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DATING OF THE GRAVE COMPLEX IN DACHARZÓW, MAŁOPOLSKA

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Abstract: **Radiocarbon dating has confirmed the division of the period when the grave complex in Dacharzów was used into two stages, between which there was a distinct gap. In the second stage the graves appeared in cycles, after longer breaks (100 years or more). The cemetery was used from the end of the 17th to the 10th or 10th/9th centuries BC.**

1. INTRODUCTION

Dacharzów (Sandomierz district) is situated in the north-eastern part of the Sandomierz Upland (**Fig. 1**). In 1991 one barrow was discovered here, marked as site 1 (Florek, 1994). It is situated on the edge of the Opatówka river valley, rising 50 metres above the flat bottom of the valley. In the years 1994-1995 archaeological excavations were carried out on the barrow and its surroundings (Florek and Taras, 1996). As a result, a whole complex of graves was uncovered, dating from the Bronze Age, from the period of the Trzciniec Culture (Florek and Taras, 1997; Florek, 1998).

In the central part of the barrow was found a stone structure consisting of two chambers (**Fig. 2**). They had a wooden rafter structure, which supported the walls, and a wooden (oak) floor; the remains of the wood have been used in radiocarbon dating.

Inside the bigger chamber there were bone remains of six people – four women and two children. The skeletons, badly-preserved, were not lying in the anatomical order, and some of the bones in the northern part were burnt out. In the smaller chamber there were scattered less burnt bones of, most probably, a man. The bone material coming from all the people buried here was radiocarbon-dated.

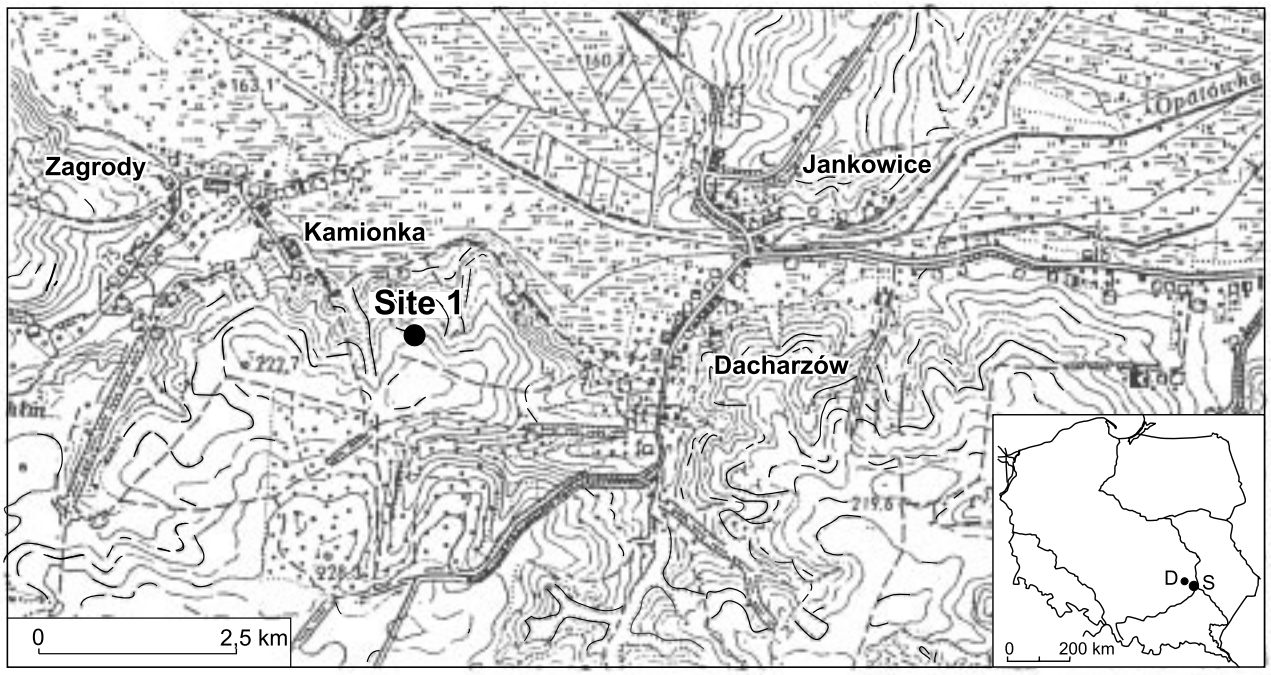


Fig. 1. *Dacharzów, site 1. Location of the site (S – Sandomierz, D – Dacharzów).*

The stone graves with their immediate surroundings were covered with an earthen mound; earth for the mound was taken mainly from the area north of the barrow, where, as a result, a semi-circular basin was created.

On the south-western part of the mound there was observed a semicrescent-like ditch (**Fig. 2**). On the circumference of the mound, in its southern and eastern parts, eight graves were discovered (No. 2, 5, 8-12, 14) containing inhumation burials. The skeletons are poorly-preserved, in some cases there are only single bones preserved. The bone remains from all the graves but one – No. 14 – have been radiocarbon-dated.

2. METHODS OF RADIOCARBON DATING OF BONE SAMPLES

In the research was used the technology developed in Kiev Radiocarbon Laboratory. This technology makes it possible to produce lithium carbide production from collagen or bone without preliminary deposition of them in a pure kind (Skripkin and Kovaljukh, 1998). The bones for this purpose are reduced to fragments, and after washing with trisodium phosphate solution they are processed by 1-3% hydrofluoric acid. This acid transforms carbonate and partly calcium phosphate into fluoride. Calcium fluoride practically does not dissolve in weak acids, but change of CO_3^{-2} and PO_4^{-3} volumetric anions for compact F^- leads to genesis of mineral matrix which is porous and cleaned from organic-silicate complex. Collagen in this case exists in semi-bound non-hydrated state. The essential advantage of hydrofluoric acid is its ability to dissolve silicates and humic acids as well as products of bacteria vital activity absorbed on them. It makes it possible to remove introduced organic substances and carbonic carbon, to wash and dry the processed sample easily and qualitatively. As a result of running processes the collagen is converted into volatile organic combinations and into bone coal. The addition of manganese dioxide plays an important role. When the temperature is above 550°C the manganese dioxide disintegrates with active oxygen liberation all over the volume of mixture. Oxygen liberation runs quietly, under the broad range of temperatures (550-940°C). Fine-dispersed bone coal therewith is oxidised till carbon oxide and dioxide,

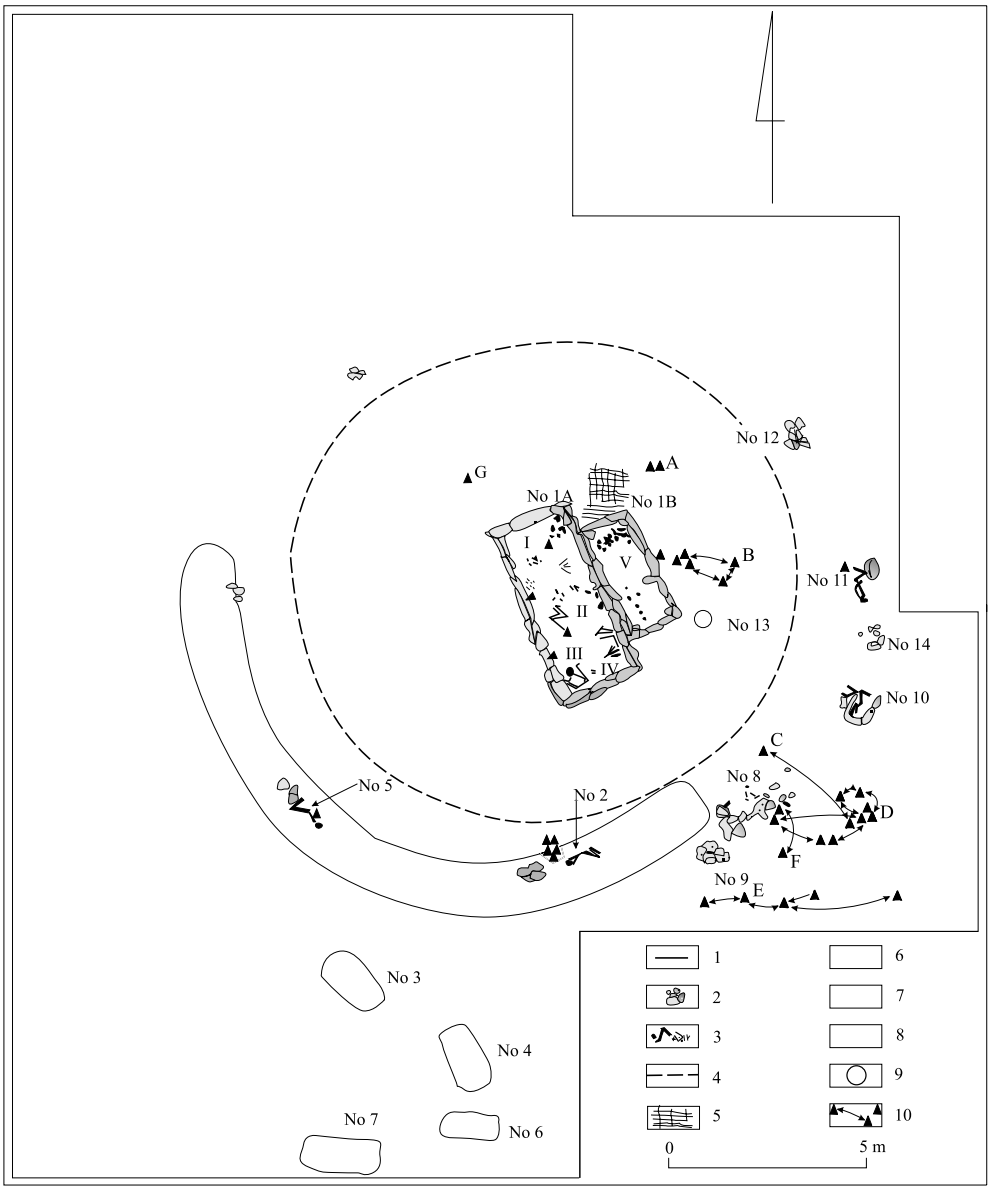


Fig. 2. *Dacharzów, site 1. Grave complex of the Trzciniec Culture: 1 - boundaries of the investigated area, 2 – stones, 3 - human bones, 4 – original circumference of the base of the barrow, 5 – traces of ploughing, 6 - range of the basin created after taking earth for erecting the mound, 7 – ditch, 8 – pits, 9 – hole left by a post, 10 - pottery; I-V - bones of individual people buried in the graves; No 1-13 – features; A-G - pottery (after Florek and Taras 1996).*

and in such a kind it is absorbed by melted metallic lithium. An essential feature of manganese oxides is their ability to link phosphorus and sulphur in thermal stable combinations. This allows getting lithium carbide of high quality, and what is more - practically from the whole carbon content of bone organic substances. Lithium carbide is subjected to hydrolysis, and gassing acetylene is converted into benzene on vanadium catalyst. The vacuum system for benzene syntheses is made from materials, which adsorb not all acetylene and benzene. Constructive particularities mentioned above allow one reach 95-97% benzene output to the total exclusion of the memory effect. As a result of summation of new complex technology advantages there appears a possibility for bone samples dating carried-out with collagen total contents up to 250-300 mg.

Measurement of benzene is carried out into the specially developed vials with the help of "Quantulus" - low-background spectrometer.

As a result of biological processes, which have been going on within the system bone - soil microorganisms, the natural relation between three main carbon isotopes (^{12}C, ^{13}C and ^{14}C) undergoes certain changes. In evaluating radiocarbon age the correction is being taken in account for biological isotopic fractionation. Undertaking such an operation is possible due to well-defined relationship between the deflection of ^{13}C isotope concentration and the degree of ^{14}C isotope fractionation. For this aim the determination is made on variation in concentrations of ^{13}C isotope in the ready benzene by mass-spectrometric method. This factor usually falls within the limit $-20.7 < \delta^{13}C < -18.5‰$. Correction entering for the isotopic fractionation is currently central for bone samples.

3. STATISTICAL APPROACH

For receiving reliable dates of bone material from the Dacharzów settlement the statistical approach of the radiocarbon dating was used. Big separate bones were cut to several parts and then all necessary procedure steps were made quite separately. The received dates were calculated for average value. Averaged dates are much more reliable and may be used for good evaluation of the main historical periods.

4. ARCHAEOLOGICAL DATING RESULTS

The site in question has clear, stratigraphically confirmed stages of use:

1. Construction and use of the stone graves and their surroundings. The smaller chamber, situated on the then ground level, was added to the already existing larger one, slightly sunk in the loess.
2. Building the mound.
3. Construction and use of the ditch surrounding the barrow from the south-west. The ditch cut into the western periphery of the basin created by digging earth for the construction of the mound, thus pointing to the sequence of the events.

The area around the ditch continued to be used, however, there is no stratigraphic evidence that would point to the chronological order of the following events:

– filling the ditch and using it for two burials,

– the appearance of further graves on the circumference of the mound that together with the ditch formed a ring.

The only certain thing that was found was that graves No. 11 and 12 – just like No. 2 and 5, that were uncovered in the ditch – appeared after the mound was made because they are situated in the eastern part of the basin created as a result of erecting the mound (**Fig. 2**). Since the flat graves form a regular ring on the circumference of the mound, the logical conclusion is that all of them were built after the barrow was made.

It has been assumed that the ditch was filled at one go. The claim is supported by the homogenous character of the filling material, both in its colour and texture, and the absence of clear pit contours as in the case of grave No. 2, which would point to a later digging of the grave in the filled ditch. As far as grave No. 5 is conserved, the situation is more complex: the contour of a rectangular, shallow pit is visible only on the level and it not possible to see the contour. Under the circumstances, it seems that graves No. 2 and 5 were built during the using (grave No. 5) and filling (grave No. 2) of the ditch.

The objects found in graves 1A and 1B and in their surroundings are connected with the first stage of using the cemetery, namely the period before the mound was built. The identical style of their production enables one to date them to the first half of phase II of the Bronze Age (16^{th} – $16^{th}/15^{th}$ centuries BC) and also suggests that the period in which they were being deposited in the graves did not last too long.

The second stage in the use of the cemetery is connected with material coming from the graves built after the erection of the mound, on its circumference. The material consists of the equipment from graves No. 2, 5 and 11. The formal features of the pottery found in these graves are typical of the late or terminal stage of the Trzciniec Culture, both in Małopolska (Górski, 1994) and in other regions (Taras, 1995), which are dated to the end of phase II and phase III of the Bronze Age ($14^{th}/13^{th}$ – 12^{th} centuries BC), and in eastern Poland even longer (Górski, 1998; Taras, 1998).

The analysis of the objects found in individual graves shows that between the stage of using the stone graves and the appearance of graves on the circumference of the mound there was a considerable time gap, possibly even 200 – 300 years.

5. RADIOCARBON DATING RESULTS

Radiocarbon dating was carried out in the Kiev Laboratory. The calibrated age was obtained using three calibrations programs worked out in: Groningen (Van der Plicht, 1993), Oxford (OxCal, v. 3.5) and Cologne (Weninger, 1986 and 1993). In the case of well-preserved material (remains of wood from the central graves, skeletons in good condition) between 2 and 5 samples were dated, in other cases single dating were done. The obtained dates

Table 1. *Age of samples from Dacharzów, site 1.*

Lab. Code (material)	**Place of origin**	**^{14}C Age** [BP]	**Cal Age [BC]** (van der Plicht, 1993)	**Point dating [BC]** (Weninger, 1993)	**Cal Age [BC]** (Ox Cal v.3.5)
Ki-8548 (wood)	Feature 1A	3340±60	1σ 1685-1599 1587-1577 2σ 1747-1495	1595±73	68.2% 1690-1520 95.4% 1770-1490
Ki-8106 (wood)	Feature 1A	2830±70	1σ 1053-899 2σ 1131-829	958±95	68.2% 1130-890 95.4% 1220-820
Ki-8610 (wood)	Feature 1A	3335±45	1σ 1587-1581 2σ 1693-1523	1580±62	68.2% 1690-1580 95.4% 1700-1510
Ki-8614 (wood)	Feature 1A	3350±50	1σ 1687-1601 1585-1583 2σ 1699-1521	1599±66	68.2% 1690-1580 95.4% 1750-1510
Ki-8615 (wood)	Feature 1A	3450±80	1σ 1829-1683 2σ 19451-1599	1745±109	68.2% 1890-1680 95.4% 1950-1520
Ki-8089 (bone)	Feature 1A-I (women)	3445±90	1σ 1833-1681 2σ 1957-1523	1740±120	68.2% 1890-1630 95.4% 1980-1520
Ki-8090 (bone)	Feature 1A-I (child)	3340±160	1σ 1775-1435 2σ 2035-1260	1604±187	68.2% 1780-1430 95.4% 2150-1200
Ki-8091 (bone)	Feature 1A-II (women)	2800±80	1σ 1023-891 2σ 1131-805	923±90	68.2% 1050-840 95.4% 1220-810
Ki-8092 (bone)	Feature 1A-II (child)	2820±80	1σ 1051-895 2σ 1133-823	937±100	68.2% 1080-890 95.4% 1220-810
Ki-8314 (bone)	Feature 1A-III	3270±70	1σ 1621-1491 2σ 1689-1411	1521±79	68.2% 1630-1490 95.4% 1690-1400
Ki-8315 (bone)	Feature 1A-III	3220±70	1σ 1527-1411 2σ 1639-1375	1465±75	68.2% 1530-1410 95.4% 1690-1370
Ki-8316 (bone)	Feature 1A-III	3310±70	1σ 1641-1519 2σ 1699-1435	1566±82	68.2% 1690-1510 95.4% 1750-1430
Ki-8094 (bone)	Feature 1A-IV	3340±70	1σ 1593-1525 2σ 1773-1491	1593±81	68.2% 1690-1520 95.4% 1780-1440
Ki-8317 (bone)	Feature 1A-IV	3415±70	1σ 1775-1679 2σ 1833-1597	1679±99	68.2% 1780-1620 95.4% 1890-1520
Ki-8318 (bone)	Feature 1A-IV	3360±70	1σ 1693-1599 2σ 1777-1497	1605±84	68.2% 1700-1580 95.4% 1780-1490
Ki-8549 (wood)	Feature 1B	3320±70	1σ 1643-1521 2σ 1745-1437	1579±81	68.2% 1690-1520 95.4% 1750-1430
Ki-8107 (wood)	Feature 1B	3390±200	1σ 1925-1445 2σ 2205-1255	1674±241	68.2% 1940-1440 95.4% 2300-1100
Ki-8611 (wood)	Feature 1B	3280±45	1σ 1621-1515 2σ 1641-1489	1537±61	68.2% 1630-1500 95.4% 1690-1440
Ki-8616 (wood)	Feature 1B	3300±50	1σ 1623-1521 2σ 1689-1491	1554±63	68.2% 1630-1510 95.4% 1690-1440
Ki-8095 (bone)	Feature 1B-V	3340±60	1σ 1587-1577 2σ 1747-1495	1594±73	68.2% 1690-1520 95.4% 1770-1490
Ki-8319 (bone)	Feature 1B-V	3270±70	1σ 1621-1491 2σ 1689-1411	1521±79	68.2% 1630-1490 95.4% 1690-1400
Ki-8096 (bone)	Feature 2	2840±60	1σ 1051-915 2σ 1131-891	975±85	68.2% 1120-900 95.4% 1220-830
Ki-8320 (bone)	Feature 2	2820±60	1σ 1049-897 2σ 1127-831	942±80	68.2% 1050-890 95.4% 1130-830
Ki-8097 (bone	Feature 2	2790±70	1σ 1003-891 2σ 1127-811	907±78	68.2% 1010-830 95.4% 1130-800
Ki-8098 (bone)	Feature 5	3270±70	1σ 1621-1491 2σ 1689-1411	1521±79	68.2% 1630-1490 95.4% 1690-1400
Ki-8321 (bone)	Feature 5	3160±70	1σ 1517-1387 2σ 1537-1261	1408±80	68.2% 1520-1380 95.4% 1610-1250
Ki-8322 (bone)	Feature 5	3180±70	1σ 1521-1393 2σ 1617-1295	1438±75	68.2% 1530-1390 95.4% 1620-1290
Ki-8617 (bone)	Feature 5	3290±60	1σ 1637-1515 2σ 1689-1435	1544±72	68.2% 1640-1510 95.4% 1690-1430
Ki-8099 (bone)	Feature 8	2940±70	1σ 1217-1043 2σ 1319-973	1116±107	68.2% 1260-1010 95.4% 1320-970
Ki-8100 (bone)	Feature 9	6980±70	1σ 5913-5785 2σ 5927-5727	5806±83	68.2% 5920-5770 95.4% 5930-5720

Ki-8101 (bone)	Feature 10	2770±80	1σ 977-831 2σ 1127-801	897±80	68.2% 1000-830 95.4% 1130-790
Ki-8102 (bone)	Feature 10	2980±70	1σ 1315-1125 2σ 1325-1005	1175±111	68.2% 1320-1110 95.4% 1400-1000
Ki-8323 (bone)	Feature 10	3070±70	1σ 1411-1259 2σ 1463-1185	1311±92	68.2% 1420-1250 95.4% 1500-1120
Ki-8324 (bone)	Feature 10	2995±70	1σ 1317-1187 2σ 1405-1041	1196±112	68.2% 1320-1120 95.4% 1410-1010
Ki-8103 (bone)	Feature 11	2950±70	1σ 1261-1047 2σ 1321-995	1127±108	68.2% 1270-1040 95.4% 1320-970
Ki-8104 (bone)	Feature 11	2595±80	1σ 687-659 2σ 901-513	689±132	68.2% 700-540 95.4% 910-480
Ki-8325 (bone)	Feature 11	2800±70	1σ 1015-893 2σ 1129-815	916±82	68.2% 1020-890 95.4% 1130-810
Ki-8105 (bone)	Feature 12	3050±70	1σ 1405-1257 2σ 1445-1123	1293±98	68.2% 1410-1250 95.4% 1450-1050

Table 2. *Dacharzów, site 1. Average ^{14}C ages and calibration results.*

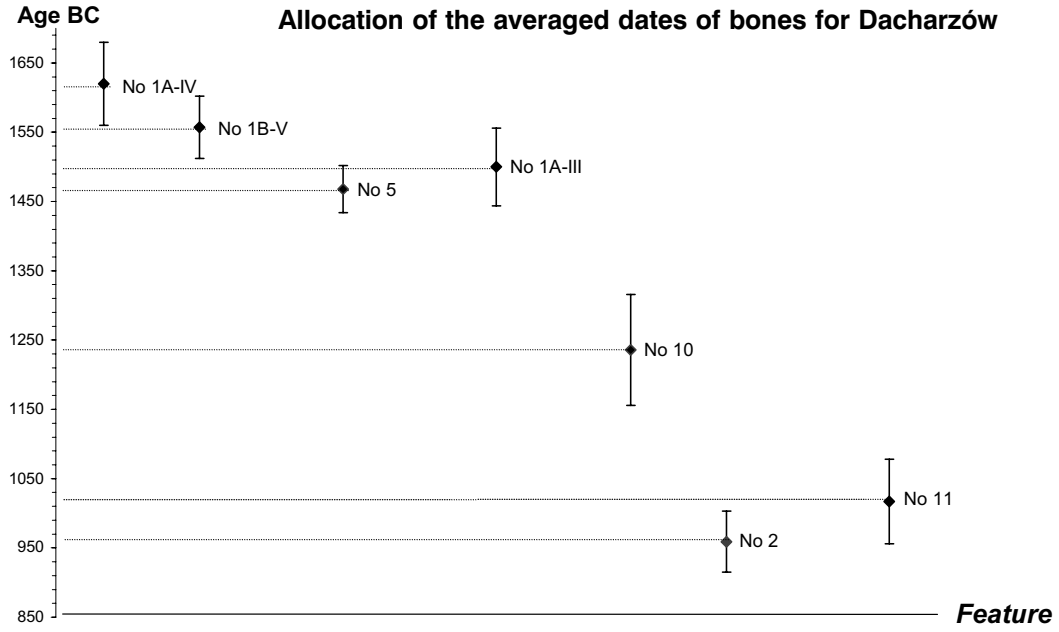
Lab. Code	**Place of origin**	**^{14}C Age** [BP]	**Cal Age [BC]** (van der Plicht, 1993)	**Point dating [BC]** (Weninger, 1993)	**Cal Age [BC]** (Ox Cal v.3.5)
Ki-8548/8610/ 8614/ 8615 (wood)	Feature 1A	3370±30	1σ 1673-1621 2σ 1695-1601	1636±52	68,2% 1690-1610 95,4% 1740-1600
Ki-8314-8316 (bone)	Feature 1A-III	3265±40	1σ 1537-1495 2σ 1623-1437	1500±56	68,2% 1610-1490 95,4% 1640-1430
Ki-8094/8317/8318 (bone)	Feature 1A-IV	3370±40	1σ 1693-1615 2σ 1741-1599	1620±62	68,2% 1700-1600 95,4% 1750-1520
Ki-8549/8611/8616 (wood)	Feature 1B	3300±30	1σ 1603-1525 2σ 1637-1519	1554±46	68,2% 1610-1520 95,4% 1690-1510
Ki-8095/8319 (bone)	Feature 1B-V	3305±30	1σ 1591-1525 2σ 1637-1521	1557±45	68,2% 1620-1525 95,4% 1690-1510
Ki-8096/8320 (bone)	Feature 2	2830±30	1σ 959-927 2σ 1049-903	959±44	68,2% 1050-900 95,4% 1130-890
Ki-8098/ 8321/8322/ 8617 (bone)	Feature 5	3225±35	1σ 1477-1455 2σ 1521-1437	1468±34	68,2% 1520-1440 95,4% 1540-1410
Ki-8102/8323/8324 (bone)	Feature 10	3015±40	1σ 1243-1213 2σ 1323-1207	1236±80	68,2% 1320-1210 95,4% 1400-1120
Ki-8103/8325 (bone)	Feature 11	2875±35	1σ 1055-999 2σ 1129-971	1017±61	68,2% 1130-990 95,4% 1130-920

confirm the division into an earlier period connected with the use of the stone chambers (dates from bone and wood samples) and a later one (graves on the circumference – dates from bone samples) and point to a distinct gap between the two stages. They do not, however, allow one to state clearly the order in which the individual graves on the circumference appeared, because the dates from single samples are not fully credible – an extreme case is here the date obtained from the bone sample from grave No. 9 (**Fig. 1**), while for another grave (No. 14) no date has been established due to the insufficient amount of bone material. The list of dates suggests that all the graves were built in cycles between 1450 and 950 BC. Thus, between the burials of people from graves 1A and 1B and the burials of those from grave No. 5 (or, to be precise, between the death of the last person to be buried in grave No. 5) approximately 50 years passed. During that time, the mound was erected and the ditch was dug. Between the burial in grave No. 5 and the next ones (graves No. 10 and 12) a maximum of 150 – 200 years passed.

6. DISCUSSION

Radiocarbon dating confirms the dating of the first stage of using the cemetery to the 16th century BC. The average dates obtained are generally within the years 1630 – 1500 BC; a couple of dates based on single samples do not fall into this period: the date obtained from the bone sample of woman I (**Fig. 2**, feature 1A-I) – second half of the 18th century BC – and that from woman and child II (**Fig. 2**, feature 1A-II) – second half of the 10th century BC. There is no justification for such dating in the stratigraphy of the site; the possibility of burying the bodies in the grave at a later time has also been excluded.

Another surprise was the dates from feature No. 5 – the grave located in the ditch, which, after calculating the average date, set the time of death of the person buried there (possibly also the time the grave was built) at approximately 1450 BC. The average date for feature No. 2, another grave from the ditch, is much later – approximately 950 BC. In the light of the above, the ideas about how the ditch was used and how it was filled should be revised. It may have been filled at one go (which view is



Fig, 3. *Dispersion averaged radiocarbon dates of bones from Dacharzów, site 1.*

supported by the character of the filling) as late as in the 10th century and that is when grave No. 2 appeared, while grave No. 5 (a secondary burial?) comes from the period of using the ditch. Another possibility is that the ditch was filled already in the 15th/14th century BC, after grave No. 5, was built and grave No. 2 was dug in the filling of the ditch at a later time. If so, the process of filling the grave pit must have been carried out in such a way that the earth dug out from the grave was not mixed with the earth from the area surrounding the ditch. There is a third possibility: both of the graves were dug in the previously filled ditch at different times and in such conditions that the earth from the graves and that of the surrounding area did not mix.

The youngest dates obtained for graves No. 2 and 11 could point to the fact that some enclaves of Trzciniec Culture settlement (or the religious tradition connected with the culture) survived in central and eastern Poland for a much longer time than was suggested by the hitherto available sources, that is even till the end of phase IV of the Bronze Age (Ha B1).

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