[RADIOCARBON, VOL. 5, 1963, P. 163-202]

# GRONINGEN RADIOCARBON DATES IV

J. C. VOGEL and H. T. WATERBOLK
University of Groningen, Netherlands*

## INTRODUCTION

An attempt has been made to assemble the large number of $C^{14}$ dates measured in Groningen since the last date list was published in 1958. We have not succeeded in preparing all the measurements done in this time; the present list contains a more or less random selection. It is hoped the rest will be included in next year's list.

The larger portion of these results were obtained by Hessel de Vries in the last two years of his life, years in which he contributed much to the problem of establishing an absolute chronology for the cultural and climatological events of the last ice age. A number of the samples were measured during the time the laboratory operated under the supervision of Prof. H. de Waard (Jan. 1960 to Sept. 1961). A few results obtained since one of us (J.C.V.) assumed responsibility for the laboratory in October 1961 have also been incorporated.

Since 1961 all ages have been given relative to 95% of the activity of the NBS oxalic-acid standard containing a relative $C^{13}$ depletion of $\delta C^{13} = -19‰$. An analysis was made of the calibration samples used in the past and the relationship established between the old reference standard (recent wood) and the oxalic acid. It is therefore now possible to give the correction for the Suess effect of all previous Groningen dates. It appears the exact correction to be applied differs for the different counters and also changed during the course of time. In this paper the corrections have been applied, and to distinguish the new values from previously published figures the laboratory serial numbers are now preceded by the prefix GrN- instead of Gro-.

The number of years to be added to the different series of Gro-numbers is summarized in Table 1. With the aid of this table any Groningen $C^{14}$ date with a Gro-number can be corrected for the Suess effect. With the correction applied a Gro-date automatically becomes a GrN-date with the same serial number. It is suggested that in new publications in which Groningen $C^{14}$ dates are cited the Gro-values be replaced by GrN-values in this manner.

The ages are calculated on the basis of a half life of 5570 and are expressed in years before 1950. To convert these ages into dates B.C., 1950 years must be subtracted.

In many cases several measurements were performed on the same gas, thus acquiring more than one laboratory number for the analyses. Generally the ultimate weighted average is denoted by the highest number. In instances where a preliminary result has been communicated it is possible the serial number will differ from the one reported in a date list. In such cases the slightly differing figures should not be regarded as different analyses and the designations in the date list accepted throughout.

The samples were all subjected to a chemical pretreatment to remove contaminating carbonaceous material. In general the procedure was the same as

* Physics Laboratory, Westersingel 34, Groningen, and Biological-Archaeological Institute, Poststraat 6, Groningen.

TABLE 1

Corrections to be applied to all Groningen dates with Gro-Numbers*

| Counter | Period | Gro-Numbers | Correction (Years) |
|---|---|---|---|
| Small copper | 1953-Oct. 1955 | 001-499 | 0 ± 20 |
| | Oct. 1955-Oct. 1958 | 600-831 | |
| Large copper | Feb. 1956-Aug. 1956 | 500-599 | |
| | Aug. 1956-Sept. 1958 | 1201-1500 | + 220 ± 12 |
| | Oct. 1958-Apr. 1959 | 1701-1800 | |
| | Apr. 1959-June 1960 | 2501-2646 | |
| | July 1960-July 1961 | 2647-2800 | + 320 ± 7 |
| Large quartz | Jan. 1956-Aug. 1957 | 901-1200 | |
| | Aug. 1957-July 1958 | 1501-1700 | + 240 ± 10 |
| | July 1958-June 1960 | 1801-2176 | |
| | July 1960-Aug. 1960 | 2177-2200 | + 340 ± 12 |
| | Aug. 1960-Aug. 1962 | 2801-3262 | |
| Small quartz | Nov. 1958-Apr. 1959 | 832-900 | + 200 |
| | | 2201-2210 | |
| | Apr. 1959-Feb. 1961 | 2211-2371 | + 100 ± 30 |
| | Apr. 1961-Dec. 1961 | 2372-2500 | + 320 ± 20 |
| | Dec. 1961-Aug. 1962 | 3501-3663 | |

* The statistical uncertainties attached to the corrections in the last column seldom change the statistical error of the sample because these two quantities are added quadratically.

described in Groningen II. All samples were treated with hot dilute hydrocholoric acid to remove carbonates. In cases where humic substances were extracted with sodium hydroxide (old samples), this is stated in the text. Occasionally rootlets were removed from charcoal samples by digesting the sample in 12% sulphuric acid and oxidizing the rest with sodium hypochlorite.

For charred bones or material consisting mainly of burnt bone fragments, de Vries developed the following procedure. After rinsing in dilute acid, the sample is destructively digested in 20% HCl and washed. Then it is extracted with ca. 3 NaOH and the solubles precipitated with acid. This fraction was found to give a reliable result while the insoluble carbonaceous material often gave too young an age. Where several fractions of one sample were measured the highest age is to be considered the most reliable.

Sample descriptions and comments have been made on the basis of written communications by the submitters. They have been kept as short as possible. As a rule, only one recent reference to literature is given.

## SAMPLE DESCRIPTIONS

### I. OLD WORLD ARCHAEOLOGY

### *A. Palaeolithic of Europe*

**Istállóskö Cave series, Hungary**

Two charcoal samples were dated from the Istállóskö Cave (ca. 47° 30′ N Lat, ca. 23° E Long), Bükk Mountains, Hungary (Vértes and de Vries, 1959).

There are two habitation layers, separated by 1 m of debris, in which a sedimentation hiatus can be demonstrated. Coll. by L. Vértes, Budapest.

**GrN-1935. Istállóskö 2** **30,900 ± 600**
**28,950 B.C.**

Charcoal from fireplace in upper habitation layer (Aurignacian II). Coll. 1958; subm. by H. Gross, Bamberg, Germany. *Comment*: sample was given the full pretreatment for charred bone. The alkali soluble fraction was measured.

**GrN-1501. Istállóskö 1** **31,540 ± 600**
**29,590 B.C.**

Charcoal from fireplace in lower habitation layer (Aurignacian I). Coll. 1951; subm. by H. Schwabedissen, Cologne, Germany. *Comment*: sample was given only an acid pretreatment; alkali pretreatment would have removed an important part of the small sample.
*General Comment*: only the upper date can be considered reliable. The thick intercalated layer would, according to the collector, cover at least 5000 yr. See also Movius (1960).

**GrN-2649. La Cotte de St. Brelade, Channel Islands** **47,000 ± 1500**
**45,050 B.C.**

Black ashes associated with a Late Acheulian type industry and a cold temperate fauna in the cave of St. Brelade (49° 12′ N Lat, 2° 12′ W Long), Jersey, Channel Islands. A Mousterian level occurs much higher in the stratigraphic succession. Coll. 1958-59 by Father C. Burdo and D. Le Cocq; subm. by K. P. Oakley, British Mus. (Nat. History), London. *Comment*: sample was treated only with dilute acid prior to combustion and could have contained recent humic material making it appear younger.

**La Quina series, France**

Two samples of charred bone were dated from the rock shelter of La Quina (45° 30′ 35″ N Lat, 0° 17′ 50″ E Long), Commune de Gardes-Le-Pontaroux, Charente, France. Coll. and subm. by Mlle G. Henri Martin, C.N.R.S., Paris.

**GrN-1493. La Quina 1** **31,400 ± 350**
**29,450 B.C.**

Charred bone from Aurignacian I occupation layer.

**GrN-2526. La Quina 2** **35,250 ± 530**
**33,300 B.C.**

Charred bone from the last Mousterian occupation level.
*General Comment*: both samples were given the full pretreatment for charred bone. A further sample from a stratigraphically deeper layer was also submitted in 1959. The humic material extracted from this sample gave an age of 25,070 ± 220 (GrN-2325, unpub.), which is too young, but nevertheless so old that the other two dates can be considered quite reliable.

**GrN-1491. Caminade, France** **29,100 ± 300**
**27,150 B.C.**

Bone charcoal from the lower of two culture layers included in a reddish

sand in the rock shelter of Caminade (44° 54′ N Lat, 1° 13′ E Long), commune de la Canéda, near Sarlat, Dordogne, France. The upper layer is Aurignacian II, the lower layer contains a probably evolved typical Aurignacian I (de Sonneville-Bordes and Mortureux, 1955). Coll. by M. R. Mortureux; subm. by F. Bordes, Univ. of Bordeaux, France. *Comment*: this date is discussed by Movius (1960, p. 367). The sample was fully pretreated as for charred bone.

**Grotte du Renne series, France**

Two samples were measured from the Grotte du Renne (47° 35′ 54″ N Lat, 3° 58′ 30″ E Long), Arcy-sur-Cure, Yonne, France (Leroi-Gourhan 1952). Coll. and subm. by A. Leroi-Gourhan, Musée de l'Homme, Paris, France.

**GrN-1717. Grotte du Renne VII** — **30,800 ± 250 / 28,850 B.C.**

Charred bone from Level VII (Aurignacian II).

**GrN-1742. Grotte du Renne VIII** — **33,860 ± 250 / 31,910 B.C.**

Charred bone from Level VIII (Châtelperron).

*Comment*: samples were given the pretreatment for charred bone. For a discussion of the dates, see Movius (1960, p. 366 and 367).

**Abri Pataud series, France**

From Movius' excavation at Abri Pataud (44° 50′ N Lat, 1° 0′ E Long), commune des Eyzies, Dordogne, France, a number of samples were dated. Extensive experiments were carried out on some of them in order to remove possible contamination. There are two levels: a Proto-Magdalenian and an underlying Perigordian VI horizon. Coll. 1958 and 1959 and subm. by H. L. Movius, Harvard Univ., Cambridge, Mass., U. S. A.

**GrN-1864. Abri Pataud, Perigordian, "bone" fraction** — **18,470 ± 280 / 16,520 B.C.**

**GrN-1892. Abri Pataud, Perigordian, "rest" fraction** — **21,540 ± 160 / 19,590 B.C.**

Ashes (burnt bone) from Perigordian horizon. *Comment*: sample pretreated as burnt bone.

**GrN-1857. Abri Pataud, Proto-Magdalenian A** — **20,960 ± 220 / 19,010 B.C.**

Charred bone from the Proto-Magdalenian level, fully pretreated.

**GrN-1861. Abri Pataud, Proto-Magdalenian B, "bone" fraction** — **20,780 ± 170 / 18,830 B.C.**

**GrN-1885. Abri Pataud, Proto-Magdalenian B, "rest" fraction** — **19,300 ± 170 / 17,350 B.C.**

Ashes pretreated as charred bone. *Comment*: Movius (1960, p. 368) incorrectly describes this sample as "ash with humus extracted" (GrN-1861) and "ash without humus extracted" (GrN-1885).

**GrN-1862. Abri Pataud, Proto-Magdalenian C** **21,940 ± 250**
**19,990 B.C.**

Uncharred bone from the Proto-Magdalenian level. Remainder after extraction.

**GrN-2081. Abri Pataud, Proto-Magdalenian D** **20,540 ± 140**
**18,590 B.C.**

New sample, remainder of bone after extraction (another experiment).

**GrN-2115. Abri Pataud, Proto-Magdalenian D** **20,340 ± 200**
**18,390 B.C.**

The same sample; collagenous proteins.

**GrN-2123. Abri Pataud, Proto-Magdalenian D** **19,780 ± 170**
**17,830 B.C.**

The same sample; collagenous proteins soluble in alkali.

*General Comment*: the submitter had expected a somewhat higher age for the Perigordian level. From the chemical point of view, however, there is no reason to assume a stronger contamination in the Perigordian sample than in the Proto-Magdalenian samples.

From the extensive experiments by de Vries on the uncharred bone sample D from the Proto-Magdalenian level, only those are given here that yielded the oldest dates. In view of the date of the charred bone sample A, they seem to be reliable. Measurements on different fractions gave ages between 5500 and 17,500 yr.

As to the ash samples from the Perigordian and Proto-Magdalenian level, it is peculiar that the "bone" fraction gives an apparently too low date for the Perigordian level, while in the case of the Proto-Magdalenian level it gives a higher age than the ashes after extraction. For further comments see Movius (1960, p. 368).

**Laugerie-Haute Est series, France**

Two samples were measured from the well-known rock shelter of Laugerie-Haute Est (44° 50′ N Lat, 1° 0′ E Long), near Les Eyzies, Dordogne, France. Excavation in 1958 by F. Bordes, who collected and submitted the samples.

**GrN-1876. Laugerie-Haute: Proto-Magdalenian** **21,980 ± 250**
**20,030 B.C.**

Bone charcoal from the Proto-Magdalenian layer, labelled "F" by Peyrony and "36" by Bordes (1958). The layer is situated between the Perigordian III and the Lower Solutrean.

**GrN-1888. Laugerie-Haute: Lower Solutrean** **20,890 ± 300**
**18,940 B.C.**

Bone charcoal from a fireplace at the bottom of the Lower Solutrean layer, labelled "H[1]" by Peyrony and "31" by Bordes (1958).

*General Comment*: dates have been discussed by Movius (1960, p. 369). Both samples were pretreated as charred bone and the alkali soluble fraction measured.

**GrN-1632. Lascaux, France** **17,190 ± 140**
**15,240 B.C.**

Charcoal from culture layer in the cave of Lascaux (45° 3′ 12″ N Lat, 1° 10′ 30″ E Long), near Montignac, Dordogne, France. A stalagmite layer, which was dated at 8510 ± 100 (GrN-1182, Groningen III, p. 1553), overlies the present layer. The submitter considers it as contemporary to one of the periods of painting (Magdalenian). Coll. 1958 and subm. by Abbé A. Glory, Strassbourg. *Comment*: date seems to confirm the old Chicago date C-406: 15,516 ± 900 (Arnold and Libby, 1951, p. 112). For a further discussion of the Lascaux cave see Movius (1960, p. 371-2), who apparently did not know the new date at that time. The sample was treated as charred bone.

**GrN-2036. Repolust Cave, Austria** **13,370 ± 150**
**11,420 B.C.**

Charred wood from fireplace in gray sands in the Repolust Cave (ca. 47° 13′ N Lat, ca. 15° 22′ E Long), (Mottl, 1951), near Peggau, SE Austria. Alt 525 m. Distance from entrance 22 m, depth 0.5 m. The sands and underlying loam contain rich archaeological remains, correlated with the Late Clactonian, the Tayacian and the Wildkirchli cultures, as well as rich faunal remains, including *Ursus spelaeus deningeri*. Expected age: end of Eem interglacial. Coll. 1948 by M. Mottl and V. Maurin; subm. by K. Murban, Mus. für Bergbau, Geologie und Technik, Graz, Austria. *Comment*: sample is much younger than was expected. It had been treated with candle wax whose carbon is presumably of recent origin, but this should have been removed by the applied pretreatment with chloroform and benzol.

**GrN-2090. Schussenquelle B, Germany** **13,090 ± 110**
**11,140 B.C.**

Marly moss-peat ("mergeliger Braunmoostorf") situated between two layers of travertine ("Kalktuff") at the Schussenquelle (48° 01′ 23″ N Lat, 9° 39′ 30″ E Long), Baden-Württemberg, Germany. Depth ca. 3.00 m below surface. Pollen zone Ib (presumably Bölling). Expected age ca. 13,000 yr. The lower layer of travertine overlies a moss-peat containing Magdalenian artifacts. This moss-peat (Pollen zone Ia) has been dated at 14,710 ± 385 (GrN-468, Groningen II, p. 6). Coll. 1953 by E. Wall; subm. by G. Lang, Landessammlungen für Naturkunde, Karlsruhe, Germany. *Comment*: date is according to expectation.

**Grotte de la Vache series, France**

Two samples were dated from the cave of la Vache (ca. 42° 50′ N Lat, ca. 1° 40′ E Long), commune d'Alliat, Ariège, France. The main culture layer belongs to the Magdalenian. They were coll. 1958 by R. Robert; subm. by F. Bordes.

**GrN-2025. Grotte de la Vache 2** **12,540 ± 105**
**10,590 B.C.**

Charcoal and ash from Couche 2.

**GrN-2026. Grotte de la Vache 4** **12,850 ± 60**
**10,900 B.C.**

Charcoal and ash from Couche 4.

*General Comment*: for a discussion of these dates, see Movius (1960, p. 371). Samples were treated as charred bone.

**GrN-1913. Angles-sur-l'Anglin, France** **14,160 ± 80 / 12,210 B.C.**

Charcoal and ash from middle Magdalenian (Magdalenian III) occupation layer in the rock shelter Roc aux Sorciers at Angles-sur-l'Anglin (46° 42′ N Lat, 0° 53′ E Long), Vienne, France (de Saint-Mathurin and Garrod, 1951). Coll. and subm. by S. de Saint-Mathurin. *Comment*: see Movius (1960, p. 370). Sample pretreated as charred bone.

**Budel series, Netherlands**

Charcoal samples were dated from two Upper Palaeolithic sites near Budel (51° 15′ 18″ N Lat, 5° 37′ 15″ E Long), province of Noord-Brabant, Netherlands (Bohmers, 1960). Coll. by A. Wouters; subm. by A. Bohmers, Biol.-Archaeol. Inst., State Univ., Groningen, Netherlands.

**GrN-1687. Budel IV** **11,070 ± 90 / 9120 B.C.**

Charcoal from Ahrensburgian habitation layer.

**GrN-1675. Budel II** **11,440 ± 120 / 9490 B.C.**

Charcoal from Tjongerian habitation layer.

*General Comment*: dates are according to expectation. Both samples were treated with dilute acid and alkali.

**Duurswoude series, Netherlands**

Two samples were dated from the excavation of a combined Palaeolithic and Mesolithic settlement near Duurswoude (53° 03′ 07″ N Lat, 6° 15′ E Long), municipality of Opsterland, province of Friesland, Netherlands. The Mesolithic finds occurred near the surface, those of the Upper Palaeolithic Tjonger culture were found below a cover sand deposit. Coll. and subm. by A. Bohmers.

**GrN-1567. Duurswoude III A** **7700 ± 70 / 5750 B.C.**

Charcoal from Mesolithic fireplace.

**GrN-1565. Duurswoude II** **11,090 ± 90 / 9140 B.C.**

Charcoal from habitation layer of the Tjonger culture.

*General Comment*: dates are according to expectation. Previous measurements on other Mesolithic sites in the same area had yielded 7700 ± 100 (GrN-1173) for Duurswoude I and 7710 ± 70 (GrN-1175) for Duurswoude III (Groningen III, p. 1553). Both samples were treated with acid and alkali.

**Milheeze series, Netherlands**

Two samples were dated from the excavation of a settlement of the Upper Palaeolithic Tjonger culture at Milheeze (51° 30′ N Lat, 5° 49′ E Long), province of Noord-Brabant, Netherlands (Bohmers, 1960). The habitation layer is situated in the soil profile of the Allerød period (Usselo layer) and is

covered by a layer of cover sand, deposited in the Younger Dryas period. On top of the cover sand Mesolithic finds occur. Coll. and subm. by A. Bohmers.

**GrN-2318. Milheeze II** **8500 ± 160**
**6550 B.C.**

Charcoal from Mesolithic fireplace on top of cover sand layer.

**GrN-2314. Milheeze I** **10,880 ± 125**
**8930 B.C.**

Charcoal from fireplace in habitation layer of the Tjonger culture, below the cover sand layer.

*General Comment*: dates are according to expectation.

**Romanelli Cave series, Italy**

A series of five charcoal samples was dated from the main occupation layer in the Romanelli Cave (ca. 40° 1′ N Lat, ca. 18° 24′ E Long), Castro, province of Lecce, Italy (Blanc, 1928). The cave contains archaeological remains of the so-called Romanellian, with backed blades and microburins, and a fauna pointing to cold steppe conditions. Coll. 1954 and subm. by the late A. C. Blanc.

**GrN-2056. Romanelli $A_2$** **9880 ± 100**
**7930 B.C.**

**GrN-2305. Romanelli $A_3$** **10,320 ± 130**
**8370 B.C.**

**GrN-2153. Romanelli $C_1$** **10,390 ± 80**
**8440 B.C.**

**GrN-2154. Romanelli $C_2$** **9790 ± 80**
**7840 B.C.**

**GrN-2055. Romanelli D** **10,640 ± 100**
**8690 B.C.**

*General Comment*: apart from GrN-2154 the dates follow the stratigraphical order. They all seem to fall within the Upper Dryas period. From Layer C a sample was dated in Italy (R-56: 11,930 ± 520, see Bella *et al.*, 1958). Humus was removed from samples $A_2$ and D by extraction with alkali.

*B. Palaeolithic of Africa and Asia*

**Haua Fteah series, Libya**

The large open cave site of Haua Fteah (32° 47′ N Lat, 21° 41′ E Long), lies on the coastal margin of the Jebel el Akhdar plateau, W of Darna, NE Libya (Cyrenaica). Excavations carried out by C. B. M. McBurney of the Dept. of Archaeol. and Anthropol., Univ. of Cambridge, U. K., have yielded a practically unbroken cultural sequence from Pre-Mousterian up to the present. The closely stratified sediments down to a depth of more than 42 ft apparently extend well into the last interglacial and have provided a wealth of material regarding cultural and climatological changes during the upper Pleistocene in this area. Reports have been published by McBurney, Trevor

and Wells (1953), McBurney (1960, p. 168ff. and 199ff.; 1961) and Higgs (1961). The purpose of the samples was to extend the range of dates previously obtained by Suess (USGS I). Coll. 1955 and subm. by McBurney.

**GrN-3541. Haua Fteah C10** **7000 ± 110**
**5050 B.C.**

Charcoal immediately below interface of Layers VIII and X. *Comment*: dates earliest Neolithic and is " . . . very close indeed to the cultural interface between final Mesolithic (local variant of Capsian) and overlying Neolithic with earliest traces of domestic animals in the form of goat" (C.B.M. McB.). The result is in exact agreement with W-98 (USGS I). The sample was carefully pretreated with dilute acid and alkali.

**GrN-3167. Haua Fteah C11** **8400 ± 150**
**6450 B.C.**

Charcoal from top of Layer X. *Comment*: sample dates "the final Mesolithic and (is) separated from the Neolithic only by the period of deposition of the lense called Layer IX" (C.B.M. McB.). Compare W-89 (Suess, 1954). Pretreatment same as GrN-3541.

**GrN-2586. Haua Fteah C87** **16,070 ± 100**
**14,120 B.C.**

Soil containing charred bone from Layer XVII unconformably overlain by Layer XIV. *Comment*: sample predates the termination of the Upper Paleolithic Dabba culture and is to be compared with W-97, 12,300 ± 350 (USGS I) which comes from Layer XIV.

**GrN-2585. Haua Fteah C86** **18,620 ± 150**
**16,670 B.C.**

Soil containing charred bone from Layer XVII. *Comment*: Dabba culture.

**GrN-2550. Haua Fteah C93** **33,100 ± 400**
**31,150 B.C.**

Charred bone from Layer XX. *Comment*: associated with Dabba culture. The sample is definitely older than W-86, 28,500 ± 800 (USGS I) from Layers XX to XXII. During the formation of Layers XXII to XX the sediment again changes indicating a change from a relatively temperate phase to a (winter) frost climate which lasts through to Layer XV and is characterized by small angular limestone chips. Compare GrN-3260 from the site of Ed Dabba (see below).

**GrN-2564. Haua Fteah C38** **43,400 ± 1300**
**41,450 B.C.**

Charred bone from Layer XXVIII. *Comment*: the change from Mousterian to the Upper Paleolithic Dabba culture occurs between this and GrN-2550 just below the interface of Layers XXV/XXIV. Again it is older than the comparable date W-85, 34,000 ± 2800 (USGS I). But Suess pointed out that this date might be too young.

**GrN-2023. Haua Fteah C46, "bone" fraction** **47,000 $^{+3200}_{-2300}$**
**45,050 B.C.**

**GrN-2022. Haua Fteah C46, "rest" fraction** **40,700 ± 1500**
**38,750 B.C.**

Charred bone from Layer XXXIII. *Comment*: Levalloiso-Mousterian. This layer produced the evolved Neandertaloid mandible described by Trevor and Wells in McBurney *et al.* (1954). They find the mandible most comparable to those from Mount Carmel; the culture, too, seems closely related to that of the Palestine sites—compare for instance GrN-2534, et Tabun B, dating upper Levalloiso-Mousterian (see below).
*General Comment*: all the charred bone samples were pretreated in the manner described in the introduction. The analysis of GrN-2022 was done on the organic material which does not dissolve in concentrated acid or dilute alkali and, as in other cases, gave a younger date. The higher value of GrN-2023 is definitely to be preferred.

**GrN-3595. Ed Dabba, Libya** **>39,500**

**GrN-3260. Ed Dabba, Libya** **40,500 ± 1600**
**38,550 B.C.**

A soil sample with specks of charcoal from the Dabba cave (32° 44′ N Lat, 22° 00′ E Long), in the Jebel el Akhdar, NE Libya (Cyrenaica). This sample dates the transition from the lower to the upper substages of the Upper Paleolithic Dabba culture and is correlated archaeologically with Layer XX at the Haua Fteah (GrN-2550, see above). (McBurney, 1960, p. 196ff.) Coll. and subm. by C. B. M. McBurney. *Comment*: pretreated with acid and alkali. GrN-3595 is a measurement on the ca. 1% insoluble carbon; for GrN-3260 the alkali soluble fraction (ca. 0.4%) was added to obtain a more precise result. Date appears to be a little too early.

**Et Tabun series, Israel**

Two samples of charcoal (probably charred bone) were dated from the cave Mugharet et Tabun (ca. 32° 40′ N Lat, ca. 35° 5′ E Long), Mount Carmel, Israel (Garrod and Bate, 1937). Coll. 1959 by J. Waechter; subm. by J. Waechter and K. P. Oakley.

**GrN-2534. Et Tabun B** **39,700 ± 800**
**37,750 B.C.**

Upper Levalloiso-Mousterian. Depth 1 m below surface. *Comment*: this sample was expected to be of the same age as the one from Kebareh (GrN-2561, this list) and perhaps slightly younger than sample 38 from Ksâr 'Akil (GrN-2579, this list). The sample was given the treatment for charred bone and agrees well with GrN-2561 (this list).

**GrN-2729. Et Tabun C** **40,900 ± 1000**
**38,950 B.C.**

Lower Levalloiso-Mousterian. Depth 2 m below surface. *Comment*: same pretreatment as et Tabun B.

**GrN-2170. Et Tabun D** **35,400 ± 900**
**33,450 B.C.**

Lower Levalloiso-Mousterian. Depth 3 m below surface. *Comment*: only

pretreated with acid. Obviously there is contamination with younger humic material.

**Shanidar Cave series, Iraq**

Samples from the Shanidar Cave (Solecki, 1958) (ca. 36° 50′ N Lat, 44° 13′ E Long), Erbil Liwa, N Iraq, had been dated at the Washington, Lamont and London (Inst. of Archaeol.) laboratories. Some proved to be infinite. At Groningen four samples were dated from the deeper layers. Coll. 1957 and subm. by R. Solecki, Dept. of Anthropol., Columbia Univ., New York, U. S. A.

**GrN-1830. Shanidar 343 III, "bone" fraction** **33,900 ± 900**
**31,950 B.C.**

**GrN-1494. Shanidar 343 III, "rest" fraction** **34,000 ± 420**
**32,050 B.C.**

Charcoal from hearth in Layer C with Baradostian blade and burin industry.

**GrN-2016. Shanidar 553 III, "bone" fraction** **35,440 ± 600**
**33,490 B.C.**

**GrN-2015. Shanidar 553 III, "rest" fraction** **34,540 ± 500**
**32,590 B.C.**

Charcoal very close to the bottom of Layer C with Baradostian industry.

**GrN-2527. Shanidar 318 III** **46,900 ± 1500**
**44,950 B.C.**

Charcoal from hearth in the very top of Layer D at short distance below the junction of the Layer C and D.

**GrN-1495. Shanidar 314 III** **50,600 ± 3000**
**48,650 B.C.**

Charcoal from hearth in the top of Layer D (Mousterian). The sample would date the adult Neanderthal Skeleton Shanidar I.

*General Comment*: GrN-2016 and GrN-1830 can be compared with the dates W-180 (>34,300) (USGS II) and L-335 I (32,000 ± 300) (Lamont IV) from the same layer. The samples were all treated as charred bone. Of the first two samples, both the alkali soluble and the insoluble fractions were measured. The fact that the two fractions give practically the same age makes the dates very reliable. There seems to be a considerable break in the occupation between Layer C and D.

**Ksâr 'Akil series, Lebanon**

From the rock shelter of Ksâr 'Akil (33° 55′ N Lat, 35° 37′ E Long), Antelias, near Beirût, Lebanon, two samples were dated. Coll. 1959 by B. Howe, H. E. Wright and F. Matson; subm. by R. J. Braidwood, Oriental Inst., Univ. of Chicago, U. S. A. For details on the site, which had been excavated some years ago, see Wright (1951) and Ewing (1947).

**GrN-2195. Ksâr 'Akil 40** **28,840 ± 380**
**26,890 B.C.**

Shells collected at 6 to 7.5 m level (Middle Aurignacian). *Comment*: rinsed in dilute acid.

**GrN-2579. Ksâr 'Akil 38** **43,750 ± 1500**
**41,800 B.C.**

Dark clay band at 16 m level (1 m below the top of the Upper Levalloisian-Mousterian). *Comment*: treated as charred bone.

**GrN-2561. el Kebareh, Israel, "bone" fraction** **41,000 ± 1000**
**39,050 B.C.**

**GrN-2551. el Kebareh, Israel, "rest" fraction** **35,300 ± 500**
**33,350 B.C.**

Small lumps of charred wood or bone from the upper Levalloiso-Mousterian level in the cave Mugharet el Kebareh (ca. 32° 40′ N Lat, 35° 5′ E Long), Mount Carmel, Israel. Depth 2.5 m below surface in cave. Comparable to et Tabun D (see above). Coll. 1958 by M. Stekelis; subm. by J. Waechter and K. P. Oakley. *Comment*: sample was treated as charred bone. As usual the alkali soluble fraction gave the higher age.

*C. Mesolithic*

**GrN-1602. Hatert, Netherlands** **7670 ± 110**
**5720 B.C.**

Charcoal from Mesolithic fireplace at Hatert (51° 47′ 57″ N Lat, 5° 52′ 35″ E Long), municipality of Nijmegen, province of Gelderland, Netherlands (Bohmers and Wouters, 1957). Coll. by A. Wouters; subm. by A. Bohmers. *Comment*: date is according to expectation. The sample was treated with acid and alkali.

**Oirschot series, Netherlands**

Charcoal samples were dated from a Mesolithic and a Palaeolithic surface site near Oirschot (51° 29′ 34″ N Lat, 5° 22′ 33″ E Long), province of Noord-Brabant, Netherlands (Bohmers and Wouters, 1957). The settlements were situated a short distance from each other. Coll. and subm. by A. Bohmers.

**GrN-1659. Oirschot Vb** **8030 ± 50**
**6080 B.C.**

Charcoal from fireplace in settlement Oirschot V. Coll. 1957.

**GrN-2172. Oirschot Vc** **6230 ± 60**
**4280 B.C.**

Charcoal from fireplace in settlement Oirschot V.

**GrN-2171. Oirschot VII** **6690 ± 65**
**4740 B.C.**

Charcoal particles scattered in the habitation layer of Oirschot VII (Tjonger culture).

*General Comment*: only the first date is according to expectation; the others are much too young. Contamination is probably responsible for the anomaly. An earlier measurement on charcoal of another fireplace in Oirschot V gave 7510 ± 60 (GrN-1510, Groningen III, p. 1553).

**GrN-3042. Rotsterhaule, Netherlands** **8365 ± 75**
**6415 B.C.**

Charcoal from fireplace D 15 in Mesolithic settlement at Rotsterhaule

(52° 54′ 15″ N Lat, 5° 51′ 44″ E Long), municipality of Haskerland, province of Friesland, Netherlands. The settlement occurs on top of a cover sand deposit and was overgrown by peat after the habitation. Coll. 1961 and subm. by A. Bohmers. *Comment*: date is according to expectation.

**GrN-1559. Ermelo, Netherlands** **8210 ± 75**
**6260 B.C.**

Charcoal from Mesolithic fireplace at Ermelo (52° 18′ N Lat, 5° 38′ E Long), province of Gelderland, Netherlands (Bohmers and Wouters, 1957). Coll. and subm. by A. Bohmers. *Comment*: date agrees with other dates of Mesolithic settlements in this area. Treated with acid and alkali.

**Rouffignac series, France**

Four charcoal samples were dated from different Mesolithic levels in the cave of Rouffignac (45° 3′ 11″ N Lat, 0° 58′ 30″ E Long), Périgueux, France. Coll. 1960 by J. Verheyleweghen and Cl. Barrière; subm. by A. Bohmers.

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

Pure Tardenoisian.

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

Upper Sauveterrian.

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

Middle Sauveterrian.

**GrN-2880. Rouffignac C 4a[1]** **8995 ± 105**
**7045 B.C.**

Lower Sauveterrian.

*General Comment*: dates prove that the Sauveterrian precedes the Tardenoisian.

**Tilburg series, Netherlands**

Charcoal samples dated from two different Mesolithic surface settlements near Tilburg (51° 35′ N Lat, 5° 03′ E Long), province of Noord-Brabant, Netherlands. In both cases the charcoal was found scattered between flint artifacts. Coll. by A. Wouters; subm. by A. Bohmers.

**GrN-2443. Tilburg-Pompstok** **3820 ± 75**
**1870 B.C.**

**GrN-1597. Tilburg-Labé** **6500 ± 120**
**4550 B.C.**

*General Comment*: in view of other Mesolithic dates from the area, these dates are too young. GrN-2443 was only treated with dilute acid while GrN-1597 was treated with acid and alkali. The large difference between the ages suggests contamination.

**GrN-2446. Maarheeze, Netherlands** **6230 ± 115**
**4280 B.C.**

Charcoal from Mesolithic fireplace at Maarheeze (51° 17′ 16″ N Lat, 5° 38′ 24″ E Long), province of Noord-Brabant, Netherlands (Bohmers and

Wouters, 1957). Coll. by A. Wouters; subm. by A. Bohmers. *Comment*: date is younger than most other Dutch Mesolithic sites. Contamination may be present.

**GrN-1683. De Leijen, Netherlands** **7230 ± 65**
**5280 B.C.**

Charcoal sample from fireplace in Mesolithic habitation layer near lake "de Leijen" (53° 9′ N Lat, 6° 3′ E Long), municipality of Smallingerland, province of Friesland, Netherlands (Bohmers and Wouters, 1957). This Mesolithic site differs from most other Dutch Mesolithic sites, and is related to the Maglemose culture. Coll. 1956 and subm. by A. Bohmers. *Comment*: an earlier measurement on charred hazel nuts from the same site gave 7200 ± 140 (GrN-685, Groningen III, p. 1553). These dates prove the site falls within the Atlantic period. Treated with acid and alkali.

**GrN-2001. La Torche, France** **5970 ± 80**
**4020 B.C.**

Charcoal from a Mesolithic kitchen midden at la Torche (ca. 47° 50′ N Lat, ca. 4° 17′ W Long), commune de Plomeur, Finistère, France (Giot *et al.*, 1962). The midden was stratigraphically situated below a passage grave. Coll. and subm. by P. R. Giot, Univ. of Rennes, France. *Comment*: date is of interest for the dating of the coastal Mesolithic of Brittany.

*D. Neolithic of the Netherlands*

**Elsloo series, Netherlands**

Charcoal samples from a Bandkeramik settlement and adjacent cemetery at Elsloo (50° 56′ 55″ N Lat, 5° 46′ 30″ E Long), province of Limburg, Netherlands. Coll. 1959 and subm. by P. J. R. Modderman, State Service for Archaeol. Inv., Amersfoort, Netherlands.

**GrN-2311. Elsloo 501** **6510 ± 100**
**4560 B.C.**

Charcoal from grave pit belonging to the youngest stage of "Linearbandkeramik." Depth 0.60 to 1.00 m below surface.

**GrN-2884. Elsloo 514** **6055 ± 80**
**4105 B.C.**

Charcoal from grave pit belonging to the youngest stage of "Linearbandkeramik."

**GrN-2310. Elsloo 332** **5080 ± 70**
**3130 B.C.**

Charcoal from pit near house, belonging to the next but youngest stage of "Linearbandkeramik." Depth 0.30 to 0.80 m below surface.

**GrN-2160. Elsloo 108** **6150 ± 70**
**4200 B.C.**

Charcoal from pit near house, belonging to the next but youngest stage of "Linearbandkeramik." Depth 0.30 to 1.10 m below surface.

**GrN-2159. Elsloo 282** **6320 ± 90**
**4370 B.C.**

Charcoal from posthole of a house, belonging to the next but oldest stage

of "Linearbandkeramik." Depth 0.30 to 0.80 m below surface.

**GrN-2164. Elsloo 130** **6270 ± 85**
**4320 B.C.**

Charcoal from posthole of a house, belonging to the oldest stage of "Linearbandkeramik." Depth 0.30 to 1.00 m below surface.
*General Comment*: samples 501 and 332 are, respectively, much older and younger than was expected. Contamination, however, can not be excluded, since there is an intensive animal life in the loess soils. The other dates can be compared with previously published Bandkeramik dates from Geleen and Sittard (GrN-320, GrN-422, GrN-423, Groningen II, p. 135; GrN-995, GrN-996, Groningen III, p. 1553). Those belonging to the earlier stages of "Linearbandkeramik" seem indeed to be higher than those from the later stages.

**GrN-2226. Odoorn, Netherlands** **4590 ± 80**
**2640 B.C.**

Small quantity of charcoal found in a flat grave, containing two Funnel Beakers, underneath the mound of the megalithic Tomb D 32 at Odoorn (52° 51′ 24″ N Lat, 6° 50′ 29″ E Long), province of Drenthe, Netherlands (van Giffen, 1961a). Coll. and subm. by A. E. van Giffen, State Univ., Groningen, Netherlands. *Comment*: date is a *terminus post quem* for the construction of the megalithic tomb; it agrees with other dates relating to the Funnel Beaker culture in the area. Pretreated with acid and alkali.

**Vlaardingen series, Netherlands**

Several samples were dated from the Neolithic settlement at Vlaardingen (51° 54′ N Lat, 4° 19′ E Long), province of Zuid-Holland, Netherlands. Apart from the main settlement stage, belonging to the Neolithic Vlaardingen culture, there are also traces of a settlement of the Bell Baker culture. Both settlements were situated on the banks of a creek (natural levees) in a fresh to brackish delta environment under tidal influence. Between the times of the two settlement the creek was silted up and again cut into by a new creek (for a detailed description of the site see van Regteren Altena *et al.*, 1962). Coll. 1959-60 and subm. by W. Glasbergen, Univ. of Amsterdam, Netherlands.

**GrN-2419. Vlaardingen U XIb:77** **3910 ± 100**
**1960 B.C.**

Charcoal from upper part of layer with Maritime Bell Beaker sherds. Trench 9b, Square U XIb, No. 77.

**GrN-3097. Vlaardingen U XIb:79** **3850 ± 50**
**1900 B.C.**

Charcoal from lower part of same layer with Maritime Bell Beaker sherds. Trench 9b, Square U XIb, No. 79.

**GrN-2158. Vlaardingen U IXb** **3910 ± 30**
**1960 B.C.**

Charcoal from layer with Maritime Bell Beaker sherds from which both samples mentioned above were also taken. Trench 9a, Square U IXb.

**GrN-2481. Vlaardingen T XIa:114** **3860 ± 110**
**1910 B.C.**

Wood (at most 5 yr rings) from small post in layer with Maritime Bell Beaker sherds. Trench 9b, Square T XIa, No. 114.

**GrN-2480. Vlaardingen U XIa:113b** **4190 ± 70**
**2240 B.C.**

Charcoal from the uppermost part (with little or no artifacts) of the refuse layer of the Vlaardingen culture habitation in the creekbed (in section). Trench 9b, Square U XIa, No. 113b.

**GrN-2304. Vlaardingen N 8** **4250 ± 75**
**2300 B.C.**

Wood from worked post (at most the last 10 yr rings) in the settlement of the Vlaardingen culture on W creek bank. Trench 12, Square N 8.

**GrN-2303. Vlaardingen MM 42a** **4330 ± 60**
**2380 B.C.**

Charcoal from habitation layer of the Vlaardingen culture on E creek bank. Trench 11, Square MM 42a.

**GrN-2487. Vlaardingen M 20** **4280 ± 100**
**2330 B.C.**

Wood from worked post (at most 10 yr rings). Trench 10, Square M 20, Post 17.

**GrN-2306. Vlaardingen JJ 42** **4410 ± 100**
**2460 B.C.**

Wood from trunk (at most the last 10 yr rings) found in subsoil on E creek bank. Sample probably is contemporaneous with the very first settlement stage of the Vlaardingen culture. Trench 17, Square JJ 42.

**GrN-2286. Vlaardingen 2 E 7b** **3360 ± 50**
**1410 B.C.**

Charcoal from habitation layer of the Vlaardingen culture. Trench 1-2, Square 2 E 7b. *Comment*: date is ca. 1000 yr too young. Contamination by material from a recent ditch cannot be excluded.

*General Comment*: dates for the Maritime Bell Beaker settlement stage lie very close together. As a mean value 3590 ± 25 (1940 B.C.) can be calculated. The dates for the Vlaardingen settlement do not scatter significantly; although the stratigraphically uppermost and lowermost samples are the youngest and oldest respectively. The average for the main occupation (GrN-2304, GrN-2303 and GrN-2487) is 4300 ± 40 (2350 B.C.). The dates agree with those of Haamstede (GrN-1577: 4410 ± 60, this list) and Hekelingen (GrN-254: 4200 ± 120, Groningen II, p. 135).

### Haamstede series, Netherlands

In 1958 a site was excavated by J. A. Trimpe Burger at Brabers, municipality of Haamstede (51° 41′ N Lat, 3° 43′ E Long), province of Zeeland, Netherlands. There were two different culture layers, a lower one belonging to the Neolithic Vlaardingen culture, and an upper one, in which an earlier local Iron Age stage could be distinguished from a later stage, characterized by 2nd

century A.D. Roman imports (Trimpe Burger, 1961). Coll. by J. A. Trimpe Burger; subm. by P. J. R. Modderman.

**GrN-1577. Haamstede I** **4410 ± 60**
**2460 B.C.**

Charcoal from Neolithic culture layer. Depth ± 1.00 m.

**GrN-1682. Haamstede II** **3070 ± 60**
**1120 B.C.**

Charcoal from an intact vessel, belonging to the local Iron Age settlement stage. It was found in a pit at depth of 1.20 m.
*General comment*: for a discussion of the Neolithic date, see van Regteren Altena *et al.* (1962, p. 20-21). The Iron Age date is older than was expected. Both samples were pretreated with acid and alkali.

**GrN-2370. Angelslo, Netherlands** **4145 ± 100**
**2195 B.C.**

Charcoal found in a flat grave, together with a human cremation and pottery belonging to a late stage of the Funnel Beaker Culture at Angelslo (52° 46′ 54″ N Lat, 6° 55′ 0″ E Long), municipality of Emmen, province of Drenthe, Netherlands. Expected age 2300-2200 B.C. Coll. and subm. by H. T. Waterbolk. *Comment*: first date for the latest stage of the Funnel Beaker Culture in the area.

### Anlo series, Netherlands

In 1958 an important archaeological site was excavated near Anlo (53° 02′ 10″ N Lat, 6° 43′ 08″ E Long), province of Drenthe, Netherlands. Remains ranging in age from the Upper Palaeolithic to the Late Bronze Age were found near the surface or in pits with a depth of at most 1 m (Waterbolk, 1960). Coll. and subm. by H. T. Waterbolk.

**GrN-1969. Anlo 136** **8770 ± 80**
**6820 B.C.**

Charcoal from a find-less pit preceding Bronze Age plow-soil. Depth 0.35 m.

**GrN-1970. Anlo 35** **8785 ± 95**
**6835 B.C.**

Charcoal from a find-less pit. Depth 0.4 m.

**GrN-1980. Anlo 68 A** **9205 ± 70**
**7255 B.C.**

Charcoal from a pit containing a Beaker sherd. It is to be noted charcoal content in this case was very small. Depth 0.21 m. *Comment*: charcoals are apparently much older than the sherd.

**GrN-853. Anlo 96 A** **4780 ± 80**
**2830 B.C.**

Charcoal from a pit containing Early Bronze Age pottery. The distance from the preceding sample is only 3 m. Depth 0.63 m. *Comment*: anomalous date can be explained by assuming contamination by much older charcoal, the nearby presence of which is proved by the preceding measurement.

**GrN-1824. Anlo 122 B** **4420 ± 55**
**2510 B.C.**

Charcoal from a pit containing rich archaeological remains of the Havelte stage of the Funnel Beaker culture. Depth 0.88 m.

**GrN-1855. Anlo 51** **4420 ± 55**
**2470 B.C.**

Charcoal from flat grave with a Beaker-with-Protruding-Foot (early type). Depth 0.58 m.

**GrN-1965. Anlo 61 A** **4195 ± 70**
**2245 B.C.**

Charcoal from burnt coffin in find-less flat grave, supposed to be somewhat younger than preceding sample. Depth 0.68 m.

**GrN-851. Anlo 49** **4140 ± 70**
**2190 B.C.**

Charcoal from flat grave, containing two all-over-corded Beakers. Depth 0.55 m.

**GrN-1976. Anlo 46b** **3965 ± 50**
**2015 B.C.**

Charcoal from circular pit, dug into a flat grave with an all-over-corded Beaker. Depth 0.50 m.

**GrN-2214. Anlo 78** **3830 ± 65**
**1880 B.C.**

Charcoal from one of a group of enigmatic horseshoe-shaped depressions, the age of which is uncertain (Waterbolk, 1960, p. 89-90). Depth 0.80 m.

**GrN-852. Anlo 1 A** **3620 ± 65**
**1670 B.C.**

Charcoal from pit containing Early Bronze Age pottery. Depth 1.08 m.

**GrN-1977. Anlo 69** **3595 ± 85**
**1645 B.C.**

Charcoal from pit containing Early Bronze Age pottery. Depth 0.41 m.
*General Comment*: although the quantity of Mesolithic flints was very small, the first three dates show the presence of Mesolithic fireplaces at the site. The pit containing sample 68 must have been dug through such a fireplace. Mesolithic charcoal probably also caused the anomalous date of sample 96. The other dates are in the relative order as expected from the archaeological evidence. The peculiar horseshoe-shaped depressions are probably from the latest Neolithic or Early Bronze Age—see also Schipborg (GrN-2445, this list). Sample Anlo 51 was expected to be somewhat younger and closer in age to samples 61 and 49. Apart from the statistical uncertainty, there is the possibility of contamination, e.g., with charcoal from the Funnel Beaker settlement.

## Dertienhuizen series, Netherlands

In 1960 two massive wheels, each made out of a single piece of oak wood, were found in a large raised bog at Dertienhuizen (52° 56′ 26″ N Lat, 7° 0′ 54″ E Long), near the village of Musselkanaal, municipality of Onstwedde,

province of Groningen, Netherlands. The wheels were lying in a depression between two cover sand uplifts. In view of the dates of other wheels of the same type, a Neolithic age was expected. Coll. by M. R. Walvius; subm. by J. D. van der Waals, Mus. of Drenthe, Assen, Netherlands.

**GrN-2878. Dertienhuizen A** **4015 ± 65**
**2065 B.C.**

**GrN-2879. Dertienhuizen B** **4070 ± 70**
**2120 B.C.**

*General Comment*: dates agree with GrN-1087, 4080 ± 55 for the trackway Nieuw-Dordrecht, near which a wheel of the same type was found (Groningen III, p. 1553), GrN-2368, 4025 ± 75 for a wheel of the same type found at the Eese (see below) and GRN-3238, 3960 ± 80 for a wheel from Gasselter Boerveen (see below). A paper on Neolithic wheels is being prepared by M. R. Walvius and J. D. van der Waals.

**GrN-2368. De Eese, Netherlands** **4025 ± 75**
**2075 B.C.**

Massive wheel, made of one piece of oak wood, found in a small bog at the Eese (52° 50′ 58″ N Lat, 6° 07′ 34″ E Long), municipality of Vledder, province of Drenthe, Netherlands. Coll. by W. van Zeist; subm. by H. T. Waterbolk. *Comment*: see Dertienhuizen series above.

**GrN-2986. Nieuw-Dordrecht, Netherlands** **4100 ± 55**
**2150 B.C.**

Wood from Neolithic trackway of Nieuw-Dordrecht (52° 41′ 32″ N Lat, 7° 0′ E Long), municipality of Emmen, province of Drenthe, Netherlands (van Zeist, 1956). Coll. and subm. by W. van Zeist, Biol.-Archael. Inst., State Univ., Groningen, Netherlands. *Comment*: another sample from the same trackway had been dated in 1956-57 to 4080 ± 55 (GrN-1087, Groningen III, p. 1553). See also Dertienhuizen series above.

**GrN-3238. Gasselter Boerveen, Netherlands** **3960 ± 80**
**2010 B.C.**

Wood drilled from the core of a massive oak wheel, found in 1838 in the raised bog Gasselter Boerveen (53° 0′ 08″ N Lat, 6° 51′ 12″ E Long), municipality of Gasselte, province of Drenthe, Netherlands. The depth is indicated as more than 2 m. The wheel is of the same type as those from de Eese and Dertienhuizen (see above). It has been kept in the Museum without apparent treatment for preservation. Coll. and subm. by J. D. van der Waals. *Comment*: see Dertienhuizen series above.

**GrN-1676. Eext-Ketenberg, Netherlands** **3775 ± 55**
**1825 B.C.**

Charcoal from burnt coffin in an undated secondary grave in the Neolithic tumulus "Ketenberg" near Eext (52° 59′ 52″ N Lat, 6° 43′ 08″ E Long), municipality of Anlo, province of Drenthe, Netherlands, excavated by A. E. van Giffen in 1927 (van Giffen, 1930, p. 45-50). Coll. and subm. by A. E. van Giffen. *Comment*: grave is apparently Late Neolithic. Sample was treated with acid and alkali.

**GrN-2996. St. Walrick, Netherlands** **3705 ± 80**
**1755 B.C.**

Charcoal from youngest grave in three-period barrow near St. Walrick (51° 47′ 10″ N Lat, 5° 47′ 37″ E Long), municipality of Overasselt, province of Gelderland, Netherlands, excavated in 1959 and 1961 (Groenman, van Waateringe, 1961a). The primary grave contained a Bell Beaker of Veluwe type, for the age of which the $C^{14}$ date would give a *terminus ante quem*. On the basis of pollen analyses there should not be a great difference in age between the three barrow stages. Coll. and subm. by W. Glasbergen. *Comment*: date agrees with other dates relating to the Bell Beaker culture, e.g., Bennekom, GrN-326, 3865 ± 180 (Groningen II, p. 135). From the same Bennekom barrow another sample was dated at 3560 ± 130 as GrN-374 (Groningen II, p. 135). The description given is not correct; the sample is not from the primary grave, but from a later capping of the barrow.

**GrN-2445. Schipborg, Netherlands** **3780 ± 60**
**1830 B.C.**

Charcoal from fireplace in one of a group of enigmatic horseshoe-shaped depressions, found during an excavation at Schipborg (53° 03′ 36″ N Lat, 6° 41′ 09″ E Long), municipality of Anlo, province of Drenthe, Netherlands (van der Waals, 1962). These depressions are of the same type as those at Anlo (this list), where they were supposed to be of Mesolithic age. At Schipborg, however, clear evidence was obtained for an earliest Bronze Age dating. Depth 0.8 to 0.9 m below surface. Coll. 1960 and subm. by J. D. van der Waals. *Comment*: date is according to expectation. It agrees also with one of the Anlo dates (GrN-2214, 3830 ± 65, this list), obtained from charcoal from a pit of the same type.

*E. Neolithic of Europe and Asia, excluding the Netherlands*

**Elateia series, Greece**

From a dwelling mound NE of Elateia (38° 37′ N Lat, 22° 44′ E Long), Greece, five samples of carbonized wood were measured for the purpose of dating Early Neolithic monochrome pottery (Weinberg, 1962). Coll. 1959 and subm. by S. S. Weinberg, Univ. of Missouri, U. S. A.

**GrN-2973. Elateia 5** **7480 ± 70**
**5530 B.C.**

Charcoal from floor 3.10 m in NE quadrant of Trench 1. Associated with early Early Neolithic monochrome pottery and a fragment of imported Corinthian variegated ware.

**GrN-3037. Elateia 4** **7360 ± 90**
**5410 B.C.**

Charcoal from floor of large *bothros* in Trench 3 at 2.70 m. *Comment* (S.S.W.): it was originally thought this sample was from the fill of the *bothros*, but the date rather suggests it was from the bunrt debris in the floor at 2.70 m. The pottery on this floor was all Early Neolithic monochrome, while that in the *bothros* was much later.

**GrN-3041. Elateia 6** **7190 ± 100**
**5240 B.C.**

Charcoal from floor 2.55 m in Trench 2 with Early Neolithic monochrome vases.

**GrN-3039. Elateia 3** **8240 ± 110**
**6290 B.C.**

**GrN-2454. Elateia 3, "humus" fraction** **6370 ± 80**
**4420 B.C.**

**GrN-3502. Elateia 3, another portion** **7040 ± 130**
**5090 B.C.**

Charcoal from next higher floor, 2.30 m in Trench 2, with earliest painted pottery. *Comment*: first measurement (GrN-3039) gave too high an age, a new analysis on selected material (GrN-3502) seems compatible with the stratigraphic sequence.

**GrN-2933. Elateia 1** **8240 ± 75**
**6290 B.C.**

Charcoal from 1.55 m level in W half of Trench 1. *Comment* (S.S.W.): sample was suspect.

*General Comment*: all samples were pretreated with acid and alkali. The fact that two samples gave dates of 8240 yr seems to indicate older charcoal is present at this site. For a full discussion of the importance of this sample series, see Weinberg (1962, p. 206-9).

## Gornja Tuzla series, Yugoslavia

Two samples were dated from Gornja Tuzla (44° 27′ N Lat, 18° 46′ 30″ E Long), district Tuzla, NE Bosnia, Yugoslavia. Coll. 1957 by A. Benac, Zemaljski Muzej, Sarajevo; subm. by H. T. Waterbolk.

**GrN-1974. Gornja Tuzla 1** **5580 ± 60**
**3630 B.C.**

Charred beam from habitation layer belonging to Vinča C stage. Depth 3.50 m.

**GrN-2059. Gornja Tuzla 2** **6640 ± 75**
**4690 B.C.**

Charcoal from dwelling pit in habitation layer belonging to Starčevo III culture. Depth ca. 5 m.

*General Comment*: first date is somewhat young in view of the dates of the Vinča D stage at Vinča and Banjica (this list); the second is of importance since the Starčevo culture is considered as one of the oldest Neolithic cultures in SE Europe, preceding, e.g., the Bandkeramik and Vinča cultures. See also Quitta (1960).

## Vinča series, Yugoslavia

Two samples were dated from the classical site of Vinča (44° 45′ N Lat, 20° 37′ E Long), near Belgrade, Yugoslavia (Vasić, 1932). Subm. by H. T. Waterbolk.

**GrN-1537. Vinča D** **5845 ± 160**
**3895 B.C.**

Charred grain, collected by Vasić during his excavation in 1908-11. (First number 362 *c*, see Vasić, 1932, II, pl. XCVI).

**GrN-1546. Vinča A** **6190 ± 60**
**4240 B.C.**

Charred grain, collected by Vasić during his excavation in 1908-11. (First zontal charcoal layer to be seen in Vasić's still standing tell section. It probably marks the end of the Vinča A stage (Vinča-Tordos).

*General Comment*: dates are much older than hitherto accepted on archaeological grounds. They are confirmed, however, by dates from the Bandkeramik and other Neolithic cultures in SE Europe. Quitta (1960) considers the Vinča D date too high, but it is confirmed by the date for the same stage at Banjica (GrN-1536, 5670 ± 120, this list).

**GrN-1581. Zwenkau, Germany** **6160 ± 70**
**4210 B.C.**

Charcoal from posthole of house belonging to the "Linearbandkeramik" in a settlement, excavated in 1952-57 by H. Quitta, Berlin, near Zwenkau (51° 13′ 47″ N Lat, 12° 20′ 50″ E Long), Harth, Germany (Quitta, 1958, p. 68-73). Depth 0.60 to 1.00 m below the surface. Coll. by H. Quitta; subm. by P. J. R. Modderman. *Comment*: date agrees with dates obtained from Bandkeramik settlements in the Netherlands. Humus was removed by extraction with dilute alkali.

**GrN-1993. Tiszapolgar-Czöszhalom, Hungary** **5845 ± 60**
**3895 B.C.**

Charcoal from the site of Tiszapolgar-Czöszhalom (47° 53′ 30″ N Lat, 21° 08′ E Long), district Hajdu-Bihar, Hungary, belonging to the late Neolithic Herpály culture. Coll. 1957 by I. Kutzian; subm. by H. Quitta and H. T. Waterbolk. *Comment*: date is somewhat older than was expected. See also Quitta (1960).

**Hamangia series, Rumania**

Two charcoal samples were dated from the site of Hamangia (44° 42′ N Lat, 28° 40′ E Long), district of Istria, Rumania. Coll. 1952 by D. Berciu, Bucuresti, Rumania; subm. by H. Quitta and H. T. Waterbolk.

**GrN-1986. Hamangia-Baia 1** **5880 ± 70**
**3930 B.C.**

Charcoal from the Hamangia culture.

**GrN-1995. Hamangia 2** **4530 ± 65**
**2580 B.C.**

Charcoal from ocher grave.

*General Comment*: first date indicates a high age for the Hamangia culture. See also Quitta (1960). Humus was extracted with acid and alkali.

**GrN-1542. Banjica, Yugoslavia** **5710 ± 90**
**3760 B.C.**

Charcoal from site of Banjica (44° 31′ N Lat, 19° 7′ 30″ E Long),

Yugoslavia, belonging to the final stage of the Vinča culture. Coll. by M. Grbič, Archaeol. Inst., Yugoslav Acad. of Sci., Belgrade, Yugoslavia; subm. by H. T. Waterbolk. *Comment*: date does not differ significantly from other dates for stages C and D of the Vinča culture (see under Vinča and Gornja Tuzla, this list). See also Quitta (1960).

**Salcuta series, Rumania**

Two samples were dated from the excavation in 1951 at Salcuta, SW Rumania by D. Berciu, who collected the samples. The Salcuta culture is correlated with the Vinča C culture; subm. by H. Quitta and H. T. Waterbolk.

**GrN-1989. Salcuta 1** **5450 ± 55**
**3500 B.C.**

Charcoal.

**GrN-1990. Salcuta 2** **5475 ± 55**
**3525 B.C.**

Charcoal from house 3.

*General comment*: the archaeological correlation is proved by the $C^{14}$ dates (*cf.* Vinča dates in this list). Humus was extracted with acid and alkali.

**GrN-1987. Vărăşti, Rumania** **5360 ± 70**
**3410 B.C.**

Charcoal from Vărăşti (44° 14′ N Lat, 27° E Long), Boian Lake, district Călăraşi, Rumania. The site belongs to the Gumelniţa culture (Boian B). The traditional age estimation would be between 2500 and 2000 B.C. Coll. 1954 by N. Anghelescu, Călăraşi Mus., Rumania; subm. by H. Quitta and H. T. Waterbolk. *Comment*: the Gumelniţa culture is correlated with stages C and D of the Vinča culture. The $C^{14}$ dates agree with the archaeological correlation. See also Quitta (1960). Humus was extracted with acid and alkali.

**GrN-1985. Hăbăseşti, Rumania** **5330 ± 80**
**3380 B.C.**

Charcoal from the Eneolithic site of Hăbăşeşti (47° N Lat, 27° E Long), district of Tg. Frumoş, Moldavia, Rumania. Depth 0.20 to 0.60 m below surface. The site belongs to a late stage of phase A of the civilization of Cucuteni. Cucuteni A is correlated with Vinča B. Coll. 1949-50 by V. Dumitrescu, Archaeol. Inst., Rumanian Acad., Bucuresti, Rumania; subm. by H. Quitta and H. T. Waterbolk. *Comment*: date is much older than was expected on the basis of the traditional chronology; it agrees, however, with dates of other Neolithic and Eneolithic sites in SE Europe (see, e.g., Vinča dates in this list). Humus was extracted with acid and alkali.

**GrN-1982. Valea Lupului, Rumania** **4950 ± 60**
**3000 B.C.**

Charred grain from the site of Valea Lupului (47° 10′ N Lat, 27° 30′ E Long), district of Jasi, Rumania. The site belongs to phase B of the civilization of Cucuteni. Expected age 2100-1900 B.C. Cucuteni B is correlated with the youngest phase of Vinča. Coll. 1954 in a pit at a depth of 3.00 m by M. Dinu,

Hist. Mus. of Moldavia, Rumania; subm. by H. Quitta and H. T. Waterbolk. *Comment*: see our remark on GrN-1985 above. Humus was extracted with acid and alkali.

**GrN-1966. Curnic, France** **5340 ± 60**
**3390 B.C.**

Charcoal from a Neolithic habitation layer exposed on the shore at low tide at Curnic (48° 38′ 23″ N Lat, 4° 27′ 34″ W Long), commune de Guissény, Finistère, France. The layer is situated on top of a loess soil and is covered by fresh-water peat. The presence of postholes and foundation trenches proves the site was actually inhabitated (Giot, 1960a). Coll. 1958 and subm. by H. T. Waterbolk, W. van Zeist and P. R. Giot, Univ. of Rennes, France. *Comment*: date is of importance for the dating of the Neolithic in Brittany; it agrees with that obtained from the passage grave of Carn (GrN-1968, see below). Humus was extracted with acid and alkali.

**GrN-1968. Carn, France** **5230 ± 75**
**3280 B.C.**

Charcoal found in the chamber of an Early Neolithic passage grave on the isle of Carn (48° 34′ 36″ N Lat, 4° 41′ 21″ W Long), commune de Ploudalmézeau, Finistère, France. Coll. 1954 by P. R. Giot; subm. by H. T. Waterbolk. *Comment*: date agrees with other dates relating to the Breton primary Neolithic (Giot, 1960b). Humus was extracted with acid and alkali.

**Barnenez series, France**

Charcoals found in Chambers D and E of the megalithic monument of Barnenez (48° 40′ N Lat, 3° 51′ 53″ W Long), commune de Plouézoch, Finistère, France. Coll. 1956 and subm. by P. R. Giot.

**GrN-1526. Barnenez E 1** **1000 ± 40**
**A.D. 950**

**GrN-1538. Barnenez E 2** **1065 ± 60**
**A.D. 885**

**GrN-1972. Barnenez D** **2135 ± 55**
**185 B.C.**

*General Comment*: charcoal was apparently brought into the chamber during the Middle Ages and the Roman period. It cannot have anything to do with the original construction and use of the monument (Giot, 1960b).

**GrN-2302. Örlenbach, Germany** **4475 ± 75**
**2525 B.C.**

Wooden coffin (0.40 x 0.60 m), containing some coarse sherds, one ornamented sherd ("jüngere Linearbandkeramik"), remnants of two small copper rings (thickness 0.1 cm, size 2 cm) and of animal bones, found at Örlenbach (50° 08′ 10″ N Lat, 10° 08′ 0″ E Long), Kreis Bad Kissingen, Germany. Coll. and subm. by J. Wabra, Bad Kissingen. *Comment*: coffin seems to be younger than the Bandkeramik settlement. The presence of copper might point in the same direction.

*F. Bronze Age*

**Wildeshausen series, Germany**

From excavations in the neighborhood of Wildeshausen (52° 53′ 30″ N Lat, 8° 29′ 20″ E Long), Kreis Oldenburg, Germany, conducted by the Staatliches Mus. für Naturkunde und Vorgeschichte in Oldenburg, Germany, under direction of J. Pätzold. A series of samples was submitted for dating. So far three of them have been measured. Coll. 1959 by J. Pätzold; subm. by H. T. Waterbolk.

**GrN-3518. Wildeshausen, Katenbäker Berg 1: I** **3630 ± 80**
**1680 B.C.**

Charcoal from primary grave in Barrow 1. Depth 1.20 to 0.80 m. No finds.

**GrN-3513. Wildeshausen, Katenbäker Berg 1: II** **3550 ± 90**
**1600 B.C.**

Charcoal from secondary grave in Barrow 1. Depth 2.10 to 1.00 m.

**GrN-3542. Wildeshausen, Pestruper Gräberfeld** **2440 ± 70**
**490 B.C.**

Charcoal from cremation grave underneath burial mound ("Brandhügel"). Pottery of Jastorf B type was found as grave goods. Secondary to the barrow is an elongated earth bank (Langwall), surrounded by a ditch.
*General Comment*: the first two measurements provide a date for an otherwise undatable barrow. It is interesting to note that apparently synchronous findless barrow graves also occur in the Netherlands (e.g., Hijken, GrN-079: 3300 ± 150, Groningen I, p. 1143). The last date agrees very well with the archaeological dating of the Jastorf B stage.

**GrN-1670. Kervingar, France** **3550 ± 50**
**1600 B.C.**

Wood from central grave in barrow, belonging to the second stage of the Armorican Early Bronze Age, excavated in 1954 at Kervingar (48° 25′ 57″ N Lat, 4° 44′ W Long), commune de Plouarzel, Finistère, France (Giot, 1960). Coll. and subm. by P. R. Giot, Univ. of Rennes, France. *Comment*: date is somewhat older than was expected on archaeological grounds. Humus was extracted with acid and alkali.

**Ipwegermoor series, Germany**

In the Ipwegermoor (53° 12′ 34″ N Lat, 8° 16′ 2″ E Long), a raised bog N of Oldenburg, Germany, a great number of prehistoric trackways have been excavated by H. Hayen, Landesmus. für Naturkunde und Vorgeschichte, Oldenburg, Germany (Hayen, 1957a, p. 87-189; 1957b, p. 242-9; 1958, p. 33-48). Expected age: Bronze Age and Neolithic. Coll. by H. Hayen; subm. by H. T. Waterbolk.

**GrN-3527. Ipwegermoor VII** **3650 ± 75**
**1700 B.C.**

Wood from *Bohlendamm* VII. Depth 0.50 m.

**GrN-3134. Ipwegermoor I** **3320 ± 70**
**1370 B.C.**

Wood from *Bohlensteg* I. Depth 0.50 m.

**GrN-3530. Ipwegermoor LI** **3110 ± 80**
**1160 B.C.**

Wood from *Pfahlsteg* LI. Depth now only 0.15 m, but overlying peat has been dug away.

**GrN-3514. Ipwegermoor V** **3360 ± 70**
**1410 B.C.**

Wood from *Pfahlsteg* V. Depth 2.70 m.

**GrN-3529. Ipwegermoor LIX** **3420 ± 75**
**1470 B.C.**

Wood from *Knüppelsteg* LIX. Depth 0.40 m.

**GrN-3509. Ipwegermoor XXV** **3415 ± 65**
**1465 B.C.**

Wood from *Pfahlsteg* XXV. Depth 0.30 m.

*General Comment*: there does not seem to be much difference in age between the different trackways.

**GrN-3036. Noordsleen, Netherlands** **3260 ± 70**
**1310 B.C.**

Charcoal from burnt wooden coffin, supposed to be the primary grave of a barrow, excavated in 1960 at Noordsleen (52° 47′ 50″ N Lat, 6° 47′ 40″ E Long), municipality of Sleen, province of Drenthe, Netherlands. Another grave in the same barrow, thought to be contemporary, had yielded Early Bronze Age objects (Sögel stage). Depth 0.60 to 0.70 m below surface. Expected age 1500-1400 B.C. *Comment*: date is younger than was expected. Because of earlier digging at the site the stratigraphic circumstances were not quite clear.

**Toterfout-Halve Mijl series, Netherlands**

To complete the series of measurements of charcoal samples of the barrow cemetery of Toterfout-Halve Mijl (51° 25′ N Lat, 5° 20′ E Long), municipality of Veldhoven, province of Noord-Brabant, Netherlands (Glasbergen, 1954) twelve more samples were dated. For the previous measurements see Groningen III, p. 1554. The samples are listed in the order as suggested by pollen analysis of soil samples from the same barrows. Coll. and subm. by W. Glasbergen.

**GrN-1821. Halve Mijl 87** **3380 ± 50**
**1430 B.C.**

Charcoal (no. 87) from primary grave of Tumulus 4. *Comment*: an earlier measurement on charcoal from the same sample gave 3375 ± 200 (GrN-066, Groningen III, p. 1554), i.e., 1425 B.C.

**GrN-1819. Halve Mijl 90** **3365 ± 55**
**1415 B.C.**

Charcoal (no. 90) particles lying scattered in places on the old surface at the centre of Tumulus 4.

**GrN-1828. Toterfout 74a** **3420 ± 45**
**1470 B.C.**

Charcoal (no. 74a) lying in the upper part of the primary urn (Hilver-

sum urn). *Comment*: an earlier measurement on charcoal from the same sample gave 3450 ± 100 (GrN-050, Groningen III, p. 1554), i.e., 1500 B.C.

**GrN-1816. Halve Mijl 46** **3310 ± 50**
**1360 B.C.**

Charcoal (no. 46) with cremated bone deposited among the soils during the construction of Tumulus 5.

**GrN-1692. Halve Mijl 41** **3175 ± 60**
**1225 B.C.**

Charcoal from funeral repast (?) in SW quadrant of Tumulus 5. *Comment* (to GrN-1816 and GrN-1692): another charcoal sample (no. 42) from the same barrow had been dated before: 3300 ± 50, GrN-1003, and 3310 ± 50 GrN-989 (Groningen III, p. 1554), i.e., 1350 and 1360 B.C.

**GrN-1605. Halve Mijl 40** **3260 ± 50**
**1310 B.C.**

Charcoal from secondary grave in Tumulus 5.

**GrN-1822. Halve Mijl 49** **3200 ± 65**
**1250 B.C.**

Charcoal from primary grave of Tumulus 8. *Comment*: two earlier measurements of charcoal from the same sample gave 3055 ± 90 (GrN-049, Groningen I, p. 1142) and 3250 ± 60 (GrN-990, Groningen III, p. 1554), i.e., 1105 and 1300 B.C.

**GrN-1604. Halve Mijl 14a** **3230 ± 50**
**1280 B.C.**

Charcoal from primary grave of Tumulus 17.

**GrN-1820. Halve Mijl 58** **3220 ± 50**
**1270 B.C.**

Charcoal from boards lying alongside the primary grave of Tumulus 16.

**GrN-1817. Halve Mijl 57** **3260 ± 50**
**1310 B.C.**

Charcoal from patch under the slope of the primary barrow of Tumulus 16.

**GrN-1693. Halve Mijl 69** **3550 ± 50**
**1600 B.C.**

Charcoal from primary grave of Tumulus 14.

**GrN-1818. Halve Mijl 85a** **3200 ± 40**
**1250 B.C.**

Charcoal from primary grave of Tumulus 12.

*General Comment*: in agreement with the pollen evdience and archaeological considerations, an earlier group can be separated from a later. All samples were pretreated with acid and alkali.

**GrN-2997. Vogelenzang, Netherlands** **3140 ± 70**
**1190 B.C.**

Charcoal from pit belonging to a settlement of the Hilversum culture near

Vogelenzang (52° 18′ 55″ N Lat, 4° 33′ 32″ E Long), province of Noord-Holland, Netherlands (Groenman-van Waateringe, 1961b). Subm. by W. Glasbergen. *Comment*: date is younger than was expected.

**The Hague series, Netherlands**

Two charcoal samples were dated from a settlement site near the Hague (52° 03′ 47″ N Lat, 4° 13′ 45″ E Long), Netherlands. There were three cultural layers, belonging to the Bronze Age (I) and to the Iron Age (II-III) (Groenman-van Waateringe, 1961b). Subm. by W. Glasbergen.

**GrN-2421. The Hague 1** **4220 ± 75**
**2270 B.C.**

Charcoal from Bronze Age settlement I (Hilversum culture). Expected age ca. 3300 B.P. (1350 B.C.).

**GrN-3010. The Hague 2** **3210 ± 75**
**1260 B.C.**

Charcoal from first Iron Age settlement II. Expected age ca. 2500 B.P. (550 B.C.).

*General Comment*: dates are at least ca. 700 yr too high. There is as yet no explanation for this anomaly.

**Eersel series, Netherlands**

Two samples were dated from a prehistoric barrow, excavated in 1957, at Eersel (51° 23′ 8″ N Lat, 5° 22′ 40″ E Long), province of Noord-Brabant, Netherlands. The barrow was surrounded by a timber circle. In the center of the barrow an Iron Age urn was found. It was thought that timber circle and urn were contemporaneous. Coll. 1957 and subm. by P. J. R. Modderman.

**GrN-1532. Eersel 5** **3440 ± 50**
**1490 B.C.**

Charcoal found in one of the postholes of the timber circle. Depth 0.50 m.

**GrN-1531. Eersel 3** **2515 ± 50**
**565 B.C.**

Charcoal found at the supposed old surface of the barrow near the place where the urn was placed. Depth 0.48 m.

*General Comment*: contrary to expectation, the timber circle and urn do not seem to be contemporaneous. The excavator hardly sees the possibility of assuming that an Early Bronze Age timber circle had surrounded an unrecognized very low barrow, in the top of which the Iron Age burial was placed. Humic material was thoroughly extracted with acid and alkali.

**GrN-1994. Kosziderpadlás, Hungary** **3270 ± 50**
**1320 B.C.**

Charcoal from Bronze Age pottery kiln at Kosziderpadlás (46° 58′ N Lat, 18° 56′ E Long), Hungary, belonging to the Vatya culture. Coll. 1950 by A. Mozsolics, Budapest, Hungary; subm. by H. Quitta and H. T. Waterbolk. *Comment*: date is according to expectation. Humus was extracted with acid and alkali.

**GrN-1552. Bargeroosterveld, Netherlands** **3240 ± 65**
**1290 B.C.**

Wood from a unique ritual structure found in 1957 in a large raised bog at Bargeroosterveld (52° 46′ 42″ N Lat, 6° 48′ 53″ E Long), municipality of Emmen, province of Drenthe, Netherlands (Waterbolk and van Zeist, 1961). The structure consisted of two broad parallel oak planks, each with four holes, in which the lower parts of upright timbers were found. A stone circle surrounded the structure. No associated datable objects were found, but pollen analysis pointed to a Bronze Age date. The sample was taken from a piece of wood with adhering bark. Coll. and subm. by W. van Zeist and H. T. Waterbolk. *Comment*: supposed age is confirmed by $C^{14}$ determination.

**GrN-797. Oostwoud, Netherlands** **3025 ± 80**
**1075 B.C.**

Charred wood from barrow at Oostwoud (52° 44′ 20″ N Lat, 5° 05′ 40″ E Long), province of Noord-Holland, Netherlands (Van Giffen, 1961b). The barrow overlies a plowed soil, with plow marks, containing Bell Beaker sherds. The barrow was surrounded by a circle of oval pits, one of which yielded the sample. Excavation in 1956 and 1957 by A. E. van Giffen, who collected and submitted the sample. *Comment*: barrow appears to be about the same age as others in the same area (e.g. Grotebroek, GrN-160, 2925 ± 140, Groningen I, p. 1143). The plowed soil may immediately precede the barrow, but the Bell Beaker sherds in it must be much older. Humus was extracted with acid and alkali.

**Wervershoof series, Netherlands**

In 1954 the Institute of Pre- and Protohistory of the University of Amsterdam excavated at Wervershoof (52° 43′ N Lat, 5° 08′ 48″ E Long), province of Noord-Holland, Netherlands, the site of a Bronze Age barrow (no. 13) that had been removed before. Traces were found of two successive timber circles, which were followed by a two-period ring ditch (Van der Waals, 1961). Coll. 1954 and subm. by J. D. van der Waals.

**GrN-2359. Wervershoof 12** **3015 ± 55**
**1065 B.C.**

Charcoal from posthole of second timber circle. Depth 0.55 to 0.60 m below surface.

**GrN-2168. Wervershoof 16** **2965 ± 45**
**1015 B.C.**

Charcoal from filling of second ring ditch. Depth 0.50 to 0.55 m below surface.

*General Comment*: dates agree with those of other barrows in the same area at Oostwoud (GrN-797, 3025 ± 80, this list) and Grotebroek (GrN-160, 2925 ± 140; Groningen I, p. 1143).

**Holsloot series, Netherlands**

In 1957 a Late Bronze Age urnfield was excavated at Holsloot (52° 44′ 10″ N Lat, 6° 47′ 22″ E Long), municipality of Sleen, province of Drenthe, Netherlands (Clason, 1959). Three charcoal samples were collected and submitted by H. T. Waterbolk.

**GrN-1563. Holsloot 7** **3060 ± 70**
**1110 B.C.**

Charcoal from urn with cremation, being the central grave of a tumulus which was surrounded by a densely spaced double timber circle.

**GrN-1561. Holsloot 10** **2880 ± 70**
**930 B.C.**

Charcoal from the central cremation grave in a burial monument consisting of a rectangular wooden structure surrounded by an oblong ditch.

**GrN-1562. Holsloot 13**[a] **2890 ± 50**
**940 B.C.**

Charcoal from a ritual pit containing also some small cremation fragments, situated in an opening in the above-mentioned oblong ditch.
*General Comment*: according to expectation the first date is older than the last two, which are apparently synchronous. The dates of these highly characteristic burial monuments agree well with the available archaeological evidence. All samples were pretreated with acid and alkali.

**GrN-1674. Hilvarenbeek, Netherlands** **2850 ± 60**
**900 B.C.**

Charcoal collected in oblong ditch of urn field Laag Spul (51° 28′ 30″ N Lat, 5° 09′ 15″ E Long), municipality of Hilvarenbeek, province of Noord-Brabant, Netherlands. Depth 0.80 m below old arable surface. Supposed age ca. 7th century B.C. Coll. and subm. by P. J. R. Modderman. *Comment*: although somewhat older than was expected, date is within the limits of the archaeological possibilities. The sample was thoroughly pretreated with acid and alkali.

**GrN-2881. Elp, Netherlands** **2755 ± 65**
**805 B.C.**

Charred grain found (1959) in a pit in one of the long houses of a Late Bronze Age settlement at Elp (52° 53′ 48″ N Lat, 6° 37′ 40″ E Long), municipality of Westerbork, province of Drenthe, Netherlands (Waterbolk, 1961). Depth 0.5 m. Coll. and subm. by H. T. Waterbolk. *Comment*: from the archaeological point of view a date not later than 900 B.C. was expected. The $C^{14}$ date does not contradict this estimation.

### *G. Iron Age and Later*

**GrN-1973. Carate, France** **2650 ± 60**
**700 B.C.**

Charcoal from Barrow 15 in an Iron Age cemetery at la Grée de Carate (47° 43′ N Lat, 2° 27′ W Long), commune de Pluherlin, Morbihan, France. Coll. by A. Lepart; subm. by P. R. Giot, Univ. of Rennes, France and H. T. Waterbolk. *Comment*: date indicates barrow belongs to the Hallstatt period. The same and another sample from the same cemetery were dated at Gif (Giot, 1960b) as FG-46, 2540 (mean value of four determinations) for the same sample and FG-33, 2510 (mean value of two determinations) for a sample from Barrow 9, i.e., 590 and 560 B.C. Humus was extracted with acid and alkali.

**GrN-1553. Gees, Netherlands** **2460 ± 45**
**510 B.C.**

**GrN-2392. Gees, Netherlands** **2360 ± 55**
**410 B.C.**

Charred grain found in an early Iron Age settlement (Jastorf B) at Gees (52° 45′ N Lat, 6° 41′ 20″ E Long), municipality of Oosterhesselen, province of Drenthe, Netherlands. Expected age ca. 400 B.C. Coll. and subm. by H. T. Waterbolk. *Comment*: these are two different samples from the same grain find. GrN-1553 was done in 1957, GrN-2392 in 1962. There is no significant difference between the two dates. Their mean value may be given as 2420 ± 35 yr (470 ± 35 B.C.)

**GrN-2402. Ermelo, Netherlands** **2460 ± 65**
**510 B.C.**

Charred grain found in an Iron Age settlement at Ermelo (52° 17′ N Lat, 5° 38′ E Long), province of Gelderland, Netherlands. Coll. and subm. by W. van Zeist and H. T. Waterbolk. *Comment*: another sample from the same grain find was dated in 1956 at 2535 ± 100 (GrN-652, Groningen II, p. 136), i.e., 585 B.C.

**GrN-1951. Broekpolder, Netherlands** **2320 ± 70**
**370 B.C.**

Wood from a worked post of a pre-Roman Iron Age settlement in the Broekpolder (51° 55′ 40″ N Lat, 4° 19′ 20″ E Long), municipality of Vlaardingen, province of Zuid-Holland, Netherlands. The peaty cultural layer was covered by a clay deposit. The excavation was directed by P. J. R. Modderman, who collected and submitted the sample. *Comment*: sample was thoroughly pretreated with acid and alkali.

**GrN-3519. Grosses Moor, Germany** **2150 ± 70**
**200 B.C.**

Wood from trackway (*Bohlenweg*) in the raised bog Grosses Moor (52° 37′ 40″ N Lat, 8° 18′ 40″ E Long), between Lohne and Diepholz, N of the Dümmer Lake, Oldenburg, Germany (Hayen, 1957a). Depth 1.00 m. Expected age between A.D. 1 and 200. Coll. and subm. by H. Hayen, Oldenburg. *Comment*: date is somewhat older than was expected.

**GrN-1673. Felsum, Netherlands** **2060 ± 65**
**110 B.C.**

Wood found at the bottom of a wooden well, together with pottery sherds from the beginning of our era at Felsum (53° 08′ 20″ N Lat, 6° 34′ 28″ E Long), near Spannum, municipality of Hennaarderadeel, province of Friesland, Netherlands. Depth 1.60 m below present surface. Expected age 2nd century A.D. Coll. 1958 and subm. by P. J. R. Modderman. *Comment*: sample was thoroughly pretreated with acid and alkali.

**Krommenie series, Netherlands**

Two samples were dated from an Iron Age settlement at Krommenie (53° 30′ N Lat, 4° 46′ E Long), province of Noord-Holland, Netherlands, excavated by the Institute of Pre- and Protohistory, Univ. of Amsterdam. Ar-

chaeological dating A.D. 45 to 65 (Groenman-van Waateringe et al., 1961). Subm. by W. Glasbergen.

**GrN-3075. Krommenie 5** **1870 ± 50**
**A.D. 80**

Fragment of wooden post, used for building a house. Expected age A.D. 1 to 45.

**GrN-3072. Krommenie 4** **1840 ± 50**
**A.D. 110**

Charcoal from fireplace that was in use during habitation. Expected age A.D. 45 to 65.
*General Comment*: dates agree with the archaeological expectation.

**GrN-1415. Valkenburg, Netherlands** **1920 ± 25**
**A.D. 30**

Charred grain from the Roman Castellum of Valkenburg (52° 10′ 50″ N Lat, 4° 25′ 40″ E Long), province of Zuid-Holland, Netherlands. Archaeological date A.D. 70. Coll. by A. E. van Giffen; subm. by H. T. Waterbolk. *Comment*: there is no significant difference between the archaeological date and the $C^{14}$ measurement.

**GrN-793. Vries, Netherlands** **1720 ± 60**
**A.D. 230**

Chaff-tempered potsherd from Iron Age settlement at Vries (53° 04′ 28″ N Lat, 6° 34′ 28″ E Long), province of Drenthe, Netherlands. Archaeological date 1st century A.D. (Van Es, 1958, p. 50-66). Coll. in 1957 by W. A. van Es; subm. by H. T. Waterbolk. *Comment*: date agrees with archaeological estimation; it shows the interesting possibility of dating chaff-tempered potsherds.

**Denekamp series, Netherlands**

In order to study the age and development of the so-called "es" fields in Twente (a part of the province of Overijssel) a series of charcoal samples was collected at Denekamp (52° 22′ 30″ N Lat, 2° 7′ 30″ E Long), province of Overijssel, Netherlands. Two successive "es" layers could be distinguished, resting in an older soil with two dark humic layers. The total thickness was ca. 2.00 m. In the lower part of the section Iron Age and older sherds occurred. The expected age of the "es" layers was 2000 to 500 yr. Coll. 1960 and subm. by T. van der Hammen, Univ. of Leiden, Netherlands.

**GrN-2815. Denekamp-Klok 4** **950 ± 25**
**A.D. 1000**

Top of lower "es" layer; depth 1.20 m.

**GrN-2812. Denekamp-Klok 3** **1795 ± 50**
**A.D. 155**

Base of lower "es" layer; depth 1.30 m.

**GrN-2814. Denekamp-Klok 2[b]** **4405 ± 55**
**2455 B.C.**

Upper dark layer of older soil; depth 1.60 m.

**GrN-2813. Denekamp-Klok 1** **6810 ± 60**
**4860 B.C.**

Lower dark layer of older soil; depth 2.00 m.

*General Comment*: dates of the two upper samples are according to expectation; those of the lower samples are much older than originally expected, but pollen analysis of the soil-layers agrees with the age of the last-mentioned samples.

**GrN-2299. Alkmaar, Netherlands** **1250 ± 65**
**A.D. 700**

Small wooden post, found in an excavation in the town of Alkmaar (52° 38′ 5″ N Lat, 4° 44′ 50″ E Long), Netherlands. The post stood in a clay layer, covered by a peaty layer and nearly 3 m of medieval and later accumulation. Posts of this type are the oldest traces of human activity in this place. Expected age 11th century A.D. or much older. Coll. 1958 by W. R. Reder; subm. by P. J. R. Modderman. *Comment*: date is somewhat older than was expected.

**GrN-2300. Brunssum, Netherlands** **1010 ± 60**
**A.D. 940**

Charcoal at the border between the first and second stages in a medieval pottery kiln at Brunssum (50° 57′ 20″ N Lat, 5° 58′ 7″ E Long), province of Limburg, Netherlands. Expected age A.D. 1180 to 1190. Coll. 1959 by A. Bruijn; subm. by P. J. R. Modderman. *Comment*: sample is older than was expected. Find circumstances were, however, not quite clear.

**GrN-2296. Heerlen-Meezenbroek, Netherlands** **780 ± 45**
**A.D. 1170**

Wood (alder) from trackway in former brook valley, covered by 1 m of redeposited loess at Meezenbroek (50° 54′ 5″ N Lat, 5° 59′ 13″ E Long), municipality of Heerlen, province of Limburg, Netherlands. The track is supposed to be part of the Roman road from Heerlen to Xanten, dating probably from the middle of the 1st century A.D. Coll. 1958 by J. E. Bogaers; subm. by P. J. R. Modderman. *Comment*: date is not in agreement with the expectation. Direct proof of Roman age of the trackway is, however, lacking.

## II. ABSOLUTE DATING OF POLLEN DIAGRAMS

### Poueyferré series, Central Pyrenees, France

In 1957 and 1958 samples were collected by H. Alimen, J. Menéndez Amor and F. Florschütz in the neighborhood of Poueyferré, Lake of Lourdes and Le Monge (ca. 43° N Lat, ca. 0° E Long), France, in depressions probably of glacial origin (de Vries *et al.*, 1960; Alimen *et al.*, 1962). They were submitted by F. Florschütz, Velp (G), Netherlands.

**GrN-1677. Poueyferré 2.45 m** **7930 ± 85**
**5980 B.C.**

**GrN-1889. Poueyferré 3.45 m** **9500 ± 100**
**7550 B.C.**

**GrN-1681. Poueyferré 4.45 m** **12,670 ± 130**
**10,720 B.C.**

| | | |
|---|---|---|
| **GrN-1879.** | **Poueyferré 5.10 m** | **13,170 ± 135**<br>**11,220 B.C.** |
| **GrN-1679.** | **Poueyferré 6.45 m** | **13,960 ± 110**<br>**12,010 B.C.** |
| **GrN-1904.** | **Poueyferré 6.60 m** | **19,000 ± 160**<br>**17,050 B.C.** |
| **GrN-1671.** | **Poueyferré 7.95 m** | **16,240 ± 120**<br>**14,290 B.C.** |

*General Comment* (F.FL) : this series is highly interesting, because the continuous sedimentation (peat succeeding gyttja) starts very early. The dates constitute a logical sequence, except the one at a depth of 6.60 m which does not fit. This may be due to cryoturbation having caused a local upheaval of deeper layers. The oldest among the other dates (16,240 yr) indicates the beginning of the Late-glacial period. The lower part of the pollen diagram reflects, consequently, the end of the third stadial phase of the Würm glaciation. Evidently, at that time trees were scarce in the surroundings. Among the shrubs and herbs, *Artemisia* was rather frequent; *Chenopodiaceae* were also present. The landscape may have had the character of a moderate steppe. Afterwards, the *Artemisia* percentages rose, pointing to an accentuation of the steppe conditions during the Oldest Dryas time. The correlation with northern European Bölling stage is confirmed by the dates 13,170 and 12,670 yr. The further oscillations of the curve of AP and NAP suggest the presence of Older Dryas, Allerød, Younger Dryas, Pre-boreal and Boreal periods. The second half of Boreal time, indicated by the date of 7930 yr, was characterized by the existence of oak-pine-hazel-forests.

| | | |
|---|---|---|
| **GrN-1835.** | **Lake of Lourdes 3.50 m** | **3830 ± 80**<br>**1880 B.C.** |
| **GrN-1836.** | **Lake of Lourdes 5.00 m** | **7070 ± 85**<br>**5120 B.C.** |
| **GrN-1834.** | **Lake of Lourdes 6.50 m** | **17,650 ± 150**<br>**15,700 B.C.** |

*General Comment* (F.FL) : the oldest date originates from a calcareous gyttja, deposited near the end of Pleniglacial time, ca. 1800 yr before the beginning of the Late-glacial. In the diagram the proportion AP to NAP is ca. 10: 90, indicating an almost treeless country. In the Late-glacial part of the diagram the periods of Oldest Dryas, Bølling, Older Dryas, Allerød and Younger Dryas, can be distinguished. During Boreal and Atlantic times, oak almost always dominated among the trees, accompanied by pine and hazel. The date 7070 refers to the first half of the Atlantic and the date 3845 to the middle of the Sub-boreal, where the percentages of alder exceed 60.

| | | |
|---|---|---|
| **GrN-1838.** | **Le Monge 3.50 m** | **6940 ± 90**<br>**4990 B.C.** |
| **GrN-1839.** | **Le Monge 5.50 m** | **8690 ± 110**<br>**6660 B.C.** |

**GrN-1840. Le Monge 7.20 m** — **12,870 ± 130 / 10,920 B.C.**

**GrN-1955. Le Monge 7.60 m** — **14,865 ± 175 / 12,917 B.C.**

*General Comment* (F.FL) : the last-mentioned date indicates the Oldest Dryas and the penultimate of the Bölling period. The pollen diagram points to the existence of steppe during Oldest Dryas and part of Bölling. The dates 8600 and 6935 relate successively to the middle Boreal and the first half of Atlantic, during which mixed oak with hazel, and pine with hazel, respectively, dominate in the diagram.

**GrN-1956. Foret de Pinet, France** — **8120 ± 105 / 6170 B.C.**

In 1958 a series of samples for pollen analysis was collected by F. Florschütz and H. J. Zwart from a layer of ca. 4.25 m peat and clay in the forêt de Pinet near Belcaire (42° 52′ N Lat, 1° 59′ E Long), in the Département de l'Aude, France. One sample for $C^{14}$-dating was submitted by F. Florschütz. *Comment* (F.Fl.) : as analysis is pending, it is not yet possible to correlate this date with the history of the vegetation.

**Les Bouillouses series, France**

In 1958 a series of samples for pollen analysis was collected by F. Florschütz and H. J. Zwart from a layer of ca. 11.50 m peat and clay in the lake-district "Les Bouillouses" (42° 34′ N Lat, 2° 1′ E Long), in the Département des Pyrénées Orientales, France. Two samples were submitted by F. Florschütz.

**GrN-1954. Les Bouillouses II, 3.50 m** — **1540 ± 60 / A.D. 410**

**GrN-1953. Les Bouillouses I, 6.12 m** — **2225 ± 65 / 275 B.C.**

*General Comment* (F.FL) : as pollen analysis is pending, it is not yet possible to correlate these dates with the history of the vegetation.

**Riofrio series, Spain**

Six samples were dated from a gyttja-deposit in a kar-lake or tarn and a superimposed peat-layer at Puertos de Riofrio (43° 10′ 25″ N Lat, 4° 50′ 35″ W Long), municipality La Vega de Liébane, province of Santander, Spain, alt 1700 m (Florschütz and Menéndez Amor, 1962). Coll. 1959 and 1960 by J. Menéndez Amor and F. Florschütz; subm. by F. Florschütz.

**GrN-3022. Riofrio 1.50 m** — **2330 ± 65 / 380 B.C.**

**GrN-3057. Riofrio 2.50 m** — **3540 ± 65 / 1590 B.C.**

**GrN-3063. Riofrio 3.50 m** — **5160 ± 60 / 3210 B.C.**

**GrN-3015. Riofrio 4.50 m** **6550 ± 80**
**4600 B.C.**

**GrN-3059. Riofrio 5.75 m** **8825 ± 100**
**6875 B.C.**

**GrN-3018. Riofrio 7.00 m** **10,250 ± 115**
**8300 B.C.**

*Comment* (F.Fl.): as the glacier retired from the kar toward the end of the Late-glacial, there existed in the environment a park landscape with scattered pines and a steppelike character. It was replaced in the Pre-Boreal by pine-oak-birch-forests that maintained themselves during the Boreal, the Atlantic and a part of the Sub-Boreal, but the share of birch-pollen in the pollen rain decreased gradually. In the second half of the Sub-Boreal the forests evidently became thinner, a change that continued in the Sub-Atlantic so that finally a park landscape with pines and oaks developed again.

**Hechtensee series, Austria**

In order to have better possibilities for correlation with other pollen diagrams, a series of four samples was dated from a boring (1958) in the Hechtensee (47° 45′ N Lat, 15° 15′ E Long), near Mariazell, Steiermark, Austria. Coll. and subm. by F. J. J. van Heyst and G. A. Cramer, Geol. Dept., State Univ., Leiden, Netherlands.

**GrN-2244. Hechtensee 1.43 m** **4250 ± 60**
**2300 B.C.**

Peat, first maximum of *Fagus*, Transition Sub-Boreal/Sub-Atlantic.

**GrN-2245. Hechtensee 2.43 m** **6400 ± 40**
**2450 B.C.**

Peat; maximum of *Picea*. Beginning of Atlantic.

**GrN-2247. Hechtensee 3.43 m** **9080 ± 70**
**7130 B.C.**

Lake marl; maximum of *Corylus*, beginning of *Alnus*. Transition Boreal/Atlantic.

**GrN-2013. Hechtensee 4.83 m** **13,340 ± 145**
**11,390 B.C.**

Lake marl; dominance of *Pinus*. Pre-Boreal.

*General Comment*: the first three dates are according to expectation; GrN-2013 is, however, much older. A hiatus might be present.

**Sittard series, Netherlands**

In January 1958 a peat deposit sealed off by colluvial clay was sampled in the valley of the Geleen River at Sittard (52° 0′ 14″ N Lat, 5° 52′ 03″ E Long), province of Limburg, Netherlands. The palynological investigation of this peat deposit was undertaken in connection with the excavation of the Danubian settlements at Sittard and Geleen. According to pollen analysis peat formation started at the end of the Boreal period and continued until mediaeval time. Coll. by H. T. Waterbolk and W. van Zeist; subm. by W. van Zeist.

**GrN-1660. Sittard 1** **5330 ± 80**
**3380 B.C.**

At this level the first pollen grains of *Plantago lanceolata* appear, suggesting the arrival of the Danubian farmers. Depth 2.22 to 2.26 m below surface. *Comment*: date is considerably younger than the $C^{14}$-dates of charcoal from the Danubian settlements (e.g. Elsloo, this list).

**GrN-1658. Sittard 2** **2230 ± 40**
**280 B.C.**

This sample corresponds with a conspicuous rise of the *Fagus* curve. Depth 2.00 to 2.04 m below surface. *Comment*: date is younger than was expected.

**Saint-Michel-de-Brasparts series, France**

In July 1958 a few series of samples were taken in the formerly large bog near Mont St.-Michel-de-Brasparts (48° 20′ 42″ N Lat, 3° 55′ 38″ W Long), Brittany, France. Pollen analysis suggests that in this area peat formation started in the course of the Atlantic period. Coll. by H. T. Waterbolk and W. van Zeist; subm. by W. van Zeist.

**GrN-1983. St.-Michel-de-Brasparts 1** **5410 ± 60**
**3460 B.C.**

This sample corresponds with a marked decline of *Ulmus*. Depth 1.20 to 1.30 m below surface. *Comment*: date lies within the range of other dates of the elm decline in western and northwestern Europe.

**GrN-2175. St.-Michel-de-Brasparts 2** **3780 ± 55**
**1830 B.C.**

At this level the percentages for *Plantago lanceolata* show a marked increase, indicating the arrival of tribes of herdsmen. Depth 0.50 to 0.60 m below surface. *Comment*: there is no reason to suspect this date (see also GrN-2161, this list).

**Spézet series, France**

In July 1958 a series of peat samples was collected in a bog between Spézet and Gourin (48° 09′ N Lat, 3° 42′ 55″ W Long), Brittany, France. According to pollen analysis the sedimentation of organic material started in the course of the Sub-Boreal period. Coll. by H. T. Waterbolk and W. van Zeist; subm. by W. van Zeist.

**GrN-2161. Spézet 1** **3940 ± 75**
**1990 B.C.**

This sample corresponds with the first increase of *Plantago lanceolata*. Depth 2.00 to 2.10 m below surface.

**GrN-2165. Spézet 2** **2775 ± 45**
**825 B.C.**

From this level on *Fagus* shows a continuous curve. Depth 1.30 to 1.40 m below surface.

**GrN-2315. Spézet 3** **1675 ± 60**
**A.D. 275**

In this part of the diagram a conspicuous decrease of human activity is

demonstrated. At the same time the *Fagus* percentages increase slightly. Depth 0.40 to 0.50 m below surface.

*General Comment*: date of Spézet 1 is somewhat older than that of the corresponding level in the diagram from the bog near Mont St.-Michel-de-Brasparts (GrN-2175, 3780 ± 55, see below). There is no reason to suspect the dates of Spézet 2 and 3.

**Flögeln series, Germany**

Five samples were dated from a standard pollen section in the largest raised bog between the Weser and Elbe Rivers at Flögeln (53° 41′ Lat, 8° 49′ E Long), 20 km NE of Bremerhaven, Germany (Grohne, 1956). The section is composed of two partly overlapping sequences 100 m apart. Coll. 1956 and subm. by U. Grohne, Niedersächsische Landesstelle für Marschenund Wurtenforschung, Wilhelmshaven, Germany.

**GrN-2285. Flögeln 1** **2910 ± 70**
**960 B.C.**

Older Sphagnum peat; depth 2 m (section-part 2). Expected age ca. 600 B.C.

**GrN-2292. Flögeln 3** **2125 ± 50**
**175 B.C.**

Younger Sphagnum peat; depth ca. 1.7 m (section-part 1). Expected age ca. 200 A.D.

**GrN-2294. Flögeln 4** **1730 ± 60**
**A.D. 220**

Younger Sphagnum peat; depth ca. 0.9 m (section-part 1). Expected age ca. 700 A.D.

**GrN-2143. Flögeln 5** **1300 ± 40**
**A.D. 650**

Younger Sphagnum peat; depth ca. 0.4 m (section-part 1). Expected age ca. 1200 A.D.

**GrN-2144. Flögeln 6** **790 ± 40**
**A.D. 1160**

Younger Sphagnum peat; depth ca. 0.05 m (section-part 1). Expected age A.D. 1600-1700.

*General Comment*: dates are generally somewhat older than expected. The age estimation was, however, mainly based on earlier Groningen $C^{14}$ dates which had not yet been corrected for the Suess effect (e.g. Emmen, Groningen II). Sample 2, from the same horizon in section-part 2 as sample 3 in section-part 1, has not been measured.

REFERENCES

Date lists:

Groningen I — Vries, Hessel de, and Barendsen, G. W., 1954
Groningen II — Vries, Hessel de, Barendsen, G. W., and Waterbolk, H. T., 1958
Groningen III — Vries, Hessel de, and Waterbolk, H. T., 1958
Lamont IV — Broecker, W. S., and Kulp, J. L., 1957
USGS I — Suess, H. E., 1954
USGS II — Rubin, M., and Suess, H. E., 1955

Alimen, H., Florschütz, et Menéndez Amor, J., 1962, Étude géologique et palynologique sur le Quaternaire des environs de Lourdes: IVe Cong. Internat. d'Études Pyrénéennes Pau et Lourdes, Actes.

Arnold, J. R., and Libby, W. F., 1951, Radiocarbon dates: Science, v. 113, p. 111-120.
Bella, F., Blanc, A. C., Blanc, G. A., and Cortesi, C., 1958, Una prima datazione con il C14 della formazione pleistocenica di Grotta Romanelli (Terra d'Otranto): Quaternaria, v. 5.
Blanc, G. A., 1928, Grotta Romanelli I, II: Archivio per l'Antropologia e l'Etnologia, v. 50 (1920), v. 58 (1928).
Bohmers, A., 1960, Statistiques et graphiques dans l'étude des industries lithiques préhistoriques V: Palaeohistoria, v. 8, p. 15-37.
Bohmers, A., and Wouters, A., 1956, Statistics and graphs in the study of flint assemblages III: Palaeohistoria, v. 5, p. 27-38.
Bordes, F., 1958, Nouvelles fouilles à Laugerie-Haute Est, premiers résultats: l'Anthropologie, v. 62, p. 205-244.
Broecker, W. S., and Kulp, J. L., 1957, Lamont natural radiocarbon measurements IV: Science, v. 126, p. 1324-1334.
Clason, A. T., 1959, Een grafveld bij Holsloot: Nieuwe Drentse Volksalmanak, v. 77, p. 207-219.
Es, W. A. van, 1958, Een versterkte nederzetting te Vries: Nieuwe Drentse Volksalmanak, v. 76, p. 50-66.
Ewing, J. F., 1947, Preliminary note on the excavations at the Palaeolithic site of Ksâr 'Akil, Republic of Lebanon: Antiquity, v. 21, p. 186-196.
Florschütz, F. und Menéndez Amor J., 1962, Beitrag zur Kenntnis der quartären Vegetation Nordspaniens. "Festschrift Franz Firbas": Geobot. Inst. Eidgen. Techn. Hochschule, Zürich, Veröffentl., v. 37.
Garrod, D. A. E., and Bate, D. M. A., 1937, The stone age of Mount Carmel: Oxford, Oxford Univ. Press, 240 p.
Giffen, A. E. van, 1930, Die Bauart der Einzelgräber. Beitrag zur Kenntnis der älteren individuellen Grabhügelstrukturen in den Niederlanden: Mannus-Bibliothek, no. 44, p. 145-150.
———— 1950, Inheemse en Romiense terpen. Opgravingen in de dorpswierde te Ezinge en de Romeinse terpen van Utrecht, Valkenburg Z. H. en Vechten: Jaarverslag van de Vereeniging voor Terpenonderzoek, v. 29, 30, 31, 32, p. 5-66.
———— 1961a, Een vlakgraf van de Trechterbekercultuur, gesneden door een standkuil van Hunebed D 32 te Odoorn (Dr.): Helinium, v. 1, p. 39-43.
———— 1961b, Nederzettingssporen van de vroege Klokbekercultuur bij Oostwoud (N.H.): In het voetspoor van A. E. van Giffen, p. 66-71.
Glasbergen, W., 1954, Barrow excavations in the eight beatitudes. The Bronze Age cemetery between Toterfout & Halve Mijl, North Brabant. I, II: Palaeohistoria, v. 2, p. 1-134; v. 3, p. 1-204.
Giot, P. R., 1960a, Une station du néolithique primaire Armoricain: Le Curnic en Guissény (Finistère): Soc. préhist. francaise Bull., v. 57, p. 38-50.
———— 1960b, Vers une échelle chronologique "absolue" pour la préhistoire et la protohistoire armoricains: Annales de Bretagne, v. 57, p. 33-44.
Giot, P. R., L'Helgouach, J., and Briard, J., 1962, La Bretagne. Préhistoire et Protohistoire: Paris, Astland.
Groenman-van Waateringe, W., 1961a, Palynologisch onderzoek van drie Laat-Neolithische tumuli te St. Walrick bij Overasselt (Gld.): In het voetspoor van A. E. van Giffen, p. 72-80.
———— 1961b, Nederzettingen van de Hilversumcultuur te Vogelenzang (N.H.) en den Haag (Z.H.): In het voetspoor van A. E. van Giffen, p. 81-92.
Groenman-van Waateringe, W., Glasbergen, W., and Hamburger, M. F., 1961, Een boerderij uit de eerste eeuw na Chr. te Krommenie (N.H.): In het voetspoor van A. E. van Giffen, p. 110-115.
Grohne, U., 1956, Zur Entwicklungsgeschichte des ostfriesischen Küstengebietes auf Grund botanischer Untersuchungen: Probleme der Küstenforschung, v. 6, p. 1-48.
Hayen, H., 1957a, Zur Bautechnik und Typologie der vorgeschichtlichen, frühgeschichtlichen und mittelalterlichen hölzernen Moorwege und Moorstrassen: Oldenburger Jahrb., v. 56, p. 87-189.
———— 1957b, Neue Untersuchungen an hölzernen Moorwegen in nordwestdeutschen Hochmooren: Die Kunde N. F., v. 8, p. 242-249.
———— 1958, Ipwegermoor B: Die Kunde N. F., v. 9, p. 33-48.
Higgs, E. S., 1961, Pleistocene fauna of some Mediterranean coastal sites: Prehist. Soc. Proc., v. 27, p. 144-154.
Leroi-Gourhan, A., 1952, Stratigrafie et découvertes récentes dans le Grotte de Arcy-sur-Cure (Yonne): Revue de Geografie de Lyon, v. 27, p. 425-433.

McBurney, C. B. M., 1960, The Stone Age of northern Africa, Harmondsworth: London, Pelican A342, 288 p.

———— 1961, Absolute age of Pleistocene and Holocene deposits in the Haua Fteah: Nature, v. 192, p. 685-686.

McBurney, C. B. M., Trevor, J. C., and Wells, L. H., 1953, The Haua Fteah Fossil Jaw: Royal Anthropol. Inst. [Great-Britain and Ireland] Jour., v. 83, p. 71-85.

Mottl, M., 1951, Die Repolusthöhle bei Peggau (Steiermark) und ihre eiszeitliche Bewohner: Arch. Austriaca, v. 8, p. 1-78.

Movius, H. L., 1960, Radiocarbon dates and Upper Palaeolithic Archaeology in Central and Western Europe: Current Anthropology, v. 1, p. 355-391.

Oakley, K. P., 1962, Dating the emergence of man: Advancement of Science, v. 75, p. 415-426.

Quitta, H., 1958, Die Ausgrabungen in der bandkeramischen Siedlung Zwenkau-Harth, Kr. Leipzig: Berlin, Neue Ausgrabungen in Deutschland, p. 68-73.

———— 1960, Zur Frage der ältesten Bandkeramik in Mitteleuropa: Praehist. Zeitschr., v. 38, p. 154-188.

Regteren Altena, J. F. van, Bakker, J. A., Clason, A. T., Glasbergen, W., Groenman-van Waateringe, W., and Pons, L. J., 1962, The Vlaardingen culture (I): Helinium, v. 2, p. 3-36.

Rubin, M., and Suess, H. E., 1955, U. S. Geological Survey Radiocarbon Dates II: Science, v. 121, p. 481-488.

Saint-Mathurin, S. de, and Garrod, D., 1951, La frise sculptée de l'Abri du Roc aux Sorciers à Angles-sur-l'Anglin: l'Anthropologie, v. 55, p. 413-424.

Solecki, R. S., 1958, Collection of material data from three archaeological sites at Shanidar, Iraq: Year Book of the Am. Philosophical Soc., p. 403-407.

Sonneville-Bordes, D. de, and Mortureux, B., 1955, l'Abri Caminade, commune de La Canéda (Dordogne): Soc. préhist. francaise Bull., v. 52, p. 608-619.

Suess, H. E., 1954, U. S. Geol. Survey radiocarbon dates I: Science, v. 120, p. 467-473.

Trimpe Burger, J. A., 1961, Beknopt overzicht van het oudheidkundig bodemonderzoek in het Deltagebied: Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek, v. 10-11, p. 195-209.

Vasić, M. M., 1932, Prehistorika Vinča, v. I-III: Beograd.

Vértes, L., and Vries, H. de, 1959, Radiokarbonbestimmung der Aurignacien II aus der Istállósköer Höhle: Arch. Értesítö, v. 86, p. 195.

Vries, Hl. de, and Barendsen, G. W., 1954, Measurements of age by the Carbon-14 Technique: Nature, v. 174, p. 1138-1146.

Vries, Hl. de, Barendsen, G. W., and Waterbolk, H. T., 1958, Groningen Radiocarbon Dates II: Science, v. 127, p. 129-137.

Vries, Hl. de, and Barendsen, G. W., 1958, Groningen Radiocarbon Dates III: Science, v. 128, p. 1550-1556.

Vries, H. de, Florschütz, F., and Menéndez Amor, J., 1960, Un diagramme pollinique simplifié d'une couche de "gyttja", située à Poueyferré près de Lourdes (Pyrénées françaises centrales), daté par la méthode du radio-carbone: Kon. Ned. Akademie van Wetenschappen, Proc., Series B, v. 63, p. 498-500.

Waals, J. D. van der, 1961, De zool van Tumulus XIII bij Wervershoof (N.H.): In het voetspoor van A. E. van Giffen, p. 98-102.

———— 1962, Sporen van bewoning en begraving uit Neolithicum en Bronstijd bij Hoeve "De Schipborg," gem. Anlo: Nieuwe Drentse Volksalmanak, v. 80, p. 223-272.

Waterbolk, H. T., 1960, Preliminary report on the excavations at Anlo in 1957 and 1958: Palaeohistoria, v. 8, p. 59-90.

———— 1961, Bronzezeitliche dreischiffige Hallenhäuser von Elp (Drenthe): Helinium, v. 1, p. 126-132.

Waterbolk, H. T., and Zeist, W. van, 1961, A Bronze Age sanctuary in the raised bog at Bargeroosterveld (Dr.): Helinium, v. 1, p. 5-19.

Weinberg, S. S., 1962, Excavations at Elateia, 1959: Hesperia, v. 31, p. 158-209.

Wright, H. E., 1951, Geologic Setting of Ksâr 'Akil, a Palaeolithic site in Lebanon—Preliminary Report: Jour. of Near Eastern Studies, v. 10, p. 112-122.

Zeist, W. van, 1956, De veenbrug van Nieuw-Dordrecht: Nieuwe Drentse Volksalmanak, v. 74, p. 314-318.