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Palynological investigations of two burial mounds of the Middle Bronze Age of Tkemlara (southern Georgia)*

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ABSTRACT. The results of palynological studies of 26 samples taken from two burial structures of the beginning of the early Middle Bronze Age are reported. According to the archaeological data burial structure No.2 is dated to the 24th century BC and belongs to the Bedenian culture. Of great interest are spore-pollen spectra of the soil beneath the mounds. The pollen spectra show that in the region studied people were actively engaged in agriculture, horticulture, and viticulture. Among the crops wheat is recorded. Stock-breeding was very intensive. The palaeolandscape of that period differed from the present-day pattern. Pollen of weeds that grow near houses, along roads, and on disturbed sites and rubbish-heaps indicates high population density in the Bedenian culture period. However, the palynological analysis of the samples taken from burial No.1, dated to the 29th – 28th century BC, showed that only a few centuries earlier the population density in the Tkemlara region was not so high. At that period meadows were not wide spread, and almost the whole territory was occupied by forests with moisture- and warmth-loving species such as *Zelkova carpinifolia*, *Castanea sativa*, *Alnus barbata*, *Hedera helix*, and *Smilax excelsior*. The climate was much warmer and more humid than nowadays.

KEY WORDS: pollen spectra, burial mounds, Middle Bronze, Bedenian culture, southern Georgia

INTRODUCTION

Through the whole history of archaeological researches in Georgia, burial mounds of various epochs have not been subjected to palynological study. However, in western Europe this method has been used for a long time. The results of researches showed the promising character of these works (van Zeist 1967, Groenman-van Waateringe 1979, Dimbleby 1985, Körber-Grohne 1985, Lityńska-Zając & Wasylikowa 2004). The necessity of using the method of palynological analysis during burial mound excavations was emphasized by Gobejishvili (1978). He studied more that ten burial mounds the Bedenian culture of the beginning of the Middle Bronze Age in the region under consideration (Gobejishvili 1980).

PHYSIOGRAPHIC CHARACTERISTICS OF THE REGION UNDER STUDY

The region under study is situated 5–6 km north-west of Tetritskaro (Fig. 1) in the extreme eastern part of the South Georgian volcanic highland on the Lower Kartli lava plateau (Maruashvili 1970), which extends for about 38 km from west to east. To the north it is limited by the Gomeri ridge (hereafter

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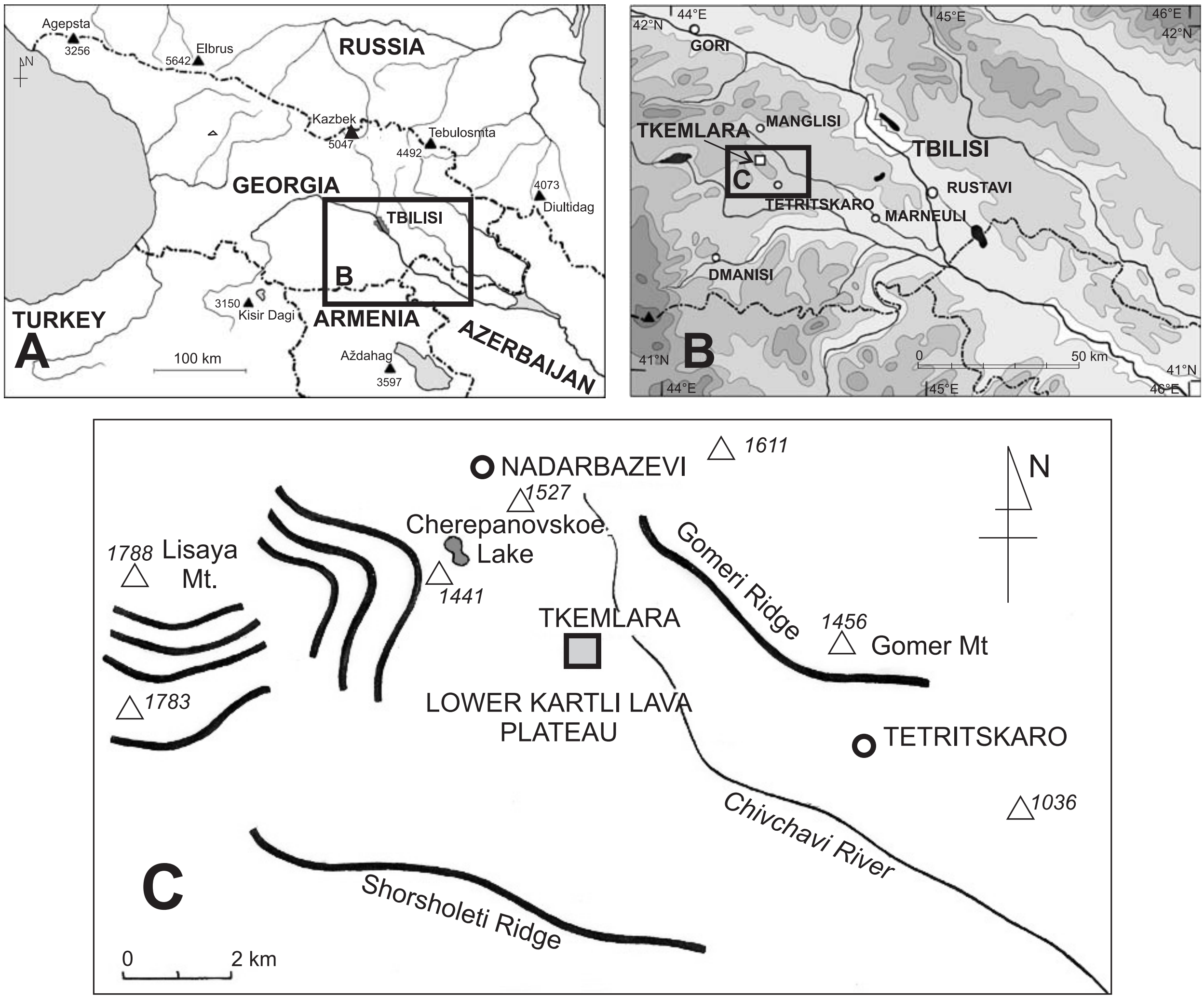

Fig. 1. **A** – map of Georgia. **B** – location of Tkemlara (in the square), **C** – map of Kveda Kartli Region

termed the Trialeti ridge spurs), on the west by the Lysaya mountain spurs, on the south by the Shorsholeti ridge, and on the east by the Marneuli lowland. The studied burial mounds are located in the northern part, called the Trialeti plateau (Fig.1), which descends from 1450–1500 m (Nadarbazevi environs) to 450–500 m a.s.l. (Marneuli district). The whole Lower Kartli plateau like the Tetritskaro plateau, is formed by repeated outflows of Upper Pliocene and Lower Pleistocene dolerite basalts. The surrounding mountain massifs consist of Cretaceous volcanic and calcareous rock masses (Maruashvili 1971).

The drainage network is not extensive. The main river is the Chivchavi and its tributaries are the most important. Underground springs feeding the temporary water-courses are rather numerous, several small lakes exist.

Due to the relief and predominance of slopes exposed to the south and south-west the climate here is rather mild. According to the data of the nearest meteorological stations (Tetritskaro and Manglisi) the average annual temperature is 8–9°C, the July and August average temperature is 18–19°C, and the average January temperature is -2.4°C. The vegetation growth period lasts for 160–170 days. Annual rainfall amounts to 780–800 mm (Lominadze & Chirakadze 1971) for which two annual maxima are characteristic (May and September). There is little precipitation in January and August. The snow cover lasts, on average 70 days on average. The average annual relative humidity is 72%, and mists are observed on 60 to 100 days annually (Chikovani et al. 1990).

Soils volcanic rocks are fertile, mainly chernozems. Their thickness often reaches 1.5 m.

Almost the whole region under consideration is situated in the middle mountain forest belt where *Quercus iberica* and *Carpinus* *caucasica* are prevalent. Only in the altitudinal range of 1500–1800 m *Quercus iberica* is replaced by *Q. macranthera*. In some shaded places *Fagus orientalis* occurs. *Acer campestre*, *A. laetum*, *Cerasus avium*, *Ulmus glabra*, *Fraxinus excelsior*, *Populus tremula*, *Pyrus caucasica*, *Crataegus curvisepala*, *C. pentagina*, and others are recorded. Among shrubs *Euonymus europea*, *E. verrucosa*, *Prunus spinosa*, *P. divaricata*, *Lonicera caucasica*, *Ligustrum vulgare*, *Cornus mas*, *Rosa canina*, *Corylus avellana*, *Salix caprea*, *S. pseudomedemii*, *Malus orientalis*, *Rubus caesius*, and others are present. Herbaceous synusia are formed by *Carex sylvatica*, *Sanicula europaea*, *Polygonatum glaberrimum*, *Prunella vulgaris*, *Primula macrocalyx*, *Dactylis glomerata*, *Lapsana grandiflora*, *Fragaria vesca*, *Campanula latifolia*, *Symphytum asperum*, *Galega orientalis*, *Knautia arvensis*, *Lysimachia vulgaris*, *Salva glutinosa*, *Geum urbanum*, *Circaea lutetiana*, *Impatiens noli-tangere*, *Astrantia maxima*, *Potentilla reptans*, and others. There are many post-forest secondary meadows where *Agrostis planifolia* prevails. *Deschampsia flexuosa*, *Poa nemoralis*, *Cichorium intybus*, *Prunella vulgaris*, *Plantago major*, *Potentilla erecta*, *Filipendula hexapetala*, *Phleum phleoides*, *Centaurea salicifolia*, *Geum urbanum*, *Agrimonia eupatoria*, *Bothriochloa ischaemum*, and others are recorded. On one such secondary meadow a burial mound clearing is situated where cereals were cultivated 10–12 years ago. Today it is used only for grazing. In the immediate vicinity of the burial mound field no populated areas are present.

The burial mound clearing is surrounded by a young oak-hornbeam forest forming a circle of about 500 m in diameter (Fig. 2). Here several burial mounds have been excavated, but in this publication we give the results of the study of burial mounds No.1 and No.2. They are located side-by-side and the stony embankment of burial mound No.1 overlaps that of burial mound No.2, which is thus older. The altitude of burial mound place is 1338 m a.s.l., coordinates: 41°04′ N; 44°24′ E.

Fig. 2. General view of the burial mound field (phot. E. Kvavadze)

MATERIAL AND METHODS

During field work from September to December 2002, 26 samples for pollen analysis were taken from various depths (270–40 cm) in burial mounds No.1 and No.2. The burial mounds clearing cover an area of about 2 hectares. From the burial No.1 (Fig. 3) palynological profile 3 was taken from a depth of 160–80 cm of a chamber wall. From the burial No.2 (Fig. 4) in the northern wall of the burial chamber palynological profile 1 has been taken from a depth of 240–200 cm,

Fig. 3. General view of burial mound No.1 during excavations (phot. E. Kvavadze)

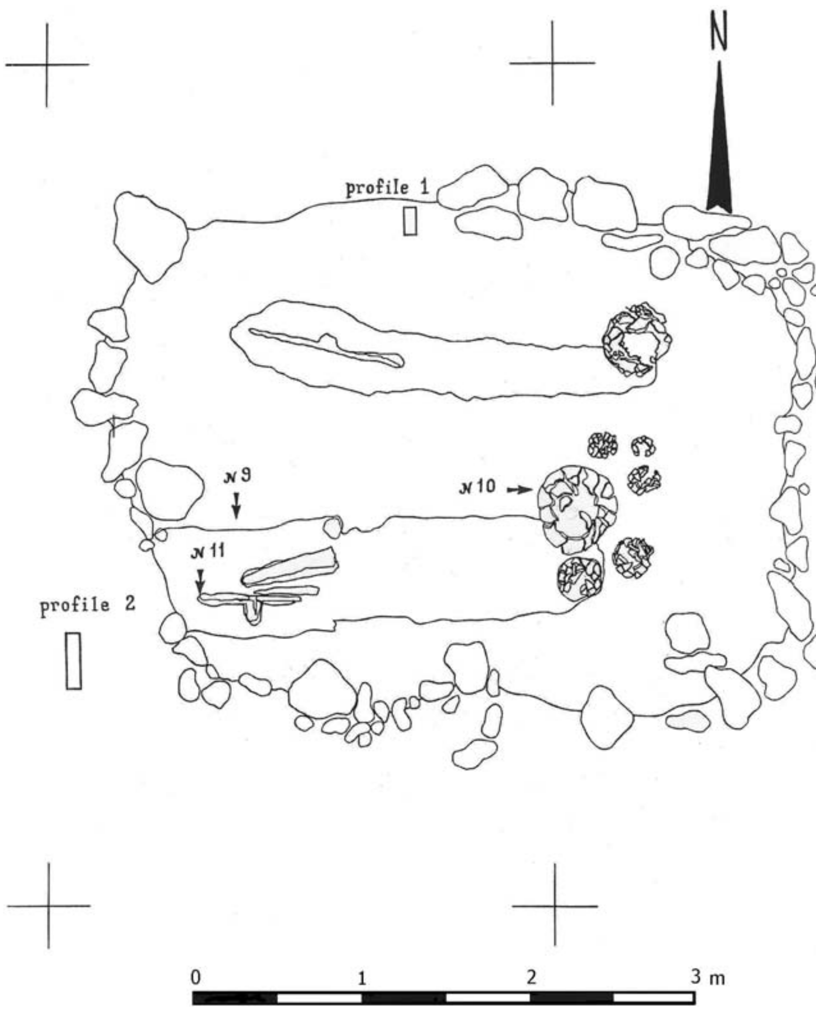

Fig. 4. Schematic plan of the burial chamber of burial mound No. 2 (arrows show the places where samples were taken and their numbers

and in the southern wall profile 2 from a depth of 120–40 cm. Soil samples were taken under the rug (sample 9), from an earthenware pot (sample 10) and from a charred bullock-cart wheel (sample 11).

The material consists of chernozem soil and yellow loams and clays buried during the funeral. In the latter the pollen content was much lower that in the humus-rich chernozem soil. The collected material was treated in the pollen laboratory of L. Davitashvili Institute of Palaeobiology, Georgian Academy of Sciences in Tbilisi. The alkaline method was used, followed by centrifuging in cadmium (Grichuk & Zaklinskaya 1948), and acetolysis (Erdtman 1943, 1960). For the treatment a sample of at least 10 cubic cm was used. In addition samples of recent soils and mosses from the Tkemlara area were studied to establish the pattern of recent pollen deposition. Altogether 13 recent samples taken under oak and hornbeam trees and in open forest clearings were analysed. Such an investigation is necessary for correct interpretation of the fossil pollen spectra of the given region. For pollen identification and counting Leitz microscope was used.

RESULTS

BURIAL MOUND NO. 2

Burial mound No. 2 appears to be richer in the contents of its burial inventory, and its size is rather large Fig. 4). It has a round form up to 23 m in diameter. The circle is covered with large stones. The height of the masonry is 120 cm, and the depth of the burial chamber 270 cm. The buried inventory includes two bullock-cart wheels, a dagger blade, a stone axe, and a lot of black-polished and red-baked ceramics (Fig. 5), suggesting that a rich man was buried hetre. The presence of the dagger blade and bullock-cart wheels shows that the deceased might have been a military person. According to the characteristics of earthenware and other contents the burial mound has been dated to the 24th century BC. The results of palynological investigations are giving the

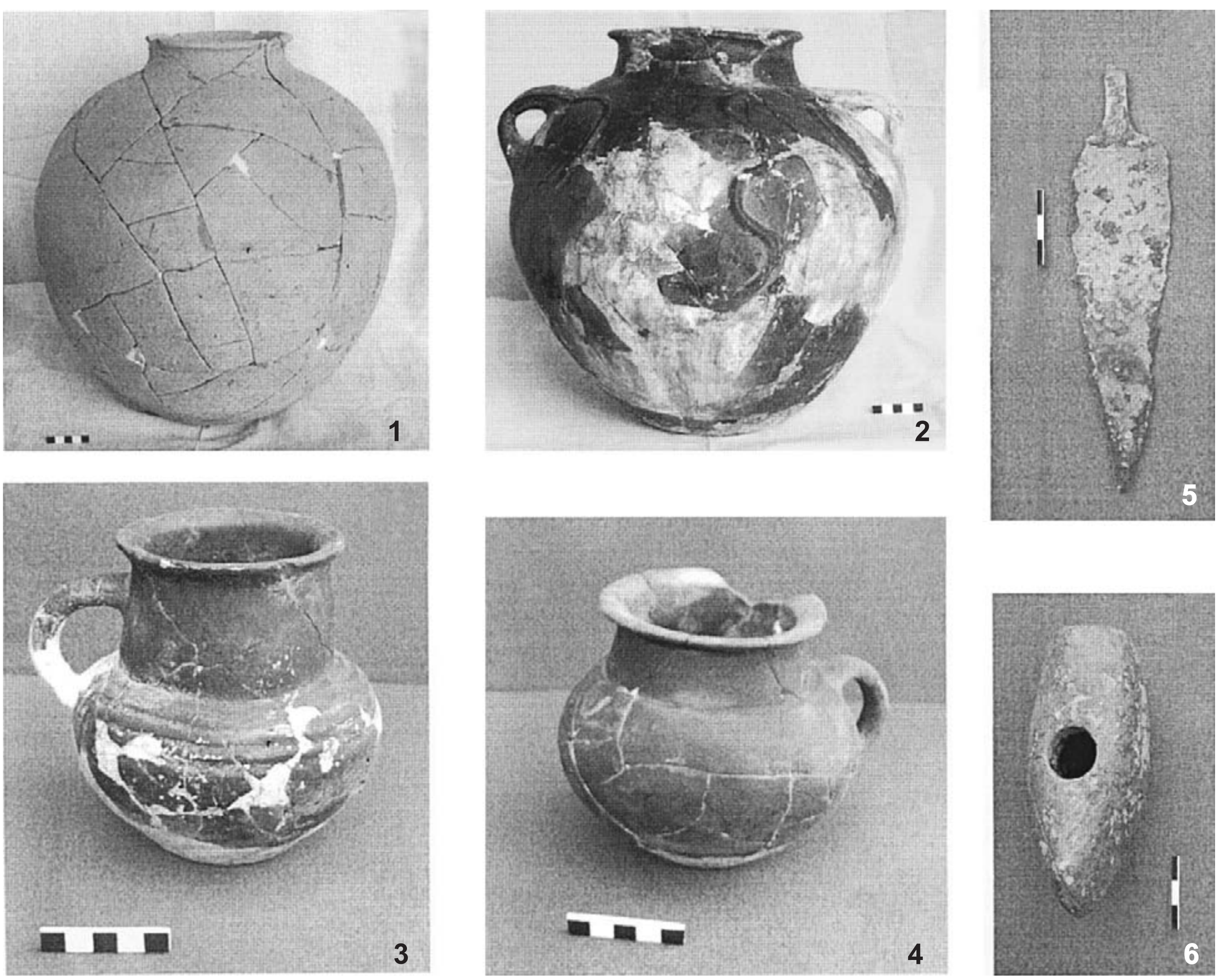

Fig. 5. Burial inventory from burial mound No.2: **1** – red-baked ceramics; **2–4** – black-polished ceramics; **5** – dagger blade; **6** – stone axe

characteristics of the landscapes and climate of the above-mentioned time.

The spore-pollen spectra of the soil buried during the funeral and taken from the burial chamber floor appear to be the most interesting. According to the traditions of that period the floor and all the walls were covered by wooden bars. The bars were strewed with earth and packed thus smoothing the floor (Gobejishvili 1980). Then the floor was covered by rugs and sometimes also with animal skins, and the deceased was put on such a soft bed.

The fossil pollen spectrum of soil sample 9 (Tab. 1) differs from the recent one. Altogether 365 pollen grains and spores were counted. The herbaceous pollen prevails up to 90.8%. Arboreal and spore-bearing species are in

Table 1. Taxonomic composition of spores and pollen of the plants found in the vault of burial mound No. 2

Taxon	Floor soil sample 9	Earthenware soil sample 10	Wheel sample 11
Abies nordmanniana	5	4	–
Picea orientalis	1	–	1
Cedrus libani	–	2	–
Pinus	23	25	2
Carpinus caucasica	2	1	–
Carpinus orientalis	–	1	–
Quercus	1	–	–
Zelkova carpinifolia	–	2	–
Salix	–	–	3
Corylus	1	–	–
AP total amount	33	35	6
Cerealia (*Triticum* type)	1	–	–
Plantago lanceolata type	1	–	18
Plantago media/major type	1	–	–
Artemisia	14	2	1
Chenopodiaceae	5	8	–
Cichorium type	132	90	9
Aster type	50	14	3
Taraxacum type	18	28	2
Carduus type	4	1	–
Cirsium type	9	2	2
Achillea type	2	–	–
Poaceae	–		4
Serratula type	8	–	–
Ranunculaceae	14	5	–
Stellaria type	1	–	–
Caryophyllaceae	5	1	–
Polygonaceae	16	5	–
Boraginaceae	1	1	–
Apiaceae	3	2	–
Primulaceae	2	2	–
Fabaceae	–	1	–
Lamiaceae	–	1	–
Indeterminate NAP	3	–	–
Polypodiaceae	16	23	5
Polypodium vulgare	1	1	–
Ophioglossum lusitanicum	1	1	–
Ophioglossum vulgatum	18	14	5
Botrychium lunaria	1	1	–
Lycopodium	1	–	–
Sphagnum	–	2	–
NAP total amount	332	205	51
Pollen sum	365	240	57
Anthropogenic indicators	232	133	35

equal quantities up to 9%. Among the arboreal plants conifers and especially pine and fir are predominant, and hornbeam, oak, and hazel are present. The herbaceous taxa are more diversified, but pollen of Asteraceae prevails. In the pollen of plants belonging to anthropogenic indicators, those of ruderal species growing near sites of human habitation are predominant. Of agriculture indicators, among cereals *Triticum* was found. Pollen indicating the existence of pastures are less common. The classification of pollen of the group of anthropogenic indicators is given on the basis of the existing schemes (Behre 1981, Blagoveshenskaya 1987, and others). The character of the synanthropic vegetation of the given region were also taken into account (Grossgeym 1946, Ketskhoveli 1960, Kvavadze & Gabashvili 1998).

Spore-bearing taxa are represented by monolete spores of *Polypodium vulgare*. Many *Ophioglossum vulgatum* spores were found. Single spores of *O. lusitanicum*, *Botrychium lunaria*, and *Lycopodium* sp. are recorded. As a whole in the palynocomplex three dominants can be distinguished: *Cichorium*, *Aster*, and *Pinus.* The quantity of pollen attributed to forest elements accounts for 18%. They also include those herbs that grow only in the forests. In the recent spectra forest elements on the burial mound clearing account for 43.8%. Among herbs the prevailing Chenopodiaceae taxa indicate intensive grazing and even overgrazing. In the subrecent spectrum quite a different situation is observed for spore-bearing species, where *Ophioglossum vulgatum* is strongly predominant (27.3%), while in the fossil spectra this index did not exceed 3.6%. In the recent pollen spectrum three quite different dominant pollen groups are recorded: *Ophioglossum*, Chenopodiaceae, and Polypodiaceae (Fig. 6), i.e. the spectrum character differs essentially from the fossil one.

In the pollen spectrum of sample 10 the share of forest elements is 32.7% (Tab. 1). Among broad-leaved species, hornbeam and *Zelkova carpinifolia* are recorded. Among herbs *Cichorium* and other representatives of Asteraceae are predominant. There are small quantities of plants indicating agriculture. Pollen belonging to anthropogenic indicators is less than in the sample taken from the burial chamber floor, especially those weeds that accompany houses. As a whole, the following three dominants are observed in the palynocomplex: *Cichorium*, *Pinus*, and Polypodiaceae. The *Cedrus libani* pollen is extraregional and is transported here from the Turkish mountains.

Of great interest is a spore-pollen spectrum of sample 11 (Tab.1). *Plantago lanceolata* is predominant. A high content of *Cichorium*, Poaceae, *Aster*, and *Taraxacum* pollen are found. Polypodiaceae and *Ophioglossum spores* are recorded in equal quantities.

Profil No. 1

The richest taxonomic composition in profile 1 is characteristic for the palynocomplex in the strip of decomposed wood (samples 5,6 at a depth 230–220 cm), which might be caused by the presence of mosses on the wooden bars buried during the funeral which were used to build the wooden constructions of the vault. In samples 5 and 6 (Fig.7) *Castanea*, *Pterocarya*, *Tilia*, *Quercus*, *Carpinus*, *Alnus*, *Salix*, *Betula*, and *Corylus* pollen grains were found. Of great interest is the *Vitis vinifera* pollen discovered in sample 5. As a whole, the share of forest elements accounts for 20–22%. In the palynocomplex the *Cichorium-Aster-Pinus* dominants occur. Anthropogenic indicators are common, including cereals and their accompanying weeds Pasture indicators are also found. The pollen spectra (samples 4,7,8) of yellow clays have a somewhat different character than those from the wooden strip. Here very few forest elements are observed (14%). The pollen of anthropogenic indicators is represented in higher proportions. The palynocomplex dominants are: *Cichorium*, Chenopodiaceae, and *Artemisia*.

Profil No. 2

The lower profile layers are represented by yellowish clay soil (samples 1–4) which contained large amounts of pollen of anthropogenic indicators (Fig. 8). Three dominants are observed: *Cichorium*, *Aster*, and *Pinus*. The pollen spectrum is similar to that of the buried soil from the burial mound floor (Tab. 1, sample 9) dated to the 24^{th} century BC. Here the amount of pollen of forest elements reaches 18–20% on average, pollen from ruderal plants around houses is common, for example *Papaver*, whose pollen content in sample 1 reaches 53.8%, shows a very high ruderal content. Here very high amounts of

Artemisia pollen are recorded. Traces of both agriculture and stock-breeding are present.

The upper part of the diagram is distinguished by an increasing role of arboreal pollen and spores of those ferns that are forest elements. As a whole, forest elements amount to 35–40%. In the palynocomplex the following three dominants are observed: *Cichorium*, *Pinus*, and Polypodiaceae. Among anthropogenic indicators, pasture indicators and ruderal taxa decrease. Pollen grains of plants indicating agriculture are represented in smaller quantities. The above mentioned pollen spectra are very similar to those of the soil taken from earthenware pots (Tab.1, sample 10).

BURIAL MOUND No. 1

As mentioned above, burial mound No. 1 is situated near the second burial mound. It is also large and has the form of a circle that is 22 m in diameter (Fig. 3). The height of the stony embankment is 1.4 m. The size of the burial chamber is 3 × 6 m. The burial chamber had been robbed and contained no inventory. However, we still decided to study the deposits of one of the burial chamber walls. The lower layers of the soil profile 3 are represented by yellowish clay overlain by black humus-rich soil. In the pollen diagram (Fig. 9) several palynocomplexes were distinguished. The lowest layer (samples 1 and 2) appeared to be the poorest both in pollen content and in its taxonomic composition. However, there are a lot of forest elements in the spectra (up to 35%). Three dominants are singled out: *Pinus*, *Cichorium*, and *Artemisia*. Among the arboreal species, besides pine, are *Abies*, *Picea*, *Carpinus caucasica*, *C. orientalis*, *Betula*, *Alnus*, *Juglans*, and *Corylus*. Anthropogenic indicators indicate weak development of agriculture and intensive grazing (Fig. 9).

The second palynocomplex (samples 3, 4) appeared to be rich and very interesting. Here a lot of pollen from of such a warmth- and moisture- loving taxa were found including *Zelkova carpinifolia* (Plate 1). In the group of arboreal pollen it accounts for 27.6%. *Castanea sativa* and *Tilia caucasica* are common. Other elements of moist forests were also found, e.g. *Smilax*, *Hedera*, and *Alnus barbata*. Among other arboreal pollen *Juglans regia*, *Fagus orientalis*, *Carpinus caucasica*, *Quercus*, *Fraxinus*, *Betula*, *Euonymus*, *Lonicera*, and *Corylus* is recorded. Pollen of forest elements accounts for up to 27%. There is also a lot of herbaceous pollen, but the role of anthropogenic indicators is Not so important. The traces of grazing were more numerous than those of cultivation. The content of ruderal elements is not high. In the palynocomplex three dominants are found: *Cichorium*, *Pinus*, and *Zelkova*.

The third palynocomplex (samples 5–9) is characterized by a greater role of upper mountain forest components – pine, fir, spruce, and birch – especially in the lower part of the layer under consideration at a depth of 120–110 cm. *Cedrus libani* and *Ephedra fragilis* pollen are of long-distance transport. Among the herbaceous species an increase in the amount pollen of meadow vegetation is observed. Here the traces of agriculture are much more pronounced. Pollen of cereals together with the weeds such as *Convolvulus arvensis*, *Polygonum aviculare*, *Carduus*, *Fagopyrum*, and others are recorded. However, there are also many traces of grazing. In the palynocomplex under consideration a significantly higher content of synanthropic pollen as *Plantago*, *Artemisia*, *Papaver*, *Xanthium*, Caryophyllaceae, and others are found. As a whole, in this palynocomplex the following three dominants are recorded: *Ophioglossum*, *Pinus*, and Polypodiaceae.

DISCUSSION

Correlation of the pollen spectra and the distinguished palynocomplexes therein according to three dominants (Tab. 2) allow us to make a stratigraphic division of the burial mound layers. It is clear from Table 2 that the palynospectra of sample 9, profile No.2 deposits at a depth of 80–120 cm, and profile No.1 at a depth of 220–230 cm are similar. In all the cases the palyno- complex of *Cichorium-Aster-Pinus* is distinguished, so it can be concluded that these deposits are of the same age and date to the 24th century BC. In the Transcaucasus this is the beginning of the Subboreal period, when climatic drying and cooling took place.

The pollen spectrum of sample 10 from burial mound No.2 is similar to that from the 2 at a depth of 70–40 cm and to the spectra from a depth 150–130 cm of profile 3 from the burial mound No.1. We date these deposits to the 29th–28th centuries BC (Kvavadze et al. 2004). This age represents the end of the

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Table 2. Palynocomplexes and stratigraphy of Tkemlara burial mound layer deposits

Profile/sample No.	Depths	Chronozone	Palynocomplex
Sample 9	270 cm	SB-1	*Cichorium-Aster-Pinus*
Profile 1	230–220 cm	SB-1	*Cichorium-Aster-Pinus*
Profile 2	120–80 cm	SB-1	*Cichorium-Aster-Pinus*
Sample 10	270 cm	AT-3	*Cichorium-Pinus*-Polypodiaceae
Profile 2	70–40 cm	AT-3	*Cichorium-Pinus*-Polypodiaceae
Profile 3	160–150 cm	AT-2	*Pinus-Cichorium-Artemisia*
Profile 3	150–130 cm	AT-3	*Cichorium-Pinus-Zelkova*
Profile 3	130–80 cm	S.A.	*Ophioglossum-Pinus*-Polypodiaceae
Profile 1	240 cm	BO	*Cichorium*-Chenopodiaceae-*Artemisia*
Recent soil	20 cm	Today	*Ophioglossum*-Chenopodiaceae-Polypodiaceae

Atlantic period, when a significant peak of the climatic optimum was observed throughout the whole Transcaucasus. The detailed consideration of this aspect is given below. Here we try to reconstruct the vegetation of the time of burial mound No.2, i.e. the beginning of the Bedenian culture (the 24th century BC).

It should be noted that the criteria for interpretation of the palaeopalynospectra are based on pollen content of the recent soils and mosses in the region under consideration. In the spectra of recent chernozem soils of the region under study content of pollen is significantly low, probably because of poor preservation of pollen in chernozem soils. Even in the forest itself the pollen content of arboreal species and shrubs rarely exceeds 40% (samples 3,4,7, Fig. 6). Samples of soil and of moos cushion from the same place have been compared (samples 3a, 4a, 7a; Fig. 10). It should be mentioned here that for moss cushions this index accounts only for 70–80% (Fig.10). In the soils of secondary forest meadows surrounded by oak forests and even in the open oak forests themselves the pine pollen of distant transport prevails, while oak amounts to only to 8–10% (Fig. 6). Therefore, in the spectra we distinguished an ecological pollen group of forest elements. Here herbaceous plants (e.g. forest species of ferns and mosses) growing only in forests are also included. It was also established that for the oak forest spectra the proportion of Polypodiaceae, *Ophioglossum*, and *Sphagnum* are very important. Monolete spores of ferns prevail in all cases, and moss and *Ophioglossum* spores are in nearly equal

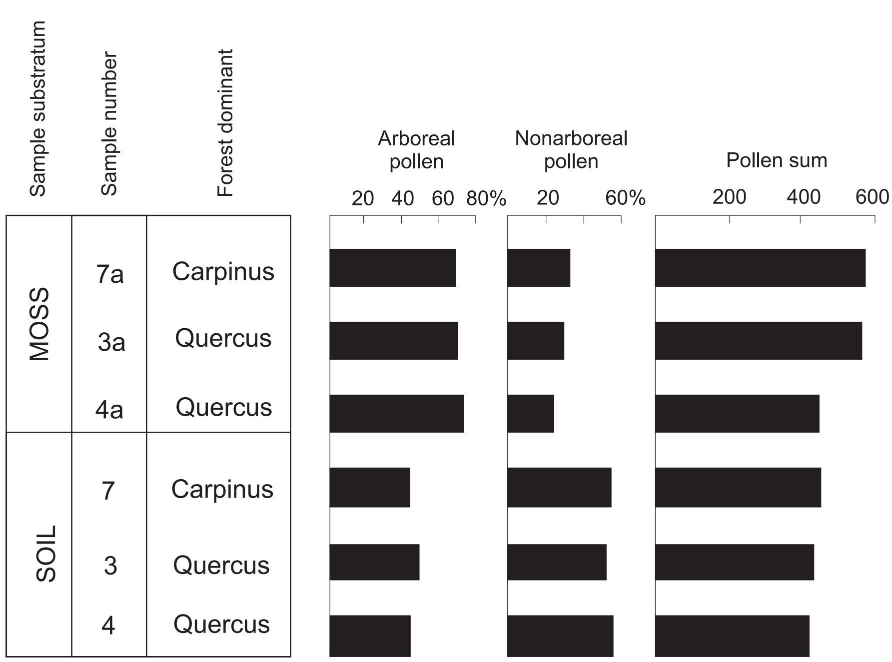

Fig. 10. Comparison of pollen content of arboreal and herbaceous species in soil and tuft of mosses

quantities. In open forest clearings *Ophioglossum vulgatum* and *O. lusitanica* are predominant. Polypodiaceae occupies the second place, and *Sphagnum* occurs in very low quantities. In open meadows *Cichorium* pollen is very important, while in the forest spectra its participation is insignificant.

On the basis of the nature of the recent palynospectra we can say that during formation of fossil pollen spectra of the burial mound No.2 in the Tkemlara area the forested area was significantly smaller than the present-day pattern due to the intensive anthropogenic activity. At that time agriculture had a leading role. Almost all plain areas of the Tetritskaro plateau were developed for agriculture and horticulture with wheat and vine cultivation. Stock-breeding was also developed, but it might have had a subordinate role. A high content of ruderal pollen indicates rather high population density in the Tkemlara area in the beginning of the Middle Bronze Age. However, the forests were not completely destroyed. They grew on steep mountain slopes and were represented by hornbeam and oak with some beech. Higher ridges of the Trialeti range were occupied by coniferous forests with *Pinus*, *Abies*, and *Picea*, and even higher by subalpine forests with predominance of *Betula*.

Palynological data (namely, abundance of *Zelkova* and chestnut pollen) for the middle layers of deposits of profile 3 of burial mound No.1 suggest the final stage of the climatic optimum of the Atlantic period. In the Transcaucasus the maximum phase of the Holocene optimum is dated to the 29–28th centuries BC (Kvavadze & Rukhadze 1989, Kvavadze 1990). Warming in that period is accompanied by greater moisture. In the western part of Georgia chestnut and oak trees extended their areas and, the upper tree limit rose by 300 m. In southern Georgia forest-steppe and steppe regions are being covered by forests (Gogichaishvili 1988, Kvavadze 1999). On the Armenian volcanic highland the forest area also increased (Sayadyan et al. 1977).

Large quantities of *Zelkova* and *Castanea* pollen as well as many of other Tertiary Colchis elements (*Alnus barbata, Smilax excelsa*, etc.) in the burial mound No.1 deposits indicates that during the maximum of the Atlantic warming in the Tkemlara area there grew dense warmth- and moisture-loving broadleaved forests with lianas similar to those of present-day in Colchis and Lagodekhi. Thus, only a few centuries before the Bedenian culture in the Tkemlara area quite different landscapes existed. Dense forests covered almost 80% of the territory. On the basis of pollen composition of the group of synanthropic vegetation one can state that agriculture at that time was not intensive. This activity might be hindered by impassable dense forests. In the 29th–28th centuries BC the population density of Tkemlara was also low.

The discovery of large amounts of *Zelkova* pollen is rather a rare phenomenon, for *Zelkova* produces small quantities of pollen and is not often found and than in very small quantities, especially in soils (Gogichaishvili 1988, Yazvenko 1991, Stuchlik & Kvavadze 1993, Garfi 1997). In this connection we assume that *Zelkova* pollen might have been introduced into the burial chamber together with flowering branches. Tree branches were used for wooden constructions of the vault to be built (Gobejishvili 1980). Flowering branches could also have had another religious meaning according to the traditions of that time.

Thus consideration of vegetational and climatic history of the region under consideration shows that the crucial moment in the human economic activity took place at the first stage of the Bedenian culture (the beginning of the Subboreal period), when the climate became drier and cooler compared to the previous period (the end of the Atlantic period). Man could easily fell the forests could be easily felled and not so rapidly restored. Disappearance of swampy areas was also favorable for development of agriculture.

CONCLUSION

The investigation shows that the study of burial mounds with wooden burial construction and big wooden bars are very promising, for a lot of palynological material was buried. Usually tree trunks and their branches were cut down in the forest for the burial (Gobejishvili 1980). On trunks and branches there are always mosses and lichens where large amounts of pollen and spores are accumulated. Moreover, branches may have flowers. The palynoloigcal content at precisely this moment is fixed in the palynospectra of burial mound No.1 where a large quantity of *Zelkova* pollen have been found. On the basis of flowering times of *Zelkova* (late March, early April) it can be stated that the burial in burial mound No.1 took place precisely in spring.

Study of the mud on the bullock-cart wheels from burial mound No.2 was similarly interesting. A high content of pollen of plantain and other weeds growing along the roads indicates that the bullock-cart was active, or at least it passed along the road immediately before the funeral.

In the beginning of the Bedenian culture the population density in the Tkemlara area was rather high. Agriculture played a leading role. Stock-breeding was of subordinate importance. Horticulture and viticulture were developed. In palaeolandscapes of that period forests grew on slopes of mountain ranges, but almost all plain landscapes were developed for agriculture.

About 5^{th}–4^{th} centuries before the beginning of the Bedenian culture dense moist forests with *Castanea sativa*, *Alnus barbata*, *Zelkova carpinifolia*, *Hedera*, *Smilax*, and others plants were spread in the Tkemlara area. Large quantities of chestnut fruit were found in the cultural layers of the same period in the Sopioseuli settlement (Tetritskaro region) situated at an altitude of 1300 m (Gobejishvili 1978). Today forests with chestnut and *Zelkova* grow in Colchis, Lagodekhi, and Lenkoran. This fact indicates that the climate of the time of the funeral in burial mound No.1 was much warmer and more humid than present and in the Bedenian culture period.

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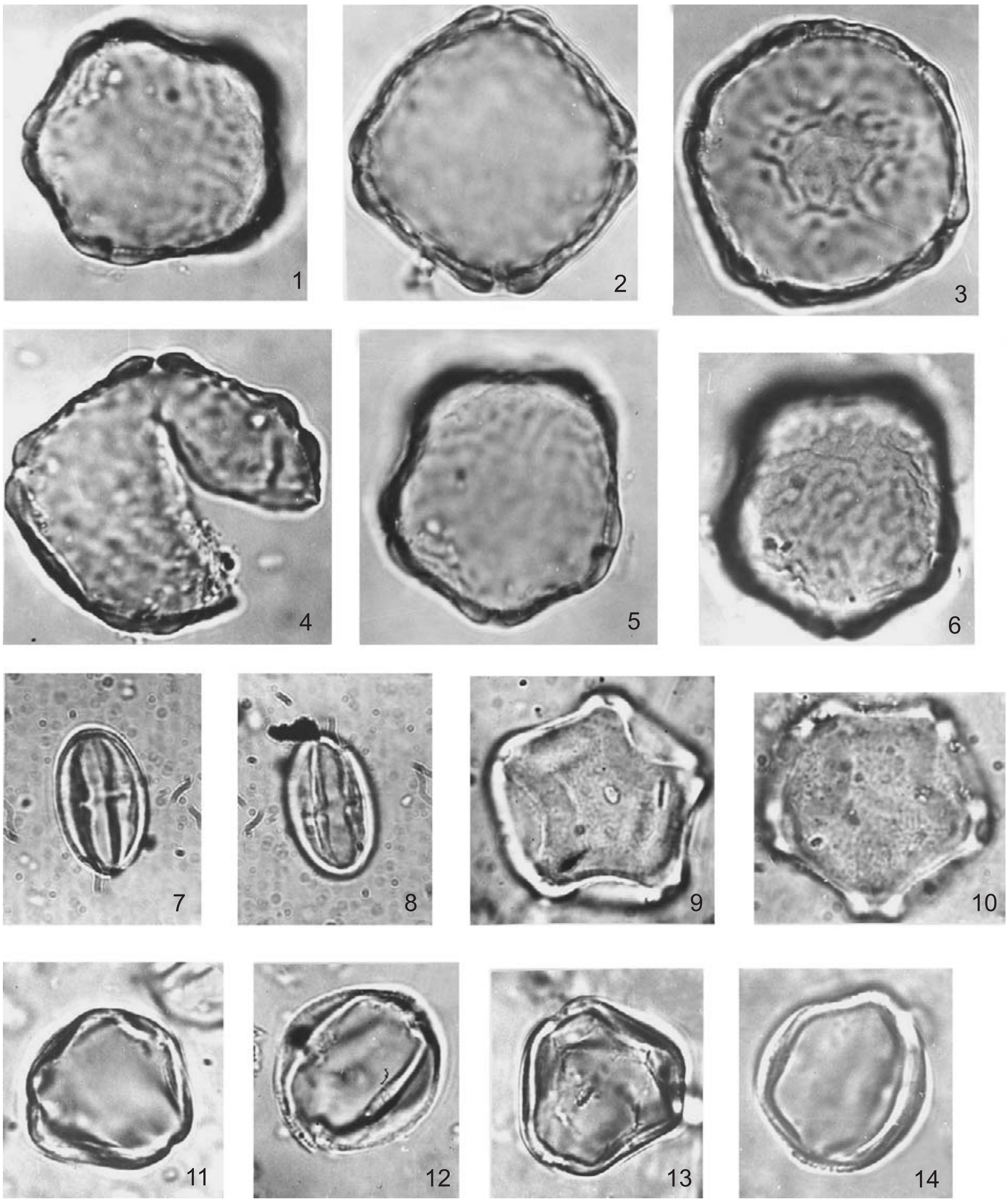
PLATE

Plate 1

1–10. Pollen grains from burial mound No. 1 (× 1000)
1–6. *Zelkova carpinifolia*
7,8. *Castanea sativa*
9,10. *Alnus barbata*
11–14. Pollen grains of *Vitis vinifera* from burial mound No. 2 (× 1000)

phot. E. Kvavadze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