

**THE FOUNDATIONS OF RADIOCARBON
CHRONOLOGY OF CULTURES BETWEEN
THE VISTULA AND DNIEPER:
3150-1850 BC**

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Editor's Foreword

This volume of the *Baltic Pontic Studies* focuses on the results of the research carried out so far into the absolute (radiocarbon) chronology of the area lying between the Vistula and Dnieper or the bio-cultural borderland between the West and East of Europe. Absolute chronology is treated here both as a research goal and fundamental premise in the broader studies of the chronometric and development synchronization of "borderland" cultural systems. In a series of articles devoted to individual taxa a considerable number of new ^{14}C dates have been compared. The dates concern source materials that have been chosen from the point of view of their representativeness and chronometric value ("short-lived" materials were preferred to minimize a potential error). The vast majority of analyses were purposefully made in the same ^{14}C laboratory of the *State Scientific Center of Environmental Radiogeochemistry of Ukrainian Academy of Sciences* in Kiev taking advantage of funds generously provided by the *Polish Committee for Scientific Research*.

The volume devoted to the "dark" section of the "borderland" history (3150-1850 BC) is the first but not the last publication on the broader issues mentioned above that we intend to present in the near future.

Editorial comment

1. All dates in the B-PS are calibrated [see: Radiocarbon vol.28, 1986, and the next volumes]. Deviations from this rule will be point out in notes.
2. The names of the archaeological cultures and sites are standarized to the English literature on the subject (e.g. M. Gimbutas, J. P. Mallory). In the case of a new term, the author's original name has been retained.
3. The spelling of names of localities having the rank of administrative centres follows official, state, English language cartographic publications (e.g. *Ukraine, scale 1 : 2 000 000*, Kiev: Mapa LTD, edition of 1996).

Elke Kaiser

RADIOCARBON DATES FROM CATACOMB GRAVES

Until now, the chronological classification of the Catacomb culture (CC) has been based on the typological comparison of findings and on synchronisation with other cultural groups, especially in south-eastern Europe [Bogataya, Manzura 1994: 81ff.]. Its absolute chronological frame had not changed substantially since its first, and last, complete examination in the fifties [Popova 1955:28ff.], according to which the CC dates from the transition of the 3rd to 2nd millennia BC to the middle of the 2nd millennium BC. In recent years, there have been a number of attempts to date the early Bronze Age in the steppe regions further back, according to the chronology of south-eastern and central Europe [Pustovalov 1994:86ff.]. However, the author did not give any reasons for these new dates. This was complicated by the fact that the absolute chronology of the early Bronze Age in south-eastern Europe did not seem sufficiently secure [Raczky 1995:51ff.; Makkay 1996:219ff.]. Additionally, there is often little evidence to compare the findings of the steppe groups with those in the Carpathian Basin and the Balkans during this period.

Thus, the pursuit to obtain an independent dating is understandable. In 1997, 22 samples taken from catacomb graves of grave mounds in the District Nikopol, of the Dnipropetrovsk Region, were analysed in the ¹⁴C Laboratory in Kiev (State Scientific Center of Environmental Radiogeochemistry Ukrainian Academy of Sciences). The grave mounds are situated in different *kurgan* groups on the western bank of the Dnieper river around the town of Ordzhonikidze (Fig. 1). They have been excavated since 1979 by annual expeditions. The samples are bones of skeletons from 21 graves (Fig. 2), five of which were excavated in the summer of 1997, the others being found in the years from 1980 to 1983. The author was able to examine the graves of the older excavations¹.

Several datings belong to graves of the same *kurgans*, and it seems interesting to check the relative chronology of these barrows. **Mound 3** of the group at Chernaya

¹ The material is still in preparation for printing. A.V. Nikolova and E.P. Bunyatyan kindly gave their permission to publish the material used in this article. Only the graves of the finds from the 1980's will be presented.

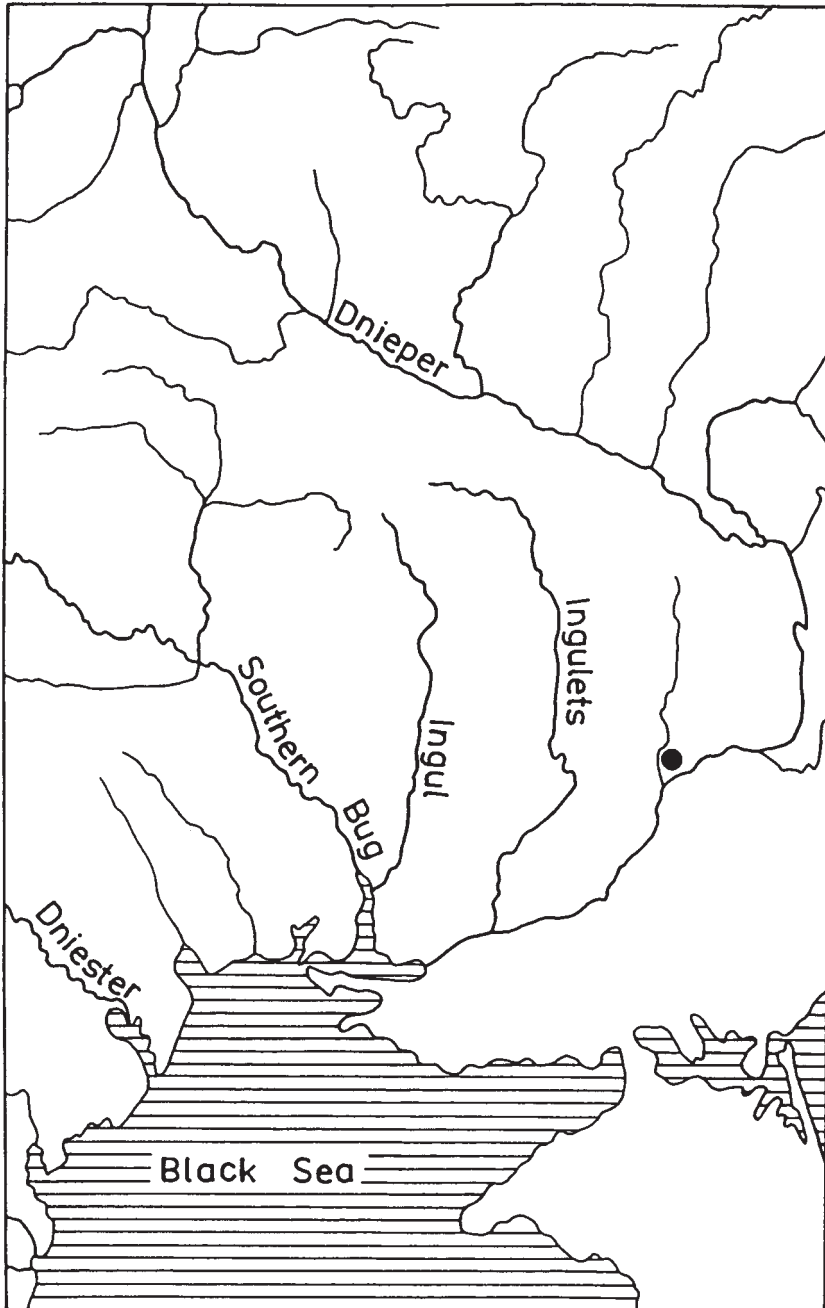


Fig. 1. Location of kurgan groups near Ordzhonikidze, Nikopol District, Dnipropetrovsk Region

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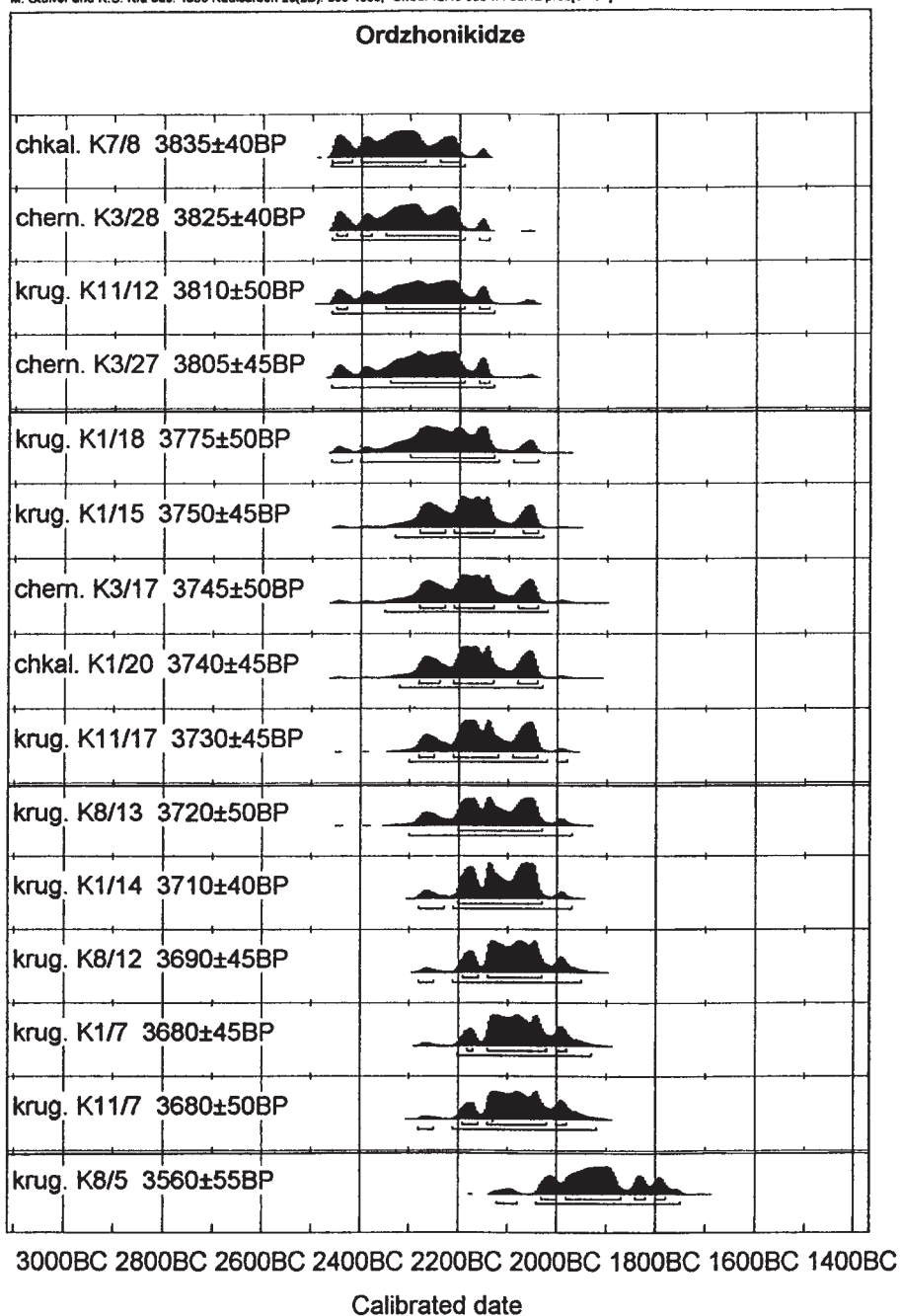


Fig. 2. Calibrated dates of 15 catacomb graves around Ordzhonikidze, Nikopol District, Dnipropetrovsk Region (the abbreviations are explained in the appendix)

Mogila was excavated in 1980, and 11 catacomb burials were found (Fig. 3). Bones from three skeletons were analysed (Fig. 2). According to the absolute dating, **grave 28** is the oldest. It displays a construction with a rectangular entrance pit, an entrance passage and a semi-circular chamber. The deceased was placed in a shallow foetal position on his right side (Fig. 4). As previously described, these features seem to be characteristic for the early phase of the CC. **Grave 27** is only 20 years more recent (in absolute terms), and was situated directly above the chamber of **grave 28** (Fig. 4). The entrance pit was not found. The deceased lay in a stretched position on his back, which suggests a dating in the late phase of the CC, which is also supported by the orientation of the grave within the *kurgan*. However, according to a calibration with a probability of 95% (2 sigma), the graves could be contemporary to one another. A probability of 68% (1 sigma) shows a time range from 2450 to 2200 BC for grave 28, and from 2350 to 2150 BC for grave 27.

Grave 17 of **barrow 3** is definitely younger (Fig. 5). It ranges from 2300 to 2050 BC, with a probability of 68%. Despite this, the deceased lay in a deep foetal position in the grave, which is constructed in the typical way for the late phase, with a round entrance pit and an oval-shaped chamber. On first view, therefore, this date seems to be contradictory to the traditional classification of catacomb graves. However, for the region between the Orel and Samara rivers, I.F. Kovaleva points out that several graves which were built in the abovementioned way, and which contain skeletons in a foetal position, lying on one of their sides, represent the latest horizon of the CC in this area [Kovaleva 1983:20ff.].

The other samples were taken from three mounds of the large group at Kru-glaya Mogila. According to the radiocarbon dates, the oldest burial was in **barrow 11** (Fig. 6). The skeleton of **grave 12** lay in a foetal position on its left side, in a rectangular chamber with a similarly formed entrance pit (Fig. 7). The ^{14}C date (3810 ± 50 BP) of the grave is slightly earlier than that for grave 28 of Chernaya Mogila. It could have been constructed between 2450 and 2150 BC (with a probability of 68% - 1 sigma). The two other graves from this barrow which were analysed are much younger. The three deceased of **grave 17**, as well as the individual of **burial 7**, were buried in grave constructions with a round entrance pit and an oval-shaped chamber. All were buried in a stretched position on their back. In grave 17, one of the skeletons was partly destroyed and apparently pushed to the wall. This was probably the result of a preceding burial. There is no information concerning which skeleton the sample was taken from. Grave 17 was sunk between 2300 and 2050 BC, grave 7 between 2200 and 2000 BC (with a probability of 68%).

Of all the graves of **barrow 1** (Fig. 8) which were analysed, **grave 18** (Fig. 9) is the oldest (with a probability of 68%, it was constructed between 2300 and 2100 BC). In this mound, six catacomb graves were found. Radiocarbon dates were made from four graves, three of which could be classified in the late phase, due to the

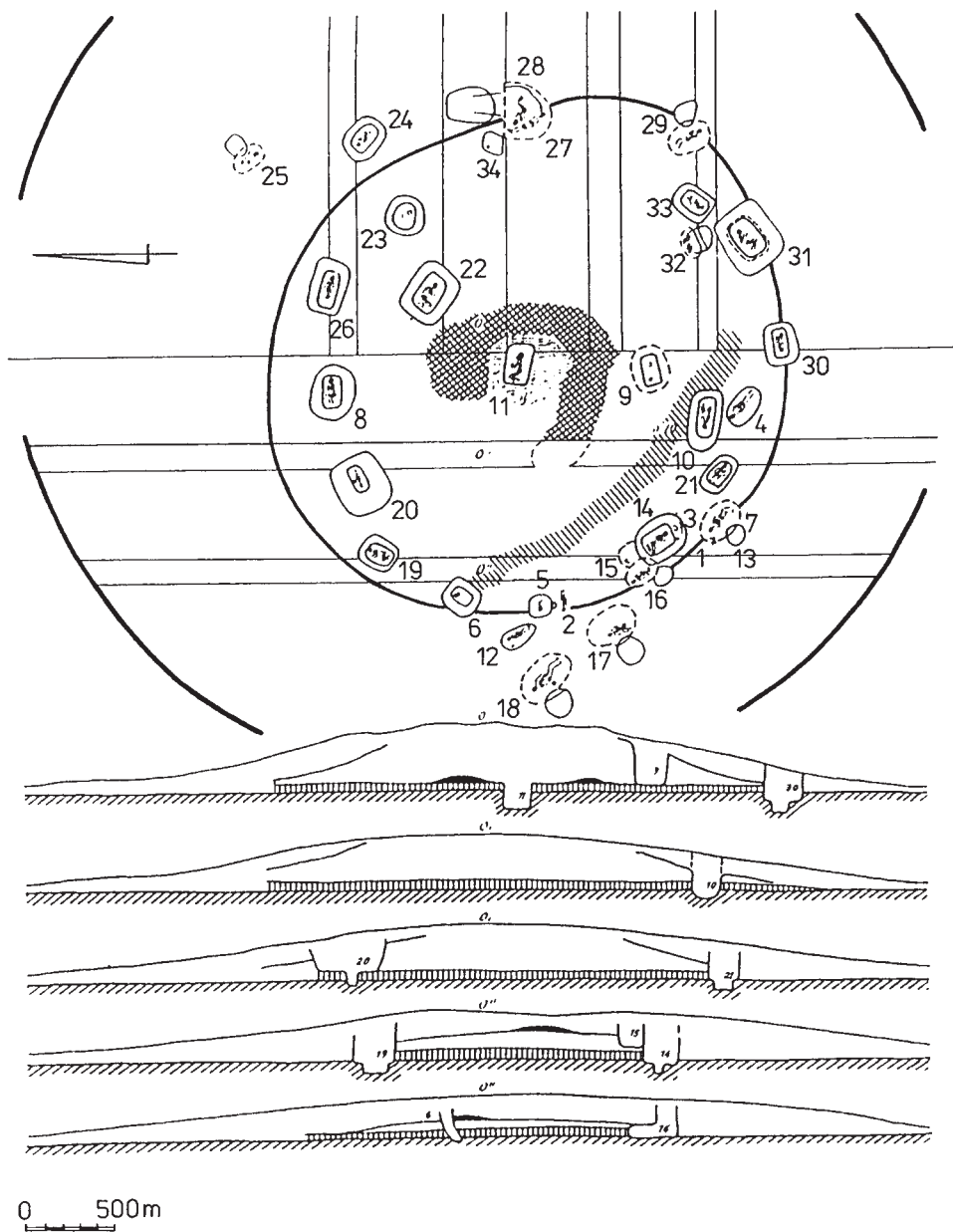


Fig. 3. Chernaya Mogila, barrow 3

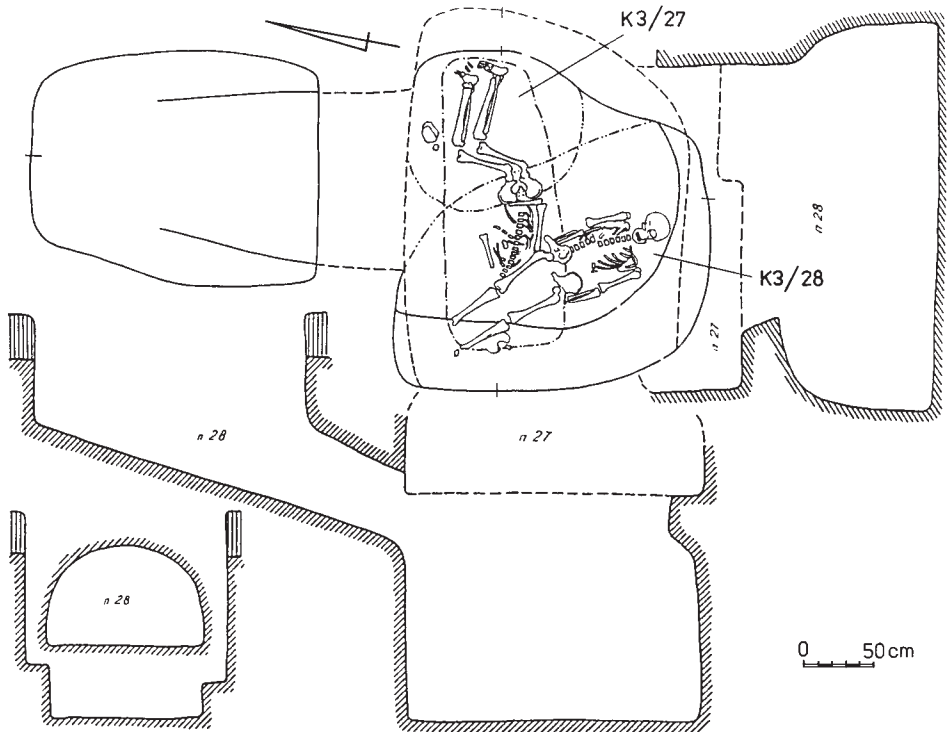


Fig. 4. Chernaya Mogila, barrow 3, grave 27 and 28

stretched position of the skeleton. **Grave 15** was empty, except for a few human bones which were found in the filling of the pits. At the bottom of the chamber, an egg-shaped pot was found, although there is no other evidence to suggest that this grave belongs to the early phase. Unfortunately, none of the skeletons in a foetal position were analysed (grave 6). Both of the graves found in the northern part of the *kurgan* seem to represent a more recent horizon of deceased buried in a stretched position (Fig. 8). **Grave 15** could also be classified in the first half of the 21st century BC, according to a probability of 68%. The two more recent graves - 14 and 7 - range from 2200 to 2000 BC, with a probability of 68%.

The most recent graves could be identified in **barrow 8** (Fig. 10). **Grave 13** is characterised by a rectangular grave construction and an entrance passage, and represents the oldest catacomb in this mound, although its absolute date is about 3720 BP (Fig. 11a). Compared to the other catacomb graves with characteristics of an older horizon, this seems to be too young. Younger than this, by 30 years, is grave 12, composed of an oval-shaped entrance and grave pit, in which an individual was

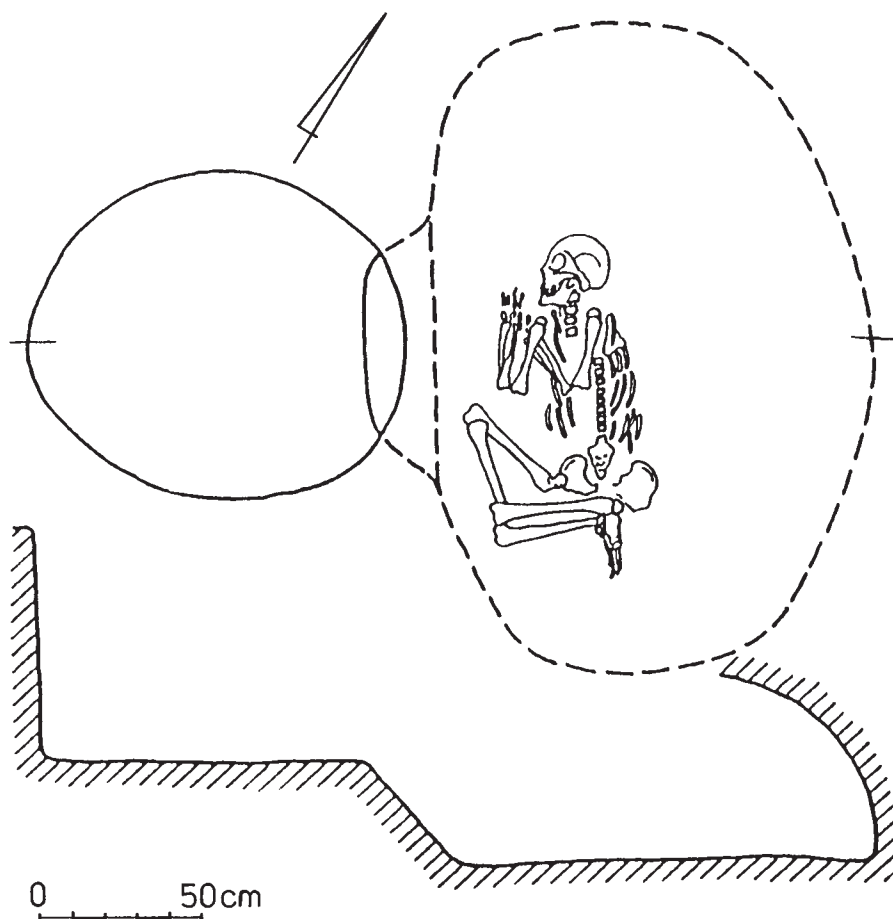


Fig. 5. Chernaya Mogila, barrow 3, grave 17

buried in a stretched position (Fig. 11b). After calibration, both graves could have been sunk between 2200 and 2050 BC, with a probability of 68%. **Grave 5** is the most recent grave (Fig. 12), showing a calibrated time range from 2050 to 1800 BC - extreme compared to the other radiocarbon results.

Thus, the ^{14}C dates from the barrow near Ordzhonikidze confirm the theory of a relative chronology of CC insofar as that, in three *kurgans*, all the graves with characteristics of the so-called older phase of the CC represent the oldest catacombs. One has to admit, however, that in two cases (mound 3 of Chernaya Mogila and mound 8 of Kruglaya Mogila), the absolute age of the next more recent burial, which already shows the characteristics of the next phase, is very close to that of the

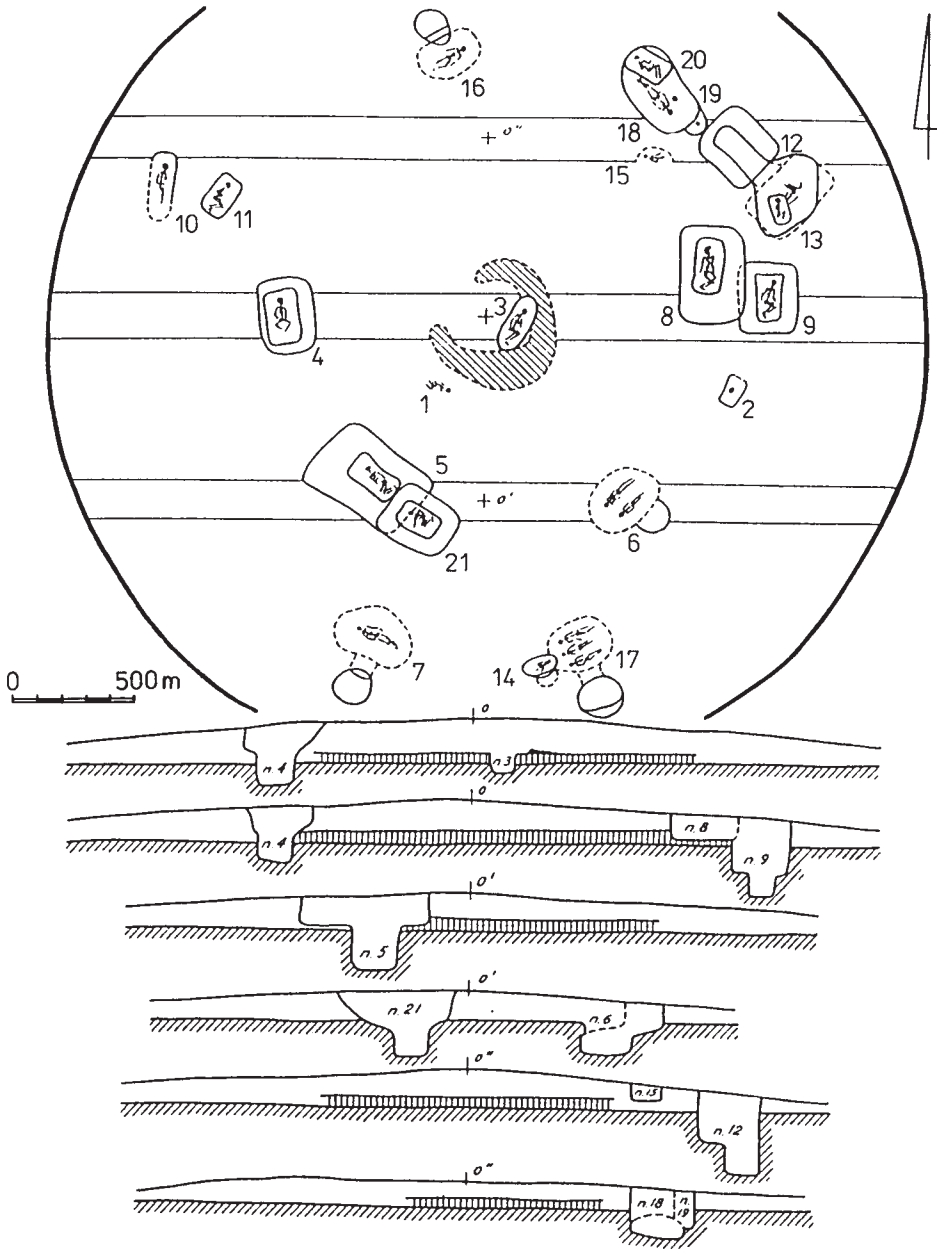


Fig. 6. Kruglaya Mogila, barrow 11

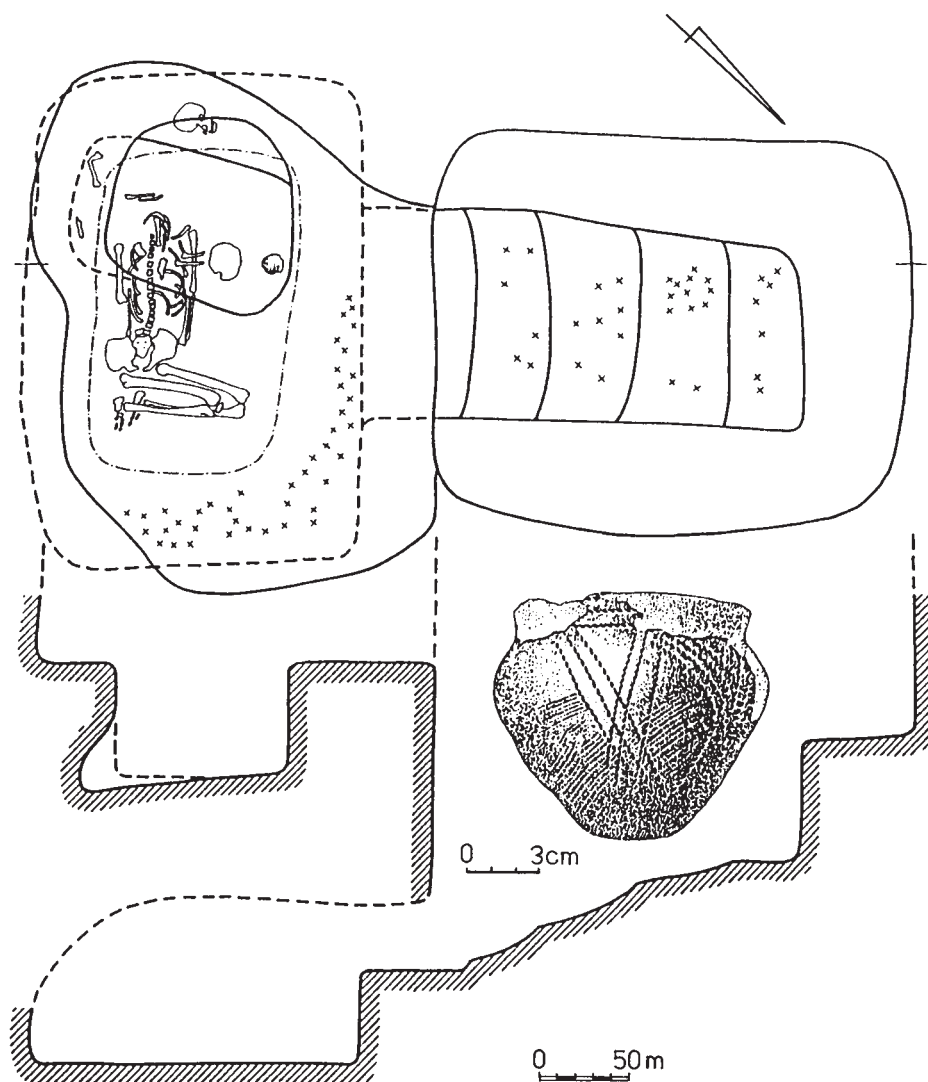


Fig. 7. Kruglaya Mogila, barrow 11, grave 12

so-called “old” grave. According to the calibration, the time range of construction is nearly the same for all of these graves.

According to their dating, with a probability of 68% confidence, the 15 catacomb graves could be divided into four chronological phases, which follow one

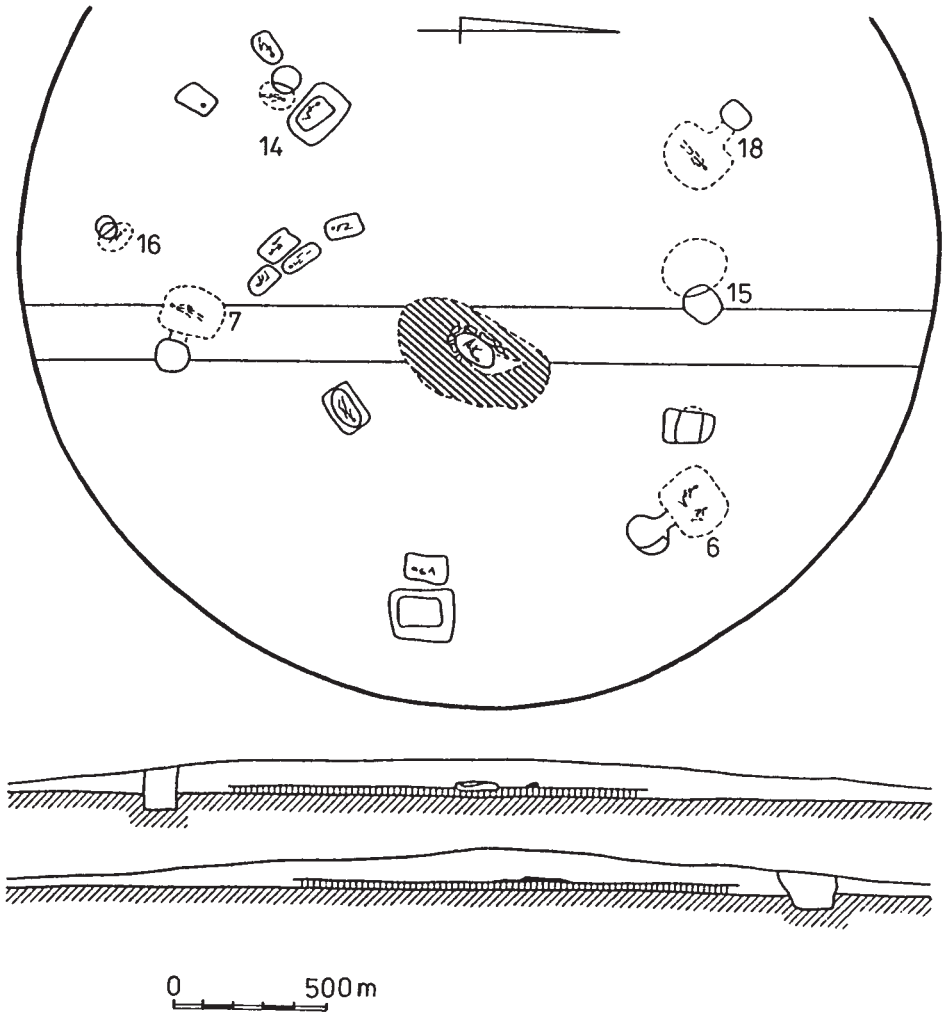


Fig. 8. Kruglaya Mogila, barrow 1

after the other and overlap in some places (Fig. 2)². The first range, which dates from 2450 to 2200 BC, covers four graves from three *kurgans*. Most of them show a further small range of probability beyond the mentioned period. The next phase, covering five catacombs, ranges from 2300 to 2000 BC, with a probability of 68%. With the exception of the date for grave 18 of barrow 1 of Kruglaya Mogila, all dates, with a probability of 95%, lie within this period, or seem to be slightly older.

² The calculations were made using the program OxCal 2.18.

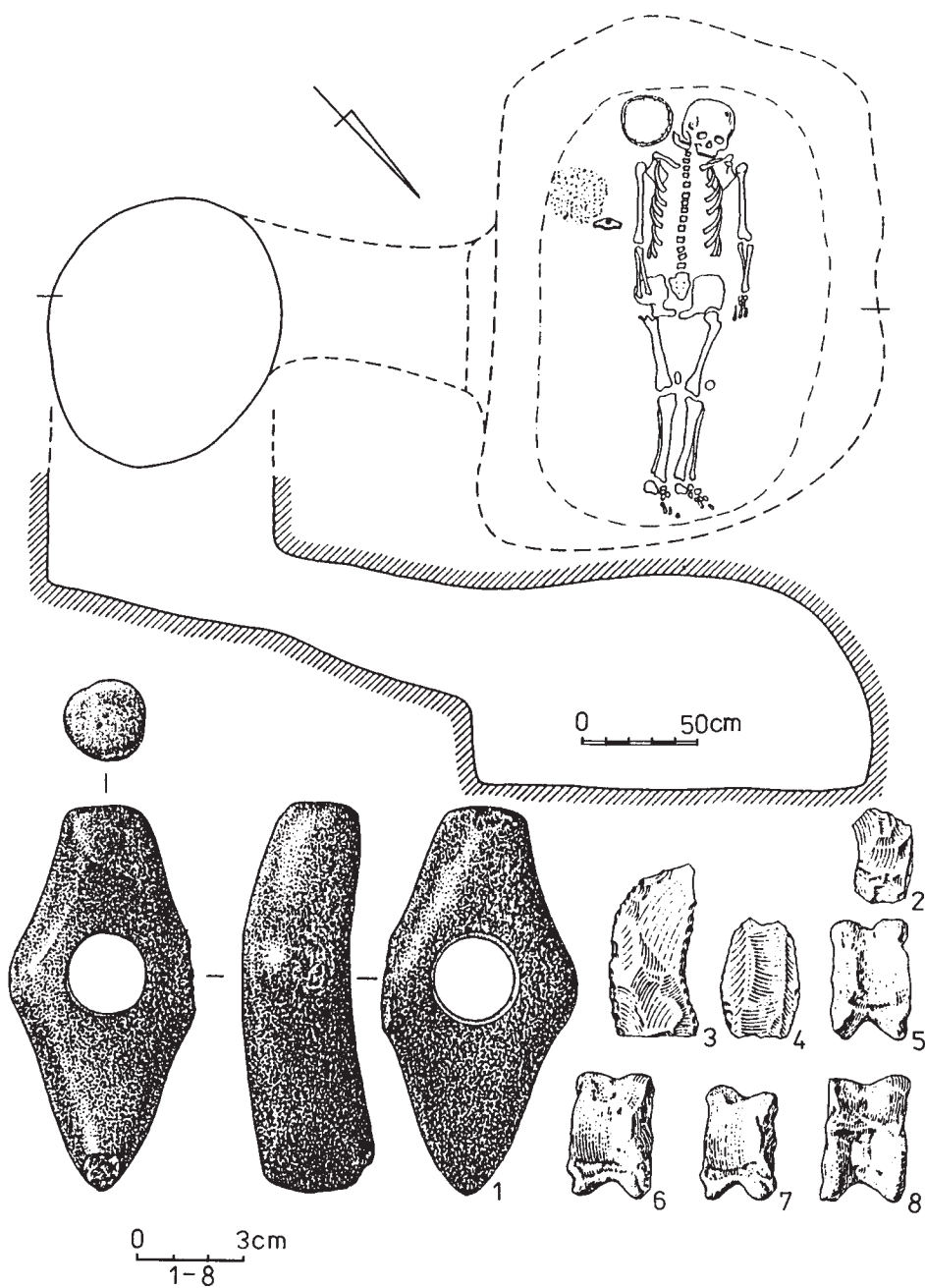


Fig. 9. Kruglaya Mogila, barrow 1, grave 18

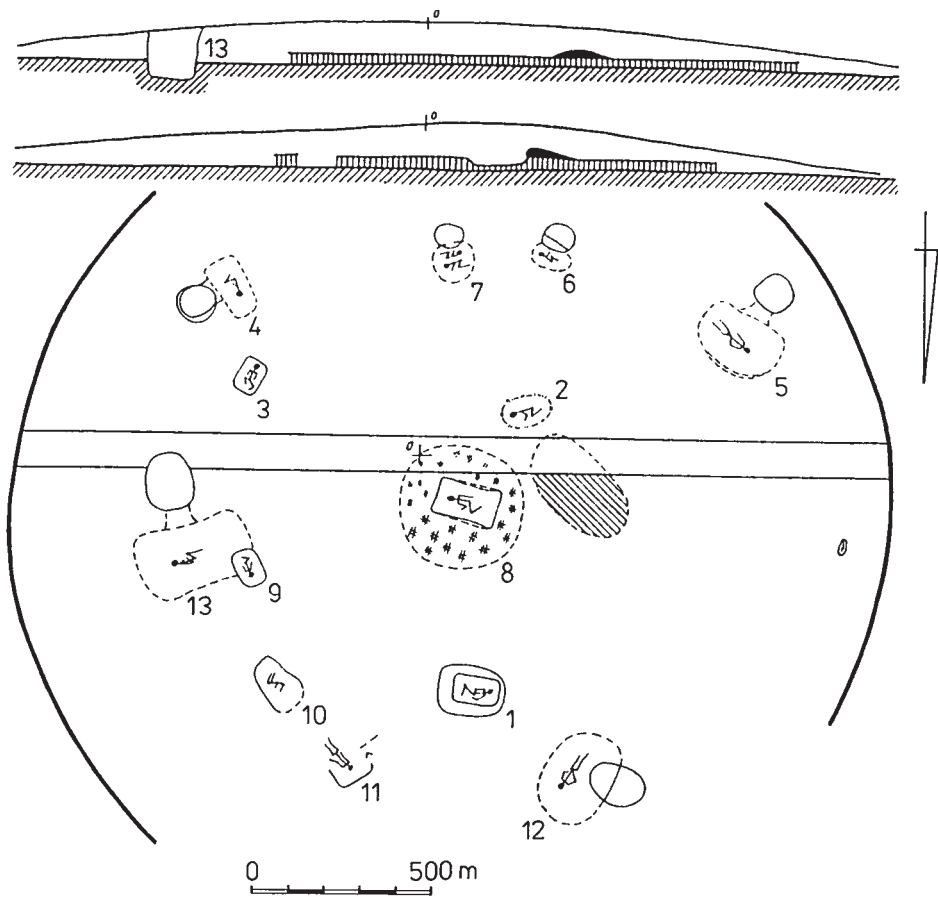


Fig. 10. Kruglaya Mogila, barrow 8

The next range, again covering five graves, of different mounds from the group at Kruglaya Mogila, dates between 2200 and 1950 BC, with a probability of 68%. A probability of 2 sigma would extend the period from 2300 to 1900 BC. The most recent grave comes from *kurgan* 8 of Kruglaya Mogila. Its absolute dating is 80 years later than the preceding one of the third phase. This grave ranges between 2050 and 1800 BC, with a probability of 68%.

A brief overview of the graves which compose each of these phases, after calibration, shows no direct conformities of grave constructions, position of the buried, rituals etc. These graves and their relative chronology will be discussed later. First, we will turn to the question of whether these datings correspond to others from Bronze Age cultures in the steppe. Datings were recently published of

wood samples taken from catacomb graves in different regions of Ukraine [Telegin 1992:68ff.]. The largest series was taken from a group of mounds situated near Svatovo on the northern Donets river. Only a few other findings from these graves have yet been published [Smirnov 1996: Fig. 9:11; 11:3; 47:23.25].

The range of time resulting from the calibration of all analysed graves is much longer than that for the graves near the Dnieper. The oldest four graves date from between 2900 and 2600 BC, with a probability of 68% (Fig. 13). The other five dates are later than 2500 BC, one grave following gradually after another. The dating of grave 2, mound 12, has to be excluded, since the standard deviation is too high to give a clear result. Unfortunately, this is the only grave of Svatovo which has had its findings analysed and published with an illustration. Its construction, with a big, semi-circular entrance pit, which is only slightly smaller than the grave chamber, is regarded as typical for the late phase of the CC in the Donets region [Bratchenko 1976:32, Fig. 11; Smirnov 1996:57]. The datings for Svatovo could prove the actual conception as to belonging to the internal chronology of the CC. According to this, the catacombs of the Donets and Don region are considerably older than those in the western parts of the Ukrainian steppe, where the population who buried their dead in catacombs later expanded. The grave constructions of the late period are characterised by round entrance pits and oval-shaped chambers (see below).

The results of radiocarbon datings of Bronze Age graves from Kalmykia, including CC graves, have already been presented [Aleksandrovskiy et al. 1997: 9ff.]. The graves of five different barrow groups were analysed and, taking extreme values into consideration, the datings for the CC range from 2600 to 1850 BC in this area. The most recent values, however, often range from 2200 to 2000 BC, the oldest being about 2500 BC [Aleksandrovskiy et al. 1997:20, Tab. 2]³.

Although these are still preliminary results, and not all of them are comprehensible, the period of the catacomb graves can be compared with that of the graves near Ordzhonikidze. In contrast to this, the early datings from Svatovo in the Donets region seem to be too high. A comparison of dates and graves is, therefore, indispensable in order to be able to work with the datings.

J.P. Mallory and D.Y. Telegin published the results of the radiocarbon analysis of wood samples taken from catacombs in which the remains of wagons were found [Mallory, Telegin 1994: 30ff.]. One wagon was found in the entrance pit of grave 11 of mound 9 near Kamenka-Dniprovskaya, Zaporizhia Region [Chernykh 1991:137ff.]. The grave was constructed with a rectangular entrance pit, which was connected through a 50 cm long entrance passage with a semi-circular chamber. On the bottom of the pit, an elderly man was buried in a shallow foetal position on his right side. The grave construction and the position of the skeleton are assigned to the early phase of the CC [Chernykh 1991: 139].

³ In Tab. 1 of this publication all results of analyses are listed in detail, but there is no cultural classification of the grave from which samples were taken, which makes it impossible to confirm the detail values with the compilation in Tab. 2.

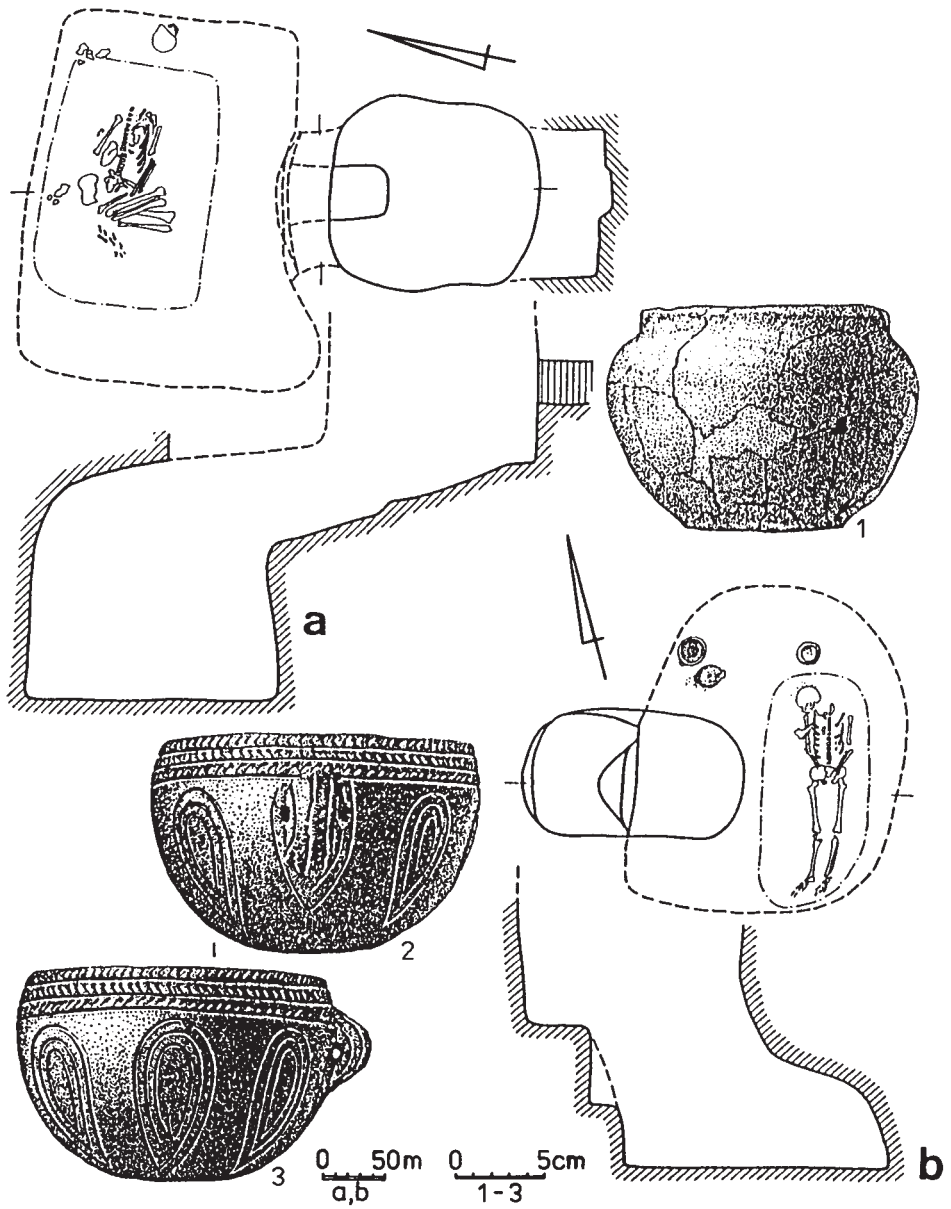


Fig. 11. Kruglaya Mogila, barrow 8 a - grave 13, b - grave 12, 1-3 - pots from grave 12

Three samples from this grave were taken and analysed. They each date from different a period. The two extreme values come from the laboratory of Kiev (Ki-3368: 3900±50 BC; Ki-3592: 4370±50 BC). Another value was determined in a different radiocarbon laboratory (UB-3135) and gives a date of 4062±19 BC. The oldest result would be much earlier than the earliest datings of Svatovo in the Donetsk region, the second could be correlated with the graves of Svatovo and the most recent is parallel with the oldest CC from Ordzhonikidze, in the Dnieper region.

The other published results of radiocarbon analyses of wagon graves range from 4200 to 4100 BC, which itself suggests that the second dating of grave 11 of Kamenka-Dniprovskaya is the correct one. The only grave which falls outside of this range is grave 27 of mound 11 at Marevka, which shows an absolute result of about 3908 BC. However, the standard deviation of ±120 years is too high to show a clear dating after calibration. The wagon was found in one of the two chambers which branch off from a more or less rectangular entrance pit [Cherednichenko, Pustovalov 1991: 206ff.]. In the eastern chamber, three adults and one child were buried behind the remains of a two-wheeled wagon. Again, the grave construction and the position of the skeleton suggest that the grave was built in the early phase of the CC. The site is situated on the right bank of the Dnieper river, not far from the city of Zaporizhia, also close to the wagon grave of Kamenka-Dniprovskaya.

Ultimately, the diverging results mean that the absolute dating of the catacomb graves containing wagons is still inconclusive. The existing values seem to prove only that they belong to the early phase of the CC. One has to admit that the base of radiocarbon dates is still not solid enough to give exact limits for the absolute chronological position of the CC.

In the relative chronology of the steppe region, the CC is followed by the Srubnaya culture (SC), which was also spread over a wide territory - between the Dnieper and the Volga rivers. The separate periods, especially in different regions, still need further investigation. As yet, there exist no interpretable radiocarbon results from the Northern Pontic zone. However, some of the graves near Utevka were analysed, which are said to represent the Potapovo period. This period is suggested to be the foundation for the evolution of the SC in the forest steppe zone of the central Volga region [Trifonov 1996: 62 Tab. 1; Vasilev, Kuznetsov, Semenova 1992: 52ff.]. The results give a possible dating from 2100 to 1700 BC, with a probability of 68% (1 sigma, Fig. 14).

The graves of Krivoye Ozero, from which horse bones were also analysed by Trifonov, probably belong to the same horizon [Trifonov 1996: 62, Tab. 1]. After calibration, the four datings show two phases - the first ranging from 2300 to 2000 BC, the second from 2000 to 1800 BC (again with a probability of 68%). If one accepts the general opinion of Ukrainian archaeologists that the CC in the eastern

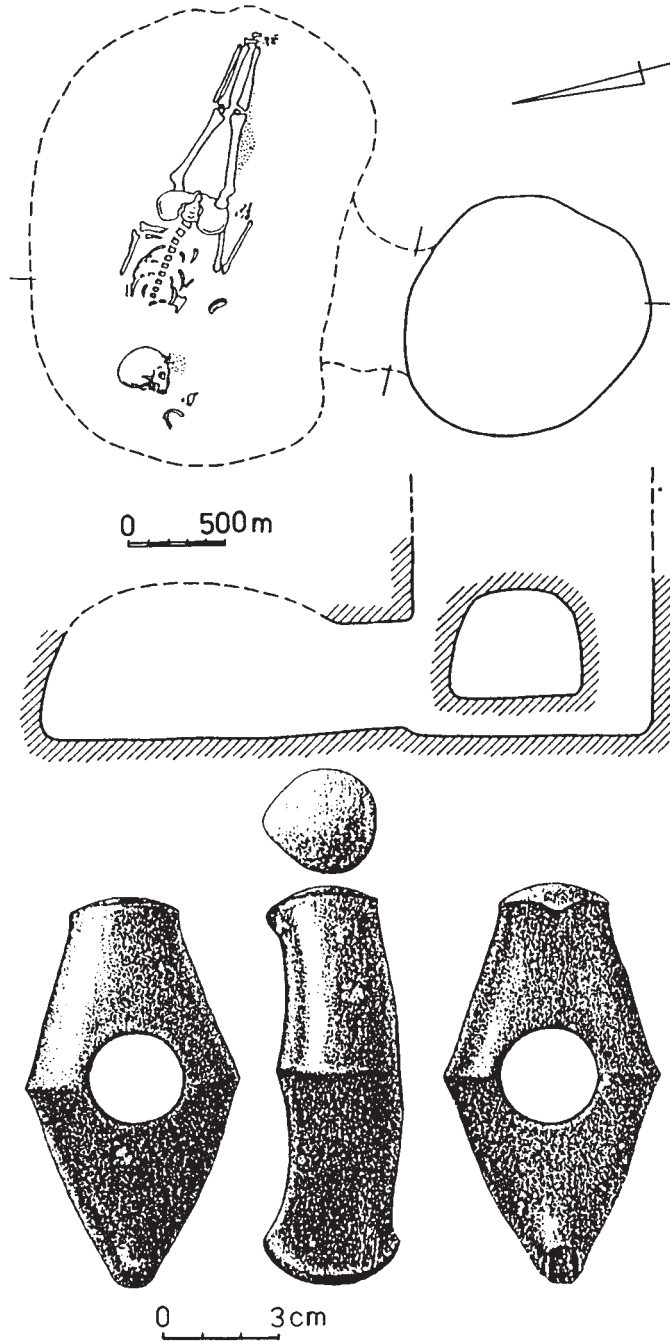


Fig. 12. Kruglaya Mogila, barrow 8, grave 5

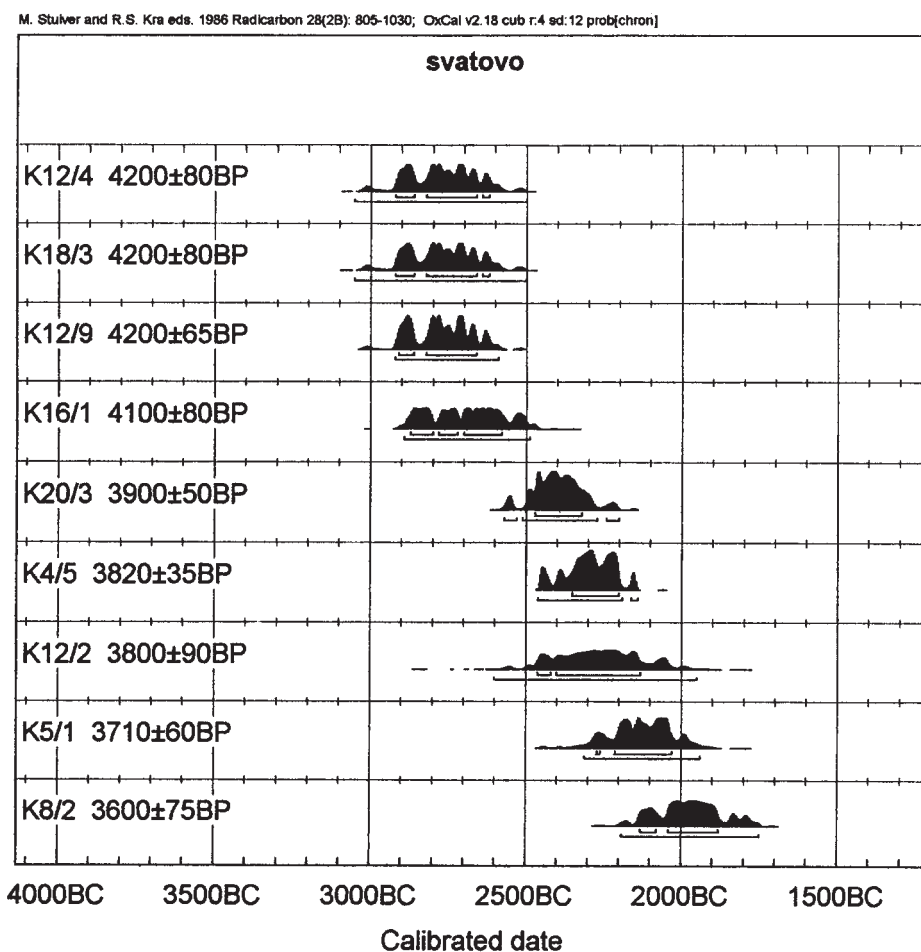


Fig. 13. Calibrated dates of nine graves of Svatovo, Donets region [after Telegin 1992, 68ff]

regions of Ukraine is much older than in western parts, and if one adjusts the datings of Svatovo, the results of the SC graves will correspond to the chronological concept.

It is ultimately proposed that the CC and SC existed simultaneously, when SC was still in an evolutionary phase. The Potapovo phase was preceded by the Poltavkinskaya culture, which, in some parts, existed parallel to the CC [Kuznetsov 1996: 56ff.]⁴.

⁴ The calculation of the intervals shown by Kuznetsov is in parts unclear, especially the datings for the Potapova culture, which show a much older timespan.

M. Stuiver and R.S. Kra eds 1986 Radiocarbon 28(2B), 805-1030, OxCal v2.18 cub r.4 sd.12 prob[chron]

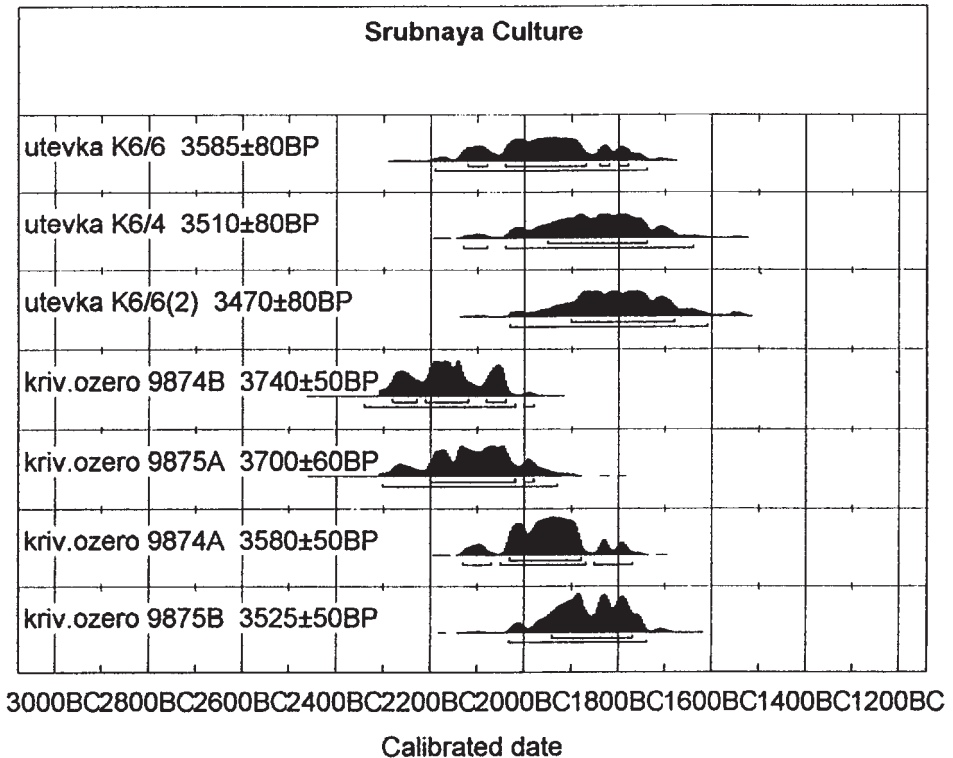


Fig. 14. Calibrated dates of Srubnaya culture graves (from Utevka and Krivoye Ozero, after Trifonov 1996:62 Tab. 1)

Although further radiocarbon analyses may, in the future, result in some changes in absolute chronology, the existing results allow us to build an initial frame for the absolute dating of the early and middle Bronze Age in eastern Europe. However, even the 15 dates from the mounds near Ordzhonikidze only (approximately) fit into this frame because datings of different regions were linked. Even more complicated is the chronological position of the Yamnaya culture (YC). Several results of radiocarbon analyses have already been published [Telegin 1977:5 ff.; Telegin, Sobotovich, Kovalyuch 1978:55ff.; Telegin, Sobotovich, Kovalyuch 1981:78ff.; Sementsov, Romanova, Dolukhanov 1969:251 ff.; Dvoryaninov, Dzigovskiy, Subbotin 1985:161], but the standard deviation is mostly too high for a calibration to be successful. Another problem with the old Ukrainian datings is the existence of many extreme values, even from samples of the same horizon. The sources of error are not clear; again, only a few of the findings from the analysed graves have been published.

The only reliable results currently available come from samples which were taken from material of pit graves in Bulgaria [Görsdorf, Boyadzhiev 1996:155f.]. Their chronological ranges are from 3100 to 2910 BC for the older graves and from 2890 to 2490 BC for the more recent ones, with a probability of 68%. Samples from both the central and the secondary burials of the mound of Poruchik Geshanovo were analysed. The authors suggest that this mound was in use for a period of about 100 years, and consequently date it from 2950 to 2850 BC (2960-2860 BC for the mound of Plačidol, the second site from which samples were taken).

Considering the final possible dating for the Bulgarian pit graves of about 2500 BC, and the fact that they probably do not represent the most recent phase of the whole late pit grave horizon, these dates can be correlated with those of the catacombs near Ordzhonikidze.

This leads to the conclusion that the CC could be synchronised with the early Bronze Age in the Carpathian Basin and in the Balkans (and with the Middle Bronze Age in Bulgaria). After linking the civilisations in Mesopotamia and Egypt, via their relations to Crete and Anatolia, with the cultures of the middle and late Eneolithic in south-eastern Europe H. Parzinger integrated the latter into an absolute chronological system. The Eneolithic in south-eastern Europe ends with the so-called horizon 13, which includes the Vučedol culture and influences of Glina III. This horizon is dated from 2500/2400 to 2300/2200 BC [Parzinger 1993: 270f., 290].

This dating, based on archaeological-historical comparison, is essentially confirmed by Raczky, who compared the radiocarbon datings for the Eneolithic graves in the Carpathian Basin and along the Lower Danube, as well as those for the Aegean and north-western Anatolia [Raczky 1995:60, Fig. 1]. According to his systematics, all Eneolithic cultures are approximately 100 years older than the dates suggested by H. Parzinger. The datings of the early Bronze Age in Bulgaria correspond with the results of the radiocarbon measurements [Görsdorf, Boyadzhiev 1996:107].

The new results of ^{14}C datings allow us to confirm the general succession of YC, CC and SC in the 3rd millennium, and the beginning of the 2nd millennium BC. Exact time ranges for the transitional periods between cultures are still not clear. In the area west of the Dnieper river, the CC definitely begins about 2500 BC, although there is some evidence of much older graves such as the wagon graves in the surroundings of Zaporizhia. In the Donets and Don regions, some of the analysed burials are much older than in the western part, and seem to prove the suggestion that a central part of CC was situated here. However, further details, and the confirmation of the internal chronology of the CC, require additional series of ^{14}C samples.

Finally, the results of the radiocarbon measurements from the three mounds of Kruglaya Mogila give rise to a number of speculations which, although as yet impossible to prove, should nevertheless be mentioned. The mounds of Kruglaya

Mogila contained more than 18 *kurgans*. In six of these, catacomb graves were found, which were all secondary burials in grave mounds of Eneolithic or YC. There is no proof of any kind of artificial accumulation of earth above the CC graves, and thus no evidence for vertical stratigraphic observations. The characteristics for graves of the so-called early and late phases of the CC have already been mentioned.

The results of the radiocarbon analysis indicate that the construction of catacomb graves was started at different times in each mound. As already shown, the oldest and the most recent graves with characteristics of the old phase were found in mound 11 in mound 8 respectively. It is not sure when the first catacomb burial in barrow 1 was established, because there is no analysis from grave 6, which is probably the oldest. However, the succession of the catacomb burials of mound 1 seems to imply that after each generation a new grave was built. There are several hints which point to the fact that a *kurgan* group represents the grave yard of a particular community (for example, the catacombs of Kruglaya Mogila are often situated in opposite “corners” of the mound; the only two graves with stone axes, of all the groups around Ordzhonikidze, were found in barrow 1 and 8 in the group of Kruglaya Mogila).

It might be suggested that the establishment of catacomb graves in a *kurgan* begins with a highly respected figure of the community, and perhaps the status of the buried was emphasised by a corresponding grave construction (compare with barrow 11/grave 12, barrow 8/grave 13 of Kruglaya Mogila and barrow 3/grave 28 of Chernaya Mogila). After this first grave had been sunk, other members of the community were allowed to be buried in the same mound. This would also explain why some of the graves hitherto considered to be older do not differ distinctly from the younger ones according to the ^{14}C dates. At the beginning of this article, it was pointed out that the values of the radiocarbon analysis of the barrows around Ordzhonikidze, after calibration, could be divided into four phases. The dates of the old catacomb graves are spread over two of these phases. No results of anthropological analyses were available, so it was not possible to make any statements concerning gender in the burial rites.

These reflections are intended to be speculative. They are to lead to new approaches in analysing catacomb graves, especially in the territory to the west of the Dnieper river. However, there is no doubt about the need for further radiocarbon measurements and further investigations to be carried out, in order to solve the general problem of absolute dating, the problem of internal chronology and specific problems of social structure.

LIST OF THE GRAVES AND THE ¹⁴C DATES

INFORM : References - M. Stuiver and R.S. Kra [eds.] 1986 Radiocarbon 28(2B): 805-1030; OxCal v2.18 cub r:4 sd:12 prob[chron]

DATE Chkal. K7/8 (Chkalovo, group I, K7/gr.8) [Ki-6558]: 3835±40BP: 68.2% confidence: 2460BC (0.14) 2420BC; 2400BC (0.68) 2270BC; 2240BC (0.18) 2200BC. 95.4% confidence: 2460BC (1.00) 2190BC

DATE Chern. K3/28 (Chernaya Mogila, K3/gr. 28) [Ki -6555]: 3825±40BP: 68.2% confidence: 2450BC (0.08) 2430BC; 2400BC (0.05) 2380BC; 2350BC (0.87) 2200BC. 95.4% confidence: 2460BC (0.97) 2190BC; 2160BC (0.03) 2140BC

DATE Krug. K11/12 (Kruglaya Mogila, K11/gr.12) [Ki-6568]: 3810±50BP: 68.2% confidence: 2450BC (0.04) 2430BC; 2350BC (0.89) 2190BC; 2160BC (0.07) 2140BC. 95.4% confidence: 2460BC (1.00) 2130BC

DATE Chern. K3/27 [Ki-6554]: 3805±45BP: 68.2% confidence: 2340BC (0.92) 2190BC; 2160BC (0.08) 2140BC. 95.4% confidence: 2460BC (1.00) 2130BC

DATE Krug. K1/18 [Ki-6563]: 3775±50BP: 68.2% confidence: 2300BC (1.00) 2130BC. 95.4% confidence: 2460BC (0.03) 2420BC; 2400BC (0.89) 2120BC; 2090BC (0.08) 2040BC

DATE Krug. K1/15 [Ki-6562]: 3750±45BP: 68.2% confidence: 2280BC (0.28) 2230BC; 2210BC (0.59) 2130BC; 2070BC (0.13) 2040BC. 95.4% confidence: 2330BC (1.00) 2030BC

DATE Chern. K3/17 [Ki-6553]: 3745±50BP: 68.2% confidence: 2280BC (0.26) 2230BC; 2210BC (0.56) 2130BC; 2080BC (0.19) 2040BC. 95.4% confidence: 2350BC (1.00) 2020BC

DATE Chkal. K1/20 (Chkalovo, group II, K1/20) [Ki-6559]: 3740±45BP: 68.2% confidence: 2280BC (0.18) 2240BC; 2210BC (0.60) 2130BC; 2080BC (0.22) 2040BC. 95.4% confidence: 2320BC (1.00) 2030BC

DATE Krug. K11/17 [Ki-6569]: 3730±45BP: 68.2% confidence: 2280BC (0.09) 2250BC; 2210BC (0.61) 2120BC; 2090BC (0.30) 2040BC. 95.4% confidence: 2300BC (0.99) 2020BC; 2000BC (0.01) 1980BC

DATE Krug. K8/13 [Ki-6566]: 3720±50BP: 68.2% confidence: 2200BC (1.00) 2030BC. 95.4% confidence: 2300BC (1.00) 1970BC

DATE Krug. K1/14 [Ki-6561]: 3710±40BP: 68.2% confidence: 2200BC (1.00) 2030BC. 95.4% confidence: 2280BC (0.06) 2230BC; 2210BC (0.94) 1970BC

DATE Krug. K8/12 [Ki-6565]: 3690±45BP: 68.2% confidence: 2190BC (0.11) 2160BC; 2140BC (0.89) 2030BC. 95.4% confidence: 2280BC (0.02) 2250BC; 2210BC (0.98) 1950BC

DATE Krug. K1/7 [Ki-6560]: 3680±45BP: 68.2% confidence: 2180BC (0.01) 2170BC; 2140BC (0.92) 2020BC; 2000BC (0.07) 1980BC. 95.4% confidence: 2200BC (1.00) 1930BC

DATE Krug. K11/7 [Ki-6567]: 3680 ± 50 BP: 68.2% confidence: 2190BC (0.07) 2160BC; 2140BC (0.84) 2020BC; 2000BC (0.09) 1980BC. 95.4% confidence: 2280BC (0.02) 2250BC; 2210BC (0.98) 1920BC

DATE Krug. K8/5 [Ki-6564]: 3560 ± 55 BP: 68.2% confidence: 2030BC (0.13) 2000BC; 1980BC (0.74) 1870BC; 1840BC (0.08) 1820BC; 1800BC (0.06) 1780BC. 95.4% confidence: 2120BC (0.03) 2080BC; 2040BC (0.97) 1750BC

Translated by author

ABBREVIATIONS

AO	– Arkheologicheskiye otkrytya, Moskva.
AJA	– American Journal of Archaeology, New York.
BPS	– Baltic-Pontic Studies, Poznań.
EA	– Eurasia Antiqua, Berlin.
FPP	– Folia Praehistorica Posnaniensia, Poznań.
KSIA	– Kratkiye soobshcheniya Instituta Arkheologii, Moskva.
KSIA AN USSR	– Kratkiye soobshcheniya Instituta Arkheologii AN USSR, Kiev.
KSIIMK	– Kratkiye soobshcheniya Instituta Istorii Materialnoy kultury, Moskva.
KSOGAM	– Kratkie Soobshcheniya Odesskogo Gosudarstvennogo Arkheologicheskogo Muzeya, Odessa.
MIA	– Materialy i issledovaniya po arkheologii, Moskva.
NA IA NANU	– Naukovy Arkhiv Instituta Arkheologii Nacionalnoi Akademii Nauk Ukrainu, Kiev.
SA	– Sovetskaya Arkheologia, Moskva.
SpA	– Sprawozdania Archeologiczne, Kraków.
ZFA	– Zeitschrift für Archäologie, Berlin.

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