most sherds in feature belong to Zeliezorska phase (III) of Linear culture in Little Poland.

M-2314. Olszanica D_1 **6700 ± 220**
4750 B.C.

Charcoal from Feature #12/S, Area D_1, 70 to 90 cm depth. Feature designated as Danubian I phase of Linear culture.

M-2320. Olszanica D_1 **5800 ± 210**
3850 B.C.

Charcoal from Feature 1/1969, Level 19, 100 to 120 cm depth. Cultural assocs. indicate Danubian I phase of Linear culture.

General Comment (S.M.): M-2165 date is good. Earliest expected date for M-2314 was ca. 6400 or 6450 B.P. M-2320 dates Feature 1/1969 near end of Linear culture.

Iwanowice site series, Poland

Charcoal from Iwanowice site (50° 13′ N Lat, 19° 58′ E Long) near Krakov, S Poland. Coll. 1968 by Jan Machnik; subm. by Sarunas Milisauskas.

M-2166. Iwanowice **4300 ± 200**
2350 B.C.

Charcoal from Feature 21, 40 to 60 cm depth. Feature id. as Baden culture, Late Neolithic.

M-2167. Iwanowice **3240 ± 160**
1290 B.C.

Charcoal from Feature 30a, 80 to 90 cm of site. Feature contained Mierzanowice culture (Early Bronze age) sherds and some Lusatian cultural sherds.

M-2168. Iwanowice **3720 ± 180**
1770 B.C.

Charcoal from Feature 56b, 100 to 110 cm. Feature designated as Mierzanowice culture, Early Bronze age in Little Poland.

M-2169. Iwanowice **3400 ± 160**
1450 B.C.

Charcoal from Feature 61, 70 to 80 cm. Feature id. as Trzciniec culture, Bronze age II in Little Poland.

3700 ± 170

M-2325. Iwanowice **1750 B.C.**

Charcoal from Feature 62S, 230 to 250 cm. Feature designated as Mierzanowice culture, Early Bronze age.

3440 ± 170

M-2327. Iwanowice **1490 B.C.**

Charcoal from Feature 61, 110 to 120 cm. Feature designated as Mierzanowice culture, Early Bronze age.

3800 ± 170

M-2328. Iwanowice **1850 B.C.**

Charcoal from Feature 62S, 190 to 200 cm. Feature designated as Mierzanowice culture, Early Bronze age.

General Comment (S.M.): all dates in series are satisfactory except M-2327. Expected date for M-2327 was 3700 B.P. M-2328 is relatively early for Mierzanowice culture in S Poland. M-2167 represents acceptable date for early phase of Lusatian culture.

Niedzwiedz I site series, Poland

Charcoal from Niedzwiedz I site (50° 14′ N Lat, 20° 08′ E Long), near Krakov, S Poland. Coll. by Barbara Burchard; subm. by Sarunas Milisauskas.

4470 ± 190

M 2321. Niedzwiedz I site **2520 B.C.**

Charcoal from Feature 71 E, 140 cm. Samples should date Funnel Beaker culture.

4600 ± 190

M-2322. Niedzwiedz I site **2650 B.C.**

Charcoal from Feature 68 E, 180 to 182 cm. Sample should date Funnel Beaker culture.

4640 ± 190

M-2323. Niedzwiedz I site **2690 B.C.**

Charcoal from Feature 62A, 240 cm. Sample should date Funnel Beaker culture.

General Comment (S.M.): all 3 dates are satisfactory.

1080 ± 120

M-2324. Raciborz-Obora, Poland **A.D. 870**

Charcoal from Raciborz-Obora site (50° 06′ N Lat, 18° 10′ E Long), near Raciborz, S Poland, from Mound 6A, 40 to 45 cm. Coll. by Elizbieta Dabrokiska; subm. by Sarunas Milisauskas. *Comment* (S.M.): early Slav cemetery containing cremated burials. Chronology based on ceramics dates cemetery from 6th to 9th century A.D. Date is acceptable.

5600 ± 200

M-2455. Lupl anica-Visoko Brdo, Yugoslavia **3650 B.B.**

Wood charcoal from Lupl anica-Visoko Brdo (45° 20′ N Lat, 18° E Long), near Derventa, Bosnia, Yugoslavia, from 1.3 m below ground

surface in Unit II/1970, the lower building level of a Late Neolithic structure in SW part of site. Coll. 1970 by H. M. Wobst; subm. by J. B. Griffin. *Comment* (H.M.W.): excavation of this multicomponent site is still in progress. Date is satisfactory pending further excavation.

Turlu series, Turkey

Ashes from Turlu (37° 03′ N Lat, 37° 45′ E Long), S Turkey. Coll. 1965 and subm. by Jean Perrot, French Consulate General, POB 182, Jerusalem.

M-1844, M-1844a. Turlu **6430 ± 220**
4480 B.C.

M-1844 is ashes from ashen layer at end of Halaf period: 4500 to 4000 B.C. M-1844a is ashes from hearth at end of Ubaid period: 4250 to 3750 B.C.

General Comment (J.B.G.): combined by accident. Date substantiates Perrot's expectations.

Tepe Farukhabad site series, Iran

Wood charcoal from Tepe Farukhabad site (37° 35′ 06″ N Lat, 47° 13′ 30″ E Long), Deh Luran Plain, Kermanshah Prov., Iran. Coll. 1968 by R. C. Gibbs and Robert Betteral; subm. by H. T. Wright, Mus. Anthropol., Univ. of Michigan.

M-2151. Tepe Farukhabad **3990 ± 180**
2040 B.C.

Wood charcoal from Excavation B, Layer 23, F #15; lower layer, refuse-filled granary. Late Jemdet Nasr phase with expected date, 2400 B.C.

M-2152. Tepe Farukhabad **4460 ± 190**
2510 B.C.

Wood charcoal from Excavation A, Layer 21, F #24; hearth designated as Late Uruk phase.

M-2153. Tepe Farukhabad **5760 ± 200**
3810 B.C.

Wood charcoal from Excavation B, Layer 45, F #41, fill from Rms. A, C, and G.

M-2419. Tepe Farukhabad **3800 ± 160**
1850 B.C.

Charcoal, probably tamarisk, from Excavation B, Layer 23, F #15, lower layer which was refuse-filled granary. M-2419 from same sample as M-2151, and was to provide a check on M-2151 which is younger than expected.

General Comment (H.T.W.): further Jemdet Nasr samples must be run before M-2151 and M-2419 can be evaluated. M-2152 compares well with later Middle Uruk at Nippur, S Iraq, dated 2722 B.C. (P-530, R., 1963, v. 5, p. 85). M-2153 compares well with samples of preceding Bayat

phase at nearby Tepe Sabz which averaged 4000 B.C. (Hole, Flannery, and Neely, 1969).

Qasr al Hayr site series, Syria

Wood charcoal and wood from Qasr al Hayr (35° 05′ 30″ N Lat, 34° 04′ 20″ E Long), Syria. Site is divided by standing monuments into a "Small Enclosure," a single huge building, and a "Large Enclosure," a city with several buildings.

1220 ± 120

M-2155. Qasr al Hayr **A.D. 730**

Wood charcoal from L.E. 2K, 30 cm above floor, probably roof beam from Building A in Large Enclosure. Archaeologically, it is 2 generations later than construction assoc. with M-2156. Coll. 1966 by William Trousdale; subm. by Oleg Grabar, Univ. of Michigan and Harvard Univ., Cambridge, Mass.

1400 ± 130

M-2156. Qasr al Hayr **A.D. 550**

Wooden part of beam in original masonry of outside wall of SE corner of palace in Small Enclosure. Coll. 1966 by Robert Hamilton; subm. by Oleg Grabar.

920 ± 120

M-2272. Qasr al Hayr **A.D. 1030**

Wood fragments from Building 14 C-D of Large Enclosure, unfinished court of 1st period, used as a dump. Coll. 1969 by William Trousdale; subm. by Oleg Grabar.

1080 ± 120

M-2273. Qasr al Hayr **A.D. 870**

Wood fragments from building at N gate of Large Enclosure. No clear stratification. Coll. 1969 by Renata Holod-Tretiak; subm. by Oleg Grabar.

610 ± 120

M-2456. Qasr al Hayr **A.D. 1340**

Wood fragments from E gate building, Level 3 of Large Enclosure. Probably roofing poles from fill ca. 10 cm over plastered floor marking latest observable occupation of Phase 3 in room of E gate building. Small sample. Coll. 1970 by R. McC. Adams; subm. by Oleg Grabar.

General Comment (O.G.): dates are satisfactory. M-2273 was expected to date before A.D. 1300 but later than A.D. 1000. Since it was part of an object, wood could have been much earlier than occupation level where it was found. M-2456 comes from latest level of 2nd major phase of occupation and shortly before abandonment of site; literary and ceramic evidence indicate abandonment ca. A.D. 1320.

Pulur site series, Turkey

Charcoal from Pulur site (ca. 38° 30′ N Lat, 38° 55′ E Long), Turkey. Chalcolithic prehistoric settlement near Euphrates R.; connec-

tions with Karaz-Aras-Malatya. Khirbet Kerak culture. Coll. 1968 by H. Z. Kosay; subm. by Robert Whallon, Jr., Mus. Anthropol., Univ. of Michigan.

M-2170. Pulur site **4300 ± 180 2350 B.C.**

Excavation K, 37.9 D 29. Fifth level from top of hill.

M-2171. Pulur site **3990 ± 180 2040 B.C.**

Hearth, Level 6, ca. 3000 to 3500 B.C.

M-2172. Pulur site **4420 ± 200 2470 B.C.**

Level 8.5 m deep. Chalcolithic, ca. 4000 B.C.

M-2173. Pulur site **4100 ± 180 2150 B.C.**

Operation A I. Level 9, 7 m deep. Chalcolithic, ca. 4000 B.C.

General Comment (R.W.): dates seem much more recent than might be expected, not surprising for locally persistent and developed "Khirbet Kerak" or East Anatolian Early Bronze age culture; dates are from upper levels of site which has 11 major occupational levels going to 11 m depth before reaching virgin soil.

M-2286. Chinese Bodhissatva **150 ± 100 A.D. 1800**

Wood, probably teak, from Chinese Bodhissatva statue, location known only as China. Statue is in style of early T'ang period. Dates of the few wooden samples of this style are questionable. Purchased in China in late 1940's by a private collector; now on loan to Mus. of Art, Univ. of Michigan. Subm. by Mus. of Art, Univ. of Michigan, Mrs. W. M. Spink, Ass't. Curator. *Comment* (W.M.S.): we must conclude that this Bodhissatva is an archaistic work in early T'ang tradition. Date is satisfactory.

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[RADIOCARBON, VOL. 14, No. 1, 1972, P. 195-222]

UNIVERSITY OF MICHIGAN RADIOCARBON DATES XV

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The following is a list of dates obtained since the compilation of List XIV, and the method is essentially the same. Two CO_2–CS_2 Geiger counter systems were used. Equipment and counting techniques have been described elsewhere (Crane, 1961). Dates and estimates of error in this list follow the practice recommended by the International Radiocarbon Dating Conference of 1962 and 1965, in that (a) dates are computed on the basis of the Libby half-life, 5570 yr, (b) A.D. 1950 is used as the zero of the age scale, and (c) the errors quoted are the standard deviations obtained from the number of counts only. In Michigan date lists up to and including VII, we quoted errors at least twice as great as the statistical errors of counting, to take account of other errors in the over-all process.

This date list represents the conclusion of the Michigan series. Operation of the laboratory ended in January 1971, for reasons of rising costs and shrinking support funds.

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I. GEOLOGIC SAMPLES

8100 ± 300

M-2079. Bagotville Bog, Quebec, Canada **6150 B.C.**

Peat from Bagotville Bog (48° 21′ 30″ N Lat, 70° 56′ 50″ W Long), Quebec, Canada. Sample taken with Hiller borer from bottom of peat bog 4 m thick, underlain by marine clay. Alt. 127.8 m above present sea level (LaSalle and Rondot, 1967). Coll. 1967 and subm. by Pierre LaSalle, Quebec Dept. Nat. Resources, Quebec, Canada. *Comment* (P.L.): date agrees well with other dates in area on marine shells, wood, marl, plant debris, and basal layer of bog (LaSalle, 1968, p. 27).

870 ± 110

M-1927. Houghton County, Michigan **A.D. 1080**

Podzol from (47° 08′ N Lat, 88° 42′ W Long), SW ¼, SW ¼, Sec. 25, Stanton Twp., Houghton Co., Michigan (Lietzke and Whiteside, 1967; Miller, 1966). Sample from B_{21} hir horizon at depth +12.7 to 22.8 cm. Coll. 1966 by E. P. Whiteside; subm. by M. M. Miller, Michigan State Univ., East Lansing. *Comment* (M.M.M. and D.L.): date represents mean time or age of organic carbon in this soil profile. Other dates from surface horizons (USDA-SCS, 1960) reveal ages from 100 to 400 yr, while other dates of similar subsurface horizons vary from 900 to 1100 yr. Dates indicate turnover rate of organic matter in soils, and that

humus material of spodic horizons is relatively resistant to further decomposition.

1330 ± 130

M-1975. Gastineau Channel, Alaska **A.D. 620**

Tree trunk from Gastineau Channel (58° 15′ N Lat, 134° 27′ W Long), Juneau B-2 quad., Alaska, between Juneau and Salmon Creek along Glacier Hwy. Alt. ca. 25.4 m. Part of overridden tree trunk *in situ* on nonweathered blue-gray till. Coll. and subm. by M. M. Miller. *Comment* (M.M.M.):if sample is of glacial origin, date should be much older. Stratigraphy suggests sample should antedate 7000 B.P.

2490 ± 140

M-1981. Taylor Valley, Antarctica **540 B.C.**

Muscle of mummified seal (*Leptonychotes weddelli*), weathered side of thorax, at Taylor Valley (77° 40 to 43′ S Lat, 162° 30 to 45′ E Long), at foot of Suess glacier, Lake Bonney, and Nussbaum Riegal, Antarctica. Exped. supported by NSF Grant G. B. 2647. Coll. 1966 by T. Blair; subm. by M. A. Marini, M. F. Orr, and E. L. Coe, Northwestern Univ., Evanston, Illinois. *Comment* (E.L.C.): date agrees reasonably with previous date on same animal (M-1919: 2045 ± 140 B.P., R., v. 10, 1968, p. 66). Difference exceeds error slightly. Antarctic samples seem to date ca. 600 yr older than they should (cf. M-1920, a seal known to be dead < 1 yr dated 615 ± 100 B.P., R., 1968, v. 10, p. 66).

Grand Sable Dunes series, Michigan

Wood and partially carbonized wood from Grand Sable Dunes (46° 40′ N Lat, 86° 01′ W Long), SE ¼ of Sec. 2 T.49N, R.14W, Alger Co., Michigan. Coll. 1968 by T. R. Detwyler and Maurice Grolier; subm. by T. R. Detwyler, Dept. Geog., Univ. of Michigan.

320 ± 100

M-2129. Sample GSD 6-3-68-1 **A.D. 1630**

In E-most N-S valley of dunes area. Partially carbonized wood (*Pinus banksiana*?) from stump protruding 22.9 cm above present dune surface. Stump rooted in and below organic-rich paleosol 81.3 to 89 cm below surface. Rooted several m above top of outwash terrace(?) at ca. 220 to 221 m alt. Stump is W-most of > 12 similar stumps nearby, ca. 68.7 m W of dune, 18.3 m N (10°E) of Sable Creek.

500 ± 100

M-2130. Sample GSD 6-3-68-2 **A.D. 1450**

In 2nd N-S valley from E edge of dunes area. Wood *(Pinus banksiana*?); 17.8 cm long piece of bole 35.6 to 53.4 cm above dune surface. Sampled bole stood 114.4 cm above ground, 16.5 cm diam. Tree (one of many similar) is ca. 27.5 m E of axis of valley bottom, ca. 25 m W of dune crest, 8.25 m higher than ground at base of log. Within 61 m S of escarpment overlooking Lake Superior; alt. ca. 221 m.

General Comment (T.R.D.): these 2 samples indicate dune ridges E Grand Sable Dunes moved E-ward during past several hundred yr at a

mean rate between .076 and .24 m per yr. Rate is consistent with contemporary rates. Pollen in paleosols of rooted trees was not analyzed (Grolier and Detwyler, 1970).

Frains Lake Core series, Michigan

Clay gyttja from Frains Lake (42° 20′ N Lat, 83° 37′ W Long), T.2S, R.7E, Sec. 9, Washtenaw Co., Michigan, 17 m core. Dates are being used to determine sedimentation rates in central lake basin, from which accumulation rates of fossil pollen and cladocera and absolute times of major changes both within lake and in communities surrounding lake are being calculated. Coll. 1968 by Linda Brubaker, M. B. Davis, W. C. Kerfoot, and Ted Calendar; subm. by W. C. Kerfoot, Great Lakes Research Div., Univ of Michigan.

M-2297. Sample A **850 ± 200** **A.D. 1100**

Clay gyttja from 3.00 to 3.08 m below mud-water interface.

M-2298. Sample B **1740 ± 140** **A.D. 210**

Gyttja from 5.77 to 5.87 m below mud-water interface.

M-2299. Sample C **4620 ± 190** **2670 B.C.**

Gyttja from 7.81 to 7.91 m below mud-water interface.

M-2300. Sample D **8000 ± 300** **6050 B.C.**

Gyttja from 9.96 to 10.06 m below mud-water interface.

M-2301. Sample E **9600 ± 330** **7650 B.C.**

Gyttja from 10.50 to 10.60 m below mud-water interface.

M-2302. Sample F **9960 ± 350** **8010 B.C.**

Clay gyttja from 10.90 to 11.00 m below mud-water interface.

General Comment (W.C.K.): dates reveal initially rapid clay sedimentation (bottom 4 m) easing into slow organic sedimentation, abruptly increased during last 150 yr by rapid accumulation of silt, clay, and organic matter in central basin following forest clearance. Other dates from core are 810 ± 90: A.D. 1140 (I-5224) from depth 3.89 to 3.96 m, and 1240 ± 90: A.D. 710 (I-5225) from depth 4.68 to 4.78 m.

M-2335. Simmons Reef, Michigan **2800 ± 150** **850 B.C.**

Stump(*Fraxinus nigra*) id. by Suzanne Harris, Mus. Anthropol., Univ. of Michigan, from Simmons Reef (45° 54′ N Lat, 85° 13′ W Long), N of Beaver I. Sample from bottom of Lake Michigan at depth 5.5 m (161 m A.T.). Coll. 1969 by R. F. Anderson; subm. by J. L. Hough, Dept.

Meteorol. and Oceanog., Univ. of Michigan. *Comment* (J.L.H.): site, uplifted 58 m since Lake Algonquin times, should have been a shoreline at elev. ca. 159 m A.T. during rise of lake level from Chippewa low stage toward Nipissing stage. Age should be nearly 7000 yr B.P.

8150 ± 300

M-2337. Straits of Mackinac, Michigan **6200 B.C.**

Tree roots (*Tsuga,* probably *T. canadensis*) id. Suzanne Harris, from Straits of Mackinac (45° 49′ 08″ N Lat, 84° 43′ 50″ W Long), NW of N bridge tower, Michigan. Sample from lake bottom, depth 37.2 m (139 m A.T.). Coll. 1969 by L. H. Somers; subm. by J. L. Hough. *Comment* (J.L.H.): site, uplifted 55 m since Lake Algonquin times, should have been shoreline elev. ca. 119 m A.T. during rise of lake level from Chippewa-Stanley low stage toward Nipissing stage. A previous date of tree stump from same location is 9780 ± 330 (M-1996: R., 1970, v. 12, p. 163).

Mile 47 Bog series, Canada

Peat, clay, and marly material from Mile 47 Bog (59° 43′ 30″ N Lat, 133° 44′ 50″ W Long), British Columbia, Canada. Sampling site 91.5 m SW from Atlin Hwy. Coll. 1967 and subm. by J. H. Anderson, Dept. Geol., Michigan State Univ., East Lansing.

3200 ± 160

M-2050. Sample No. 97 **1250 B.C.**

Taken with Hiller sampler, from transition zone at base of peat. Upper and lower mixed. Elev.: 777 m; depth: 135 to 145 cm. Upper portion: peat—fine, fibrous, no stems. HCL reaction mild. Few shells present. Lower portion: marly material, containing many shells, light color. HCL reaction strong.

Organic: 8600 ± 330

M-2051. Sample No. 98 **6650 B.C.**

Inorganic: 8670 ± 900
6720 B.C.
Error 3X

Taken with Davis sampler, from upper level blue-gray glacial lake clay at transition of overlying material. Elev. ca. 777 m. Upper portion: particulate material, very fine, clayey, homogeneous, dark gray-blue color. Shell moderately abundant. HCL reaction moderate. Plant remains are fine, fibrous, particulate, moderately abundant. Lower portion: glacial lake clay, blue-gray. Shells few. HCL reaction moderate. No plants, but few small whitish inclusions of same consistency as clayey matrix.

4160 ± 180

M-2054. Piddlin' Pond Bog, Canada **2210 B.C.**

Peat from Piddlin' Pond Bog (59° 40′ 05″ N Lat, 133° 42′ 30″ W Long), British Columbia, Canada, near Atlin Hwy. W at Milepost 52, 384

m W of post, elev. ca. 732 m. From transition zone at base of peat mixed in bog. Coll. 1967 and subm. by J. H. Anderson. Upper portion of sample: peat—fine fibrous to particulate, few stem pieces > 1 cm long, few recognizable leaf fragments. Shells few, well-preserved. No HCL reaction except shell. Lower portion: peat similar to upper but more particulate, few plant parts recognizable, shell abundant. Black stem sec. gritty (ashy) when crushed.

Mile 16 Bog site series, Canada

Organic material from Mile 16 Bog site (60° 08′ 50″ N Lat, 133° 49′ 24″ W Long), British Columbia, Canada, taken with Davis sampler from small, sedge-peat bog at elev. 732 m in kettle hole in extensive recent glacial deposits. Coll. 1968 and subm. by J. H. Anderson.

M-2219. Sample No. 373 **2560 ± 140**
610 B.C.

Dark gray organic material mixed with fine sand and some macroscopic plant remains. Depth, 160 to 183 cm in base of major peat sec. extending to surface.

M-2220. Sample No. 276 **6700 ± 300**
4750 B.C.

Dark gray, very fine-grained organic material mixed with some clay. Compact organic-clay matrix contains few macroscopic plant remains including stems and gymnosperm seeds. Depth, 645 to 669 cm.

M-2221. August 22nd Bog, Canada **8000 ± 350**
6050 B.C.

Fine-grained, firm peat from August 22nd Bog (59° 22′ 10″ N Lat, 133° 24′ 08″ W Long), British Columbia, Canada, from depth 323 to 346 cm at base of major peat sec. extending to surface. *Sedge-sphagnum* peat bog is ca. 91.5 m N of O'Donnel River Rd., 29 km airline SE of Atlin. Coll. 1968 and subm. by J. H. Anderson.

General Comment (J.H.A.): individually, dates enable calculation of sediment accumulation rates and the dating of vegetation changes, as inferred from pollen diagrams, at sites. Collectively, dates are basis of an absolute chronology for 9 major geobotanic or bioclimatic time zones established for Atlin region, from ca. 11,500 B.P. to present (Anderson, 1970).

Kuhl Mastodon site series, Michigan

Wood and slightly decomposed peat from Kuhl Mastodon site (42° 15′ 24″ N Lat, 84° 57′ 30″ W Long), T.2S, R.4E, Sec. 33, (SW?), NE, SE, Lima Twp., Washtenaw Co., Michigan. Site NW (outside) of Ft. Wayne Moraine of E edge of depression of unknown extent. Coll. 1969 by R. S. Rhodes; subm. by W. R. Farrand, Dept. Geol., Univ. of Michigan.

2550 ± 250

M-2435. Kuhl Mastodon site **600 B.C.**

Sample, KM-17-a, is slightly decomposed peat of unknown composition, from depth 43 cm, will date close to cessation of deposition in basin but is hopefully below much contamination from modern rootlets. It will also be uppermost dated sample in quantitative pollen study.

4470 ± 160

M-2436. Kuhl Mastodon site **2520 B.C.**

Sample, KM-4a-a, from log ca. 15 cm diam., touching a mastodon rib, in horizon ca. 180 cm deep, will date assoc. mastodon remains and provide part of time framework for a quantitative pollen study.

General Comment (W.R.F.): considering these 2 dates and 2 others from same site (I-5080: 11,050 ± 160 B.P. on organic debris at —200 cm in close assoc. with mastodon bones and I-5081: 9590 ± 160 B.P. on woody fragments at —130 cm), M-2435, I-5081, and I-5080 are probably in their correct stratigraphic sequence, but M-2436 is distinctly out of line. M-2436 dates a conifer log in vertical position (but not apparently rooted) next to a disarticulated rib of the mastodon. Both its position and reported age suggest that the log was either intrusive into bog long after death of mastodon or date is spurious.

Akron Mastodon site series, Ohio

Mastodon bone and wood from Akron Mastodon site (41° 10′ N Lat, 81° 30′ W Long), Akron, Summit Co., Ohio. Coll. 1966 by R. F. Keller and R. O. Kapp; subm. by R. O. Kapp, Dept. Biol., Alma College, Alma, Michigan.

12,750 ± 500

M-1970. Mastodon bone **10,800 B.C.**

Remains discovered during excavation of building.

13,300 ± 600

M-1971. Wood **11,350 B.C.**

Portion of trunk 15.2 cm diam., possibly spruce. Discovered during building excavation; should be approx. contemporaneous with mastodon. *General Comment* (J.B.G.): dates are reasonable for mastodon in this area.

Upper Mississippi Valley and Great Lakes

Itasca Bison site series, Minnesota

Wood, peat, and conifer cone fragments from Itasca Bison site (47° 12′ N Lat, 95° 14′ W Long), Minnesota (Shay, 1963, 1971) Coll. 1964 and subm. by C. T. Shay, Univ. of Minnesota.

8810 ± 300

M-1725. Itasca Bison site **6860 B.C.**

Conifer cone fragments, Cat. No. 540-1483, (21 *Picea glauca* and 1 *P. Mariana*), from 8 to 9 W, 12.20 to 12.55 N at depth 2.87 to 2.95 m in sandy marl at base of pollen, shell, and soil series. Cones are possible

part of "trash" layer forming interface between till and marl. Basal pollen spectrum represents spruce dominance. Should date base of marl layer overlying till of ca. 11,000 B.C. plus, which date is based on stratigraphic position, basal pollen spectrum, and date at Bog D, 3.22 km SE of site, of 11,000 B.C. (Y-1418, R., 1969, v. 11, p. 576).

M-1726. Itasca Bison site **7200 ± 250**
5250 B.C.

Rerun- 7740 ± 270
5790 B.C.

Wood fragments including bark, Cat. No. 540-1836 from 15.70 W, 12.46 N at depth 2.20 m in coarse sand with shell. Assoc. with pollen and knife. Postdates deposition of scapula and predates knife. Age should be ca. 9000 B.P. based on assoc. pollen spectrum, in pine period, upper limit of which was dated 3.22 km away at Bog D at 8500 B.P. (Y-1419, R., 1969, v. 11, p. 576).

M-1728. Itasca Bison site **1870 ± 130**
A.D. 80

Wood and twig fragments, Cat. No. 540-620, from 41.10 to 41.25 N, 1.50 to 1.75 E at depth 2.05 to 2.10 m in part of wood concentration above pebble and sandy marl layer and below ca. 1 m of sedge peat. Assoc. with concave base, side-notched projectile point and pollen. Should date deposition of projectile point and predate peat formation at 2000 to 4000 B.P. Pollen evidence indicates hiatus in depositional sequence up to 6000 yr. Most cultural material occurs below presumed hiatus and some bones above it may be redeposited. Peat development presumably began late here, maybe as late as 2000 B.P. Therefore, sample may not show age of projectile point.

M-1729. Itasca Bison site **8580 ± 300**
6630 B.C.

Wood, Cat. No. 540-1628, from 6.95 to 6.99 W, 18.56 to 19.00 N at depth 2.61 m in sand directly under sandy marl. Assoc. with Bison bone and pollen. Should date wood concentration stratum below bone concentration and predate deposition of bone with est. age of 11,000 B.P. based on pollen spectrum assoc. with Bison tibia.

M-1730. Itasca Bison site **7370 ± 250**
5420 B.C.

Wood, Cat. No. 540-933, from 35.00 N, 9.47 W at depth 2.55 m in marl. Assoc. with Bison bones and pollen. Should date horizon near upper limit of marl in immediate area and is contemporaneous with and predates Bison bones, with age est. ca. 9000 to 10,000 B.P. based on assoc. pollen spectra at similar depth.

General Comment (C.T.S.): with exception of M-1728, dates are substantially later than expected.

II. ARCHAEOLOGIC SAMPLES

Voss site series, Ohio

Charcoal, midden refuse, and vegetal material from Voss site (39° 53′ 02″ N Lat, 83° 12′ 48″ W Long), Pleasant Twp., Franklin Co., Ohio. Cole-type site; mound erected over ceremonial center and burials at edge of center. Ceremonial house structure (nearly square, round cornered) 30.5 m N of ceremonial center (Baby, Potter, and Mays, 1966). Coll. 1966 and subm. by R. S. Baby, Ohio State Mus., Columbus, Ohio.

M-1870. Feature II — **720 ± 100** — **A.D. 1230**
Refuse pit.

M-1871. Feature II — **550 ± 100** — **A.D. 1400**
Refuse pit.

M-1872. Feature III — **575 ± 100** — **A.D. 1375**
Refuse pit.

M-1873. Feature IV — **780 ± 110** — **A.D. 1170**
Refuse pit.

M-1875. Feature VII — **1030 ± 120** — **A.D. 920**
Refuse pit.

M-1876. Feature VIII — **450 ± 100** — **A.D. 1500**
Refuse pit.

M-1877. Feature IX — **520 ± 100** — **A.D. 1430**
Refuse pit and foetal burial.

M-1879. Feature XIV — **540 ± 100** — **A.D. 1410**
Refuse pit.

M-1881. Feature XIX — **830 ± 100** — **A.D. 1120**
Refuse pit assoc. with House II.

M-1882. Feature XX — **880 ± 100** — **A.D. 1070**
Refuse pit assoc. with House II.

M-1883. Sq. 220 L 10 — **470 ± 100** — **A.D. 1480**
Midden area, Feature XI.

470 ± 150

M-1884. Sq. 190 L 12 **A.D. 1480**

Midden area, Feature XVIII, House I, small sample.

General Comment (J.B.G.): dates are later than expected by excavators and show unexpected time range. Presence of strap handles and guilloche decoration, however, suggests that at least part of occupation is between A.D. 1200 and 1400.

890 ± 100

M-2010. Oliver Farm site, Indiana **A.D. 1060**

Carbonized wood from Oliver Farm site (39° 54′ 30″ N Lat, 86° 05′ 30″ W Long), NE ¼, NE ¼ Sec. 20, Twp. 17N, Range 4 E, Marion Co., Indiana. Sample from Feature 22, basin-shaped pit beneath more recent alluvial deposits. Pit contained Late Woodland-Fort Ancient pottery, mammal and fish bone. Should date Late Woodland occupation, probably Late Prehistoric to early Historic. Sample placed in Oliver focus (Griffin, 1946) and is characterized by apparent Fort Ancient influence. Coll. 1967 and subm. by J. H. Kellar, G. A. Black Lab. Archaeol., Indiana Univ., Bloomington. *Comment* (J.H.K.): date does not confirm supposed Late Prehistoric or Early Historic occupation. But, with no definitive study of samples and with possibility of some temporal depth present at sites used to define the focus, date might prove correct for some local chronology.

1020 ± 120

M-2076. Boyce Village site, Missouri **A.D. 930**

Partially burned acorns from Boyce Village site (38° 10′ N Lat, 91° 30′ W Long), Jefferson Co., Missouri. Sample from corner of Feature 2. Coll. late 1930's by R. McC. Adams; subm. by J. B. Griffin. *Comment* (J.B.G.): Middle Mississippian site with a considerable amount of clay-tempered cord-marked pottery and Old Village vessels (Adams, 1941; Adams, 1949).

Long Village site series, Missouri

Charred wood and corn from Long Village site (38° 15′ N Lat, 91° 15′ W Long), Jefferson Co., Missouri. Middle Mississippian site (Adams, 1949). Coll late 1930's by R. McC. Adams; subm. by J. B. Griffin.

330 ± 100

M-2077. Long Village site **A.D. 1620**

Charred wood, probably red oak, from F-9, M-66, Sq. 8L1.

320 ± 100

M-2087. Long Village site **A.D. 1630**

Burned corn from F-9, M-66, Sq. 8L1.

General Comment (J.B.G.): dates do not apply to substantial Old Village occupation; charred corn and charred oak have essentially same date.

2690 ± 200

M-2110 and M-2111. Thurman site, Missouri **740 B.C.**

Small fragments of charcoal from Thurman site (23 HE 151) (38° 16′ 12″ N Lat, 93° 35′ 25″ W Long), Henry Co., Missouri. Material from hearth, Feature 62, in NE ¼, Unit 60 SW 5, Level 4 below cultural zone. Assoc. with lithic material, probably Late Archaic component. Samples combined; M-2110 from 58.5 cm below datum, and M-2111 from 57.8 cm below datum. Coll. 1967 by C. R. Falk; subm. by W. R. Wood, Univ. of Missouri, Columbia, Missouri. *Comment* (C.R.F.): date is consistent with both stratigraphic evidence and C^{14} dates from nearby sites (M-1929, 2680 ± 150 B.P., R., 1968, v. 10, p. 86, and GXO-749), and appears to document Late Archaic occupation in W margins of Ozark Highlands, Missouri.

Collins site series, Missouri

Charcoal from Collins site (23 MN 223) (39° 30′ N Lat, 91° 30′ W Long), Monroe Co., Missouri. Coll. 1968 by Alan Osborn; subm. by W. E. Klippel, Illinois State Mus., Springfield, Illinois.

2610 ± 200

M-2142. Feature 2 **660 B.C.**

From basin-shaped pit, 45.7 to 71.1 cm below site surface. Pit contained charred walnut hulls, bone, 2 Woodland points, burned clay, 2 small sherds, many chert flakes, burned limestone, chert hammer stones, retouched flakes, bi-pitted mano, and some roots of modern vegetation.

2520 ± 150

M-2143. Feature 9 **570 B.C.**

From basin-shaped pit, 35.6 to 60.9 cm below site surface. Pit contained few charred nut hulls, some bone, many flakes, burned clay, 2 proximal projectile point fragments, misc. stone, and roots of modern vegetation.

General Comment (W.E.K.): samples date a late Archaic/Early Woodland transition occupation in Missouri's Prairie Peninsula. These are the earliest dates for a ceramic-bearing assemblage in N Missouri. Contents of site, indicate dates are fairly reliable.

Twenhafel site series, Illinois

Charcoal from Twenhafel site (37° 40′ N Lat, 89° 31′ W Long), Jackson Co., Illinois. Near Gorham and Fountain Bluff. Coll. 1958 by J. R. Caldwell; subm. by Thorne Deuel, Illinois State Mus., Springfield, Illinois.

1150 ± 150

M-1190. Twenhafel **A.D. 800**

From fill of abandoned storage pit containing Raymond sherds exclusively. Date should fall within Raymond period of Late Woodland period of S Illinois.

550 ± 100

M-1191. Twenhafel **A.D. 1400**

From burned timbers of a house (Feature 18) containing Mississippian pottery.

520 ± 200

M-1192. Emmons site, Illinois **A.D. 1430**

Charcoal from Emmons site (40° 11′ N Lat, 90° 13′ W Long), Fulton Co., Illinois. From burned timber of a Mississippian house. Pottery on house floor was Mississippian Plain and Cordmarked; the latter resembled Cahokia Cordmarked but with interior red slips. Coll. 1960 by J. R. Caldwell; subm. by Thorne Deuel.

Dickson Mound series, Illinois

Charcoal from Dickson Mounds (40° 20′ N Lat, 90° 10′ W Long), Fulton Co., Illinois. Pre-Spoon River Mississippian occupation at the Eveland Tract, Dickson Mounds. Coll. 1959 and 1960 by J. R. Caldwell; subm. by Thorne Deuel.

680 ± 150

M-1193. Dickson Mounds **A.D. 1270**

From burned roof timbers of an earthlodge-like structure, House 2.

650 ± 200

M-1194. Dickson Mounds **A.D. 1300**

From a burned timber of House 6 which had a cruciform ground plan.

1040 ± 150

M-1195. Meyer (Bluff) Cave, Illinois **A.D. 910**

Charcoal from Meyer (Bluff) Cave zoologic deposit, NW ¼, Sec. 6, T.2S, R.10W, New Hanover Twp., Monroe Co., Illinois. From cave zoologic deposit layer .915 to 1.22 m down. Nearby in same level are bones of striped skunk, spotted skunk, and porcupine, all extinct in Illinois. Coll. 1960 by Paul Parmalee; subm. by Thomas Deuel.

General Comment (T.D.): Raymond is S Illinois Late Woodland focus and differs from analogous focus in Fulton Co. The dates for Late Woodland at Bluff Cave and Mississippian "Old Village" at Eveland do seem rather close together, but sites are 161 kms apart. Hopewellian maintained its characteristic artifacts longer in S Illinois than farther N, consequently Late Woodland appears later in S Illinois.

Middle Mississippian culture seems to have flourished at Cahokia and vicinity from 10th century or earlier to ca. 1500 or somewhat later. Dates for sites of that culture lie within that range.

Because 5 or possibly 6 foci of Late Woodland are strung from the S to N boundaries of Illinois and all show incipient Mississippi traits, it seems that Mississippian culture in Illinois developed out of Late Woodland which in turn had replaced Hopewellian.

1720 ± 300

M-2045. New Castle site, Indiana **A.D. 230**

Charcoal from New Castle site (40° 47′ 03″ N Lat, 85° 21′ W Long), T.17N, R.10E, SW ¼, NE ¼, Sec. 2, Henry Co., Indiana. Sample from 8F9-11, Pit N1-W7, 0 to 40.7 cm N, 35.6 to 50.8 cm E, 22.8 cm deep, Woodland site (Swartz, 1966; Lilly, 1963; Redding, 1892; Strickler and Wilson, 1967). Coll. 1965 by Walter Koch; subm. by B. K. Swartz. *Comment* (B.K.S.): date is somewhat later than A.D. 10 ± 140 obtained from previous sample deeper in earthwork, M-1852 (R., 1970, v. 12, p. 163). It seems to be from a later component, probably the one of the intrusive infant burial. Sample was stored in paper and may be slightly contaminated.

Malone Site series, Michigan

Charcoal from Malone site (43° 15′ N Lat, 83° 15′ W Long), Saginaw Co., Michigan, 153 m S of N edge of ridge above flood plain 183 m W of Flint R. Coll. 1967 by Bernard Spence; subm. by J. E. Fitting, Case Western Reserve Univ., Cleveland, Ohio.

540 ± 100

M-2122. Feature 9 **A.D. 1410**

Upper element: assoc. with shell-tempered Oneota rim, late Saginaw Wayne ware with narrow neck and many small castellations, a sherd of Parker Festooned, and carved bone antler. Should date Mississippian influenced Woodland in Saginaw Valley: ca. A.D. 1300 to 1500. *Comment* (J.E.F.): dates distinctive Mississippian occupation at Malone site and is very satisfactory. Occupation is known from rare surface colls., but Malone is 1st site where it was isolated.

850 ± 110

M-2123. Feature 10 **A.D. 1100**

Lower element: assoc. with large, globular Wayne ware vessel, 2 Pickering (?) rim sherds, and drilled shell fragments. Should date Saginaw Valley Late Woodland similar to Bussinger site or slightly later: ca. A.D. 1100 to 1400. *Comment* (J.E.F.): dates late Woodland feature, is satisfactory, and is in correct stratigraphic placement in relationship to M-2122, as well as consistent with other Saginaw Valley Late Woodland dates from Schultz and Bussinger sites (R., 1968, v. 10, p. 74, 77, and 78).

120 ± 100

M-2218. Van Nuys site, Indiana **A.D. 1830**

Charcoal from Van Nuys site (12 Hn 25) (39° 57′ 30″ N Lat, 85° 22′ 00″ W Long), T.17N, R.10E, NW ¼, Sec. 2, Henry Twp., Henry Co., Indiana, from SE corner of pit S16, W1, 8.25 cm deep, assoc. with firepit. Pottery is Late Woodland. Coll. 1968 by Ben Morris; subm. by B. K. Swartz, Jr., Ball State Univ., Muncie, Indiana. *Comment* (B.K.S.): sample was recovered from an undisturbed area, but not in direct assoc. with any pottery, the features of which would not rule out possible

proto-historic late Woodland occupation at the Van Nuys site (Swartz, 1970, p. 15).

1860 ± 140

M-2223. Peisker site, Illinois **A.D. 90**

Wood charcoal from Peisker site (39° 05′ 26″ N Lat, 90° 35′ 43″ W Long), Calhoun Co., Illinois, from a Havana-Hopewell habitation site underlying a Hopewell burial mound. Sample from pit intruded into fossil river beach underlying Mound 3 prior to mound construction. Feature 5, Submound 3. Assoc. with Havana- and Hopewell-ware sherds. Should date Havana-Hopewell phase in Lower Illinois Valley. Coll. 1968 and subm. by Stuart Struever, Northwestern Univ., Evanston, Illinois. *Comment* (S.S.): pottery is "early Hopewell" and date seems appropriate.

Macoupin site series, Illinois

Wood charcoal and charred nuts from Macoupin site (39° 10′ N Lat, 90° 34′ 30″ W Long), Jersey Co., Illinois. Coll. 1968 by F. Rackerby and Stuart Struever; subm. by Stuart Struever.

2020 ± 200

M-2225. Sample 6 **70 B.C.**

Small fragments of wood charcoal and possibly charred nutshells from redeposited hearth assoc. exclusively with Havana-ware sherds. Not a good run.

2410 ± 210

M-2226. Sample 9 **460 B.C.**

Consolidated wood charcoal and possibly nutshell from areas within fill of pit feature, No. 31. Charcoal is probably redeposited general midden.

1950 ± 200

M-2229. Sample 109 **0 B.C./A.D.**

Charcoal from pit containing exclusively Havana-Hopewell pottery; no Pike or Baehr pottery. Pit, Feature 127, contained limestone slab and restorable vessel. Small sample.

1900 ± 140

M-2243. Sample 63 **A.D. 50**

Wood charcoal from charcoal concentration in redeposited hearth excavated in upper level of large refuse-storage pit, Feature 173. Charcoal from a single fire appears to be represented here. Sample from pit containing exclusively Havana-ware and Hopewell-ware sherds.

1500 ± 130

M-2244. Sample 97 **A.D. 450**

Redeposited charcoal in pit fill, Feature 44b. Pit contained 8 Havana-ware and 2 Crab Orchard Fabric-Impressed sherds only.

1730 ± 130

M-2245. Sample 101 **A.D. 220**

Redeposited hearth residue in pit feature, No. 215. Six Havana-ware sherds were recovered from this feature.

General Comment (S.S.): all 6 dates were from context containing Havana-ware and Hopewell-ware pottery only and should pertain to Havana-Hopewell phase (*i.e.*, "early Hopewell") in the lower Illinois Valley. M-2225, M-2229, M-2243, and M-2245 fall within 100 B.C. to A.D. 200 range expected for Havana-Hopewell. M-2226 is much too early and probably represents redeposited charcoal assoc. with a preceding Black Sand phase site at Macoupin; date is appropriate for Black Sand. M-2244 is too late for Havana-Hopewell, but falls within range of later Pike-Hopewell phase. This charcoal may be assoc. with the Pike-Hopewell occupation at Macoupin.

Old Clarksville site series, Indiana

Charcoal from Old Clarksville site (38° 17′ 20″ N Lat, 85° 46′ 00″ W Long), Clark Co., Indiana. Sample from midden deposit; should date Archaic occupation of Indian Knoll "type". Coll. 1969 and subm. by D. E. Janzen, Beloit College, Beloit, Wisconsin.

4180 ± 180

M-2307. Old Clarksville site **2230 B.C.**

Unit C, 38.1 to 45.7 cm below datum.

4460 ± 180

M-2308. Old Clarksville site **2510 B.C.**

Unit F, 60.9 to 68.5 cm below datum.

4460 ± 180

M-2309. Old Clarksville site **2510 B.C.**

Unit D, 60.9 to 68.5 cm below datum.

General Comment (D.E.J.): samples date Indian Knoll type component at the Falls of the Ohio R.

1620 ± 140

M-2342. Hopewell site, Ohio **A.D. 330**

Wood charcoal, ash, id. by Suzanne Harris, from Mound 17, Hopewell site, Ross Co., Ohio. Possibly from "charred oak" of Moorehead or charcoal on mound floor. Assoc. with 3000 sheets of mica, 200 lbs. of galena, and fossil sharks teeth. From Field Mus. colln. Coll. 1891 by W. K. Moorehead; subm. by J. B. Griffin with permission of Donald Collier, Field Mus. of Nat. History, Chicago. *Comment* (J.B.G.): somewhat later than expected.

910 ± 110

M-1784. Cahokia Mound 51, Illinois **A.D. 1040**

Burned twigs and grass (R-14) from Cahokia Mound 51 (38° 39′ 48″ N Lat, 90° 13′ 33″ W Long) St. Clair Co., Illinois. Mound across from old Ramey house, SE corner of Monks Mound at corner of US 40 and Catherine St., 20.3 to 25.4 cm below top of water laid (very hard

packed) silty sand (heavy rust line). Water laid material found below base of mound fill. Assoc. pottery, composed of much shell; would suggest mound was built later in sequence of mounds. Coll. and subm. by James Porter, P.O. Box 276, Marshall, Wisconsin.

720 ± 110

M-1785. Bischoff site, Illinois **A.D. 1230**

Burned thatch from Bischoff site (38° 42′ 27″ N Lat, 90° 06′ 56″ W Long), SE ¼, SE ¼ Sec. 17, Twp. 3 N, Range 9 W, Madison Co., Illinois, from 35 m S and 10.7 m E of construction stake 2+ 24.74 at 1 m depth below surface of 420 to 422 contour ridge. Assoc. with Mississippian and Cahokia Cordmarked pottery. Coll. 1965 and subm. by James Porter. *Comment* (J.B.G.): excellent date for this assemblage.

Bowen site series, Indiana

Charred wood from Bowen site (39° 53′ 45″ N Lat, 86° 07′ 10″ W Long), Marion Co., Indiana. Coll. 1961 and 1963 by J. C. Householder; subm. by J. H. Kellar and J. T. Dorsey, Glenn A. Black Lab. Archaeol., Indiana Univ., Bloomington, Indiana.

1370 ± 130

M-2421. Bowen site **A.D. 580**

Feature 46, a circular refuse pit 1.37 m diam.; floor lined with heat-cracked rock and large pieces of charred wood. Entire bottom showed heavy burning in form of ash and reddened soil. Sample from charred log 1.09 m below surface and well within burned area. Fort Ancient and Late Woodland pottery and considerable corn in pit.

740 ± 110

M-2422. Bowen site **A.D. 1210**

Feature 88. Large rectangular refuse pit 2.14 by 1.83 m, from .49 to .61 m level under dog burial but still .18 m above floor. Fort Ancient and Late Woodland pottery mixed in pit.

General Comment (J.B.G.): M-2421 is too early for assoc. cultural material which should be closer in time to date on M-2422.

2840 ± 250

M-2424. Yankeetown site, Indiana **890 B.C.**

Carbonized plant material from Yankeetown site (12 W 1) (37° 54′ 20″ N Lat, 87° 18′ 45″ W Long), Anderson Twp., Warrick Co., Indiana. Sample from Feature 7, a circular pit with rounded bottom occurring in alluvial deposits at depth 3.37 to 3.54 m below ground surface. Pit contained numerous fragments of hickory and walnut as well as flint chips, 2 pieces of sandstone, and 1 flint nodule. Date should approximate M-2009: 2740 ± 150 B.P. (R., 1970, v. 12, p. 170). Coll. 1968 by Kent Vickery; subm. by J. H. Kellar. *Comment* (J.B.G.): date supports age assessment on M-2009 for this Early Woodland horizon at Yankeetown site.

Mounds State Park series, Indiana

Carbonized plant material from Mounds State Park (12 M 2) (40° 06′ N Lat, 85° 37′ 30″ W Long), Union Twp., Madison Co., Indiana, from large circle ca. 91.5 m diam. defined by a deep trench, removed earth cast outside with an entrance to the SW. A small mound is in approx. center, consisting of 2 primary structures, the earlier being 3 superimposed baked clay platforms. The secondary mantle contained 4 burials, 2 of which were in a log tomb. Assoc. artifacts: a plain platform pipe, bone bear effigy canines, and ceramics seemingly related to the Newcastle series. Coll. 1969 by Kent Vickery; subm. by J. H. Kellar, Dept. Anthropol., Indiana Univ., Bloomington, Indiana.

1720 ± 130

M-2428. Post Hole 2 **A.D. 230**

Protruding into primary platform in small mound in approx. center of "Great Mound".

2010 ± 140

M-2429. Post Hole 3 **60 B.C.**

Protruding into primary platform in small mound in approx. center of "Great Mound."

General Comment (J.B.G.): dates are satisfactory for E central Indiana middle Woodland complex.

Lower Mississippi Valley and Southeast U.S.

840 ± 110

M-2075. Spiro site, Oklahoma **A.D. 1110**

Bark (*Juniperus virginiana*) from Spiro site (35° 18′ 45″ N Lat, 94° 30′ 00″ W Long), Le Flore Co., Oklahoma, from Craig Mound, combining A-20, Layers 2 and 3, and B167-4, from adjacent layers of cedar bark that cover group burials in a small primary mound in 3rd mound unit of Craig (Brown, 1966). Sample lies stratigraphically above burial (B-177) with vessels of French Fork Incised, Coles Creek Incised, and Le Flore Plain assoc. with a "bugstone" quartz crystal effigy atlatl weight. Burial is one of Orr's (1952) principal Evans Focus graves. Coll. 1937 by F. E. Clements; subm. by J. A. Brown, Dept. Anthropol., Michigan State Univ., East Lansing. *Comment* (J.A.B.): stratigraphically equivalent sample was assayed as O-2283 (Brown, 1967) dated 500 ± 100 B.P. Latter determination was thought too young and, although present C^{14} date is older and more consistent with other Spiro dates, it still is probably too young.

810 ± 110

M-2149. Pine Harbor site, Georgia **A.D. 1140**

Charred wood from Pine Harbor site (9 McI 64) (31′ 33′ N Lat, 81° 22′ W Long), McIntosh Co., Georgia. From base of short (probably one season) occupation shell heap. Late, immediately pre-Spanish Lamar occupation. Coll. 1966 by Trawick Ward; subm. by L. H. Larson, Eastern Kentucky Univ., Richmond, Ky. *Comment* (L.H.L.): sample

dated too early, even if end of its time range is considered. Typologically, the materials appear to belong to the period immediately preceding the arrival of the Spanish on the Georgia coast in the latter half of the 16th century.

M-2187. Schafner Mound I site, Illinois **1730 ± 140** **A.D. 220**

Charred human bone from Schafner Mound I site (39° 31′ 03″ N Lat, 90° 59′ 37″ W Long), Pike Co., Illinois. Hopewell burial mound containing a log tomb; Havana vessels assoc. with bundle burials, 5 vessels covered with red ochre. Coll. and subm. by Gregory Perino, Thomas Gilcrease Inst. Am. History and Art, Tulsa, Oklahoma. *Comment* (G.P.): date verifies continued manufacture of Havana ware at this late date.

Dumond site series, Arkansas

Charcoal from Dumond site (3 AR 40) (34° 16′ N Lat, 91° 13′ W Long), Arkansas Co., Arkansas. Samples from mound-buried houses at extensive multicomponent site. Remains under Mounds 4 and 6 are of round Baytown houses with 4-center-support-post construction and large central basin firepits; major assoc. pottery types Baytown Plain and Mulberry Creek cord marked, minor Evansville Punctated, Larto Red Filmed, and Indian Bay Stamped. Remains under Mound 59 are of a rectilinear Mississippi house with central hearth and no interior supports; major assoc. pottery type Neeley's Ferry Plain, minor Old Town Red and Parkin Punctated. Earlier report of site describes different house construction at an intermediate component (Scholtz, 1968). Coll. 1968 by J. A. Scholtz; subm. by C. R. McGimsey, Ark. Archaeol. Survey, Fayetteville, Arkansas.

M-2139. Mound 6 **990 ± 150** **A.D. 960**

Sample 68-285-333. Central firepit of Baytown house, 200 to 227 cm below datum.

M-2140. Mound 6 **790 ± 110** **A.D. 1160**

Sample 68-285-241. Wall posthole of Baytown house, 180 to 195 cm below datum.

M-2141. Mound 4 **800 ± 110** **A.D. 1150**

Sample 68-285-180. Central firepit of Baytown house.

M-2144. Mound 59 **430 ± 100** **A.D. 1520**

Sample 68-285-S61. Central hearth of Mississippi house, 220 cm below datum.

General Comment (C.R.McG).: dates are consistent with assoc. materials and may be considered good. Samples M-2139-2141 should be nearly identical dates and easily overlap within the 1 σ range. House under

Mound 6 was rebuilt at least once, but central firepit was used through all periods of house suggesting an actual 200-yr difference between any of the walls and firepit. These 3 samples average A.D. 1090, close to a terminal date for Baytown in E Arkansas. The Mississippi house of M-2144 is adjacent to a large flat-topped pyramidal temple mound and is probably contemporaneous with it.

2820 ± 150

M-2154. Poverty Point site, Louisiana **870 B.C.**

Charred cane from Poverty Point site (16 wC 2) (32° 38′ 10″ N Lat, 91° 24′ 20″ W Long), West Carroll Parish, Louisiana, N sec., Ridge 2, at junction of ridge and bank of Bayou Macon. Sample from mass of charred cane in shallow pit immediately subadjacent to midden exposed to caving and protected under root system of large tree, ca. 2.44 m from surface, in lowest occupation level. Beneath tree was level length of midden, with 3.66 to 7.32 m unburned streaks in lower part, immediately above and extending laterally on each side of sample pit. Suggests burning of house and partial firing of pit material. Below midden and around pit was sterile, undisturbed Arkansas white clay-sand. Assoc. with Poverty Point clay objects, cylindrical grooved and cross-grooved, with other occupational debris, but no sherds. Coll. 1968 by Mitchell Hillman; subm. by C. H. Webb, The Childrens Clinic, Shreveport, Louisiana. *Comment* (C.H.W.): sample is part of same material from which Tx-680, 3000 ± 90 B.P. (R., 1970, v. 12, p. 636-637), was derived. The two dates are consistent within 1 σ range and agree reasonably well with M-403: 2850 ± 250 B.P. (Science, 1958, v. 127, p. 1101); L-195: 2860 ± 90 (Science, 1956, v. 124, p. 163); O-66: 3150 ± 120 (Science, 1957, v. 125, p. 149) and several others from the site (Ford and Webb, 1956, p. 121-122). Present date and the one from Texas Lab. suggest construction of geometric ridges at Poverty Point began after 1000 to 900 B.C. Recent dates from Teoc Creek site (M-2393-95; M-2412-17, R., this issue) in Yazoo Basin of Mississippi established Poverty Point cultural occupation between 1700 B.C. and 1070 B.C. at this site and suggest that Poverty Point culture may have been established earlier along ancestral Mississippi R. than along ancestral Arkansas at Poverty Point site.

Yokem Mounds site series, Illinois

Charcoal and charred human bone from Yokem Mounds site (39° 29′ 38″ N Lat, 90° 56′ 16″ W Long), Pike Co., Illinois. Coll. and subm. by Gregory Perino.

1040 ± 120

M-2188. Yokem Mounds 6 and 7 **A.D. 910**

Charcoal from stone-lined subfloor tomb between Yokem Mounds 6 and 7.

1080 ± 120

M-2189. Yokem Mound 7 **A.D. 870**

Charred human bone, fragment right femur and fragment innomi-

nate bone of male, id. by C. L. Brace, Univ. of Michigan, from Feature A, Tomb A, Late Woodland.

M-2190. Yokem Mound 8 **1080 ± 120**
A.D. 870

Charcoal from burned log of roof in W end of single tomb of stone. Late Woodland.

M-2191. Yokem Mound 9 **1180 ± 120**
A.D. 770

Charred human bone, fragments of femur and skull, id. by C. L. Brace, from Feature A, Tomb A of mound.

General Comment (G.P.): tombs were constructed of limestone slabs. Pottery style is Late Woodland defined by 4 castilations on rim in "Maple Mills" style but these are earlier. Arrow points were side-notched and made on flakes; dart points were small, usually fully flaked and also side-notched. Pipes were like some from Effigy Mound culture in Wisconsin. Average of dates shown should indicate latest period when Late Woodland people were making stone crypts in Illinois although at least 1 burned log structure was found in line with 2 stone structures in Mound 6. According to technologic progress noted for these people, M-2191 (A.D. 770) should be a mean date for existence of group.

M-2256. McCarter Mound, Mississippi **1610 ± 140**
A.D. 340

Charcoal from McCarter Mound (ca. 34° 20′ N Lat, 90° 54′ W Long), Batesville, Panola Co., Mississippi, from balk 95 to 100, 91.5 cm deep from 100 in mound, Stage 2, down from center. Twin Lakes phase of Hopewellian period. Purpose is to date appearance of conjoined tubes in Lower Mississippi Valley. Coll. and subm. by Glenn Johnson, Delano, Tennessee. *Comment* (G.J.): charcoal from Stage 2 construction which postdates copper conjoined tube and Crowder and Twin Lakes bowls. Date rules out possibility that Twin Lakes and Crowder Punctate pottery (from Stage 1) are later than 1610 ± 140 B.P. and supports an earlier date. Charcoal came from Stage 2, separated from Stage 1 by a humus layer, 7.62 to 12.7 cm thick, suggesting a considerable time lapse between Stage 1 and Stage 2 construction.

Saint Albans site series, West Virginia

Charcoal from St. Albans site (46 Ka 27) (38° 23′ N Lat, 81° 48′ W Long), Kanawha Co., West Virginia. Coll. 1968 and subm. by Bettye Broyles, West Virginia Geol. Survey.

M-2288. St. Albans site **8470 ± 300**
6520 B.C.

Charcoal, Cat. No. 135, from Zone 24.

M-2289. St. Albans site **8800 ± 320**
6850 B.C.

Charcoal, Cat. No. 196, from Zone 16.

9330 ± 330
M-2291. St. Albans site **7380 B.C.**

Charcoal, Cat. No. 198, from Zone 20. Assoc. with small Kirk projectile point within zone. Yale date is 6980 B.C. ± 160 (Y-1538, R., 1969, v. 11, p. 616).

8240 ± 300
M-2292. St. Albans site **6290 B.C.**

Charcoal Cat. No. 134, from Zone 12. Assoc. with St. Albans A projectile point within zone. Earlier Michigan date: 6880 B.C. ± 700 (M-1821, R., 1968, v. 10, p. 96).

9000 ± 600
M-2293. St. Albans site **7050 B.C.**

Charcoal, Cat. No. 133, from Zone 11, 75 R, 25, Feature 22. Assoc. with St. Albans B projectile point within zone. Earlier Michigan date: 6870 B.C. ± 500 (M-1820, R., 1968, v. 10, p. 96). Small sample.

8850 ± 320
M-2294. St. Albans site **6900 B.C.**

Charcoal, Cat. No. 204, from Zone 18. Assoc. with large Kirk corner-notched projectile point.

8560 ± 600
M-2295. St. Albans site **6610 B.C.**

Charcoal, Cat. No. 203, from Zone 19A or 20, circular hearth. Assoc. with large Kirk corner-notched projectile point.

General Comment (J.B.G.): dates should be compared with earlier Michigan and Yale age assessments (Broyles, 1971).

Northeastern U.S.

Antonio site series, Pennsylvania

Charcoal from Antonio site (41° 59′ N Lat, 77° 16′ W Long), Tioga Co., Pennsylvania. Possibly Early Woodland assoc. Coll. 1967 and subm. by J. W. Gruber, College of Liberal Arts, Temple Univ., Philadelphia, Pa.

800 ± 110
M-2124. Sample 67-C1 **A.D. 1150**

Feature 76, .885 m diam., .794 m deep from interface, 1.02 m from stake 0 + 50 L220. Charcoal in feature assoc. with bone and rim sherds.

1160 ± 120
M-2125. Sample 67-C2 **A.D. 790**

Feature 48, large discolored area 4.58 m diam. Charcoal throughout assoc. with sherds and flint artifacts including 2 points.

1260 ± 120
M-2126. Sample 67-C3 **A.D. 690**

Feature 64. Bone, flint chips, and pottery sherds assoc. with charcoal. Lower half of feature.

M-2127. Sample 67-C4 **830 ± 100**
A.D. 1120

Feature 48A intrusive in Feature 48. Charcoal assoc. with pottery and 1 point.

M-2128. Sample 67-C5 **2570 ± 160**
620 B.C.

Feature 31, fire pit. Sample from beneath fire-cracked rocks in feature .489 m deep from interface and .326 m deep from top of stake 0 + 20 L110.

General Comment (J.B.G.): dates suggest at least 2 occupations on site.

St. Croix Island series, Maine

Shell (*Mya arenaria* Linné) Gaper or soft shell clam, id. by Henry van der Schalie, Mollusc div., Mus. Zool., Univ. of Michigan, from St. Croix I., Maine. Coll. and subm. by J. W. Gruber, Temple Univ., Philadelphia.

M-2409. St. Croix Island **0 ± 100**
A.D. 1950

Sample STC-69-5, 50-18.

M-2410. St. Croix Island **180 ± 100**
A.D. 1770

Sample STC-69-5, 50-19.

M-2411. St. Croix Island **150 ± 100**
A.D. 1800

Sample STC-69-5, 50-20.

General Comment (J.B.G.): shell apparently assoc. with French occupation.

Great Plains and Western U.S.

M-1420. Arp site, South Dakota **1140 ± 120**
A.D. 810

Charcoal from Arp site (39 BR 101) (43° 35′ N Lat, 99° 20′ W Long), Brule Co., South Dakota. Sample from Excavation Unit 3, Feature 4, small fire pit in Level 4, at depth 104.3 cm from surface. Corn cobs and cache pits were present but no house remains (Hurt, 1961). Coll. 1961 by Mike McCurry; subm. by W. R. Hurt, Univ. Mus., Indiana Univ. *Comment* (W.R.H.): sample assoc. with typical Late Woodland sherds, such as Scalp wares, found in sites extending S-ward from middle Missouri into N central Nebraska (Gant, 1967).

Tom Pound Ranch site series, New Mexico

Mammoth bone and tusk from Tom Pound Ranch site (34° 26′ N Lat, 105° 46′ W Long), SE/Y, NW/Y, NE/Y, Sec. 33, T.3N, R.11E, Torrance Co., New Mexico. Samples occurred in "Big Sink" clay, a sandy, white calcareous and gypsiferous deposit, laid down in Pleistocene Lake Estanica. Coll. 1965 by T. R. Lyons; subm. by J. M. Campbell, Univ. of New Mexico.

6000 ± 200
M-1764. Tom Pound Ranch site **4050 B.C.**
Sample 4.

7950 ± 300
M-1765. Tom Pound Ranch site **6000 B.C.**
Sample 5.

General Comment (J.B.G.): dates are too late for mammoth at this location.

Hidden Valley site series, Montana

Black, humic deposit, containing decayed vegetal material, from Hidden Valley site (24 Pw 340) (46° 42′ 40″ N Lat, 112° 40′ 42″ W Long), SE ¼, Sec. 14, Twp. 11 N, Range 9 W, Powell Co., Montana. Coll. 1967 by C. A. Stevens and P. M. Hobler; subm. by P. M. Hobler, Simon Fraser Univ., Burnaby, British Columbia.

9620 ± 330
M-1973. Hidden Valley site **7670 B.C.**
Feature 1, lowest of 3 humic levels.

9200 ± 300
M-1974. Hidden Valley site **7250 B.C.**
Feature 4, lowest of 3 thin humic levels.

General Comment (P.M.H.): dates are from organic material in a pond deposit. Cultural material was found throughout deposit to almost 2-m depth. Lusk-type projectile points were found in upper portion of deposit stratigraphically above dated unit. Dates seem consistent with cultural and stratigraphic data.

Mexico, Central America, South America

La Lagunita site series, Mexico

Charcoal from La Lagunita (16° 03′ 08″ N Lat, 95° 00′ 05″ W Long), Juchitan, Oaxaca, Mexico. Coll. 1963 by Agustin and Hilda Delgado; subm. by Agustin Delgado, San Luis Potosi, Mexico.

1920 ± 140
M-1771. La Lagunita **A.D. 30**
Wood charcoal from Pit 6, Level 10, NE corner, 2.5 m depth. Proto-Zapotec culture, Middle Preclassic.

1750 ± 120
M-2080. La Lagunita **A.D. 200**
Wood charcoal from Pit 6, Level 10, 2.5 m depth. Proto-Zapotec culture, Middle or Late Formative. *Comment* (A.D.): expected date: ca. 400 B.C.

2080 ± 140
M-1773. Medidas de Bixa'ana, Mexico **130 B.C.**
Wood charcoal from Medidas de Bixa'ana (16° 03′ 02″ N Lat, 95° 02′ 03″ W Long), Tehuantepec, Oaxaca, Mexico. Sample from Pit 3,

Level 10, 2.5 m depth. Should date Early or Middle Preclassic. Coll. 1963 and subm. by Agustin Delgado. *Comment* (J.B.G.): date is later than expected.

M-1774. Ti Pin site, Mexico **2260 ± 140** **310 B.C.**

Wood charcoal from Ti Pin site (16° 01′ 09″ N Lat, 94° 09′ 08″ W Long), San Mateo del Mar, Tehuantepec, Oaxaca, Mexico. Sample from Hearth No. 2, 0 to 10 cm. Coll. 1963 and subm. by Agustin Delgado. *Comment* (A.D.): date seems satisfactory.

M-1993. Panuco site, Mexico **3950 ± 180** **2000 B.C.**

Charcoal from Panuco site (22° 04′ N Lat, 98° 11′ W Long), Veracruz, Mexico. Sample from Site 2R, FN 33, Feature 2, prehistoric pottery stove or kiln, 2nd *estufa* found in pre-Columbian archaeologic context. Chronologic position would be Panuco IV based on Ekholm-McNeish scheme. Coll. 1967 and subm. by A. R. Kelly, Dept. Anthropol., Univ. of Georgia, Athens, Georgia. *Comment* (A.R.K.): date is much earlier than expected.

Ajijac series, Mexico

Charcoal from site PN. 6 just W of village of Ajijac, on N shore of Lake Chapala, Jalisco, Mexico, in Puerta Nueva region. Site is ca. 11.2 km W of town of Chapala (20° 20′ N Lat, 103° 10′ W Long). Samples from the same stratigraphic levels in 2 different test pits at site. Coll. by M. N. Bond; subm. by D. S. Phelps, East Carolina Univ., Greenville, North Carolina.

M-2437. Ajijac **510 ± 200** **A.D. 1440**

General level, 1.80 m depth.

M-2438. Ajijac **510 ± 100** **A.D. 1440**

Test pit G, 1.95 to 2.10 m depth, "garbage pit" with heavy accumulation of sherds.

General Comment (M.N.B.): 1st analysis of material assoc. with samples indicated levels should be correlated with Chapala phase of S basin of Lake Chapala. But further study indicates levels should be assigned to later Santa Cruz phase; dates 510 ± 200 and 510 ± 100 (A.D. 1440) support this tentative dating. Assoc. cultural remains, however, suggest levels probably belong to early part of Santa Cruz phase, ca. A.D. 1100 or 1200, rather than as late as A.D. 1440.

M-2442. Kaminaljuyu site, Guatemala **1730 ± 130** **A.D. 220**

Sample from Kaminaljuyu site (16° 19′ N Lat, 90° 45′ W Long), Valley of Guatemala, Guatemala. Sample No. KJ68-1786; Zone Area Sec. 46-22-090, Sq. NL, Feature 36, Level 13, Elite residence platform. Assoc. with obsidian specimens dated by obsidian hydration. Coll. 1968

by J. W. Michels and W. T. Sanders; subm. by J. W. Michels, Pennsylvania State Univ., University Park, Pennsylvania. *Comment* (J.W.M.): dates one of occupational phases of a Terminal Formative elite residence platform (Mound B II 1). Provisional hydration rate for Kaminaljuyu (7.09 mu^2/1000 yr) suggests 1σ standard deviation below the mean represents actual time of occupancy (A.D. 90 to 220), based on obsidian dating of 4 obsidian artifacts in direct assoc. with C^{14} sample.

630 ± 120
M-1639. Juella site, Argentina **A.D. 1320**

Wood from Juella site, Prov. Jujuy, Argentina, from room No. 21, Unit 20 to 22, in cist with skeleton of adult. Assoc. with 3 types of pottery: Tilcara Black on Red, Angosto Chico Invised, Hernillos Black on Red. Pottery belongs to Humahuaca culture and will be 1st absolute date on this culture. Coll. 1964 and subm. by A. R. Gonzales, Mus. de La Plata, La Plata, Argentina. *Comment* (A.R.G.): date is satisfactory.

Europe and Near East

Tell er-Rumeith site series, Jordan

Charcoal from Tell er-Rumeith site (32° 32′ 51″ N Lat, 36° 00′ 31″ E Long), Jordan. Syrian Iron Age pottery of this area has not been extensively dated or published. Pottery from 4 distinct strata within period provided evidence of typologic development. Detailed literary and historic documents have been correlated with stratigraphy, but assessment with C^{14} dates is needed. Coll. and subm. by P. V. Lapp, Pittsburgh Theological Seminary, Pittsburgh, Pa.

2860 ± 160
M-2028. Sample No. 1 **910 B.C.**

From burnt debris on cobbled floor of gateway of Stratum VIII. Floor laid upon thin makeup set up bedrock. Floor cut by construction trench for Syrian fort wall Stratum VII. Burnt debris dates destruction of VIII. Est. date: ± 900 B.C.

2420 ± 140
M-2029. Sample No. 2 **470 B.C.**

From posts used in mudbrick wall rebuilt in Stratum VII and destroyed by fire at end of period. Est. date by typology and history: ± 850 B.C.

2580 ± 140
M-2030. Sample No. 3 **630 B.C.**

From posts in fallen mudbrick superstructure of Stratum VII. Syrian fort wall of same destruction as Sample 2.

2530 ± 150
M-2031. Sample No. 4 **580 B.C.**

From posts of Stratum VIII. Brick fort wall superstructure destroyed at end of Stratum VII as Samples 2 and 3.

2610 ± 150

M-2032. Sample No. 5 **660 B.C.**

In layer of burnt brick destruction upon Stratum VI floor of domestic room; dates Stratum VI destruction. Est. typologic date: ± 800 B.C.

2820 ± 150

M-2033. Sample No. 6 **870 B.C.**

From burnt debris on flagstone floor of cistern court probably reused in Stratum VI just outside Stratum VII defense line.

2800 ± 150

M-2034. Sample No. 7 **850 B.C.**

From burnt debris E end of Stratum V kiln fire box; end of Stratum V set by typologic-historic correlation: 732 B.C.

2130 ± 140

M-2035. Sample No. 8 **180 B.C.**

From burnt debris of floor of house destroyed at end of Stratum V.

General Comment (Howard Jamieson): the 2 terminal dates reported in radiocarbon studies agree with tentative conclusions of excavators. Both reports date occupation at bed rock to 10th century B.C. and most recent material is dated to 2nd century B.C. Separation of strata by pottery typology and architectural features is not closely supported by radiocarbon studies, but general scheme agrees well with these studies. Radiocarbon studies of material established date which agrees with typologic data. Destruction at Tell er-Rumeith was massive; thus, materials were understandably concentrated and dispursed by later occupations. M-2029 is only date that does not fit.

Korucutepe site series, Turkey

Charcoal from Korucutepe (38° 42′ N Lat, 39° 30′ E Long), 30 km E of Elazig, Turkey (Mellink, 1969, p. 210-211). Subm. by M. N. van Loon, Oriental Inst., Univ. of Chicago, Chicago, Illinois.

3900 ± 170

M-2376. Korucutepe **1950 B.C.**

Operation O 11, Area 1, Level 5, +827.87 m. Beam lying immediately inside doorway of burned house, with carbonized branches and pieces of roof. House contains plastered hearth platform and "black burnished" pottery typical of East Anatolian Early Bronze Age culture, specifically of Early Bronze II phase. Estimated date: ca. 2600 to 2300 B.C. Coll. 1968 by Juris Zarins. *Comment* (M.N.vL.): even 1950 ± 170 = 2120 B.C. seems too late, but with MASCA tree-ring correlation of + 400 we get 2350 B.C. ± 170, which seems correct.

3060 ± 150

M-2377. Korucutepe **1110 B.C.**

Operation O 21, NE, Level 2, Pit B. Elev.: +827.47 m. Sample from set of pits containing Late Bronze Age "orange wheel-marked" pottery

and hieroglyphic seal impressions as found at Bogazköy and other Hittite sites. Estimated date: ca. 1250 to 1200 B.C. Coll. 1968 by M. K. Buccellati. *Comment* (M.N.vL.): Hittite Empire was destroyed ca. 1175 B.C., so 1110 B.C. seems too late, but MASCA tree-ring correction gives 1110 + 100 = 1210 ± 150 B.C., which seems correct.

100 ± 100

M-2420. Gar-i-Gur, Iran **A.D. 1850**

Wood fragments from Gar-i-Gur cave (32° 44′ N Lat, 47° 16′ E Long), Deh Luran, Kermanshah Prov., Iran. Sample is from lowest exposed layer of dry deposit. Deposit is several m thick and middle layers contained an Islamic jar handle. Coll. 1968 and subm. by H. T. Wright, Mus. Anthropol., Univ. of Michigan. *Comment* (H.T.W.): interesting cloth and wooden artifacts are apparently quite recent.

Walanczow site series, Poland

Decomposed peat with some pieces of charcoal from Walanczow site (50° 56′ N Lat, 18° 51′ E Long), near Klobuck, Katowice Prov., S Poland. Coll. 1969 and subm. by Magdalena Ralska-Jasiewiczowa, Inst. Bot. Polish Acad. Sci., Krakow, Poland.

1970 ± 140

M-2263. Walanczow **20 B.C.**

Sample from wall of pit made approx. in center of peat bog, 35 cm below surface. Should date beginning of Sub-Atlantic period.

6860 ± 240

M-2264. Walanczow **4910 B.C.**

Sample from wall of pit made approx. in center of peat bog, 50 cm below surface. Should date fall of sub-Boreal period.

General Comment (S. Milisauskas): M-2263 seems satisfactory; M-2264 is probably too high.

11,930 ± 400

M-2265. Czajkow 2/II, Poland **9980 B.C.**

Peat from bog from Czajkow (50° 35′ N Lat, 21° 10′ E Long), near Staszow, Kielce Prov., Poland. Sample from approx. center of bog, 5.00 to 5.10 m below surface. Should date Younger Dryas and Karst phenomenon in S Poland. Coll. 1967 by Kazimierz Szaepanek; subm. by Magdalena Ralska-Jasiewiczowa. *Comment* (S. Milisauskas): date seems satisfactory.

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[RADIOCARBON, VOL. 14, No. 1, 1972, P. 223-238]

RIKEN NATURAL RADIOCARBON MEASUREMENTS VII

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The C^{14} dates given below are continued from our previous list (R., 1970, v. 12, p. 559-576), and results obtained mainly during 1970 are described. A 2.7 L stainless steel counter and a 3.3 L copper counter are used, yielding background counting rates of 5.5 and 8.5 cpm, respectively, when filled with dead CO_2 at ca. 1.8 atm. Dates have been calculated on the basis of the C^{14} half-life of 5568 yr and 95% of NBS oxalic acid as modern standard.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Japan

Futtsu series

Sample from boring core obtained at various localities near Futtsu-cho, Kimitsu-gun, Chiba Pref. Coll. 1966 and subm. by K. Kojima, Public Works Research Inst., Ministry of Construction.

N-749. Futtsu 1 — **2440 ± 115** / **490 B.C.**

Shell fragments from muddy sand in sub-bottom core, −29.2 to 29.7 m, off Futtsu (35° 19′ N Lat, 139° 45′ E Long). Sample from base of sediments overlying Pleistocene sub-bottom topography.

N-750. Futtsu 2 — **7720 ± 150** / **5770 B.C.**

Shell fragments from sand in core as above, −50.3 to 51.4 m, from top of sediments filling submarine buried valley.

N-751. Futtsu 3 — **12,600 ± 270** / **10,650 B.C.**

Decayed wood from clay in core as above, −67.4 to 68.6 m, from near bottom of sediments filling submarine buried valley.

N-752. Futtsu 4 — **12,800 ± 450** / **10,850 B.C.**

Humic substance from sandy clay in core as above, −74.85 to 77.35 m, from near base of sediments filling submarine buried valley.

N-777. Futtsu 5 — **2970 ± 125** / **1020 B.C.**

Shell fragments from sand in core, −18.35 to 18.50 m at Daini Kaiho near Futtsu (35° 18′ N Lat, 139° 44′ E Long). Deposit overlies diluvial formation at −50 m.

4700 ± 150

N-778. Futtsu 6 **2750 B.C.**

Shell fragments from sand in core, −4.48 to 4.78 m at Futtsu Bar (35° 18′ N Lat, 139° 47′ E Long). Sand overlies old wave-cut terrace at −20 m.

5330 ± 135

N-779. Futtsu 7 **3380 B.C.**

Shell fragments in sand deposit from core, +5 m near Futtsu Lodge (35° 18′ N Lat, 139° 48′ E Long). Deposit overlies old wave-cut terrace at depth −20 m.

N-780. Kimitsu **>37,800**

Wood in silty mudstone from −17.50 m in diluvial strata beneath old wave-cut terrace, at Kimitsu-cho, Kimitsu-gun, Chiba Pref. (35° 21′ N Lat, 139° 52′ E Long). Coll. 1969 and subm. by K. Kojima.

N-790. Ukishima **>37,800**

Shell fragments (*Ostrea* sp.) from core in Pleistocene valley fill at −.85 m, 4.5 km off Okishima-cho, Kawasaki City, Kanagawa Pref. (35° 30′ N Lat, 139° 50′ E Long). Coll. 1967 and subm. by K. Kojima.

Takaoka series

Pieces of timber buried in bog sediments, Takaoka-Oyachi, Muremura, Kami-minochi-gun, Nagano Pref. (36° 45′ N Lat, 138° 10′ E Long). Coll. 1969 and subm. by T. Ochiai, Agric. Engineering Research Sta.

1010 ± 100

N-804. Takaoka 1 **A.D. 940**

From depth 1.1 m in dark green clay overlain by loam.

1840 ± 105

N-805. Takaoka 2 **A.D. 110**

From depth 1.4 m.

3440 ± 110

N-806. Takaoka 3 **1490 B.C.**

From depth 1.58 m.

3290 ± 100

N-807. Takaoka 4 **1340 B.C.**

From depth 1.13 m, 6.3 m apart from N-804 ~ 6.

B. Australia

Alice Springs series

Material from late Quaternary piedmont sediments and paleosols in Alice Springs region, N Territory. Coll. 1969 and subm. by G. E. Williams, Univ. of Adelaide. *Comment* (G.E.W.): carbonate samples rinsed in dilute HCl prior to submission for dating.

5300 ± 120

N-686. Jessie Creek **3350 B.C.**

Charcoal from moderately consolidated red sand, 1.7 m below top of bluff, W side of Jessie Creek, ca. 300 m S of Jessie Gap (23° 45′ S Lat, 134° 1′ E Long).

N-687. Undoolya 1 **Modern**

Charcoal from poorly consolidated red sand and gravel, 15 to 20 cm below top of bluff 2.5 m high, midfan area of small fan 11 km E of Undoolya Gap (23° 45′ S Lat, 134° 13′ E Long).

565 ± 100

N-689. Undoolya 2 **A.D. 1385**

Charcoal from moderately consolidated red sand, 1.35 m below top of bluff and directly below N-687.

790 ± 100

N-688. Undoolya 3 **A.D. 1160**

Charcoal from red sand and silt, 80 cm below top of terrace within main gully near apex of same fan (23° 44′ S Lat, 134° 13′ E Long).

1570 ± 105

N-691. Undoolya 4 **A.D. 380**

Charcoal from prismatic red silt and fine sand, 1.2 to 3 m below top of vertical bluff at apex of same fan (23° 44′ S Lat, 134° 13′ E Long).

1220 ± 100

N-690. Williams Creek 1 **A.D. 730**

Charcoal from moderately consolidated red sand, 1 to 2 m below top of bluff on N side of Williams Creek near junction with Todd R. (23° 48′ S Lat, 134° 19′ E Long).

25,700 ± 800

N-693. Williams Creek 2 **23,750 B.C.**

Nodules of pedogenic carbonate from prismatic red silt ca. 2.5 m below top of bluff on E side of Williams Creek, just S of Alice Springs–Allua Well rd. (23° 48′ S Lat, 134° 19′ E Long).

12,100 ± 200

N-692. Twin Bore **10,150 B.C.**

Nodules and cylindroids of pedogenic carbonate from prismatic red sand 2.5 m below top of bluff on S side of gully, 8 km S of Twin Bore (24° 6′ S Lat, 134° 34′ E Long).

18,600 ± 360

N-694. Allua Well **16,650 B.C.**

Massive authigenic carbonate ("ground-water calcrete") from prismatic red silt 2.5 m below top of bluff on S side of gully, 100 m S of Allua Well (23° 46′ S Lat, 134° 44′ E Long).

25,300 ± 750

N-695. Jessie Gap **23,350 B.C.**

Nodules of pedogenic carbonate from blocky red clay 1.5 m below

top of road cut at base of alluvial cone, ca. 400 m E of Jessie Gap (23° 45′ S Lat, 134° 1′ E Long).

7510 ± 150

N-730. Sellicks Hill **5560 B.C.**

Charcoal from consolidated gray sand 2.6 to 2.8 m below top of alluvial terrace (Waldeila Formation, Ward, 1966), gully sec. W of Sellicks Hill, ca. 55 km S of Adelaide, S Australia (35° 20′ S Lat, 138° 28′ E Long). Coll. 1969 and subm. by G. E. Williams.

Ocean Grove series

Material from coastal dune and foreshore, ca. 4 km E of Ocean Grove, Victoria (38° 17′ S Lat, 144° 34′ E Long). Coll. 1970 and subm. by G. E. Williams.

5780 ± 140

N-831. Ocean Grove 1 **3830 B.C.**

Charcoal from older gray loam horizon in coastal dune, ca. 11 m above high-water line.

470 ± 105

N-832. Ocean Grove 2 **A.D. 1480**

Charcoal from younger gray loam horizon in coastal dune, ca. 11 m above high-water line.

N-833. Ocean Grove 3 **124 ± 1.5% of modern**

Modern shells of marine gastropod (*Subninella undulata*) from rock pools on foreshore. *Comment*: high C^{14} content attributed to hydrogen bomb effect.

335 ± 90

N-834. Ocean Grove 4 **A.D. 1615**

Shells from younger gray loam horizon, assoc. with N-832. *Comment* (G.E.W.): outer 20% of material removed by HCl treatment.

14,900 ± 280

N-835. Ocean Grove 5 **12,950 B.C.**

Shell fragments from beach rock of sandstone and conglomerate on foreshore. *Comment* (G.E.W.): outer 20% of material removed by HCl treatment. This date, for material from indurated shore deposits near modern sea level, is incompatible with chronology of late Wisconsin sea levels. The material has probably recrystallized; the date is minimum for the beach rock.

C. United States

N-781. San Miguel Island **>37,800**

Pismo clam (*Tivela stultorum*) from surface at old beach terrace, ca. 85 m above mean sea level, San Miguel I., California (34° 2′ N Lat, 120° 25′ W Long). Coll. 1969 and subm. by D. L. Johnson, Univ. of Illinois. *Comment* (D.L.J.): concentration of pismo clams on upper terrace of W end of island near Judith Rock indicates former sandy

bottom, suggesting, with other evidence, existence of former strait which bisected island in W to SE direction (Johnson, 1971).

D. Great Britain

N-798. Sand Hutton **800 ± 100**
A.D. 1150

Charcoal from 83 to 90 cm below surface at Scrogs Wood, Sand Hutton, Yorkshire (54° 1′ N Lat, 0° 56′ W Long). Coll. 1968 and subm. by B. Matthews, Soil Survey of England and Wales. *Comment* (B.M.): sample was anticipated to relate to Neolithic forest clearance. Date suggests, however, that it results from medieval burning and that ca. 80 cm of eolian sand and colluvium has accumulated near base of York moraine in 800 yr, burying former Podzol.

N-820. East Moor **9950 ± 180**
8000 B.C.

Organic material (gyttja) in eolian sand from 94 to 95.5 cm below surface, East Moor, Sutton-on-the-Forest, Yorkshire (54° 4′ N Lat, 1° 4′ W Long). Coll. 1969 and subm. by B. Matthews. *Comment* (B.M.): this and N-488 (10,700 ± 190, R., 1969, v. 11, p. 455) provide limiting dates for deposition of eolian sand in Vale of York (Matthews, 1970).

N-810. Doncaster **11,100 ± 200**
9150 B.C.

Organic material from peaty layer over lacustrine silt, overlain by 22 cm silt and 43 cm sand, 8 km NE of Doncaster, England (53° 33′ N Lat, 1° 1′ W Long). Coll. 1968 and subm. by R. A. Jarvis, Soil Survey of England and Wales.

E. Africa

Late Quaternary stratigraphy and archaeology in E Africa

In S part of Lake Nakuru basin in Kenya, 3 stratigraphic units, each separated by disconformities, have been given interim designations as formations "A", "B", and "C" (oldest to youngest). "Formation A" is Upper Pleistocene (see date I-5062-64); "Formation B" consists largely of deposits relating to most recent episode in which Lake Nakuru filled up to its outlet level (ca. +20.88 m) and is terminal Pleistocene and early Holocene (Washbourn 1967, 1970). "Formation C" includes evidence of a mid-Holocene minor high stand. Sample N-821 relates to age of "Formation C" while N-822 (1-3) were drawn from base of "Formation B".

Lake Magadi is ringed by a discontinuous terrace of sediments evidently deposited during a higher-water phase (Baker, 1958). Sample N-862 dates one horizon in these beds.

N-821. Prolonged Drift (GrJi 1) **3640 ± 120**
1690 B.C.

Charcoal from a horizon (brush fire?) in brown alluvial silt that directly overlies diatomaceous silt of mid-Holocene high stand of Lake

Nakuru. Pottery occurs on charcoal horizon and rich "Kenya Wilton" industry with stone bowls and edge-ground axe is stratified in silt above (0° 29′ S Lat, 36° 6′ E Long). Coll. 1969 and subm. by G. L. Isaac and C. M. Nelson, Univ. of California, Berkeley.

Enderit Drift series (GsJi 2/T)

Charcoal from archaeologic occurrence dominated by delicate awls, backed blades, and burins. Charcoal and artifacts were recovered by excavation into consolidated lens of colluvium stratified at base of "Formation B" at alt. ca 2088 m, *i.e.,* 67.06 m above modern lake. The strata document a transgressive phase in lake fluctuation (0° 31′ S Lat, 36° 6′ E Long). Coll. 1969 and subm. by G. L. Isaac and H. V. Merrick.

N-822-1. Enderit Drift 1 (No. 190) — **12,300 ± 220 / 10,350 B.C.**

N-822-2. Enderit Drift 2 (No. 177) — **12,200 ± 220 / 10,250 B.C.**

N-822-3. Enderit Drift 3 (No. 195) — **12,000 ± 220 / 10,050 B.C.**

N-862. Lake Magadi — **9120 ± 180 / 7170 B.C.**

Organic fraction of a highly carbonaceous, fish-fossil lamina in High Magadi Beds at "Dry Lagoon" (1° 59′ S Lat, 36° 6′ E Long). Coll. 1969 and subm. by G. L. Isaac.

II. PEDOLOGIC SAMPLES

Total organic carbon of humic horizon in volcanic ash soil from various localities, coll. 1970 by Y. Yamada, Natl. Inst. Agric. Sci., and dated to determine relationship between soil age and properties of humus in soil.

Nakanohara series

Sample from various depths in volcanic ash beds at Nakanohara, Ina City, Nagano Pref. (35° 52′ N Lat, 137° 55′ E Long).

N-844. Ina 1 — **810 ± 105 / A.D. 1140**

From depth 0 to 14 cm, A_p horizon. Carbon content: 10.55%.

N-845. Ina 2 — **1850 ± 110 / A.D. 100**

From depth 14 to 23 cm, A_{12} horizon. Carbon content: 9.63%.

N-846. Ina 3 — **3930 ± 130 / 1980 B.C.**

From depth 23 to 48 cm, IIA horizon. Carbon content: 8.29%.

N-847. Ina 4 **6920 ± 150**
4970 B.C.

From depth 48 to 80 cm, IIIA horizon. Carbon content: 3.69%.

N-848. Ogurohara **1270 ± 105**
A.D. 680

From A_{11} horizon, depth 0 to 22 cm, at Ogurohara, Ina City, Nagano Pref. (35° 50′ N Lat, 137° 55′ E Long). Carbon content: 13.45%.

N-910. Minami Rokuroshi **4910 ± 130**
2960 B.C.

From A_{12} horizon, depth 13 to 37 cm, at Minami Rokuroshi, Ono City, Fukui Pref. (36° 1′ N Lat, 136° 34′ E Long). Carbon content: 9.58%.

III. ARCHAEOLOGIC SAMPLES

A. Japan

Irie series

Fossil animal bone from Irie, Abuta-gun, Hokkaido (42° 34′ N Lat, 140° 45′ E Long). Coll. 1966 and subm. by N. Shimoda, Muroran Inst. of Technol. *Comment*: collagen fraction dated. Dates serve to test possibility of dating bones by measurements of their manganese content (Shimoda, 1971a, 1971b).

N-680. Irie 1 **3700 ± 130**
1750 B.C.

N-681. Irie 2 **3520 ± 130**
1570 B.C.

Both samples are from same shell bed.

N-682. Ponnai, Muroran **4620 ± 160**
2670 B.C.

Fossil animal bone from Ponnai, Motowanishi, Muroran City, Hokkaido (40° 20′ N Lat, 140° 0′ E Long). Assoc. with pottery of Early Jomon (Ento-Kaso type) to Middle Jomon (Ento-Joso type) periods.

B. United States and Canada

Snyder site series

Charcoal from Snyder site, N of El Dorado, Butler Co., Kansas (37° 52′ N Lat, 96° 49′ W Long). Coll. 1969 and subm. by R. Grosser, Univ. of Kansas.

N-769. Snyder Site 1 **1970 ± 110**
20 B.C.

From 40 to 55 cm below surface. Assoc. with Archaic remains.

N-770. Snyder Site 2 **3650 ± 140**
1700 B.C.

From 100 to 125 cm below surface. Assoc. with Archaic remains.

3910 ± 160

N-771. Snyder Site 3 **1960 B.C.**

From 125 to 140 cm below surface. Assoc. with Archaic remains.

Kisameet series

Charcoal from shell midden in Kisameet, British Columbia, Canada (51° 58′ N Lat, 127° 53′ W Long). Coll. 1969 by Terja Birkedal; subm. by R. Luebbers, Univ. of Colorado.

1810 ± 100

N-788. Kisameet 1 (FS2.10B.1) **A.D. 140**

From midpoint of site, 1.5 m below surface.

2290 ± 110

N-789. Kisameet 2 (FS2.17C.1) **340 B.C.**

From hearth near basement gravels, 2.55 m below surface, 15 cm above gravel.

C. Mexico

Cerro Chacaltepec series

Charcoal from site at Cerro Chacaltepec, Tlaltizapan, Morelos, Mexico (18° 40′ N Lat, 99° 7′ W Long). Coll. 1967 and subm. by D. C. Grove, Univ. of Illinois at Urbana-Champaign (Grove, 1968).

2640 ± 120

N-816. Cerro Chacaltepec 1 **690 B.C.**

From level 260 to 280 cm below surface, marking stratigraphic transition from Olmec to Middle Preclassic styles.

2730 ± 130

N-817. Cerro Chacaltepec 2 **780 B.C.**

From level 300 to 320 cm below surface, marking an apparent period of Olmec influence.

2920 ± 160

N-818. San Pablo **970 B.C.**

Charcoal from levels yielding Olmec ceramics at San Pablo, Morelos, Mexico (18° 35′ N Lat, 99° 2′ W Long). Coll. 1969 and subm. by D. C. Grove.

D. Africa

4440 ± 120

N-869. Hidden Valley, Adrar Bous **2490 B.C.**

Charcoal from hearth assoc. with Burial 1, beneath tumulus at Hidden Valley, Adrar Bous, Republic of Niger (20° 19′ N Lat, 8° 57′ E Long). Hearth situated ca. .61 m below base of cairn and former ground surface and .3 m above and immediately NE of burial. Coll. 1970 and subm. by J. D. Clark, Univ. of California, Berkeley. *Comment* (J.D.C.): estimated age: Pre-Islamic (Libyco-Berber). Chouchet-type cairn in which this burial occurred is usually considered to date to Libyco-Berber times. That at El Barkat, W Fezzan (24° 52′ N Lat, 10° 23′ E Long) was dated to 1300 ± 120 yr, 510-750 A.D.) N-869 appears too

old for burial itself. Presumably, it dates wood used for probable funeral fire.

N-870. North East Valley, Adrar Bous **4910 ± 140**
2960 B.C.

Fine charcoal fragments from saucer-shaped hollow beneath concentration of broken and burned animal bones, food waste from a single meal, Area 5, North East Valley, Adrar Bous (20° 19′ N Lat, 8° 57′ E Long). Coll. 1970 and subm. by J. D. Clark. *Comment* (J.D.C.): estimate age: Tenerian Neolithic. Date agrees with estimated age for Tenerian 3500 to 2500 B.C.

N-871. Temet Wadi, Graboun **520 ± 100**
A.D. 1430

Charcoal from hearth at base of dune overlying main terrace deposits at Temet Wadi, ca. 2.4 km NE of T-junction, Graboun, Aïr Mts., Republic of Niger (20° 2′ N Lat, 8° 32′ E Long). Coll. 1970 and subm. by J. D. Clark. *Comment* (J.D.C.): localities at Graboun yielded unspecialized lithic industry, grindstones and sherds of decorated Neolithic and undecorated wares, the latter probably final or post-Neolithic. Although no artifacts were in direct assoc. with hearth, association was thought possible. Result disproves this, except, possibly, for some undecorated pottery.

Bornu series

Charcoal from Bornu site, NE Nigeria (11° 32′ N Lat, 13° 40′ E Long). Coll. 1969 and subm. by G. E. Connah.

N-793. Bornu 1 (UI 703) **3830 ± 250**
1880 B.C.
From Spit 14, Cutting I.

N-794. Bornu 2 (UI 704) **2960 ± 160**
1010 B.C.
From Spits 11 and 12, Cutting I.

N-795. Bornu 3 (UI 705) **2880 ± 140**
930 B.C.
From Spit 12, Cutting II.

N-796. Bornu 4 (UI 706) **2590 ± 170**
640 B.C.
From Spits 7, 8, 9 and 10, Cutting II.

Baha mound series

Charcoal from Site HK.68.4, Tr. 1, Sq. 1, Baha mound, Nigeria (10° 50′ N Lat, 4° 46′ E Long). Coll. 1968 by D. P. Hartle; subm. by T. Shaw, Univ. of Ibadan.

N-824. Baha Mound 1 (UI 707) **2080 ± 105**
130 B.C.
From depth 460 to 480 cm.

1050 ± 125

N-825. Baha Mound 2 (UI 708) **A.D. 900**

From depth 340 to 360 cm.

1150 ± 140

N-826. Baha Mound 3 (UI 709) **A.D. 800**

From depth 320 to 340 cm.

1170 ± 120

N-827. Baha Mound 4 (UI 7010) **A.D. 780**

From depth 200 to 220 cm.

1010 ± 110

N-828. Baha Mound 5 (UI 7013) **A.D. 940**

From depth 100 to 120 cm.

Leopard's Kopje Main Kraal site series

Sample from Leopard's Kopje Main Kraal site, Rhodesia (20° 7′ S Lat, 28° 26′ E Long). Coll. 1969 by T. N. Huffman, Univ. of Illinois; subm. by B. M. Fagan, Univ. of California, Santa Barbara.

1050 ± 100

N-772. Leopard's Kopje Main Kraal Site 1 **A.D. 900**

Carbonized seeds incl. sorghum, cowpeas, and groundnuts, as well as wild seeds from storage hut.

125 ± 100

N-773. Leopard's Kopje Main Kraal Site 2 **A.D. 1825**

Charcoal from recent occupation of site.

Mutobo series

Charcoal from 1.2 m below surface at Iron age mound at Kalomo, S Prov. Zambia (17° 2′ S Lat, 26° 21′ E Long). Assoc. with Kalomo-type occupation. Coll. 1968 and subm. by B. M. Fagan.

1030 ± 110

N-596. Mutobo 1 (MU/RC/01) **A.D. 920**

1120 ± 110

N-597. Mutobo 2 (MU/RC/02) **A.D. 830**

Comment (B.M.F.): samples are from same cultural level, and agree well with dates obtained from other Kalomo mounds.

Makwe series

Charcoal from Makwe rock shelter of Late Stone age, Katete dist., Zambia (14° 24′ S Lat, 31° 56′ E Long). Coll. 1966 by D. W. Phillipson; subm. by B. M. Fagan.

4380 ± 130

N-903. Makwe 1 **2430 B.C.**

From 76 to 79 cm below surface of Sq. c-12, Horizon 3ii.

4920 ± 130

N-904. Makwe 2 **2970 B.C.**

From Sq. c-13, Level 12, Horizon 3ii. *Comment* (D.W.P.): dates agree well with others from same site (GX-1553; SR-205; GX-1554; SR-204 and GX-1555) and date main Late Stone age occupation of Makwe rock shelter.

Thandwe series

Charcoal from Thandwe rock shelter of Late Stone age and Iron age, Chipata dist., Zambia (13° 49′ S Lat, 32° 28′ E Long). Coll. 1970 by D. W. Phillipson; subm. by B. M. Fagan.

890 ± 110

N-905. Thandwe 1 **A.D. 1060**

From Sq. G, Layer 5.

1060 ± 110

N-906. Thandwe 2 **A.D. 890**

From Sq. F-G, Layer 6.

1620 ± 115

N-907. Thandwe 3 **A.D. 330**

From Sq. D-E, Layer 7. *Comment* (D.W.P.): an internally consistent series. N-905 and N-906 date 1st appearance of Early Iron age pottery at Thandwe: dates are somewhat later than those for same phenomenon elsewhere in E Zambia, but are supported by evolved typology of pottery. N-907 dates 2 human burials assoc. with a Late Stone age industry.

1600 ± 110

N-908. Kamnama **A.D. 350**

Charcoal from Kamnama site of Early Iron age, Chipata dist., Zambia (13° 32′ S Lat, 32° 51′ E Long), from Tr. V, Layer 2. Coll. 1970 by D. W. Phillipson; subm. by B. M. Fagan. *Comment* (D.W.P.): dates a large (5 ha.) Early Iron age village site on the Luangwa-Lake Malawi watershed. Early date is supported by similarity between the Kamnama pottery and that of contemporary earliest Iron age in Malawi.

Simbusenga series

Charcoal from stratified Iron age village midden at Simbusenga, Zambia (17° 35′ S Lat, 25° 35′ E Long). Total midden accumulation averages 1.68 m. Mound contains 7 village horizons. Basal horizon assoc. with Kumadzulo-type ceramics above which are horizons affiliated with Kamangoza and Sekute phase of Kalomo tradition and typical Simbusenga pottery-bearing horizons related to Sinde, Simonga, and Mukuni sites. Coll. 1969 and subm. by J. O. Vogel, Livingstone Mus. Samples are divided into 5 groups.

Group I

N-731. Simbusenga 1 **Modern**

15 to 30 cm below surface.

365 ± 105

N-732. Simbusenga 2 **A.D. 1585**

15 to 30 cm below surface.

395 ± 105

N-733. Simbusenga 3 **A.D. 1555**

15 to 30 cm below surface.

Samples assoc. with Village Horizon G, uppermost stratigraphically defined occupation level. *Comment* (J.O.V.): should date latest occupation of midden.

Group II

680 ± 105

N-734. Simbusenga 4 **A.D. 1270**

167 cm below surface.

1170 ± 105

N-735. Simbusenga 5 **A.D. 780**

167 cm below surface.

Samples recovered from pits, containing pottery of Early Iron age type and located in sterile Kalahari sand at base of mound. *Comment* (J.O.V.): should date earliest occupation of Simbusenga midden.

Group III

N-736. Simbusenga 6 **Modern**

51 cm below surface, charred hut pole assoc. with Village Horizon G.

Group IV

390 ± 105

N-737. Simbusenga 7 **A.D. 1560**

61 cm below surface.

405 ± 105

N-738. Simbusenga 8 **A.D. 1545**

76 cm below surface.

1020 ± 105

N-739. Simbusenga 9 **A.D. 930**

91 cm below surface.

900 ± 100

N-740. Simbusenga 10 **A.D. 1050**

107 cm below surface.

820 ± 100

N-741. Simbusenga 11 **A.D. 1130**

122 cm below surface.

1010 ± 100

N-742. Simbusenga 12 **A.D. 940**

137 cm below surface.

920 ± 100

N-743. Simbusenga 13 **A.D. 1030**

1.5 m below surface.

Series of samples from various localities within site combined to form a stratified collection. *Comment* (J.O.V.): date village Horizons B through F. N-743 dates same assocs. as Group II.

Group V

545 ± 100

N-744. Simbusenga 14 **A.D. 1405**

46 cm below surface.

660 ± 100

N-745. Simbusenga 15 **A.D. 1290**

61 cm below surface.

1030 ± 100

N-746. Simbusenga 16 **A.D. 920**

76 cm below surface.

675 ± 90

N-747. Simbusenga 17 **A.D. 1275**

91 cm below surface.

850 ± 100

N-748. Simbusenga 18 **A.D. 1100**

1.1 m below surface.

Series of samples duplicating part of Group IV. *Comment* (J.O.V.): N-744 dates same assocs. as Group III.

General Comment (J.O.V.): dated samples form 5 very distinct groups. Group A, 8th century date assoc. with Early Iron age pit (N-735). Group B, predominantly 10 to 11th century occupation of site (N-746, N-739, N-740, N-748, N-741, N-742, N-743). Group C, predominantly 13th century occupation of site (N-734, N-747, N-745, N-744 and N-741) and later Group D of predominantly 16th century provenance (N-732, N-733, N-737, N-738). Two modern dates (N-731, N-736) represent very latest Leya occupation. A rank correlation analysis of chronologic ranking with stratigraphic order of sample means shows a highly significant correlation and dated sequence is probably reasonable indication of occupation chronology at Simbusenga. There were 7 village horizons in Simbusenga deposit. The earliest is typologically compatible with 8th century date. A short hiatus separates this occupation from Kalomo tradition assoc. ones of Group B dates. These agree well with known dates from Kalomo tradition materials. Remaining groups date distinctive Simbusenga series of ceramics and agree with series from Sinde, Mukuni, and Simonga.

Shilma series

Charcoal from site at Shilma, N.E. Nigeria (11° 55′ N Lat, 14° 21′ E Long). Coll. 1969 and subm. by G. E. Connah, Univ. of Ibadan.

2680 ± 180

N-791. Shilma 1 (UI 701) **730 B.C.**

From Cutting I, Spit 3.

2720 ± 120

N-792. Shilma 2 (UI 702) **770 B.C.**

From Cutting II, Spit 2.

Narosura series

Samples from various depth from surface at Narosura, Narok dist., Kenya (1° 32′ S Lat, 35° 50′ E Long), assoc. with obsidian industry, pottery, stone bowls, stone axe, and bones mostly of domesticated animals. N-496 coll. 1968 by B. Golden, remainder coll. 1969 by K. Odner; subm. by R. C. Soper, Brit. Inst. Hist. Archaeol., E. Africa.

2260 ± 110

N-496. Narosura, bone **310 B.C.**

Animal bone fragments, 30 to 80 cm below surface. *Comment*: collagen fraction dated.

2360 ± 110

N-700. Narosura 1 (E12/E14) **410 B.C.**

Charcoal from 30 cm below surface.

2660 ± 120

N-701. Narosura 2 (F16) **710 B.C.**

Charcoal from 50 to 70 cm below surface.

2760 ± 120

N-702. Narosura 3 (F16) **810 B.C.**

Charcoal from 70 to 80 cm below surface.

2640 ± 120

N-703. Narosura 4 (E17) **690 B.C.**

Charcoal from 80 to 90 cm below surface.

1660 ± 130

N-784. Chobi **A.D. 290**

Charcoal from 28 to 38 cm below surface in lower part of pottery-bearing horizon on open site ca. 1 km N of Victoria Nile in Chobi Sec., Murchison Falls Natl. Park, Uganda (2° 15′ N Lat, 32° 12′ E Long). Assoc. with quartz flakes and pottery incl. both Urewe ("Dimple-based") ware and "Boudiné ware" in close assoc. Coll. 1968 and subm. by R. C. Soper.

3720 ± 170

N-787. Luluampembele (F16) **1770 B.C.**

Charcoal from 50 to 60 cm below surface at Luluampembele, Iramba dist., Tanzania (4° 23′ S Lat, 34° 24′ E Long), from Late Stone age rock shelter, below rock wall with paintings at alt. 1432 m. Finds include quartz, animal bone, ostrich egg shell beads. Coll. and subm. 1970 by K. Odner.

Kilimanjaro region series

Charcoal from various sites in Kilimanjaro region, Tanzania. Coll. and subm. 1970 by K. Odner.

725 ± 180

N-882. Marangu Teacher's College **A.D. 1225**

Charcoal from Marangu Teacher's College site at alt 1463 m, Marangu, E Vunjo (3° 17′ S Lat, 37° 31′ E Long). Assoc. with unknown pottery.

1700 ± 330

N-883. Mwika **A.D. 250**

Charcoal from Mwika site at alt. 1509 m, Mwika, E Vunjo (3° 16′ S Lat, 37° 35′ E Long). Assoc. with pottery of Kwale and Maore ware.

2200 ± 430

N-884. Old Moshi **250 B.C.**

Charcoal from Old Moshi site at alt. 991 m, E Hai (3° 19′ S Lat, 37° 24° E Long). Assoc. with pottery probably developed from Maore ware.

510 ± 190

N-885. Matunda **A.D. 1440**

Charcoal from Matunda site at alt. 914 m, Central Hai (3° 20′ S Lat, 37° 17′ E Long). Assoc. with pottery seemingly connected with N-884.

Lothagam Hill series

Samples from sites within 24.2 km area near Lothagam Hill, ca. 11.3 to 16 km W of Lake Rudolf, Turkana dist., N Kenya (2° N Lat, 36° E Long). Coll. 1969 and subm. by L. H. Robbins, Michigan State Univ.

6200 ± 130

N-812. Lothagam Hill 1 (Zu-10) **4250 B.C.**

Charcoal from scattered stain, 10 to 20 cm below surface, in compact sand. Assoc. with cultural remains of E African Late Stone age.

7960 ± 140

N-813. Lothagam Hill 2 (Zu-6) **6010 B.C.**

Shell from shell bed, 35 cm below surface, in grayish-white sandy clay of lake beds of Holocene Lake Rudolf. Site is of Late Stone age assoc. with 2 types of decorated pottery.

5020 ± 220

N-814. Lothagam Hill 3 (Bb-14) **3070 B.C.**

Burned clay? eroding out *in situ* from brown sandy-clay like deposit, 10 to 12 cm below surface. Assoc. with several types of pottery as well as Late Stone Age artifacts.

General Comment (L.H.R.): N-813 dates high beach level and agrees very well with UCLA date (7560 ± 1000, UCLA-1247E, R., 1968, v. 10, p. 402) from shell sample for same high lake stage nearby. Decorated

pottery incorporated in deposits is oldest for E Africa. N-812 seems to date cultural activity on site assoc. with old lake. Pottery assoc. with N-814 is different from either of above sites and the site is located at higher elev.

Rangi site series

Samples from Rangi site of Late Stone/Iron age on slopes of Kadam Mt., Karamoja dist., E Uganda (1° 48′ N Lat, 34° 48′ E Long). Coll. 1970 and subm. by L. H. Robbins.

N-815. Rangi, Bone 1 **Modern**

Burned bone from rock shelter, 160 to 180 cm below surface, in brown soil containing broken and decayed bedrock originating from shelter. Artifacts include microliths, pottery, and ground stone.

510 ± 105

N-863. Rangi, Bone 2 **A.D. 1440**

Bone fragments from gray brown soil very rich with decorated pottery, chipped stone, and iron artifacts.

290 ± 135

N-864. Rangi, charcoal **A.D. 1660**

Charcoal from lower level.

General Comment (L.H.R.): date of N-863 is quite reasonable. Younger date of N-864 might be due to contamination. Modern date of N-815 is probably due to collecting error.

330 ± 105

N-865. Kaupokwalot cave **A.D. 1620**

Charcoal from Kaupokwalot cave, 8 km S of Rangi site (2° 52′ N Lat, 35° 18′ E Long), from burned zone underlying 20 cm of soft powdery soil with high content of decomposed bat guano. Coll. 1970 and subm. by L. H. Robbins. Assoc. with highly weathered iron blade fragments.

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UNIVERSITY OF CAMBRIDGE NATURAL RADIOCARBON MEASUREMENTS X

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Measurements reported in this paper were obtained in the Cambridge Radiocarbon Dating Laboratory during 1970-71. For most determinations, pure carbon dioxide at a pressure of 2 atm was used to fill the copper proportional counters, of 0.5 L or 1.5 L volume. The counters were protected by a massive lead shield and a plastic scintillation anticoincidence screen (Switsur, Hall, and West, 1970). Modern sample gas was obtained from the 1845 to 1855 growth rings of a locally grown oak tree which was felled in 1950. Background was prepared from Welsh anthracite. The contemporary standard is compared frequently with the activity of the International NBS oxalic acid standard. Sample ages are calculated using the conventional half-life of 5568 ± 30 years and the uncertainty stated in terms of one standard deviation of the counting statistics.

Most samples were pretreated to remove non-contemporary carbonaceous contamination. This involved the manual removal of rootlets during microscopic examination, followed by boiling the shredded sample with 1% hydrochloric acid solution for one hour, washing and vacuum filtering, and normally, boiling with 1% sodium hyroxide solution before finally washing and drying. Certain samples (noted in the text) produced an unfilterable colloidal solution when treated with sodium hydroxide solution so that this step had to be omitted.

Combustion of most samples was effected cleanly and rapidly in high pressure purified oxygen in the combustion bomb (R., 1970, v. 12, p. 590-598). Some difficult samples of low carbon content were oxidized using a 'wet' chemical method with acidified permanganate as the oxidizing agent. A system was constructed to control foaming and to oxidize under slightly elevated pressure, using a carrier gas for bleeding the oxidation products into the purification system (Birks and Switsur, ms. in preparation).

We have continued to focus on research projects with other members of the University Sub-department of Quaternary Research and Department of Archaeology and Anthropology, which, in 1970 included dating of pollen zone boundaries from Wales, Isle of Skye lake deposits, and of archaeologic sites in Scotland, SW England and Crete.

We particularly wish to acknowledge the technical help of A. P. Ward and C. R. Devine in the Radiocarbon Dating Laboratory. Financial support for development projects in the laboratory has been 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 (Tregaron S.E. Bog series)

Core of peat 10 cm diam., taken with a Pilcon piston sampler, from raised bog, Tregaron S.E. bog Cardiganshire, Wales (52° 15′ N Lat, 3° 55′ W Long, Nat. Grid Ref. 22/687623) has been subjected to pollen analysis and radiocarbon dating. Two or three peat samples were taken as thin slices at each boundary and at intermediate points corresponding to significant changes in the pollen diagram. Samples pretreated to remove contaminants and combusted in pure oxygen. Sequence extends from near beginning of Flandrian to late Flandrian. Results will be discussed elsewhere, and compared with those from Red Moss (Hibbert, Switsur, and West, 1971) and other sites in this investigation (ms. in preparation). Coll. and pollen analysis by F. A. Hibbert; radiocarbon measurements by V. R. Switsur.

Samples id. by depth in pollen diagram.

Q-930. Tregaron S.E. Bog, 413 to 416 cm — **10,205 ± 220 / 8255 B.C.**

3 cm detritus mud representing beginning of organic deposition. *Betula-Pinus-Juniperus* zone.

Q-931. Tregaron S.E. Bog, 404 to 406 cm — **9747 ± 220 / 7797 B.C.**

2 cm fen peat at end point of detritus mud. *Betula-Pinus-Corylus* zone opens.

Q-932. Tregaron S.E. Bog, 398 to 400 cm — **9550 ± 200 / 7600 B.C.**

2 cm fen peat, middle of *Corylus* rise. *Ulmus* curve becomes continuous.

Q-933. Tregaron S.E. Bog, 390 to 392 cm — **9303 ± 190 / 7353 B.C.**

2 cm fen peat at end of *Corylus* rise. *Corylus-Pinus* zone opens.

Q-934. Tregaron S.E. Bog, 354 to 356 cm — **8285 ± 150 / 6335 B.C.**

2 cm fen peat with pine wood. Pollen frequencies of *Pinus* begin to exceed those of *Betula*. *Pinus-Corylus-Ulmus* zone opens.

Q-935. Tregaron S.E. Bog, 348 to 350 cm — **8152 ± 150 / 6202 B.C.**

2 cm fen peat. Check sample on Q-934.

Q-936. Tregaron S.E. Bog, 248 to 250 cm — **7128 ± 180 / 5178 B.C.**

2 cm fen peat admixed with birch and pine wood. First of a series of 3 samples dating *Alnus* rise. *Alnus* curve becomes continuous.

6991 ± 180

Q-937. Tregaron S.E. Bog, 242 to 244 cm **5041 B.C.**

2 cm fen peat, at mid point of rise of *Alnus* pollen curve. See Q-936. *Quercus-Ulmus-Alnus* zone begins.

6978 ± 140

Q-938. Tregaron S.E. Bog, 236 to 238 cm **5028 B.C.**

2 cm fen peat. *Alnus* pollen curve continues to rise. See Q-936.

6526 ± 110

Q-939. Tregaron S.E. Bog, 228 to 230 cm **4576 B.C.**

2 cm fen peat, admixed with wood. End of *Alnus* rise.

5979 ± 100

Q940. Tregaron S.E. Bog, 214 to 216 cm **4029 B.C.**

2 cm ombrogenous peat. Deposit here indicated a raised bog characterized by humified *Sphagnum* and *Calluna* peat. *Tilia* curve becomes continuous.

5110 ± 70

Q-941. Tregaron S.E. Bog, 172 to 174 cm **3160 B.C.**

2 cm *Sphagnum-Eriophorum-Calluna* peat. Beginning of main *Ulmus* decline and 1st of 3 samples dating this decline.

4990 ± 70

Q-942. Tregaron S.E. Bog, 167 to 169 cm **3040 B.C.**

2 cm *Sphagnum-Eriophorum-Calluna* peat from mid-point of *Ulmus* decline. See Q-941. *Quercus-Alnus* zone opens.

4893 ± 70

Q-943. Tregaron S.E. Bog, 163 to 165 cm **2943 B.C.**

2 cm *Sphagnum-Eriophorum-Calluna* peat. Last of series dating *Ulmus* decline. See Q-941.

4715 ± 55

Q-944. Tregaron S.E. Bog, 152 to 154 cm **2765 B.C.**

2 cm *Sphagnum-Eriophorum-Calluna* peat. Pollen curve shows increase of frequency of *Plantago,* indicating a maximum of anthropogenic effect.

4695 ± 52

Q-945. Tregaron S.E. Bog, 144 to 146 cm **2745 B.C.**

2 cm humified *Sphagnum-Eriophorum-Calluna* peat. Pollen diagram shows rise in *Ulmus* and *Fraxinus.*

3336 ± 50

Q-946. Tregaron S.E. Bog, 86 to 88 cm **1386 B.C.**

2 cm fresh ombrogenous peat. Increase in *Plantago* pollen indicating a maximum anthropogenic effect.

2922 ± 50

Q-947. Tregaron S.E. Bog, 62 to 64 cm **972 B.C.**

2 cm ombrogenous peat, more humified than Q-946. This level shows a further anthropogenic effect.

General Comment: results are internally consistent and fully comparable with those obtained at Scaleby Moss (R., 1959, v. 1, 63-65) and Red Moss (R., 1970, v. 12, p. 590-598).

Isle of Skye series

Limnic mud used in study of Late Weichselian and present vegetation of the Isle of Skye, in collaboration with H. J. B. Birks, Sub-department of Quaternary Research, Univ. of Cambridge (Birks, 1969), coll. 1968 from 3 sites by H. J. B. Birks, H. H. Birks, R. G. West, and K. Rybnicek (Brno) with a 5 cm sq. rod piston sampler (Wright, 1967). Pollen analysis by H. J. B. Birks and radiocarbon determinations by V. R. Switsur. Much sulphur was present, though not all was evolved as hydrogen sulphide during prolonged boiling with hydrochloric acid. Preparation of samples for combustion were difficult, especially for that of Loch Fada, which could not be treated with sodium hydroxide due to formation of colloidal material. Samples were all of very low organic content and the method of obtaining a sample of pure CO_2 from them is described elsewhere (Birks and Switsur, ms. in preparation).

10,254 ± 220

Q-955. Lochan Coir 'A' Ghobhainn, No. 1 8304 B.C.

Fine diatomaceous detritus mud from depth 380 to 382.5 cm (57° 11′ N Lat, 6° 18′ W Long, Nat. Grid Ref. 18/417183); beginning of organic mud deposition. Pollen diagram shows expansion of *Betula* and *Juniperus*.

9691 ± 150

Q-956. Lochan Coir 'A' Ghobhainn, No. 2 7741 B.C.

Diatomaceous mud from depth 362.5 to 365 cm (57° 11′ N Lat, 6° 18′ W Long, Nat. Grid Ref. 18/417183). Dates beginning of influx by amorphous solifluction processes of silt and fine soil.

9420 ± 150

Q-957. Lochan Coir 'A' Ghobhainn, No. 3 7470 B.C.

Fine detritus mud from 335 to 337.5 cm (57° 11′ N Lat, 6° 18′ W Long, Nat. Grid Ref. 18/417183). Dates end of solifluction and solid instability and beginning of vegetational stabilization.

8650 ± 150

Q-958. Lochan Coir 'A' Ghobhainn, No. 4 6700 B.C.

Fine detritus mud from 315 to 317.5 cm (57° 11′ N Lat, 6° 18′ W Long, Nat. Grid Ref. 18/417183). Pollen curve for *Corylus* shows rapid rise at this point.

9655 ± 150

Q-959. Loch Cill Chriosd 7705 B.C.

Fine detritus mud from depth 395 to 400 cm (57° 13′ N Lat, 5° 58′ W Long, Nat. Grid Ref. 18/605203). Pollen diagram shows expansion of *Betula* which is characteristic of pollen diagrams from W Britain for the Flandrian. Sample dates this event.

Q-960. Loch Meodal **9482 ± 150**
7532 B.C.

Fine detritus mud from 725 to 730 cm (57° 8′ N Lat, 5° 5′ W Long, Nat. Grid Ref. 18/656112). Dates lower sediments at site and expansion of *Corylus* pollen.

Q-961. Loch Fada **7500 ± 120**
5550 B.C.

Silty and clayey limnic muds from fen at S end of Loch at contact between muds and underlying clays and silts (57° 27′ N Lat, 6° 12′ W Long, Nat. Grid Ref. 18/494494). Date is minimum for these clays and silts.

Q-929. Loch Mealt Borehole **10,820 ± 350**
8870 B.C.

Inorganic limnic muds from depth 834 to 852 cm in borehole in a marginal fen at Loch Mealt (57° 36′ N Lat, 6° 8′ W Long, Nat. Grid Ref. 18/505650). Five m of sediments below, probably Late Weichselian, were sampled using a 10 cm diam. piston corer. Radiocarbon age is later than anticipated. Coll. by H. J. Birks and R. G. West.

General Comment (H.J.B.B.): dates provide time scale for ordering of various pollen assemblage zones at sites investigated. Q-961 appears rather young.

II. ARCHAEOLOGIC SAMPLES

Somerset Levels series, S W England

Collaboration of F. A. Hibbert and V. R. Switsur, Sub-dept. Quaternary Research, with J. M. Coles Dept. Archaeol. and Anthropol., Univ. of Cambridge, in the excavations and dating of prehistoric trackways of the Somerset Levels has continued in order to obtain precise correlation between the numerous tracks in the area.

Q-991. Sweet Track, Shapwick Heath **4887 ± 90**
2937 B.C.

Corylus wood from trackway underlying 1.5 m peat (51° 09′ N Lat, 2° 50′ W Long, Nat. Grid Ref. ST 422403). This track is the only known Neolithic roadway between Polden Hills and Westhay Meare Is. and may have been constructed partly of timbers of a dismantled Neolithic house on an adjacent sand bed (Coles and Hibbert, 1972).

Q-999. Honeygore Track, Westhay Level **4757 ± 60**
2807 B.C.

Corylus wood from trackway underlying 2 m peat (51° 11′ N Lat, 2° 50′ W Long. Nat. Grid Ref. ST 416428). Check sample for date of Honeygore track. Identification of track may not be certain due to large number in area. Previous dates are Q-431: 4750 ± 130, Lu-297: 4760 ± 65, Q-909: 4773 ± 80. Agreement is very good (Coles and Hibbert, 1972).

4230 ± 60

Q-987. Baker Field Platform **2280 B.C.**

Alnus wood from large platform near complex system of trackways, possibly a landing stage or bridge across a persistently wet bog margin (51° 11′ N Lat, 2° 50′ W Long, Nat. Grid Ref. ST 416428). Possibly contemporary with Bell trackway system 20 m S. It overlies 1.30 m fen wood peat and underlies 0.50 m ombrogenous peat. Check sample from another part of the platform was dated at Lund Univ. Lu-238, 4280 ± 65 B.P. (Coles, Hibbert, and Clements, 1970).

6115 ± 110

Q-928. Morton, Fife, T59/T50 **4165 B.C.**

Wood charcoal from upper midden surface sealed beneath 0.5 m earth (56° 25′ N Lat, 2° 52′ W Long, Nat. Grid Ref. NO/467257). Part of investigation of earliest traces of man in Scotland. See Q-948, Q-981, Q-988, Q-989. Coll. 1970 by J. M. Coles (1971).

6382 ± 120

Q-981. Morton Fife, T50-5, T57-2 **4432 B.C.**

Wood charcoal from depth 45 to 75 cm into shell midden, sealed by 1 m earth, resting directly on emerged beach at 9.7 m (32 ft) O.D. (56° 25′ N Lat, 2° 52′ W Long, Nat. Grid Ref. NO/467257). May be assoc. with Mesolithic stone industry at top of volcanic bluff ca. 100 m away. New Zealand Radiocarbon Lab. obtained different result from material of this midden, (Ref. No. 2826/4 12,200 ± 240 B.P.). Coll. by J. M. Coles (See Q-948 6735 ± 180 B.P. for Mesolithic stone industry, Coles, 1971).

6147 ± 90

Q-988. Morton, Fife, T50-1 and 3 **4197 B.C.**

Wood charcoal from lower and middle layers of shell midden sealed by 30 to 50 cm earth, contemporary with adjacent Mesolithic occupation site (56° 25′ 20″ N Lat, 2° 51′ 50″ W Long, Nat. Grid Ref. NO/468258). Coll. by J. M. Coles (1971).

6450 ± 80

Q-989. Morton, Fife, T53-1 **4500 B.C.**

Wood charcoal from hearth *in situ* on sand surface of stone industry assoc. with Q-988. Very little overlying soil, but no visible contamination. Hearth was dated by thermoluminescence method at Natl. Mus. of Scotland (6000 B.P. ± 1000) and duplicate sample of charcoal was dated by New Zealand Radiocarbon Lab., Ref. No. 2826/3; 6400 ± 125 B.P. The 2 dates agree well. Coll. by J. M. Coles.

3209 ± 75

Q-990. The Culbin Sands, Morayshire **1259 B.C.**

Wood charcoal from dense, black wood remains 1.3 m from surface stratified between 2 midden deposits, all apparently contemporary (57° 38′ 20″ N Lat, 3° 41′ 40″ W Long, Nat. Grid Ref. NH 991622).

This area of Scotland yielded several sites with pottery and metal work comparable with that of the Culbin site, but so far little knowledge of economy. Animal bones and shell in these middens will now make available hitherto unknown dating evidence. Coll. by J. M. Coles and J. J. Taylor, Dept. Archaeol. and Anthropol., Univ. of Cambridge (Coles, 1972).

Myrtos series, Crete

More samples (see R., 1970, v. 12, p. 590-598) from site of Early Minoan II settlement at Myrtos, on hilltop on S coast of Crete, 11 km W of Herapetra (35° 00′ N Lat, 25° 36′ E Long). Like many such settlements, Myrtos was destroyed by fire, which should be dated. Samples were near surface and contaminated by many modern rootlets which were removed by hand-picking by O. Rackham and V. R. Switsur prior to chemical pretreatment. Alkaline solution could not be boiled since colloidal solutions were formed by test samples of all the specimens. Coll. by P. M. Warren, British School of Archaeol., Athens.

Q-951. Myrtos, Rm. 76 **3835 ± 80** **1885 B.C.**

Carbonized wood from depth 1.8 m in destruction debris at center of room.

Q-952. Myrtos, Rm. 77 **4172 ± 70** **2222 B.C.**

Carbonized wood from depth 1.2 m in debris near a corner of a walled room containing burnt earth and fragments of roof plaster.

Q-954. Myrtos, Building 96, The Well **300 ± 60** **A.D. 1650**

Charcoal from floor of depression in ground, which may have been a well, from light gray burnt earth 0.22 m below modern surface under a stone filling. Well is ca. 20 m below Minoan settlement.

Q-1002. Myrtos, Rm. 32 **3965 ± 80** **2015 B.C.**

Carbonized wood from a large charcoal patch ca. 40 cm diam., probably remains of one piece of wood. It lay 0.28 m from modern surface, 0.20 m above natural sandstone rock near summit of hill, adjacent to wall of room containing much burnt mud-brick and pottery.

Q-1003. Myrtos, Rm. 32 **3907 ± 80** **1957 B.C.**

Carbonized wood from level lower than Q-1002 in same room, 1.15 m from modern surface, from inside smashed remains of large clay jar (original height ca. 1.2 m) lying in burnt debris of room. Jar possibly contained oil since burning in room was very severe and surroundings appeared oily.

3986 ± 80
Q-1004. Myrtos, Rm. 32 **2036 B.C.**

Carbonized wood immediately above clay floor, 0.5 below modern surface.

General Comment (P.M.W.): all samples except Q-954 are from burnt contexts of final destruction of Early Minoan II settlement. Series internally consistent and with dendrochronologic calibration produces dates within archaeologic date range of settlement ca. 2600 to 2170 B.C. (Early Minoan II). Corrected results suggest final destruction date for settlement not later than (and probably before) 2150 B.C., which confirms archaeologic date ca. 2170 B.C. Q-954 indicates that the circular construction on plain NW of settlement was open and used in medieval times. (See Warren, 1968, 1969.) The final report will appear later.

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UPPSALA NATURAL RADIOCARBON MEASUREMENTS XI

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The following list covers some old measurements not included in previous lists and most of the samples measured at the Uppsala C^{14} laboratory since the last list (R., 1969, v. 11, p. 515-544); samples utilized for determining the increase of the C^{14}/C^{12} ratio due to explosion of nuclear devices are omitted.

The technique used is mainly the same as previously described by Olsson (1958) and the pretreatment is also similar. In autumn 1970, we changed from bottles filled with saturated CrO_3 in conc. H_2SO_4 to more CrO_3 (a mixture of 60 g CrO_3, 60 ml H_2O and 100 ml conc. H_2SO_4 dissolved in the same amount of water as the mixture), as suggested by A. Heikkinen, Finland. Peat, gyttja, other organic sediments, charcoal, wood, roots, leaves, and other plant remains are heated to ca. 100°C for some hours with HCl, 1 to 2%, left at least over night, washed with distilled water, transferred to NaOH, 1 to 2%, at +80°C over night, washed with distilled water and finally acidified to pH < 3 before being dried. Combustion shortly follows pretreatment. Foraminifera and mollusk shells are leached with HCl. Fractions used for shell samples are given in per cent as a mean value. Since shell fragments usually are different in size, the fraction of shell samples does not give the fraction of individual shells.

Bone samples were treated differently to test methods (Olsson *et al.*, ms. in preparation). Each method is indicated with the sample. Tree-ring samples were also treated differently as indicated in each description. Any other deviation from normal treatment is indicated in the description.

The reference sample is 95% of the C^{14}/C^{12} ratio of the NBS oxalic-acid standard. Any corrections for apparent water ages are thus not included here, but are discussed in papers dealing with the samples. Corrections for deviations from the normal C^{13}/C^{12} ratio (−25.0‰ in the PDB scale) are applied for unknown samples. Our 6 oxalic-acid samples did not show any significant difference in their C^{31}/C^{12} ratio according to measurements made in Stockholm. W. G. Mook in Groningen, The Netherlands, has kindly measured our 4 remaining standard samples. Oxalic acid 1, 4, 5, and 6 were measured as −19.12, −19.27, −19.24 and −19.62‰, respectively. Our secondary C^{13} standard, oxalic-acid 1, was measured by Craig (1961) and it had a δC^{13} value of −18.97‰ which should be corrected by ca. 1%, giving a value of ca. −19.2‰, consistent with recent measurements made by Mook for us. Since the value given by Craig in 1961 for our oxalic acid standard agrees with

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the international oxalic acid standard, we have not applied corrections, based on the C^{13} content, to our standard.

The value 5570 yr has been used for the half-life of C^{14}, except for some samples of geochemical interest, when 5730 yr was used as stated in the table. These Δ values will not be changed if results are calculated with the half-life 5570 yr.

Results in this list are given B.P. (before 1950) or as an excess, Δ, over the reference sample:

$$\Delta = \delta C^{14} - (2\ \delta C^{13} + 50)\ (1 + \frac{\delta C^{14}}{1000})$$

where δC^{14} is the age-corrected C^{14} deviation from the reference sample in per mil in A.D. 1950, and δC^{13} is the deviation from PDB standard in per mil. Errors include standard deviation (σ) of counted particles and errors in corrections due to the C^{13}/C^{12} ratio, filling pressure, temperature, working voltage, barometric pressure, etc., as described by Olsson (1965, 1966). When measured activity is lower than zero, 2σ has been used for calculation of minimum age. When it is between zero and 2σ, net activity is increased by 2σ for calculation of minimum age. Since results are physical measurements, no terms are included for the error in the half-life or previous C^{14}/C^{12} variations. These errors are discussed elsewhere.

Several samples had to be diluted with CO_2 from an old source to bring them to normal working pressure of the counters. This has been about 2600 mm Hg for samples with numbers U-704 or lower, proportional counter 1; ca. 1000 mm Hg for samples with numbers from U-705 to U-757, proportional counter 1; and ca. 1600 mm Hg for samples with numbers from U-2000, proportional counter 4.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Deep-sea cores

Indian Ocean Series 1

Foraminifera tests from deep-sea core 156 (07° 14′ N Lat, 52° 49′

E Long), Somali Basin, Indian Ocean, depth 5107 m. Coll. 1948 by Swedish *Albatross* Expedition (Pettersson); subm. by Eric Olausson, Maringeol. Lab., Univ. Göteborg, Sweden. Core is rich in coccoliths except in a few horizons (Olausson *et al.*, 1971). One horizon dated previously U-677: 39,500 $^{+\,5400}_{-\,3300}$ and U-678: > 33,500 (R., 1969, v. 11, p. 516-517). *Comment*: sample ultrasonically washed in acidified, boiled, distilled water, sieved, pH ca. 4, and dried before subm. to Uppsala.

U-2143. Core 156, w **15,000 ± 1000**
13,100 B.C.
$\delta C^{13} = -1.3‰$

Core 156, depth 170.5 to 178.5 cm, Pt. I, > 65μ, whole fraction. *Comment*: diluted.

U-2144. Core 156, b **$^{+3700}_{5300\ \ -2500}$**
3300 B.C.
$\delta C^{13} = -0.5‰$

Core 156, depth 170.5 to 178.5 cm, Pt. II, > 65μ, innermost 30%. *Comment*: diluted.

U-2145. Core 156, a **$^{+2200}_{13,300\ \ -1900}$**
11,300 B.C.
$\delta C^{13} = -0.3‰$

Core 156, depth 170.5 to 178.5 cm, Pt. II, > 65μ, outermost 65%. *Comment*: diluted.

Indian Ocean Series 2

Foraminifera tests from deep-sea Core V16-66 (42° 39′ S Lat, 45° 40′ E Long), Indian Ocean, depth 3072 m. Samples date appearance of *Globorotalia truncatulinoides*. Coll. 1966 by Lamont *Vema* Expedition; subm. by Olausson. All samples give an activity 0.022 ± 0.036 (weighed mean-value) corresponding to an age > 34,300. *Comment*: samples ultrasonically washed in acidified, boiled distilled water, sieved, pH ca. 4, and dried before subm. to Uppsala. All samples diluted.

U-2139. Vema 16-66, b **>13,400**
$\delta C^{13} = -4.1‰$

Core V16-66, depth 182 cm, > 65μ. Innermost 30% was used.

U-2140. Vema 16-66, a **>20,500**
$\delta C^{13} = -0.1‰$

Same as U-2139; outermost 70% was used.

U-2141. Vema 16-66, b **>31,700**
$\delta C^{13} = -1.2‰$

Core V16-66, depth 182 cm, 44 to 65μ. Innermost 85% was used.

U-2142. Vema 16-66, a **>18,500**
$\delta C^{13} = -3.4‰$

Same as U-2141; outermost 15% was used.

U-2135. Vema 16-66, b **>26,500**
$\delta C^{13} = -1.8‰$

Core V16-66, depth 202 cm, > 65μ. Innermost 55% was used.

U-2136. Vema 16-66, a **>22,800**
$\delta C^{13} = -2.1‰$

Same as U-2135; outermost 45% was used.

U-2137. Vema 16-66, b **>29,000**
$\delta C^{13} = -2.9‰$

Core V16-66, depth 202 cm, 44 to 65μ. Innermost 90% was used.

U-2138. Vema 16-66, a **>12,800**
$\delta C^{13} = -3.5‰$

Same as U-2137; outermost 10% was used.

Pacific Ocean core series

Foraminifera from Core MSN 138 G (00° 15′ S Lat, 147° 34′ W Long). Coll. 1961 by the *Monsoon* Expedition. Samples were separated into fractions by sieving by acidified boiled distilled water (pH 4) and leached in HCl to give different fractions for studies of contamination such as was seen in cores from Mediterranean (Eriksson and Olsson, 1963; Olsson and Eriksson, 1965; Olsson *et al.*, 1968). Upper samples in core dated previously (R., 1969, v. 11, p. 517-518). Results presented in Paris, 1969 (Olsson and Eriksson, 1971). Pretreated and subm. by K. Gösta Eriksson, Inst. Geol., CTH and Univ. Gothenburg, Sweden.

U-2148. MSN 138 G, b **+1800 16,600 −1500 14,700 B.C.**
$\delta C^{13} = +1.3‰$

Core MSN 138 G, depth 30 to 40 cm, > 63μ. *Comment*: innermost 20% was used. Diluted.

U-2149. MSN 138 G, a **+620 18,030 −580 16,080 B.C.**
$\delta C^{13} = +1.0‰$

Shell layer surrounding U-2148. *Comment*: corresponds to outermost 80% of tests. Diluted.

U-2150. MSN 138 G, b **+500 20,670 −470 18,720 B.C.**
$\delta C^{13} = -0.7‰$

Core MSN 138 G, depth 30 to 40 cm, 4 to 45μ. *Comment*: innermost 35% was used.

U-2151. MSN 138 G, a **+840 18,250 −760 16,300 B.C.**
$\delta C^{13} = -0.4‰$

Shell layer surrounding U-2150. *Comment*: corresponds to outermost 15% of tests. Diluted.

U-2152. MSN 138 G, b **18,500 ± 500 16,550 B.C.**
$\delta C^{13} = +0.2‰$

Core MSN 138 G, depth 40 to 50 cm, > 63μ. *Comment*: innermost 45% was used. Diluted.

U-2153. MSN 138 G, a **+480 19,930 −450 17,980 B.C.**
$\delta C^{13} = +0.4‰$

Shell layer surrounding U-2152. *Comment*: corresponds to outermost 55% of tests.

U-2155. MSN 138 G, c **+560 20,430 −520 18,480 B.C.**
$\delta C^{13} = +3.0‰$

Core MSN 138 G, depth 40 to 50 cm, 4 to 45μ. *Comment*: innermost 50% was used.

U-2156. MSN 138 G, b **+530 20,180 −500 18,230 B.C.**
$\delta C^{13} = +3.6‰$

Shell layer surrounding U-2155. *Comment*: corresponds to 30% of tests.

+540
19,100
−510

U-2157. MSN 138 G, a **17,150 B.C.**

$\delta C^{13} = -1.7‰$

Shell layer surrounding U-2156. *Comment*: corresponds to outermost 20% of tests.

+1170
24,200
−1020

U-2158. MSN 138 G, b **22,250 B.C.**

$\delta C^{13} = +1.0‰$

Core MSN 138 G, depth 50 to 60 cm, > 63μ. *Comment*: innermost 40% was used. Diluted.

+1000
24,000
− 900

U-2159. MSN 138 G, a **22,100 B.C.**

$\delta C^{13} = +0.6‰$

Shell layer surrounding U-2158. *Comment*: corresponds to outermost 60% of tests. Diluted.

+880
24,890
−800

U-2160. MSN 138 G, c **22,940 B.C.**

$\delta C^{13} = -0.4‰$

Core MSN 138 G, depth 50 to 60 cm, 4 to 45μ. *Comment*: innermost 35% was used.

+760
23,860
−690

U-2161. MSN 138 G, b **21,910 B.C.**

$\delta C^{13} = -1.3‰$

Shell layer surrounding U-2160. *Comment*: corresponds to 45% of tests.

+800
23,100
−700

U-2162. MSN 138 G, a **21,100 B.C.**

$\delta C^{13} = +10.0‰$

Shell layer surrounding U-2161. *Comment*: corresponds to outermost 20% of tests.

+1200
31,700
−1100

U-2163. MSN 138 G, w **29,800 B.C.**

$\delta C^{13} = +0.5‰$

Core MSN 138 G, depth 80 to 88 cm, > 63μ. *Comment*: whole tests were used.

+4400
37,400
−2800

U-2164. MSN 138 G, c **35,500 B.C.**

$\delta C^{13} = -0.7‰$

Core MSN 138 G, depth 80 to 88 cm, 4 to 45μ. *Comment*: innermost 30% was used.

+1400
31,600
−1200

U-2165. MSN 138 G, b **29,600 B.C.**

$\delta C^{13} = +1.7‰$

Shell layer surrounding U-2164. *Comment*: corresponds to 35% of tests.

+1700
26,700
−1500

U-2166. MSN 138 G, a **24,700 B.C.**

$\delta C^{13} = -1.3‰$

Shell layer surrounding U-2165. *Comment*: corresponds to outermost 35% of tests.

B. Iceland

Surtsey series

Cyprina islandica from Surtur II crater (63° 18′ N Lat, 20° 37′ W Long), Surtsey, Iceland. Alexandersson (1970) discussed marine sediments lithified on the sea floor. Coll. 1968 and subm. by Torbjörn Alexandersson, Dept. Hist. Geol. and Paleontol., Univ. Uppsala, Sweden. *Comment*: sample, ca. 10 g, consisted of 3 fragments of varying sizes (12% very thin, 23% rather thin and 65% appreciably thicker) but due to small amount, fragments were used as 1 sample. Ca. 0.6 g removed from each shell by leaching with dilute HCl before they were joined to 1 sample. "Outer" fraction consists, largely, of CO_2 from smallest fragments, whereas "inner" fraction consists, mainly, of CO_2 from the largest shell. Comparison between U-2146 and U-2147 proves, that the sample consisted of fragments of varying ages. Ages given are mean for shells, which may vary within at least 4000 yr range but probably much longer.

6010 ± 190
U-2146. Surtsey 200668, b **4060 B.C.**
$\delta C^{13} = +0.7‰$

"Innermost" 50% was used. *Comment*: diluted.

+390
10,570
−370
U-2147. Surtsey 200668, a **8620 B.C.**
$\delta C^{13} = -1.6‰$

Shell layer surrounding U-2146 and smallest shell. *Comment*: corresponds to 35% of shells; 15% removed by washing. Diluted.

Shoreline series

Shells and peat from Iceland to determine chronology of late- and Post-glacial shorelines. Subm. by Thorleifur Einarsson, Sci. Inst., Univ. Iceland.

12,830 ± 170
U-2225. Röndin, Kópasker, 1-70, b **10,880 B.C.**
$\delta C^{13} = +2.7‰$

Mya truncata from cliff Röndin at Kópasker (66° 17.5′ N Lat, 18° 27′ W Long), Iceland, from silt layer with boulders and shells above pillow lava. Sample underlying 2 m moraine overlain by 1 m loose sand. Innermost 35% was used. *Comment*: difference between U-2225 and U-2226 indicates contamination. Coll. 1969 by Einarsson.

11,710 ± 210
U-2226. Röndin, Kópasker, 1-70, a **9760 B.C.**
$\delta C^{13} = +2.7‰$

Shell layer surrounding U-2225. *Comment*: corresponds to 35% of shells; 30% removed by washing.

9730 ± 160
U-724. Arnes, Vídidalur, 2-70, b **7780 B.C.**
$\delta C^{13} = -2.2‰$

Fragments of *Mytilus edulis, Mya truncata,* and *Saxicava arctica* from Árnes, Vídidalur (65° 27′ N Lat, 20° 36′ W Long), Iceland, from E bank of R. Vídidalsa, 15 m alt, in silt layer, 4 m thick, overlain by 1 m soil. Innermost 95% was used. Coll. 1969 by Einarsson.

+2600
9800
−2000
U-725. Arnes, Vídidalur, 2-70, a **7850 B.C.**
$\delta C^{13} = +1.2‰$

Shell layer surrounding U-724. *Comment*: corresponds to 5% of shells. Whole sample only 8 g. Diluted.

U-2227. Kaldárbrú, 3-70, b **11,630 ± 160**
9680 B.C.
$\delta C^{13} = -2.8‰$

Fragments of *Saxicava arctica and Mya truncata* from Kaldárbrú (64° 47′ N Lat, 22° 17′ W Long), Kolbeinsstadahreppur, Iceland, from 5 m silt below 2 m layer with gravel, on N bank of R. Kaldá, near bridge. Innermost 80% was used.

U-726. Kaldárbrú, 3-70, a **+540 11,330 −510**
9380 B.C.
$\delta C^{13} = +1.5‰$

Shell layer surrounding U-2227. *Comment*: corresponds to 15% of shells; 5% removed by washing. Whole sample only ca. 14 g. Diluted.

U-2224. Faxaflói-bay, 2-69, INS **9460 ± 100**
7510 B.C.
$\delta C^{13} = -29.4‰$

Peat from floor of Faxaflói-bay (64° 13.5′ N Lat, 22° 19′ W Long), Melakriki, Iceland, underlying 3 m shelly sand. Depth 40 m. No *Betula* pollen in sample; probably redeposited. Coll. 1968 by Ludvik Jonsson on *M/s Sandey* and subm. by Einarsson.

U-750. Faxaflói-bay, 2-69, SOL **9120 ± 180**
7170 B.C.
$\delta C^{13} = -29.6‰$

Humus products extracted from U-2224.

U-2167. Tjarnargata 4, 1-69 **1190 ± 90**
A.D. 760
$\delta C^{13} = -27.2‰$

Wood (*Betula nana*) from Tjarnargata 4, Reykjavik (64° 09′ N Lat, 21° 57′ W Long), Iceland in peat below ground water level, with wood fragments of *Larix decidua* dated as U-2082: 1140 ± 70 (R., 1969, v. 11, p. 520-521) and bones. Coll. 1944 by Finnur Gudmundsson, Mus. Nat. Hist., Reykjavik, Iceland and subm. by Einarsson. Species determined by E. Åberg, Uppsala.

C. Svalbard

Vestspitsbergen series

Shells and whale bones from Vestspitsbergen coll. for determination of land uplift but also used for testing different methods for pretreatment of bones. Alt. given above mean sea level. Previous determinations in this series in R.: 1960, v. 2, p. 115-116; 1961, v. 3, p. 82-83; 1964, v. 6, p. 296-298; 1965, v. 7, p. 317-318; 1967, v. 9, p. 456-457; 1969, v. 11, p. 521-524. Quaternary geology and land uplift is discussed by Birkenmajer (1960), Feyling-Hanssen (1955), Feyling-Hanssen and Olsson (1959-1960), and Birkenmajer and Olsson (1970). Samples from Hornsund coll. 1966 and subm. by Krzysztof Birkenmajer, Polish Acad. Sci., Krakow,

Poland and those from Isfjorden coll. 1960 by D. H. Maling, Rolf Feyling-Hanssen, Dept. Geol., Aarhus Univ., Denmark, and I. U. Olsson. *Comment*: bone treatment with EDTA described in R., 1967, v. 9, p. 456.

910 ± 110

U-2229. Rettkvalbogen E, 1st, Q5a, W **A.D. 1040**

$\delta C^{13} = -20.7‰$

Wrong fraction from EDTA-treatment of U-2048.

9480 ± 180

U-2228. Isbjørnhamna, $2a_2$, Q3a, *Balanus*, b **7530 B.C.**

δC^{13} *assumed* $+2.8‰$

Fragments (*Balanus*) from Isbjørnhamna (77° 00′ N Lat, 15° 33′ 30″ E Long), Wilczekodden, Hornsund, Spitsbergen, alt 7.5 m. Sample overlay sand and gravel but underlay sand, Horizon "d" of $2a_2$ Terrace, *Saxicava-Mya* Terrace. *Comment*: fragments (*Mya truncata, Saxicava arctica*) from same batch dated previously (R., 1969, v. 11, p. 522). Innermost 55% was used.

+210
9470
−200

U-727. Isbjørnhamna, $2a_2$, Q3a, *Balanus*, a **7520 B.C.**

$\delta C^{13} = +2.8‰$

Shell layer surrounding U-2228. *Comment*: corresponds to 25% of shells; 20% removed by washing.

280 ± 100

U-2270. Kapp Linné 6005, Al, R **A.D. 1670**

$\delta C^{13} = -14.6‰$

Vertebra of whale from Kapp Linné (78° 04′ N Lat, 13° 40′ E Long), Isfjorden, Spitsbergen, alt ca. 1 m. Coll. 1960 by Feyling-Hanssen and Olsson. *Comment*: sample treated with acetone before EDTA extraction. Diluted.

+800
4690
−750

U-2271. Kapp Linné 6005, Al, A **2740 B.C.**

$\delta C^{13} = -25.4‰$

Acetone extract from U-2270. *Comment*: probably contaminated with oil from radio sta. Diluted.

680 ± 80

U-2272. Kapp Linné 6005, B1, R **A.D. 1270**

$\delta C^{13} = -14.7‰$

Sample from same vertebra as U-2270. *Comment*: not treated with acetone before EDTA extraction.

U-2273. Ekholmvika 6022 b, HCl, <250 μ, r **+210 7550 −200 5600 B.C.**
$\delta C^{13} = -21.4‰$

Insoluble remains after HCl treatment of whalebone from Ekholmvika (78° 35′ N Lat, 16° 38′ E Long), Billefjorden, Spitsbergen; alt ca. 50 m. Deeply buried in fine gravel. Coll. 1960 by D. H. Maling. *Comment*: grains < 250μ used. HCl added until pH of liquid remained at 1 to 1.5 for 4 days. 1-N HCl used.

U-2274. Ekholmvika 6022 b, HCl, <250 μ, l **8960 ± 130 7010 B.C.**
$\delta C^{13} = -18.1‰$

In HCl soluble fraction of bone received at treatment giving U-2273.

U-2275. Ekholmvika 6022 b, HCl, 250-500 μ, r **9660 ± 180 7710 B.C.**
$\delta C^{13} = -16.6‰$

Insoluble remains after HCl treatment of whalebone also used for U-2273. *Comment*: grains 250 to 500μ used; pH 1 to 1.5 for 7 days. 1-N HCl used.

U-751. Ekholmvika 6022 b, HCl, 250-500 μ, l **+540 7700 −510 5750 B.C.**
$\delta C^{13} = -17.5‰$

In HCl soluble fraction of bone received at treatment giving U-2275. *Comment*: diluted.

U-169. Gipshuken 6016 a, inorganic $\Delta = 3121 \pm 30‰$
δC^{13} *assumed* $-20.0‰$

Inorganic fraction of bone of U-467, CO_2 liberated at HCl-treatment, with assumed false result. *Comment*: sample was pulverized before treatment. Ca. 25% HCl used. Sample stored in room with high C^{14} content before treatment. Diluted.

D. Sweden

Sörmon series

Charcoal from Sörmon (59° 23′ N Lat, 13° 22′ E Long), Värmland, Sweden. Blomquist (1969) has described Sörmon formation. Coll. 1968 and subm. by Thorsten Blomquist, Inst., Quaternary Geol., Univ. Uppsala, Sweden.

U-2133. Sörmon 8C **7060 ± 180 5110 B.C.**
$\delta C^{13} = -27.1‰$

Charcoal from Quarry VII, ca. 0.5 m below surface.

2900 ± 100
U-2132. Sörmon 10C **950 B.C.**
$\delta C^{13} = -18.5‰$

Charcoal from Quarry VII, ca. 0.6 m below surface.

Kyrkviken series

Post-glacial sediments from Kyrkviken (62° 55′ N Lat, 17° 47′ E Long), 1 km S Kramfors, Ångermanland, Sweden. Samples from sharp transition from black clay rich in sulphur to light-gray clay with somewhat disturbed micro-varves with organic substance. Salinity analyses by Birgitta Ericsson, diatom analyses by Maj-Britt Florin, both of Inst. Quaternary Geol., Univ. Uppsala, Sweden. Brackish-water sediments. Carbon content ca. 1.4% according to Ericsson. Contamination with graphite not excluded. Kyrkviken sediments described by Ericsson (1970). Coll. 1969 and subm. by Ericsson. *Comment*: due to risk of contamination with allochtonous material, sediments are not suitable for dating; different fractions must be studied. NaOH-soluble fraction dated at lower age than insoluble fraction, as seen previously in similar samples (R., 1964, v. 6, p. 303; 1969, v. 11, p. 532). Insoluble fraction difficult to combust, in comparison with peat, gyttja, or soluble fraction. Total yield in radiocarbon lab. corresponds to $< 1\%$ carbon. A detailed description will be given by Olsson, 1971.

12,660 ± 260
U-713. Kyrkviken 1, INS **10,710 B.C.**
$\delta C^{13} = -28.3‰$

Insoluble part, 0 to 5 cm above transition.

+1200
8000
−1000
U-714. Kyrkviken 1, SOL **6100 B.C.**
$\delta C^{13} = -27.5‰$

In warm dilute NaOH soluble part from U-713. *Comment*: diluted.

+350
12,100
−340
U-715. Kyrkviken 2, INS **10,150 B.C.**
$\delta C^{13} = -27.2‰$

Insoluble fraction, 0 to 5 cm above transition. *Comment*: diluted.

8760 ± 270
U-716. Kyrkviken 2, INS + SOL, 1st **6810 B.C.**
$\delta C^{13} = -27.5‰$

In warm dilute NaOH soluble part mixed with insoluble part from U-715. Fraction corresponds to gas received at 1st step of combustion, when sample is heated very little. *Comment*: diluted.

U-717. Kyrkviken 2, INS + SOL, 2nd **+5000 16,200 −3100 14,200 B.C.**
$\delta C^{13} = -27.9‰$

Fraction corresponds to gas received at 2nd step of combustion of U-716. Sample is heated more and stronger stream of oxygen is used. *Comment*: diluted.

U-718. Kyrkviken 3, INS **8970 ± 250 7020 B.C.**
$\delta C^{13} = -28.8‰$

Insoluble part, 0 to 5 cm below transition. *Comment*: diluted.

U-719. Kyrkviken 3, SOL **+1700 6300 −1400 4300 B.C.**
$\delta C^{13} = -27.4‰$

In warm dilute NaOH soluble part from U-718. *Comment*: diluted.

U-2276. Graphite 200169, C **+5000 32,100 −3100 30,100 B.C.**
$\delta C^{13} = -20.9‰$

Graphite from chemicals dealer, Kebo. *Comment*: gas obtained at normal combustion. High temperature, strong stream of oxygen, bad yield. Diluted.

Fjällsjö series

Sediments from Sil, Fjällsjö (63° 46′ 13″ N Lat, 16° 27′ 43″ E Long), Ångermanland, Sweden, alt 225 m. Coll. 1969 and subm. by Erling Lindström, Inst. Nat. Geog., Univ. Uppsala, Sweden.

U-707. Sil, Fjällsjö, I, INS **2650 ± 150 700 B.C.**
$\delta C^{13} = -33.0‰$

Peat, 63 to 65 cm below surface.

U-2205. Sil, Fjällsjö, I, SOL **2540 ± 80 590 B.C.**
$\delta C^{13} = -27.4‰$

Humus products extracted from U-707.

U-2206. Sil, Fjällsjö, II, INS **2660 ± 80 710 B.C.**
$\delta C^{13} = -28.1‰$

Silt-gyttja, 65 to 67 cm below surface.

2620 ± 80

U-2207. Sil, Fjällsjö, II, SOL **670 B.C.**

$\delta C^{13} = -26.8‰$

Humus products extracted from U-2206.

+350
10,920
−340

U-708. Sil, Fjällsjö, III, INS **8970 B.C.**

$\delta C^{13} = -27.2‰$

Silt with low content of organic material, 118 to 120 cm below surface.

+1500
10,300
−1300

U-709. Sil, Fjällsjö, III, INS + SOL **8300 B.C.**

$\delta C^{13} = -29.1‰$

Mixture of soluble and insoluble fractions from same level as U-708. *Comment*: ca. 2/3 insoluble fraction removed. Sample corresponds to ca. 1/3 insoluble and all soluble fraction. Diluted.

+1000
8600
− 900

U-710. Sil, Fjällsjö, III, SOL **6650 B.C.**

$\delta C^{13} = -28.6‰$

Humus products extracted from U-708. *Comment*: diluted.

Bjurselet series

Gyttja from Bjurselet (65° 10′ N Lat, 21° 10′ E Long), Byske parish, Västerbotten, Sweden, to date vegetational development recognized in pollen diagrams related to archaeologic studies (see Archaeologic Samples, this series, below) in same area. Pollen analyses by Lars-König Königsson and Thorolf Candolin, Inst. Quaternary Geol., Univ. Uppsala, Sweden. Geol. description by Königsson (1970) including Königsson's interpretation of C^{14} dates. Geol. samples dated previously (R., 1967, v. 7, p. 454-470). Coll. 1964 and subm. by Königsson. *Comment*: all samples highly humified and roots removed by sieving before subm. to radiocarbon lab.; earlier described as carr peat, information when samples were subm., based on preliminary field studies.

2600 ± 600

U-500. Bjurselet 14 G, INS **700 B.C.**

$\delta C^{13} = -22.1‰$

Sandy silt with gyttja substance, 56 to 53.5 cm below surface, below big decrease of *Salix*. Comment: diluted. Very small remainder used to certify that 14 G younger than 11 G. Complete new pretreatment.

3970 ± 70

U-612. Bjurselet 11 G, INS **2020 B.C.**

$\delta C^{13} = -29.1‰$

Silty gyttja, 48.5 to 46 cm below surface. CO_2 from new combustion, after treatment with HCl, of sample pretreated for U-579. Below 1st appearance of cerealia and *Hordeum*.

3610 ± 60

U-600. Bjurselet 6 G, INS **1660 B.C.**

$\delta C^{13} = -28.6‰$

Silty gytjja with wood fragments, 38 to 36 cm below surface. Before beginning of *Picea*.

3450 ± 90

U-2056. Bjurselet 6 G, INS **1500 B.C.**

$\delta C^{13} = -28.6‰$

Same CO_2 as for U-600, but measured in another counter.

2630 ± 80

U-602. Bjurselet 4 G, INS **680 B.C.**

$\delta C^{13} = -29.7‰$

Peaty gyttja with wood fragments, 34 to 32 cm below surface. Dates maximum of *Pinus* and minimum of *Alnus*.

2420 ± 80

U-601. Bjurselet 3 G, INS **470 B.C.**

$\delta C^{13} = -28.8‰$

Peaty gyttja with wood fragments, 32 to 29 cm below surface. Dates minimum of *Pinus* and *Picea*, although both show increasing tendency in pollen curves. Also dates maximum of *Alnus* in curve showing decreasing tendency and decrease of *Betula*. *Gramineae* and *Sphagnum* sp. increase strongly.

II. ARCHAEOLOGIC SAMPLES

A. Africa

Ivory coast series

Shells and charcoal from shell mounds adjacent to lagoons, Ivory Coast. Samples dated to prove that shell accumulations are artificial. Mounds generally lense-shaped; formerly regarded as natural deposits, but Dorthe (1964) and Madon (1967, 1969) reported bone and pottery finds. Raymond Mauny, Fac. Lettres et Sci. Humaines, Univ. Paris, France, described sites archaeologically (1971). Present radiocarbon dates discussed by Mauny and Olsson (mss. in preparation). Some dates on different fractions of 1 sample given previously, U-264: 970 ± 110, U-265: 990 ± 70 and U-266: 950 ± 70 (R., 1964, v. 6, p. 294-295), from +15 m, not 48 m as Tricart stated. *Comment*: *Pachymelania byronensis* lives in slightly brackish water, *Egeria paradoxa* in fresh water, and *Aloidis trigona* in brackish water. Only one possibility given to determine apparent age of water by cross-dating with charcoal from same site. Dif-

ference between weighed mean value of shells (U-2194 and U-2195, *Aloidis*) and charcoal (U-753) is 385 ± 120.

U-2184. Songon Kassemblé, c **1200 ± 90** **A.D. 750**

$\delta C^{13} = -6.1‰$

Aloidis trigona from Songon Kassemblé (05° 18′ N Lat, 04° 17′ W Long), Daval, 22 km W Abidjan, from 1 m depth in mound, +0.2 to 1.65 m. Coll. 1969 and subm. by Mauny. *Comment*: innermost 40% was used.

U-2185. Songon Kassemblé, b **1430 ± 130** **A.D. 520**

$\delta C^{13} = -5.1‰$

Shell layer surrounding U-2184. *Comment*: corresponds to 15% of shells.

U-2186. Songon Kassemblé, a **+410 1130 −390** **A.D. 820**

$\delta C^{13} = -8.2‰$

Shell layer surrounding U-2185. *Comment*: corresponds to 25% of shells; 20% removed by washing.

U-2187. Songon Dagbé, 1b **2630 ± 120** **680 B.C.**

$\delta C^{13} = -11.9‰$

Aloidis trigona from Songon Dagbé (05° 18′ N Lat, 04° 18′ W Long), 23 km W Abidjan, 1 m depth in mound, + 0 to 8 m, containing copper bracelets, axes, pottery and iron harpoon. Coll. 1969 and subm. by Mauny *Comment*: innermost 30% was used.

U-2188. Songon Dagbé, 1a **2640 ± 130** **690 B.C.**

$\delta C^{13} = -11.5‰$

Shell layer surrounding U-2187. *Comment*: corresponds to 35% of shells; 35% removed by washing.

U-2189. Songon Dagbé, 2c **2840 ± 150** **890 B.C.**

$\delta C^{13} = -10.8‰$

Aloidis trigona from same colln. as U-2187. *Comment*: innermost 30% was used.

U-2190. Songon Dagbé, 2b **2730 ± 100** **780 B.C.**

$\delta C^{13} = -7.7‰$

Shell layer surrounding U-2189. *Comment*: corresponds to 40% of shells.

U-2191. Songon Dagbé, 2a **2460 ± 200**
510 B.C.
$\delta C^{13} = -10.2‰$

Shell layer surrounding U-2190. *Comment*: corresponds to 30% of shells; 0% removed by washing.

U-2192. Dabou-Tchotchoraf, −2, b **2920 ± 100**
970 B.C.
$\delta C^{13} = -11.4‰$

Aloidis trigona from Dabou-Tchotchoraf (05° 18′ 51″ N Lat, 04° 21° 56″ W Long), 2 km ESE Dabou, from 2 m depth in mound, + 1 to 5.15 m, containing pottery. Coll. 1969 and subm. by Mauny. *Comment*: innermost 40% was used.

U-2193. Dabou-Tchotchoraf, −2, a **2920 ± 140**
970 B.C.
$\delta C^{13} = -11.8‰$

Shell layer surrounding U-2192. *Comment*: corresponds to 15% of shells; 45% removed by washing.

U-2194. Dabou-Tchotchoraf, −1.1, b **2920 ± 80**
970 B.C.
$\delta C^{13} = -10.1‰$

Aloidis trigona from same mound as U-2192, from 1.1 m depth in mound. *Comment*: innermost 25% was used.

U-2195. Dabou-Tchotchoraf, −1.1, a **3010 ± 140**
1060 B.C.
$\delta C^{13} = -10.4‰$

Shell layer surrounding U-2194. *Comment*: corresponds to 40% of shells; 35% removed by washing.

U-2196. Tiebissou, b **3630 ± 100**
1680 B.C.
$\delta C^{13} = -8.5‰$

Egeria paradoxa from Tiebissou (05° 20′ N Lat, 04° 51′ W Long), 100 km W Abidjan, on the 2 banks of river at Bandama, 23 km from coast. Sample from several sites 4 to 8 m above level of river. Coll. 1967 by H. Madon, Sodemi, Abidjan and subm. by Mauny. *Comment*: innermost 35% was used.

U-2197. Tiebissou, a **3750 ± 150**
1800 B.C.
$\delta C^{13} = -11.8‰$

Shell layer surrounding U-2196. *Comment*: layer corresponds to 35% of shells; 30% removed by washing.

U-2198. Ehoussou, −1.7, b **3010 ± 100**
1060 B.C.
$\delta C^{13} = -12.1‰$

Pachymelania byronensis from Ehoussou, near lagoon Aby (05° 14′ 21″ N Lat, 03° 16′ 20″ W Long), 82 km E Abidjan, from 1.7 m depth

in mound, + 0.1 to 0.9 m, containing bones. Coll. 1967 by Melseaux, Abidjan and subm. by Madon. *Comment*: innermost 25% was used. Sample probably contaminated by CO_2 dissolved in water penetrating into bottom layers of mound.

U-2199. Ehoussou, −1.7, a — **2680 ± 140**, **730 B.C.**, $\delta C^{13} = -12.8‰$

Shell layer surrounding U-2198. *Comment*: corresponds to 35% of shells; 40% removed by washing.

U-2200. Ehoussou, −1.0, b — **3310 ± 80**, **1360 B.C.**, $\delta C^{13} = -13.2‰$

Pachymelania byronensis from same mound as U-2198, from 1.7 m depth. *Comment*: innermost 25% was used.

U-2201. Ehoussou, −1.0, a — **3210 ± 150**, **1260 B.C.**, $\delta C^{13} = -12.4‰$

Shell layer surrounding U-2200. *Comment*: corresponds to 35% of shells; 40% removed by washing.

U2202. Ehoussou, −0.3, b — **3340 ± 100**, **1390 B.C.**, $\delta C^{13} = -11.6‰$

Pachymelania byronensis from same mound as U-2198 and U-2200, from 0.3 m depth. *Comment*: innermost 25% was used.

U-2203. Ehoussou, −0.3, a — **3120 ± 140**, **1170 B.C.**, $\delta C^{13} = -12.1‰$

Shell layer surrounding U-2202. *Comment*: corresponds to 35% of shells; 40% removed by washing.

U-753. Dabou-Tchotchoraf, −1.1, k — **2560 ± 90**, **610 B.C.**, $\delta C^{13} = -25.9‰$

Charcoal from soil separated from shells, part of U-2194. *Comment*: diluted.

B. Sweden

Gårdlösa series

Charcoal from Iron age settlement Gårdlösa No. 2 (grave-field) and No. 3 (house foundations) (55° 34′ N Lat, 14° 08′ E Long), Smedstorp parish, Skåne, Sweden. Coll. and subm. by Berta Stjernquist, Hist. Mus., Univ. Lund, Sweden. Several samples were dated previously (R., 1965, v. 7, p. 326-327; 1967; v. 9, p. 465-467; 1969, v. 11, p. 536.)

U-746. Gårdlösa 2, Stone-settings 1967, No. 67:8 **1550 ± 80**
A.D. 400
$\delta C^{13} = -26.5‰$

Charcoal from 0.55 to 0.65 m below surface, with melted bronze, fragment of iron, bead, and fragment of a comb. Coll. 1967.

U-706. Gårdlösa 2, Stone-settings 1967, No. 67:11 **1800 ± 80**
A.D. 150
$\delta C^{13} = -25.9‰$

Charcoal from 0.45 to 0.60 m below surface, with melted bronze, fragment of an iron pin, and bead. Coll. 1967.

U-2222. Gårdlösa 2, Stone-settings 1967 No. 67:16 **1600 ± 80**
A.D. 350
$\delta C^{13} = -24.5‰$

Charcoal from 0.55 to 0.65 m below surface, with melted bronze, fragments of bronze sheets, iron fragments, beads, and parts of 2 spindle whirles. Coll. 1967.

U-705. Gårdlösa 2, Stone-settings 1967 No. 67:27 **1300 ± 70**
A.D. 650
$\delta C^{13} = -28.3‰$

Charcoal from 0.45 to 0.55 m below surface, with part of the bronze spring of a fibula, iron fragments, beads, and melted glass. Coll. 1967.

U-2219. Gårdlösa 2, Stone-settings 1967, No. 67:32 **1430 ± 70**
A.D. 520
$\delta C^{13} = -25.4‰$

Charcoal from 0.58 to 0.63 m below surface with bones of a dog. Coll. 1967. *Comment*: part of sample dated previously, U-672: 1340 ± 70.

U-2220. Gårdlösa 2, Stone-settings 1967, No. 67:33 **1505 ± 75**
A.D. 445
$\delta C^{13} = -25.5‰$

Charcoal from 0.55 to 0.70 m below surface, with a bead. Coll. 1967.

U-2221. Gårdlösa 2, Stone-settings 1967, No. 67:39 **1360 ± 80**
A.D. 590
$\delta C^{13} = -24.9‰$

Charcoal from 0.50 to 0.65 m below surface, with bronze fragment with ornament, and bead. Coll. 1967.

U-747. Gårdlösa 3, House LI **1310 ± 100**
A.D. 640
$\delta C^{13} = -24.0‰$

Charcoal from layer, underlying 20-cm-thick layer with cultivated soil from 0.65 to 1.05 m below surface, with potsherds and a bead. Coll. 1966.

1550 ± 80

U-2261. Gårdlösa 3, House XLVII **A.D. 400**

$\delta C^{13} = -24.3‰$

Charcoal from layer, underlying 20-cm-thick layer with cultivated soil, from 0.70 to 0.95 m below surface, with fibula of bronze, iron and bronze pin, fragments of knives, bead, and potsherds. Coll. 1965.

2290 ± 130

U-752. Ödehoburga I[21] **340 B.C.**

$\delta C^{13} = -24.3‰$

Charcoal from Ödehoburga (57° 54′ N Lat, 19° 6′ E Long), Fårö, Gotland, Sweden, from big piece of charcoal in hearth with potsherds. Coll. 1970 and subm. by Anna-Lena Gerdin, Gotland's Hist. Mus., Visby, Sweden.

Bjurselet series

Charcoal and bones from Bjurselet (65° 00′ N Lat, 21° 04′ E Long), Byske parish, Västerbotten, Sweden. From Stone age dwelling-site, alt 53 m, with imported flint axes, scrapers, and potsherds. Upper layer consisted of cultivated soil, Layer I, underlain by sand, Layers II, III, and IV (Christiansson, 1965a, b, 1970). Samples dated previously (R., 1967, v. 9, p. 467-469; 1969, v. 11, p. 539). Pollen profile from same area discussed by Königsson (1970), with his interpretation of radiocarbon dates from Uppsala lab., partly pub. previously (R., 1969, v. 9, p. 465; this list, above). Subm. by Christiansson, Inst. Nordic Antiquities, Univ. Uppsala, Sweden.

480 ± 70

U-2223. Bjurselet 116/266, Härdplatsen **A.D. 1470**

$\delta C^{13} = -25.0‰$

Charcoal from hearth. Coll. 1968 by Christiansson.

+580
1970
−550

U-2204. Bjurselet 194/230, Åkern **20 B.C.**

δC^{13} *assumed* −19‰

Burned seal bone (*Pusa hispida*) from field, Layer II and III. Coll. 1966 by Christiansson. *Comment*: sample EDTA-treated, but was so small that "right" and "wrong" fractions were combined and dated as one sample. Diluted.

III. TREE-RING SAMPLES

Northern Sweden series

Pinus from Hörnett at Hörnsjön (63° 17′ N Lat, 18° 40½′ E Long), Ångermanland, Sweden. Tree from hill S of lake, 100 m alt, felled 1969, age 56 yr, ca. 1.5 m above ground. Softwood. Subm. by A. Assarsson, Mo and Domsjö AB, Örnsköldsvik, Sweden, where part of wood was

chemically treated as described previously (R., 1969, v. 11, p. 539-540). Standardized treatment was applied on part of wood (Uppsala) as a check.

General Comment: "atomic-bomb effect" seen in the extract from tree rings grown as early as A.D. 1950-1945 is assumed due to radial movement of nutrients in the parenchyma cells. Extraction with NaOH (1% b. w.) also gave an extract showing "atomic-bomb effect", although slightly smaller than that observed following more sophisticated treatment. Treatment of remaining wood at Uppsala gave higher activity than the holocellulose and wood extracted at Mo and Domsjö, implying that standard treatment with NaOH may be insufficient for precise work such as calibration of radiocarbon time scale. A similar result was observed for *Fitzroya* (see "Argentina series" below).

Age-corrected excess in activity of *Pinus* wood, A.D. 1945-1950

Lab. no.	Substance	δC^{13} ‰	Δ ‰ $T1/2 = 5730$	Prepared in
U-2168	Holocellulose	−22.8	− 35.6 ± 7.8	Örnsköldsvik
U-2169	Extracted wood	−23.1	− 42.0 ± 7.0	Örnsköldsvik
U-2170	Extract	−27.4	+145.8 ± 10.2	Örnsköldsvik
U-2171	Extracted wood (INS)	−25.1	− 13.9 ± 6.7	Uppsala
U-2172	Extract (SOL)	−13.6	+114.3 ± 22.2	Uppsala

Argentina series

Tree trunk (*Fitzroya cupressoides*) from Parque Nac. Los Alerces (43° S Lat, 71° W Long), Esquel, Chubut, Argentina. Park created 1937. Trunk donated by Intendencia, Parc Nac. Los Alerces via Åke Vinterbäck, Univ. Uppsala, Sweden. Tree rings counted by Horring, High School of Forestry, Stockholm, Sweden. Tree probably was felled A.D. 1934. Cellulose and lignin prepared according to Olson and Broecker (1958), the 2 cellulose fractions, however, with slightly different procedures. One sample separated into fractions at Mo and Domsjö (see N Sweden series, above; R., 1969, v. 11, p. 539-540). Some results pub. previously (R., 1969, v. 11, p. 541). Results from same trees pub. by Lerman *et al.* (1970).

Lab. no.	Age before A.D. 1934	Age B.P. (1950)	Substance	Age-corrected excess δC^{13} ‰	δC^{14} ‰	Δ ‰
U-2281	619-610	630.5	Lignin	−24.6	−17.3	−18 ± 9
U-2282	619-610	630.5	Cellulose w	−22.8	−19.7	−24 ± 9
U-2283	619-610	630.5	Cellulose y	−22.9	−22.6	−27 ± 9
U-2284	589-580	600.5	Holocellulose	−22.4	− 2.7	− 8 ± 5
U-2285	589-580	600.5	Extracted wood	−24.6	− 6.3	− 7 ± 5
U-743	589-580	600.5	Extract	−25.1	+20.4	+21 ± 8

IV. GEOCHEMICAL SAMPLES

Tree leaves series

Tree leaves coll. to investigate influence of dissolved carbonate on C^{14}/C^{12} ratio in trees. Contemporaneous C^{14}/C^{12} ratio of atmosphere will be given later (Olsson, ms. in preparation). Present samples from Uppland, from area with soft ground-water and those from Öland, from area with hard ground-water (Olsson *et al.*, 1969).

U-689. *Salix*, Järlåsa 10 06 68, INS

$\delta C^{14} = +587 \pm 11‰$
$\Delta = +600 \pm 11‰$
$\delta C^{13} = -29.0‰$

Leaves (*Salix*) at ditch with water at Rönningen (17° 13′ N Lat, 59° 58½′ E Long), Norra Hagunda; Uppland, Sweden. Coll. 1968 by Olsson.

U-690. *Betula*, Järlåsa 10 06 68, INS

$\delta C^{14} = +593 \pm 11‰$
$\Delta = +601 \pm 11‰$
$\delta C^{13} = -27.5‰$

Leaves (*Betula*) at Hedbolund (17° 13′ N Lat, 59° 56′ E Long), Norra Hagunda, Uppland, Sweden. Coll. 1968 by Olsson.

U-691. *Salix*, MM 10 06 68, INS

$\delta C^{14} = +611 \pm 9‰$
$\Delta = +623 \pm 9‰$
$\delta C^{13} = -28.5‰$

Leaves (*Salix*) at Möckelmosen (56° 32′ N Lat, 16° 31′ E Long), Öland, Sweden. Coll. approx. same day as Järlåsa samples, 1968 by Königsson.

U-692. *Salix*, MM 10 06 68, SOL

$\delta C^{14} = +576 \pm 8‰$
$\Delta = +588 \pm 8‰$
$\delta C^{13} = -28.8‰$

In warm dilute NaOH soluble fraction of U-691.

U-693. *Betula*, MM 10 06 68, INS

$\delta C^{14} = +578 \pm 9‰$
$\Delta = +592 \pm 9‰$
$\delta C^{13} = -29.5‰$

Leaves (*Betula*) at Möckelmosen (56° 32′ N Lat, 16° 31′ E Long), Öland, Sweden. Coll. approx. same day as Järlåsa samples, 1968 by Königsson.

U-694. *Betula*, MM 10 06 68, SOL

$\delta C^{14} = +585 \pm 9‰$
$\Delta = +595 \pm 9‰$
$\delta C^{13} = -28.2‰$

In warm dilute NaOH soluble fraction of U-693.

Plant series

Tomato plants grown to investigate influence of dissolved carbonate on C^{14}/C^{12} ratio in plants. Contemporaneous C^{14}/C^{12} ratio of atmosphere will be given later (Olsson, ms., in preparation). Plants grown in plastic buckets on balcony outside C^{14} lab., 1968.

U-2278. Tomato 68, L, C12, INS

$\delta C^{14} = +575 \pm 10$
$\Delta = +576 \pm 10$
$\delta C^{13} = -25.2‰$

Tomato leaves grown in peat to which C^{14}-free carbonate was added.

U-2279. Tomato 68, L, Cn, TW, INS

$\delta C^{14} = +590 \pm 12$
$\Delta = +590 \pm 12$
$\delta C^{13} = -25.8‰$

Tomato leaves grown in peat. Watered by rain and tap water.

U-2280. Tomato 68, L, C14, INS

$\delta C^{14} = +576 \pm 9$
$\Delta = +565 \pm 9$
$\delta C^{13} = -21.8‰$

Tomato leaves grown in peat to which 6 g $CaCO_3$ with $\Delta = 3940 \pm 80$ was added, δC^{13} assumed −25. ‰.

U-757. Tomato 68, L, C14, SOL

$\delta C^{14} = +569 \pm 17$
$\Delta = +585 \pm 17$
$\delta C^{13} = -30.1‰$

In warm dilute NaOH soluble fraction extracted from U-2280.

U-754. Tomato 68, R, C12, INS

$\delta C^{14} = +550 \pm 12$
$\Delta = +551 \pm 12$
$\delta C^{13} = -25.2‰$

Roots of tomato plant used for U-2278. *Comment*: diluted.

U-755. Tomato 68, R, Cn, TW, INS

$\delta C^{14} = +590 \pm 11$
$\Delta = +593 \pm 11$
$\delta C^{13} = -26.0‰$

Roots of tomato plants used for U-2279.

U-756. Tomato 68, R, C14, INS

$\delta C^{14} = +577 \pm 12$
$\Delta = +582 \pm 12$
$\delta C^{13} = -26.7‰$

Roots of tomato plant used for U-2280 and U-757. *Comment*: diluted.

Corrections to earlier lists

R., 1967, v. 9, p. 457: U-506 should be U-482.

R., 1967, v. 9, p. 458: U-2019. Ekruhorn, 11,620 ± 240 (9670 B.C.)

R., 1967, v. 9, p. 463: U-468. Lillsjön I, 70 to 74, 9180 ± 380 (7230 B.C.).

R., 1969, v. 11, p. 523: U-2121 should be U-2120.

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