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NEW RADIOCARBON DATES FOR THE BADEN CULTURE

Tünde Horváth[1] • S Éva Svingor[2] • Mihály Molnár[2]

ABSTRACT. In 2001–2002, a settlement of the Baden culture was excavated in the vicinity of Balatonőszöd. During the rescue excavation along the M7 highway, in an area of 100,000 m^2, 2800 pits dug into the subsoil, 320 hearths, and cultural layers rich in material were discovered. The material of the Baden culture represents phases IB–IC (Boleraz), IIA (Transitional), IIB–III (Early Classical) according to Němejcová-Pavúková's (1981, 1998) typological system. We took 20 samples from the large number of human and animal skeletons for radiocarbon dating, of which 16 measurements were successful. These results provide absolute dates for a Baden culture settlement with the longest occupation and the largest excavated surface in Hungary. This provides an opportunity to review the chronological position of the Baden culture, with special emphasis on its beginning and end.

INTRODUCTION

In his monograph, Banner (1956) presented finds from the central distribution area of the Baden culture. It was Kalicz (1958), who then dated the Baden culture to the Late Copper Age—an assessment still valid in connection with the Copper Age cultures of Hungary—based on the stratigraphy of Székely-Zöldtelek. At the time, the Baden period was considered to follow immediately the Bodrogkeresztúr culture.[3]

Later research refined and enriched the period of the end of the Middle Copper Age with further cultures. According to our present knowledge, in the Great Hungarian Plain the Baden culture was preceded by the Hunyadihalom culture, in Transdanubia by a little known phase with sparse material called Furchenstich—part of the Furchenstich-Retz-Bajč-Mondsee cultural complex (Kalicz 2001). In certain areas, Furchenstich material is preceded by material of the Balaton-Lasinja culture. The relationship between Balaton-Lasinja and Furchenstich, and between Furchenstich and the initial phase of the Baden culture (called the Proto-Boleráz phase), is still unclear due to the large number of stray finds, the scarcity of authentic materials, and the lack of published data.[4]

At Balatonőszöd-Temetői dűlő, separate features of both the Balaton-Lasinja and Boleráz phases of the Baden culture were found. In a few pits, the characteristic finds of the Balaton-Lasinja culture were mixed with Furchenstich Ware, although this latter culture has no separate features at the site. The material of the Balaton-Lasinja and Baden cultures, however, was found mixed in the same assemblage on a few occasions without any observable trace of later disturbances in the section. This mixing of finds occurred even in the classical phase of the Baden culture.

Banner dated the culture between 2400/2300 to 2000/1900 BC on the basis of the data of Menghin, Pittioni, Willvonseder, Schrálins, Childe, and Milojčić (Banner 1956:242–243). Nándor Kalicz correlated the Bodrogkeresztúr and Baden cultures with Troy III–V. He connected the emergence of the Baden culture to migrations from Anatolia around 2100/2050 BC (Kalicz 1963:81–87).

Korek, in his unpublished doctoral dissertation (Korek 1983), estimated the lifespan of the culture at ~350 yr. He dated phase I to 2350–2200 BC, phase II to 2200–2100 BC, phase III to 2100–2000, and the Kostolac, Bošáca, and other post-Baden groups to 2000–1900 BC (Korek 1983:168–169).

[1]Hungarian Academy of Sciences, Archaeological Institute, H-1014, Úri. u. 49, Budapest, Hungary. Email: valdemar@archeo.mta.hu.
[2]Hungarian Academy of Sciences, Institute of Nuclear Research (ATOMKI), H-4001, Pf. 51, Debrecen, Hungary.
[3]Kalicz's extremely important stratigraphical observations were already included in Banner's work as well.
[4]Along the route of the M7 highway, at the Balatonlelle-Országúti dűlő site, Siklósi and Sófalvi (2004:56) excavated closed assemblages in which Balaton-Lasinja, Furchenstich-Ware, and Proto-Boleráz finds were clearly mixed.

In the 1960s, new perspectives emerged regarding the dating of the Copper Age. The avalanche of publications began with Renfrew's (1969) study on the autonomous development of the Southeast European Copper Age. Neustupný's (1968) paper had a similarly great significance. As the first to accept the results of radiocarbon dating, Neustupný connected the Baden culture with the Aegean-Anatolian circle through Poliochni: classical Baden = Poliochni II blue = pre-Troy I; later Baden/Kostolac = Poliochni III green = Troy I; in absolute dates: 3600–2900 cal BC.

Němejcová-Pavúková in her works on the ceramic typology of the Baden culture dated the culture mostly on the basis of uncalibrated ^{14}C dates between 2800 and 2300/2200 BC (Němejcová-Pavúková 1981). Near the end of her career, with the knowledge of calibrated dates, she dated the Baden culture between 3690/3360 and 2910/2700 cal BC (Němejcová-Pavúková 1998:399).

Based on the appearance of gynecomorphic vessels, Petrasch (1984) dated the beginning of the formation of the Baden culture on Swiss lakeshore settlements to ~3850 cal BC. After evaluating all the available ^{14}C dates for the period, Forenbaher (1993: Figure 4 on p 246) estimated the duration of the Baden culture at ~800 yr, placing it between 3600 and 2800 cal BC.

Unfortunately, most Hungarian scholars did not accept the results of ^{14}C dating until the 1980s and 1990s. In Hungarian prehistoric research, it was Raczky who first used the so-called "long chronology," as delineated by Renfrew and Neustupný, in connection with the Baden culture (Raczky 1995). Raczky dated the formation of the Baden culture to ~3600 BC, synchronizing it with Kumtepe Ib, and its end around 3000 BC, which is contemporary with the beginning of Troy I and the Early Helladic I (Raczky 1995: Figure 1). Some scholars, however, have continued to support the short chronology (see e.g. Makkay 1996, 2003; Horváth 2001). In most Hungarian works on the Copper Age, however, the new chronology, and the resulting shift of more than 1000 yr back in time, is accepted.

Synchronization with the various occupation layers at Troy has received new impetus with Korfmann's new excavations at Troy, which for the first time provided ^{14}C dates from the settlement (Korfmann and Kromer 1993). Based on these new data, the beginning of the Baden culture can be placed about 3700–3400 BC ("pre-Troy I" – Beşik-Yassitepe) and its end about 2920–2700 BC (Troy I early) (Korfmann and Kromer 1993:164–165). After collecting and evaluating 32 samples from Baden culture sites, Stadler et al. (2001) dated the culture between 3640 and 2930 BC.

From our point of view, the Boleráz material from Arbon/Bleiche 3 on the shore of Lake Constance in Switzerland is of great importance and provides a secure point of departure. The life of the settlement can be dated between 3385 and 3371 BC (de Capitani et al. 2002).

NEW RESULTS

Balatonőszöd-Temetői dűlő

In 2001 and 2002, during a 1-yr-long excavation campaign, we excavated a settlement of the Baden culture at Balatonőszöd-Temetői dűlő. The area is located on the western bank of a tributary of Lake Balaton in a meridional valley stretching north-south along the river. The core of the early Boleráz phase settlement is in the north, that of the transitional and classical Baden settlement is in the south.

The survey and excavation of 3 pits with material from the classical phase suggest that on the eastern bank of the riverbed (today a swamp), opposite the excavated area, a similar settlement was located along the river. These 2 parts probably belonged to a single settlement whose area exceeded 200,000 m^2 (a size similar to that of Çatal Höyük) (Figure 1). In the northern part of the Boleráz area, close to the southern shore of Lake Balaton, the pits of the Boleráz phase were mixed with features of the Middle Copper Age Balaton-Lasinja and Furchenstich cultures.

Figure 1 The Balatonőszöd-Temetői dűlő site, the excavated area and its immediate vicinity (prepared by Zsolt Viemann, with the map based on www.szekely.kiado.hu).

The extent of the settlement of the Baden culture is identical to the boundaries of the excavated area in the east, north, and west; it exceeds it, however, in the south. It is possible that in this unexcavated area the features of phase IV of the Baden culture could have been found. Unfortunately, this archaeologically intact area was destroyed during the construction of the highway (Horváth et al. 2007).

Data on the size of the settlement and the typological study of the material suggest that it is not only the largest settlement known so far, but also has the longest continuous occupation. The earliest, IA or Proto-Boleráz phase was not attested at the site. The most characteristic archaeological features of the settlement are pits and hearths. The plans of 4 so-called Pfahlbau-type houses could be identified (Horváth et al. 2007). Besides the everyday refuse pits, the most interesting pits contained special finds (human mask, stamp seals, figurines, house models) and the remains of human and animal sacrifices (Horváth 2002a,b,c; 2004a,b).

The number of human skeletons (usually interpreted as intramural burials) is almost 60. Some pits contained 1 burial, others 2, 3, or 4, and in 1 case even 5 burials (Horváth and Zoffmann 2004). Feature 1099 (Well 1) contained Balaton-Lasinja sherds at the bottom and 10 human skeletons in the upper part of the fill, which, according to the ^{14}C dates, were placed in the (probably cleaned and reused) well in the Boleráz phase of the Baden culture (Horváth et al. 2003). The multilayered sacrificial pits contained both human and animal skeletons. In about 50 pits, only animal remains were found (Horváth 2006). Samples for ^{14}C dating were taken from the pits (Pits 203, 426, 1612), usually from human or animal bones, and in 1 case from charcoal (Table 1, Figure 2).

Unfortunately, from the samples taken from the fill of Well 1, only the skeleton of Grave 70 from the uppermost layer of the fill yielded usable data. The sample taken from the skeleton of Grave 84 (the skeleton of a child) was unsuitable for dating; groundwater probably dissolved the collagen from the bones needed for the measurement. Similarly, the sample from the lower layer of the fill of Pit 1612 was contaminated and provided an unrealistic date; consequently, it cannot be used in interpreting the chronological relationship between the lower and upper layers of the pit.

Table 1 Overview of samples and ^{14}C results.

Lab code	Description of samples	$\delta^{13}C_{VPDB}$ (‰) ±0.2‰	^{14}C age BP 1 σ (68.3%)	Calibrated date[a] range, cal BC 1 σ (68.3%)
Deb-13381	Pit 2689 (with gynecomorphic vessel). Animal bone.	–19.3	4110 ± 50	2854–2803 (25%) 2734–2591 (75%)
Deb-13389	Grave 37, Pit 1489. Human bone.	–19.2	4200 ± 35	2889–2856 (34%) 2807–2751 (54%) 2719–2702 (12%)
Deb-13245	Grave 50, Pit 2019. Human bone.	–19.7	4220 ± 50	2904–2851 (47%) 2808–2720 (53%)
Deb-13387	Multilayered sacrificial Pit 426: middle layer. Charcoal.	–24.5	4310 ± 50	3000–2969 (23%) 2950–2888 (77%)
Deb-13386	Pit 2596 (with figurine). Animal bone.	–19.4	4330 ± 35	3007–2976 (31%) 2944–2899 (69%)
Deb-13382	Pits 1072–1096 (with human mask fragment). Animal bone.	–20.2	4360 ± 45	3017–2913 (100%)
Deb-13292	Multilayered sacrificial Pit 426: Grave 67, lowermost layer. Human bone.	–19.7	4380 ± 45	3072–2919 (100%)
Deb-13374	Multilayered sacrificial Pit 1036: sheep skeleton. Animal bone.	–19.9	4390 ± 60	3091–2920 (100%)
Deb-13244	Multilayered sacrificial Pit 203: lower layer. Skull of bovine.	–20.3	4440 ± 60	3321–3220 (38%) 3126–2952 (62%)
Deb-13412	Multilayered sacrificial Pit 1612: upper layer. Dog skeleton.	–19.9	4440 ± 70	3319–3214 (37%) 3136–2985 (63%)
Deb-13286	Pit 2635: Grave 79. Human bone.	–19.7	4440 ± 45	3315–3225 (36%) 3122–3000 (64%)
Deb-13411	Pit 2060 (with house model). Animal bone.	–19.5	4445 ± 45	3323–3222 (40%) 3122–3012 (60%)
Deb-13395	Pit 2614: Grave 74. Animal bone beside human skeleton.	–20.3	4460 ± 50	3326–3216 (51%) 3128–3028 (49%)
Deb-13379	Pit 1099. Well 1: Grave 70, human (Boleraz) skeletons in the well of Balaton-Lasinja culture.	–20.6	4480 ± 70	3333–3090 (100%)
Deb-13277	Multilayered sacrificial Pit 426: Grave 23, upper layer.	–19.9	4520 ± 60	3349–3286 (31%) 3251–3113 (69%)
Deb-13291	Pits 2327–2346. Animal bone.	–20.4	4550 ± 80	3366–3111 (100%)
Deb-13398	Pit 2581 (with stamp seal). Animal bone.	–20.9	4680 ± 45	3519–3491 (30%) 3469–3373 (70%)

[a]Calibrated with CALIB 5.0.1 (Stuiver and Reimer 1993) based on IntCal04 calibration curve (Reimer et al. 2004).

^{14}C Dating

The ^{14}C dating of 1 charcoal sample and 17 bone samples was performed in the Hertelendi Laboratory of Environmental Studies of ATOMKI. The samples were dated according to the standard laboratory procedures. The charcoal sample was first mechanically cleaned, then treated by the standard acid-base-acid (ABA) method. For bone measurements, after the mechanical cleaning we extracted collagen following the method introduced by Longin (1971). The dried samples were combusted and the liberated CO_2 gas was purified over charcoal, then cryogenically separated from other gases using liquid N_2 (Csongor et al. 1982), then stored for about a month to allow the radon to decay. Sample ^{14}C activity was measured using the gas proportional counting method (Csongor and Hertelendi 1986; Hertelendi et al. 1989). The standard deviation applying this method for a single modern ^{14}C measurement was 0.5% (Hertelendi 1990). $\delta^{13}C_{PDB}$ (‰) values were measured using a ThermoFinnigan Delta^{PLUS} XP mass spectrometer. Each sample is routinely measured twice and the mean value is calculated. The age is calculated following the recommendations given by

Figure 2 Balatonőszöd-Temetői dűlő. Plan of the excavation and features with samples for ^{14}C dating. Prepared by Zsolt Viemann.

Stuiver and Polach (1977) and the fractionation correction for $\delta^{13}C$ is applied. The conventional ^{14}C age was calibrated with the CALIB 5.01 program (Stuiver and Reimer 1993) using the IntCal04 data set (Reimer et al. 2004). The quality system in the laboratory has been improved and the ISO 9001: 2000 standard has been implemented. Participation in several ^{14}C intercomparison studies (TIRI, VIRI, FIRI) is part of the quality assurance program.

^{14}C dating results of 17 samples from the Balatonőszöd-Temetői dűlő settlement are shown in Table 1. Both the conventional ^{14}C age and calibrated age ranges (with 1-σ confidence intervals) are given. Probabilities of the calibrated age ranges are also given; probabilities <5% are omitted.

Based on this data set, the apex of the Balatonőszöd settlement dates between 4680 ± 45 BP (Deb-13398, Pit 2581) and 4110 ± 50 BP (Deb-13381, Pit 2689), while its whole occupation lasted for ~570 yr. This timespan correlates well with those established by Forenbaher (1993) and Stadler et al. (2001) for the whole life of the culture (800 and 710 yr, respectively), since at Balatonőszöd the formative-early phase IA and the late classical phase IV were not attested. Thus, we witness here an extremely long, continuous, autochthonous development.

Based on the typological study (according to Němejcová-Pavúková's [1981] system) of the material from the pits, phases IB and IC are regarded as a single period (Boleráz), phase IIA is considered a transitional phase, while phases IIB and III are again treated as 1 period, the Early Classical Baden phase (Horváth et al. 2007, 2008).

From data in Table 1, different phases were grouped and analyzed by sum calibration with the CALIB 5.0.1 program (Stuiver and Reimer 1993). A graphical representation of calibrated results is presented in Figure 3, sorted according to the currently understood phases.

In Horváth et al. (2006), the samples for sum calibration were selected strictly on archaeological typological grounds. Based on these, we delineated 3 groups (Boleráz, Transitional, Early Classic). This grouping, however, was not confirmed by the ^{14}C dates.

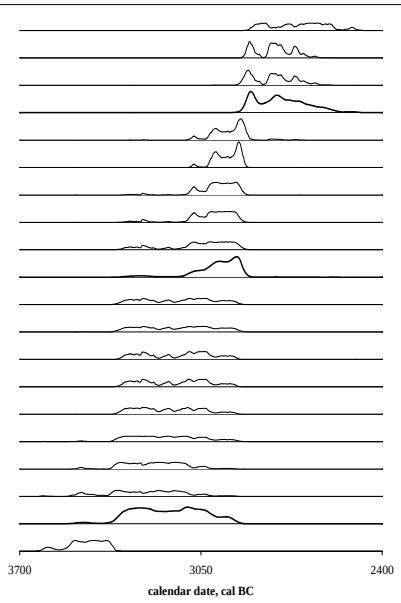
Timespan	Lab code: ^{14}C age, BP	Probability distributions	Calibrated date, cal BC 1 σ (68.3%) ranges
Early Classical Baden, younger	Deb-13381: 4110 ± 50		2854–2591 cal BC
	Deb-13389: 4200 ± 35		2889–2702 cal BC
	Deb-13245: 4220 ± 50		2904–2720 cal BC
sum Early Classical Baden younger (3 samples)			**2892–2687 cal BC**
Early Classical Baden, older	Deb-13387: 4310 ± 50		3000–2888 cal BC
	Deb-13386: 4330 ± 35		3007–2899 cal BC
	Deb-13382: 4360 ± 45		3017–2913 cal BC
	Deb-13292: 4380 ± 45		3072–2919 cal BC
	Deb-13374: 4390 ± 60		3091–2920 cal BC
sum Early Classical Baden, older (5 samples)			**3016 –2900 cal BC**
Boleraz	Deb-13244: 4440 ± 60		3321–2952 cal BC
	Deb-13412: 4440 ± 70		3319–2985 cal BC
	Deb-13286: 4440 ± 45		3315–3000 cal BC
	Deb-13411: 4445 ± 45		3323–3012 cal BC
	Deb-13395: 4460 ± 50		3326–3028 cal BC
	Deb-13379: 4480 ± 70		3333–3090 cal BC
	Deb-13277: 4520 ± 60		3349–3113 cal BC
	Deb-13291: 4550 ± 80		3366–3111 cal BC
sum Boleraz (8 samples)			**3325–3027 cal BC**
Earliest Boleraz IB	Deb-13398: 4680 ± 45		3519–3373 cal BC

Figure 3 Graphical presentation of ^{14}C results

During the archaeological analysis of the Baden material from Balatonőszöd-Temetői dűlő, the faults of Němejcová-Pavúková's (1981, 1998) system became clear on a number of occasions. This has also been implied in other studies of the Baden culture (e.g. Bondár 2002).

Consequently, in this paper we grouped the usable samples according to their ^{14}C age. Sum calibration was restricted to 2 phases (Boleráz and Early Classic), where ^{14}C ages with a 95% confidence level coincided. In this system, 2 samples were assigned to different groups than their archaeological typological identification (Deb-13386, Pit 2596: originally Early Baden; Deb-13412, Pit 1612: originally phase IIB–III according to their finds). We decided to integrate the rather controversial (and typologically not clearly defined) transitional phase IIA into 2 basic groups according to the age of the samples. Thus, the Early Classic IIB–III group could be further divided into an older and a younger subgroup (see Figure 4).

According to the correlation of the fine periodization based on typological study and the ^{14}C dates, we can place the Boleráz IB–C phases to 3519/3373–3027 cal BC, and the Early Classical IIB–III phases to 3016–2687 cal BC (Figure 3; Table 2) at Balatonőszöd. The 3800 cal BC date for the beginning of the Baden culture suggested by Petrasch(1984) thus seems a bit too early (for a critique, see Pavelčík 1988).

The absolute dates of the formative, Proto-Boleráz phase of the Baden culture do not seem to be markedly different from those of the Boleráz phase: Červený Hrádok: 4820–4710 BP (3640–3520 cal BC); Gyöngyöshalász: 4790 BP[5] (3640–3520 cal BC); Hlinsko: 4775–4670 BP (3630–3380 cal BC).

[5]Szabó (1983: note 3): Charcoal sample, uncalibrated date! Based on the published material, the settlement belongs to the Boleráz IB–C horizon rather than Proto-Boleráz IA.

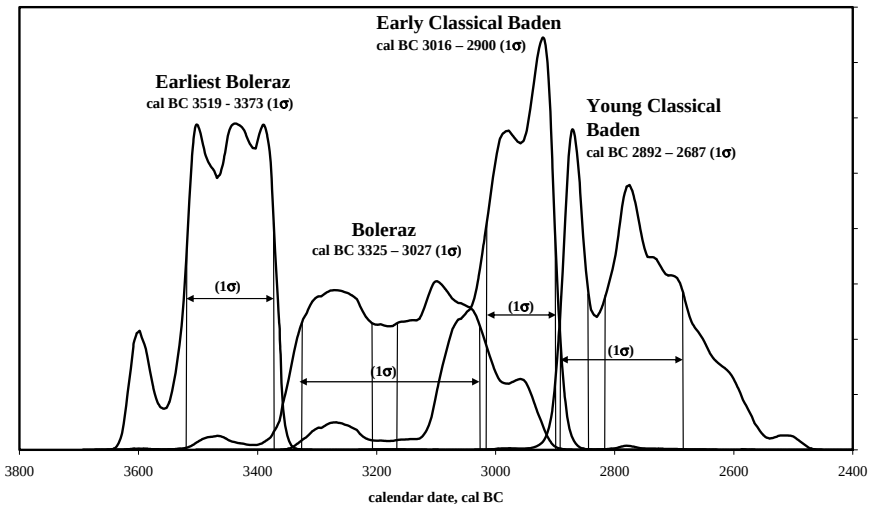


Figure 4 Result of sum calibration of ^{14}C ages of samples from individual groups of the Baden culture

Table 2 List of ^{14}C dates from the Baden culture sites in Hungary.

Name of site	Time period	Nr of samples	^{14}C date cal BC	^{14}C yr BP	References
Gyöngyöshalász-Encspuszta	IA Protoboleraz?	2	3650/3630 to 3380/3370 ±50	4790	Wild et al. 2001: Table 1
Keszthely-Fenékpuszta	IA Protoboleraz	2	3720/3680 to 3690/3580	—	Kalicz 2001: 406.
Győr-Szabadrét-domb	IB–C Boleraz	10	3508/3286 to 3284/2924	—	Figler et al. 1997: Table 2
Szihalom	IB–C Boleraz	8	3780/3630 to 3380/3600	4850–4735	Wild et al. 2001, Table 1; Stadler et al. 2001: Table 7
Sümeg	Classical	1	3350–3100 ±60	4520	Forenbaher 1993; Stadler et al. 2001: Table 7
Vámosgyörk	Classical	2	3330/3090 to 3040/2920	4475–4400	Stadler et al. 2001: Table 7
Nagykanizsa	Classical III–IV	5	3320/2870 to 3030/2510 ±50	4455–4080	Stadler et al. 2001: Table 7; Barna 2003
Szigetcsép	Post-Baden Kostolác	1	3040–2910 ±45	4350	Forenbaher 1993; Stadler et al. 2001: Table 7

According to Raetzel-Fabian and Furholt (2006), the earliest known ^{14}C dates for the Baden culture from Grub an der March (3 samples, 4790–4760 BP [3630–3530 cal BC]), Schwechat (1 sample, 4935 BP [3760–3660 cal BC]); Szihalom[6] (8 samples, 4850–4735 BP (3650–3520 cal BC]); and Jevišovice C2 (~3700 cal BC) should be handled with caution. Instead, a date of 3600/3500 cal BC for the beginning of the Baden culture (i.e. beginning of Boleraz IB) should be preferred. We would place the formative (Proto-Boleraz?) phase of the culture before 3600/3500 cal BC, which cannot yet be called the Baden culture proper (maybe the Schöninger group in Lower Saxony; Raetzel-Fabian and Furholt 2006).

Based on the situation in the Late Copper and Early Bronze Age in Hungary, placing the end of the Baden culture around 3000 cal BC (Pétrequin et al. 2006: end of Kostolac culture) or 2930 cal BC (Stadler et al. 2001) seems too early.[7] This would leave a period of many centuries for the transi-

[6]According to the extremely short excavation report, Middle Copper Age graves of the Ludanice culture and Late Copper Age Boleráz phase pits were excavated at the site. It is possible that the samples were taken from features of the Ludanice group, and not the Boleráz phase, which is why they are so early (Szabó 1997).

tional phase between the Late Copper and Early Bronze Age (Kostolac and Vučedol cultures) and the first (Bell Beaker, Makó-Kosihy-Čaka, Formative Nyírség, and Late Vučedol cultures) and second phases (Bell Beaker, Somogyvár-Vinkovci, Late Makó, Nyírség, Proto-Nagyrév, and Pitvaros cultures) of the Early Bronze Age. This would result in a (not archaeologically supported) long lifespan of these cultures or a longer hiatus without occupation, which is one of the main arguments of those who still do not believe in the ^{14}C-based "long chronology" (e.g. Makkay 1996, 2003). This apparent contradiction, however, can be solved. In Hungary, the Classical phase of the Baden culture would begin at a time that has been previously suggested as the date for the end of the culture by international research.

Thus, the end of the Baden culture can be dated to 2800/2600 BC, conforming with those opinions that date the beginning of the Bronze Age (Bz A1) around 2300 BC (which is parallel to phase 3 of the Early Bronze Age in Hungary; Reményi 2003).[8]

DISCUSSION

Based on the literature on the Baden culture (mainly focusing on ceramic typology and ^{14}C dates), the following statements can be formulated regarding the absolute and relative chronology of the culture:

1. One of the most problematic phases is the first, formative phase of the culture. At present, the Proto-Boleráz and Boleráz phases cannot be distinguished from each other on the basis of ^{14}C dates, as opposed to the Boleráz and Classical phases.
   The same tendency can be observed in archaeological typology as well: Proto-Boleráz material is not everywhere attested in the distribution area of the later Boleráz phase. It is thus questionable to what extent the Proto-Boleráz phase can be regarded as a predecessor of the Boleráz phase. Is it possible that it could have emerged in other areas as well? The exact distribution of the Proto-Boleráz phase in Hungary also needs further investigation, as does the description of its material from authentically excavated sites.
2. The latest works examining the Baden culture (Stadler et al. 2001; Wild et al. 2001) point out that the Cernavodă I culture is already contemporaneous with the Baden culture according to the ^{14}C dates; consequently, the Cernavodă III culture cannot be contemporaneous with the Boleráz phase. It can only be later. Thus, these cultures must be re-examined with the help of traditional archaeological typological methods as well, and new calibrated ^{14}C dates must be compared to the whole Cernavodă I–III–II developmental sequence.
   In the southern distribution area of the Baden culture, Ezero XIII–VII and Sitagroi IV are already contemporaneous with the classical Baden. All this suggests that the Baden culture emerged in central Europe (Lower Austria, Burgenland, Moravia, Slovakia, and western Hungary) and spread towards southeastern Europe (Stadler et al. 2001; Wild et al. 2001). At the same time, the west-east spread suggested by Maran (1998) is possible as well.

[7] At Balatonőszöd-Temetői dűlő, the end of the Baden settlement is dated by samples Deb-13245, -13389, and -13381 (2892–2687 cal BC). Presently, the only Baden site in Hungary that reaches the final phase IV of the Baden culture, which has been dated with ^{14}C, is Nagykanizsa-Billa (phase III–IV according to Němejcová-Pavúková's system: see Barna 2003). Its latest date is 4080 ± 40 BP (2840–2570 cal BC) (Stadler et al 2001: Table 7).

[8] This way, however, it is conceivable that the beginning of the Early Bronze Age, especially the ^{14}C dates of the Bell Beaker-Csepel group, will overlap with the end of the Baden culture (see Raczky et al. 1994:42–43). It is now impossible to realistically assess the relevance of the ^{14}C dates from samples collected by H Quitta and evaluated in the Berlin laboratory. The dates are given in conventional BP and calibrated BC form, without giving the sigma values.

Based on the new data from Balatonőszöd-Temetői dűlő, we may add the following to the above statements:

1. According to the ^{14}C dates, the features of the Boleráz phase at Balatonőszöd-Temetői dűlő are contemporaneous with the settlement of Arbon/Bleiche 3. Other sites in Hungary, assigned with certainty to the Boleráz phase, have yielded similar dates (Table 3: Győr-Szabadrét-domb). On the basis of archaeological typology, other Hungarian sites (Szihalom-Sóhajtó, Gyöngyö-shalász-Encspuszta: Szabó 1983) are problematic, and, unfortunately, unpublished. We may thus conclude that the fully developed Boleráz material culture appeared at the same time in western Europe (Switzerland) and east-central Europe (Hungary). Thus, the west-east spread suggested by Maran (1998) seems unlikely. A north-south spread, however, seems equally unlikely, at least it cannot be demonstrated on such a spatial scale.
2. We have to take into account that the technological innovations of the Late Copper Age (woolly sheep – weaving and spinning, new raw materials for clothing and new costumes; the so-called Secondary Products Revolution in agriculture, alcoholic beverages, and the vessels used for their consumption) and the invention of the wheel (together with the wagon and the whole traction complex) spread so rapidly in the European continent along the larger rivers (especially the Danube) that this process cannot be demonstrated at the current level of accuracy of ^{14}C dates. We also have to take into account the possibility that the inventions of this technological revolution spread from 2 directions at the same time: from western and east-central Europe (Köninger et al. 2001) and Anatolia through southeast Europe (Uruk expansion: Sherratt 2003), and met somewhere in the Carpathian Basin.
   It is conceivable that the speed of the dispersion of these innovations was so high that hundreds of km were covered within a decade or less (the distance between Lake Constance and Lake Balaton along the Danube is ~750 km), and ^{14}C is not yet suitable for the detection of such short periods. It is a question whether there is actually an archaeological or scientific method that is capable of such a resolution (except for dendrochronology, which is, however, useless in the Carpathian Basin due to the lack of arboreal remains).
3. The direction of the so-called "Badenization" process (which, in our opinion, means the spread of Boleráz/Cernavodă III-type material) can be examined only with traditional archaeological methods at the present. For this, however, we need a distribution map that would present the sites of the Baden culture in Europe at least in 2 stages (early or Boleráz phase and late or Classical Baden phase).

Such a distribution map was prepared on the occasion of the publication of a conference volume on the Baden culture in 1973 (Chropovský 1973). Based on this map, the data published since, and especially the partial distribution maps in Roman (2001), a new distribution map was created, which presents the distribution of the early and late phases on a single map (Figure 5).

Obviously, the map has many shortcomings: there are empty spaces between areas most certainly in contact with each other, which are probably caused by the lack of research or publications there. Despite this, it can give us an impression for the first time of the vast continuous area where the material of the Baden culture can be found.

What this distribution map also shows, however, is that we are certainly not looking at a population forced to migrate for some political or demographic reason, and then conquering a huge area after a subsequent demographic expansion (the "refugees" from Troy II–V). Instead, this is a period of exceptional innovations, which due to their revolutionary nature, reached a huge area within a relatively short time.

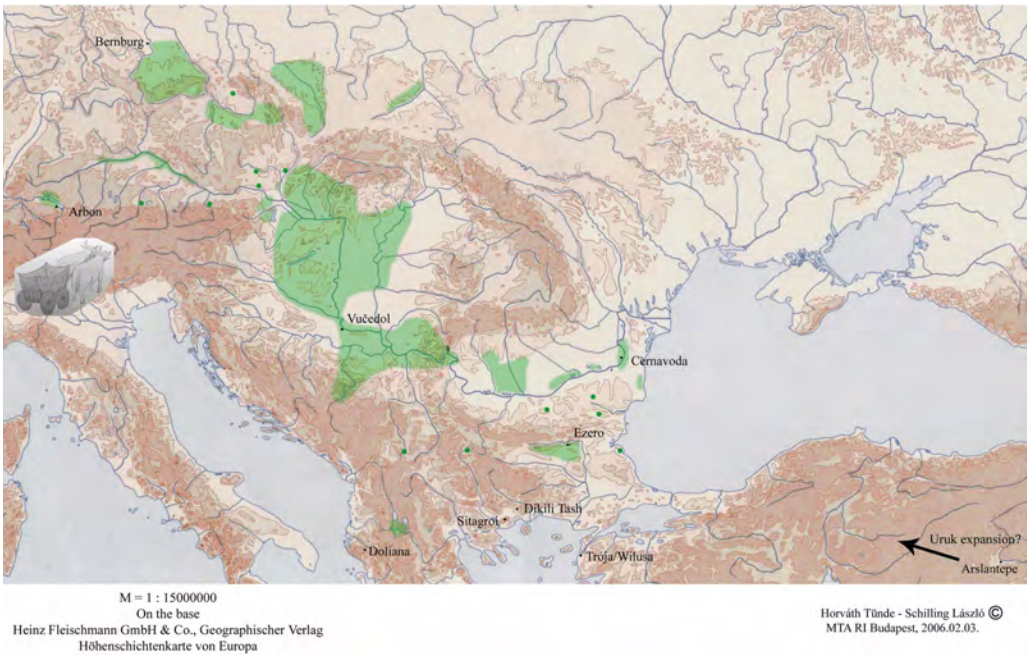


Figure 5 Distribution map of the Baden culture. Prepared by Tünde Horváth and László Schilling, based on the partial maps of Roman (2001).

This superficial unity, especially the uniformity of fine ceramic wares, however, falls apart into local units when we examine the other, local elements of the culture (e.g. burials, stone implements, etc.), which reflect well the distribution of the autochthon populations of the preceding Middle Copper Age (e.g. the Balaton-Lasinja, Ludanice, Pfyn/Horgen or Funnel Beaker cultures). Their distribution became uniform, at least regarding their material culture, during the fast process of the transmission of the technological revolution.

The distribution map also suggests that the dispersal of Baden culture elements followed the Danube River, basically from its source in the Black Forest region to its estuary in the Black Sea. Also, its direction is sometimes west-east, sometimes north-south, depending on the geography of the environment of the river. It seems that if there ever was a Danubian culture, in Childe's (1925: chapter 7) sense, then it was at the time of the Baden culture. In regions outside the main distribution area, further away from the Danube—where the distribution of Baden-type material does not seem to be spatially continuous at the present stage of research, e.g. in Poland (Zesławice-Pleszów group) or in the case of the isolated sites of mainland Greece (e.g. Doliana, Sitagroi, Dikili Tash)—the finds of the Baden culture probably appear only as a result of exchange. They do not constitute an archaeological culture, but only enrich the repertoire of the local cultures. In other words, these faraway, isolated areas are a manifestation of the mental projection of the society of the Baden culture. They are located in a region that could be included in the known universe, either through trade or in thought (see Mauss' notion of the talent for geographical discovery: Mauss 2004:497–498).

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