PROBLEMS WITH THE PERIODIZATION OF THE EARLY BRONZE AGE IN THE CARPATHIAN BASIN IN LIGHT OF THE OLDER AND RECENT AMS RADIOCARBON DATA

A KÁRPÁT-MEDENCEI KORA BRONZKOR PERIODIZÁCIÓJÁNAK NEHÉZSÉGEI A RÉGI ÉS AZ ÚJABB AMS RADIOKARBON ADATOK TÜKRÉBEN

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Abstract

The latest data of radiocarbon examinations, the number of which has suddenly increased in recent years, have increasingly raised questions in relation to the periodization of the early Bronze Age in Europe and Hungary. The historical processes drawn up on the basis of radiocarbon data may not be closely related to the chronological system created by István Bóna in the 1950s dividing Hungary's early Bronze Age into three parts based on the stages (beginning, prospering, declining) of the general theory of social development. The latest research results and the increasing number of radiocarbon data both indicate that within the Carpathian Basin the early Bronze Age can be split up rather into two distinct periods. The dividing line between these periods is unclear, and on the regional level the old and new cultures had existed parallel to each other for longer and shorter periods of time. For this reason, instead of the previous artificially created three-part division of the early Bronze Age in Hungary recent research justifies a two-part division, which better corresponds to the actual historical processes. The re-measured data of the early Bronze Age cemetery of Singen (Germany), as well as the AMS radiocarbon data of the Encrusted Pottery Culture grave No. BBQ242 excavated at Bonyhád's biogas plant indicate that the line between the two periods lies, similarly to the RBz A0-A1 periods, around 2150 cal BC.

Carpathian Early Bronze Age 1 (CEBA 1: 2600/2500 cal BC – ~2150 cal BC) spanning over the lifetimes of the Makó-Kosihy-Čaka, Somogyvár-Vinkovci, proto-Nagyrév cultures and Bell Beaker Csepel Group occupying the region according to radiocarbon data after 2600/2500 cal BC, corresponding with István Bóna's Early Bronze Age period 1-2/A.

Carpathian Early Bronze Age 2 (CEBA 2: ~2150 cal BC – ~1900 cal BC) involving the early period of expansion (Bonyhád phases I-III) of the Nagyrév, early Maros, Nyírség, Hatvan cultures, as well as the Encrusted Pottery culture in Transdanubia, reflecting the influences of the Late Corded Ware culture, corresponding with István Bóna's Early Bronze Age period 2/A-3.

Kivonat

Az európai és a magyarországi kora bronzkor kutatásában is az utóbbi években robbanásszerűen növekvő számú radiokarbon vizsgálatok legújabb adatai egyre több kérdést vetnek fel a korszak periodizálásával kapcsolatban. A dél-németországi Singen temetőjének radiokarbon adatai tükrében az 1980-as évek végétől a közép-európai kora bronzkor kezdetét Reinecke hagyományos kronológiai beosztása szerinti RBz A1 időszak kezdetét mintegy fél évezreddel korábbra, Kr. e. 2300/2200 helyzeték (Becker et al. 1989, 433). A Reinecke óta hagyományosan technológiai szempontok szerinti belső periodizáció, az RBz A1 időszakban kalapálással alakított tárgyak után feltűnő öntött bronztárgyak alapján elkülönített RBz A2 időszak kezdetét pedig Kr. e. 2000 körülre keltezték, amit a leubengi főnöki sír dendrokronológiai adata is alátámasztott (Becker et al. 1989, Abb. 4). Stockhammerék csapata tíz singeni sír újramérése során meglepetéssel tapasztalta, hogy ezúttal az új AMS eljárással következetesen fiatalabb adatokat kaptak, ami alapján az RBz A1 időszak kezdetét Kr. e. 2150/2100 körülre szállították le. A Stuttgart környéki és a kelet-németországi sírok adatait összevetve az is világossá vált, hogy az RBz A1 és A2 időszak pusztán technológiai szempontok szerinti szétválasztása nem lehetséges, mert a tipológiai alapon egyik vagy másik időszakhoz sorolt sírok mérési adatai között jelentős átfedés van (Stockhammer et al. 2015, 3., 18–24). Az azonban világosan kitűnt az új adatokból, hogy az RBz A időszak vége Kr. e. 1700 körülre tehető, ami a korábbi 750/700 éves időtartammal szemben mindössze 450 évet jelent. Ebből következően a középső bronzkor kezdetével már a Kr. e. 17. század elejétől számolnak, a korábban feltételezett Kr. e. 1600/1550 időhatárral szemben (Stockhammer et al. 2015, 18). Az sem hagyható figyelmen kívül, hogy a késő neolitikum_kora bronzkor átmenetének hosszabb vagy rövidebb időtartamának kérdésében adatsoraik alapján a rövid, zökkenőmentes átmenetet tartják valószínűnek (Storckhammer et al. 2015, 24). Ezek az új kutatási

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eredményeik a közép-európai kora bronzkor korszakhatárainak pontosítása mellett arra is felhívják a figyelmet, hogy a régi, hagyományos módszerrel mért minták adatai és az új AMS eljárás eredményei még újrakalibrálással sem kezelhetők együtt minden esetben.

A német kutatók eredményei közül a hagyományos módszerekkel mért mintáknál rövidebb, új AMS adatok különösen érdekes kérdéseket vetnek fel a magyarországi kora bronzkor kezdetének és végének, de belső korszakhatárainak meghatározásával kapcsolatosan is. A radiokarbon adatok alapján kirajzolódó történelmi folyamatok a Kárpát-medencében nem kapcsolhatók össze Bóna Istvánnak az 1950-es években az általános társadalmi fejlődéselmélet fokai alapján (kezdet, virágzó, hanyatló) kidolgozott, a magyarországi kora bronzkort három részre osztó kronológiai rendszerével. Az újabb kutatási eredmények és a szaporodó AMS radiokarbon adatok egyaránt arra mutatnak, hogy a Kárpát-medencén belül a kora bronzkor sokkal inkább két jól elkülöníthető időszakra osztható, amelyek között a határ nem éles, regionális szinten az új és a régi kultúrák hosszabb-rövidebb ideig tartó párhuzamos élete figyelhető meg. Ezért a magyarországi kora bronzkor korábbi mesterséges hármas felosztása helyett inkább a történelmi folyamatokhoz jobban igazodó két periódusú felosztását indokolják, amelyben a két periódus közötti határ a RBz A0-A1időszakokhoz hasonlóan 2150 cal BC körül húzódott.

A Kárpát-medencei kora bronzkor 1. a területet a radiokarbon adatok szerint 2600/2500 cal BC után elfoglaló Makó-Kosihy-Čaka-, Somogyvár-Vinkovci-, Proto-Nagyrév-, Harangedényes kultúrák korát, a Bóna István kora bronzkori rendszerének 1-2/A időszakát fogja át (Carpathian Early Bronze Age – CEBA 1: 2600/2500 cal BC – ~2150 cal BC)

Kárpát-medencei kora bronzkor 2. pedig a Nagyrév, Korai-Maros, Nyírség, Hatvan, kultúrák és a késő zsinegdíszes hatásokra a Dunántúlon kialakuló Mészbetétes edények elterjedésének korai (Bonyhád I-III. fázis) IDŐSZAKÁT ÉRINTI. (CARPATHIAN EARLY BRONZE AGE 2 –CEBA 2: ~2150 CAL BC – ~1900 CAL BC)T.

KEYWORDS: EARLY BRONZE AGE, PERIODIZATION, CARPATHIAN BASIN, RADIOCABON DATING

KULCSSZAVAK: KORA BRONZKOR, IDŐREND, KÁRPÁT-MEDENCE, RADIOKARBON DATÁLÁS

Introduction

The latest data from the suddenly increasing number of radiocarbon examinations both in the research of European and Hungarian Early Bronze Age raise more and more questions about the periodization of the era. Most recently Phillip W. Stockhammer and his colleagues have used almost 140 new or re-evaluated samples from the end of the Neolithic to the Middle Bronze Age to review and evaluate the boundaries of the Central European Early Bronze Age period (RBz A1-2) based on the results of ^{14}C tests (Stockhammer et al. 2015). In the meantime, in Hungary Éva Svingor and her colleagues have evaluated the results of the then-used ^{14}C gas proportional counting (GPC) research in relation to the results of the latest three large international radiocarbon compare measurements of the ATOMKI GPC laboratory of Debrecen, and also compared with the LSC and AMS measurement data (Svingor et al. 2016). From the point of view of a practicing archaeologist, the two publications of completely different views come to a hardly compatible conclusion. The German colleagues, who have processed scientific data in an archaeological approach, by comparing the previous data measured mostly in GPC laboratories and the new AMS results, found deviations concerning the area of the Central European Early Bronze Age, dating them about one and a half century younger. However, after comparing the international comparative measurement results of the Debrecen laboratory and the measurement results evaluated strictly in accordance with the rules of scientific test protocols, the Hungarian authors came to the conclusion that practically there was no meaningful deviation between the data of LSC, GPC and AMS laboratories, they are all within the tolerance margin. A good example of this is the cemetery of the Encrusted Pottery culture at Bonyhád, where samples from the skeleton grave BBQ 242 (Bonyhád I) were examined both in the laboratories of Mannheim and Debrecen. Though the results were within the margin of tolerance, there was still a 100-year difference between the data of the two (Kiss et al. 2015, Fig. 11). At the same time, when the samples (graves BBQ 242 and 243) were re-measured in the same laboratory, there was only a minimal difference apparent compared to the previous result, which confirms Svingor's opinion that the results are consistently reproducible, thus the problem is not with the reliability of the method or the laboratories but with the archaeological interpretation of the measured data (Svingor et al. 2016).

The periodization and dating of the Early Bronze Age in Hungary

It's been nearly a quarter of a century that the Frankfurt exhibition's catalogue was published, indicating both the end of an era and a beginning of a new one, reflecting accurately the situation of research in Hungary. The tension between the studies published there was not only perceivable but also evident, arising from difference between the historical-chronological approach of the

previous decades and the shorter- or longer chronology based on the new ^{14}C data, published without any special explanation (Bóna 1992; Raczky et al. 1992). However, due to radiocarbon dating, the longer chronology of Bronze Age quickly became generally accepted, and the dating of the beginning to around 2800-2700 BC has also come up (Kulcsár 2011, Fig. 5; 215; Endrődi 2014, 260). At the same time, the previous inner periodization outlined by István Bóna remained in use unchanged, only refined later by Rózsa Schreiber and Nándor Kalicz in the 1980's based on new findings. By dividing period 2-3 of the Early Bronze Age to phases A and B, the Nagyrév culture was split up into four chronological groups: Bell Beaker-Csepel Group period (Early Bronze Age 2/A), the age of Budatétény and Csepel cemeteries (Early Bronze Age 2/B), the period of Diósd and Budafok sites (Early Bronze Age 3/A), the age of Kulcs-type findings (Early Bronze Age 3/B) (Schreiber 1984; Kalicz 1984; Kalicz-Schreiber 1984).

Recently, Gabriella Kulcsár has discussed the question of the beginning of Early Bronze Age development in Hungary in several of her works (Kulcsár 2009; Kulcsár & Szeverényi 2013; P. Fischl et al. 2015). The change in her opinion indicates the long way the study, which barely had modified the chronological framework during the evaluation of the rapidly increasing number of scientific data, has gone through in the last few years. After examining the findings of the Makó-Kosihy-Čaka culture, and considering periods 1-2 of Early Bronze Age Hungary parallel with the RBz A0 period, she has come to dating it between 2800/2700-2500/300 BC (Kulcsár 2009, 15). Then, in light of the new AMS ^{14}C data, she has inserted a transition period between the Copper Age and the Early Bronze Age dated to 2800-2600 BC (Kulcsár & Szeverényi 2013, 75., 82), and starting with its second phase, she has dated the beginning of the Early Bronze Age Hungary around 2600 BC (P. Fischl et al. 2015, 505., Fig. 1a-b).

In recent years the AMS radiocarbon data indicating the end of the Copper Age – though showing a considerable dispersion – mostly end around 2600 cal BC, which at the same time marks the beginning of Early Bronze Age (Dani-Horváth 2012, 81). For example, at the Dunaföldvár-Kálvária site, in the subhumus under the proto-Nagyrév layer Late Copper Age findings of the Kostolac group were found (Szabó 1992). The data from Foeni Gaz site lying in the Banat region of Romania clearly show that the 28-26 century BC settlement layers of the Kostolac group are followed by the 26-23 century BC findings of the Makó culture, and then by the Nagyrév culture until the 21st century BC (Krauß & Ciobotaru 2013, 61). AMS radiocarbon data indicate that along the River Kapos, at the Dombóvár-Tesco site, in the 1st period Early Bronze Age Hungary settlement of the Somogyvár-Vinkovci culture – which then occupied the inner regions of Transdanubia – life was active around 2570-2470 BC. These observations support well the suggestion, made at the end of the 1980's based on the Dunaföldvár-Kálvária layer sequence, that in the Carpathian Basin the people of the Somogyvár-Vinkovci, Makó-Kosihy-Čaka and proto-Nagyrév cultures are almost of identical age and their territories complete one other (Endrődi 2014, 260).

There is one fundamental question forming more and more clearly in light of the latest research results, which in the three-part division of István Bóna's Early Bronze Age Hungary framework were only vaguely touched upon. The duration and the view of the absolute chronology regarding the Early Bronze Age in Hungary have changed a lot in the past decades. After using a duration of 300 years, then almost a thousand years, most recently we could calculate with 600-700 years. The latest results consistently indicate that today based on the new AMS radiocarbon data the Early Bronze Age in Hungary can be quite steadily dated to 2600-1900 BC. By now we have found out about the archaeological cultures, which were thought to be in sequential succession when the age division system was created based on the knowledge of the end of the 1950's, that in many cases they were in fact more or less contemporary cultures with territories completing each other. For this reason the question is inevitable, whether it is really justifiable to keep the many-times reinterpreted internal division of the Hungarian Early Bronze Age, consisting three phases – or even half a dozen if we include the sub-periods. Does it really help or rather impede the results of Hungarian research – thinking more and more in a European context – to become internationally incorporated? For example, while analysing radiocarbon data Slovenian researchers have recently pointed out that the Early Bronze Age in Hungary seems to start only in its 2nd period (Črešnar & Teržan 2014, 663). The anomaly was basically due to a contradiction between previously dating the beginning of the Early Bronze Age in Hungary too low around 2800 BC and the new AMS radiocarbon results. A number of Hungarian researchers came up with two solutions for resolving this contradiction. Considering that based on the overlapping calibration curves Late Copper Age and Early Bronze Age cultures were much more likely to live parallel, they could not exclude the possibility that the radiocarbon data could simply not be separated correctly (Kulcsár & Szeverényi 2013, 71). It is this latter possibility why it is especially important what Alin Frînculeasa and his colleagues have observed. They have examined Copper Age samples from the eastern foregrounds of the Carpathians based on the

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results of the Kiev laboratory and they have noted a striking density of data between 3300-3100 cal BC and 2880-2580 cal BC. Relying upon these findings they presumed to find two plateaus appearing in the radiocarbon measurements in these periods (Frînculeasa et al. 2015, 48). Based on all this, due to the coincidence between the dating of the plateau to around 2880-2580 cal BC and the data sorted to the Carpathian Basin transition period, today it seems more likely that the wider than normal overlapping of data was only a metrological phenomenon, which has not reflected a real historical process. This argument is also supported by the fact that no one have successfully observed and separated the mixed material of finds of the Late Copper Age-Early Bronze Age periods belonging to the supposed transition period.

Paul Reinecke's Central European chronology and the new AMS data

In light of the radiocarbon data of the cemetery of Singen in southern Germany, from the end of the 1980's, the beginning of the Central European Early Bronze Age was placed in accordance with the beginning of the RBz A1 period of Reinecke's traditional chronological division almost 500 years earlier, to 2300/2200 BC (Becker et al. 1989, 433). The internal periodization traditionally using technological aspects since Reinecke, separating the beginning of the RBz A2 period based on the strikingly different cast bronze objects after the hammered objects of the RBz A1 period, dated it around 2000 BC, which is also supported by the dendrochronological data of the chieftain's grave in Leubingen (Becker et al. 1989, Abb. 4). When Stockhammer's team re-measured ten graves from the Singen site, they were surprised to find that the new AMS procedure consistently gave them younger data, based on which they have lowered the beginning of the RBz A1 period to around 2150/2100 BC. Comparing the data of the graves found around Stuttgart and in eastern Germany it became clear that it is impossible to separate RBz A1 and A2 periods strictly according to technological aspects, since there is a significant overlapping between the measurement data of graves classified to one or the other period strictly on a typological basis (Stockhammer et al. 2015, 32. 18-24). What was evident from the data is that the end of the RBz A period could be placed around 1700 BC, meaning that the period instead of the previous 750/700 years long duration would cover only 450 years. Consequently, instead of the previously presumed dating of 1600/1550 BC, the beginning of the Late Bronze Age would be now at the beginning of the 17 century BC (Stockhammer et al. 2015, 18). It has to be also taken into consideration that regarding the question of a longer or shorter duration of the transition period between the Late Neolithic Age and the Bronze Age they deem more probable a short, smooth transition based on their datasets (Storckhammer et al. 2015, 24). Their new results call attention to not only clarifying the starting and ending points of Central European Early Bronze Age, but that the data measured by using the older, traditional technique and the results of the new AMS procedure cannot always be used together, not even with recalibrations (**Figs. 1-2.**).

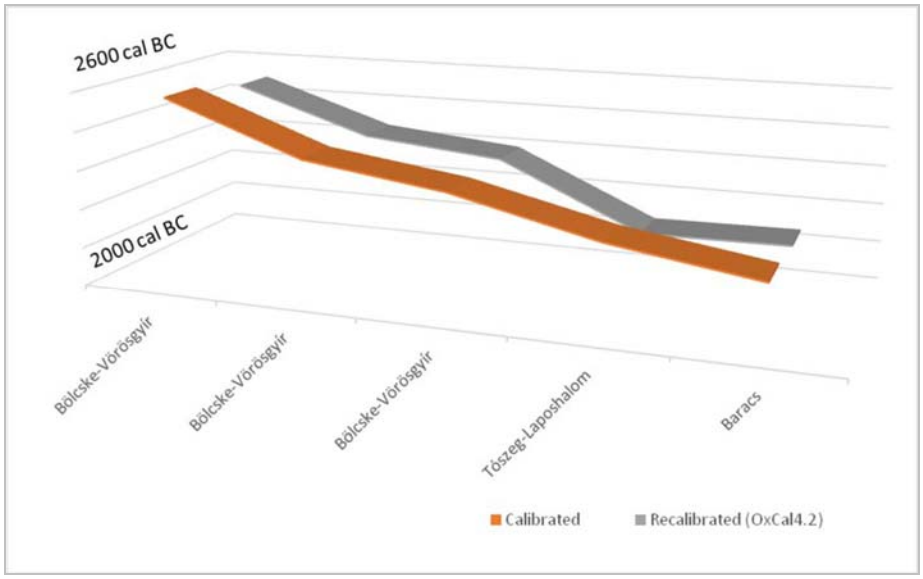

Fig. 1.: The previous and the recalibrated radiocarbon data of the Nagyrév culture (Raczky et al. 1992; OxCal 4.2 Bronk Ramsey 2013)

1. ábra: A Nagyrév kultúra régi és újrakalibrált radikarbon adatai (Raczky et al. 1992; OxCal 4.2 Bronk Ramsey 2013)

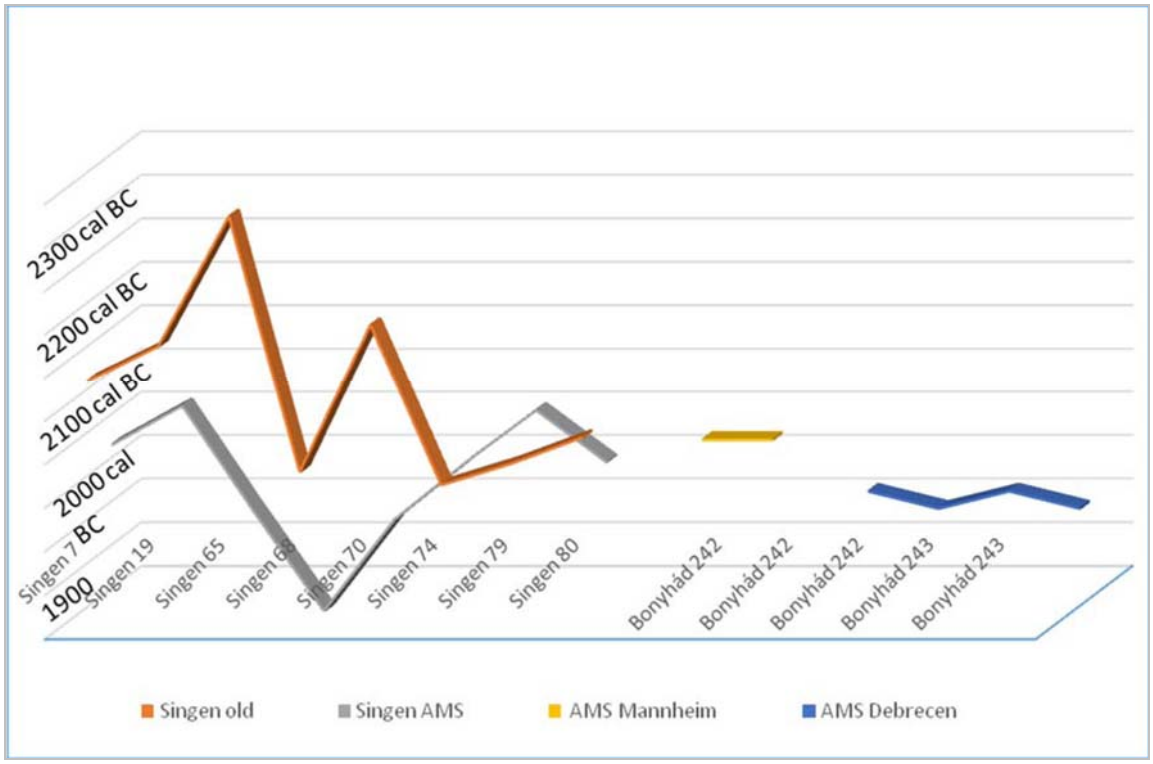

Fig. 2.: Comparison between the traditional and the new BP radiocarbon data of the Early Bronze Age cemetery of Singen (Stockhammer et al. 2015, based on Table 4) and date of Bonyhád-Biogáz BBQ242-243 graves (Hajdu et al. 2016; Kiss et al. 2014, Fig. 11.)

2. ábra: Singen kora bronzkori temetőjének eltérő módszerekkel mért régi és új BP radiokarbon adatainak (Stockhammer et al. 2015, Table 4. alapján) valamint Bonyhád-Biogáz BBQ242-243 sírok összehasonlítása (Hajdu et al. 2016; Kiss et al. 2014, Fig. 11.

Among the results of the German researchers, the new AMS data, shorter than those of the samples traditionally measured, raise some especially interesting questions about the beginning and ending of the Early Bronze Age in Hungary, but also about determining the starting and ending points of internal periods. Up to this very day, Hungarian research uses István Bóna's three-part division system of Bronze Age, developed in the 1950's, based on the stages of general social development theory (Bóna 1958). Though from time to time it was updated to align it with new scientific accomplishments, its internal division has been kept unchanged ever since. Bóna, in his own system, has placed the entire Carpathian Early Bronze Age period before the RBz A1 period, between 1900-1650 BC (Bóna 1960a, 46). He has drawn parallels between the Central European Early Bronze Age and the period from which the Middle Bronze Age findings were originated (Bóna 1958, 223). He stuck to his opinion even in the catalogue published in 1992, though then already a whole range of new archaeological findings and radiocarbon data have indicated both in Hungary and abroad that the Carpathian Early Bronze Age does not precede the RBz A1 period, but the two are parallel to each other, and that the period is much longer than previously presumed (Kalicz 1984; 1989; Kalicz-Schreiber 1984). Only after the death of the professor, who had founded this school of thought, did his students assemble and compare the data of scientific examinations in relation to both Paul Reinecke's Central European- and István Bóna's Hungarian chronologies of the Bronze Age, in light of the results of European Bronze Age research of the time, as well as with the typo-chronological observations primarily focusing on bronze objects. After the turn of the millennium both radiocarbon and dendrochronological data became available, so Viktória Kiss took the two into consideration together to find the connections between the two areas and chronological systems while primarily focusing on the bronze objects found in the graves and the absolute chronological boundaries (Kiss 2005, Fig. 9. 2). Regarding the beginning of the Early Bronze Age in Hungary, she only briefly mention that although some deem the date 2800/2700 BC a possible beginning (MRE 2003, 476), she was rather focusing on determining the boundaries of the last phase of that age. Using the data of German research, she has also used the radiocarbon data of the Singen cemetery and the

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dendrochronological results of the oak wood remains in Leubingen as a starting point (Kiss 2005, 221-222). Based on the data available, she thought it possible to synchronise the chronological systems of the two areas by putting the 3rd phase of the Hungarian Early Bronze Age between 2200-2000 BC, corresponding to the RBz A1 period of Central European Bronze Age, and the subsequent Hungarian Middle Bronze Age placing it between 2000-1500 BC (RBz A2a-b, RBz A2c-B). She considers that the findings from cultures which had occupied the Eastern and Western areas of the Carpathian Basin, as well as the Western parts of Central Europe, could be all connected by setting the starting and ending points of the Hungarian Early and Middle Bronze Age at the turn of the RB A1 and A2 periods (Kiss 2005, 221-222). Based on new AMS radiocarbon data, she and her co-authors have recently dated the 3rd period of Early Bronze Age Hungary a bit later, between 2100-1900 BC, which comes close to Stockhammer's results in many respects (Kiss et al. 2015, 32). On the one hand, they calculate with a shorter interval than previously presumed, while on the other hand even their data show younger starting and ending points for the phase, which has been still regarded parallel with the RBz A1 period.

Problems with the periodization and dating of the Early Bronze Age in the Hungary

The contradictions between the different radiocarbon dating results could be clarified by the target-oriented processing of Carpathian Late Copper Age-Early Bronze Age radiocarbon data from most of the important sites, according to certain problem-specific aspects (Ilon 1991; Raczky et al. 1992; Dani & Horváth 2012; Kiss 2012; Jaeger & Kulcsár 2013; Kulcsár–Szeverényi 2013; Krauß 2013; Črešnar &Teržan 2014; Kiss et al. 2015; P. Fischl et al. 2015; Frînculeasa et al. 2015). Due to the change in measurement techniques, as well as the effects of environmental and other factors, the data available are often very diffused and they are hardly compatible with traditional archaeological chronologies. For this reason I have only used the mixed, older data for illustrating only the direction of the main tendencies, and in every case they have been recalibrated by using the IntCal atmospheric calibration curve with the OxCal 4.2 program (Bronk Ramsey 2009; Reimer et al. 2013). In light of the recalibrated data it was clear that even in case of the extremely high or low values, one margin of the measuring range was still overlapped by seemingly average data..

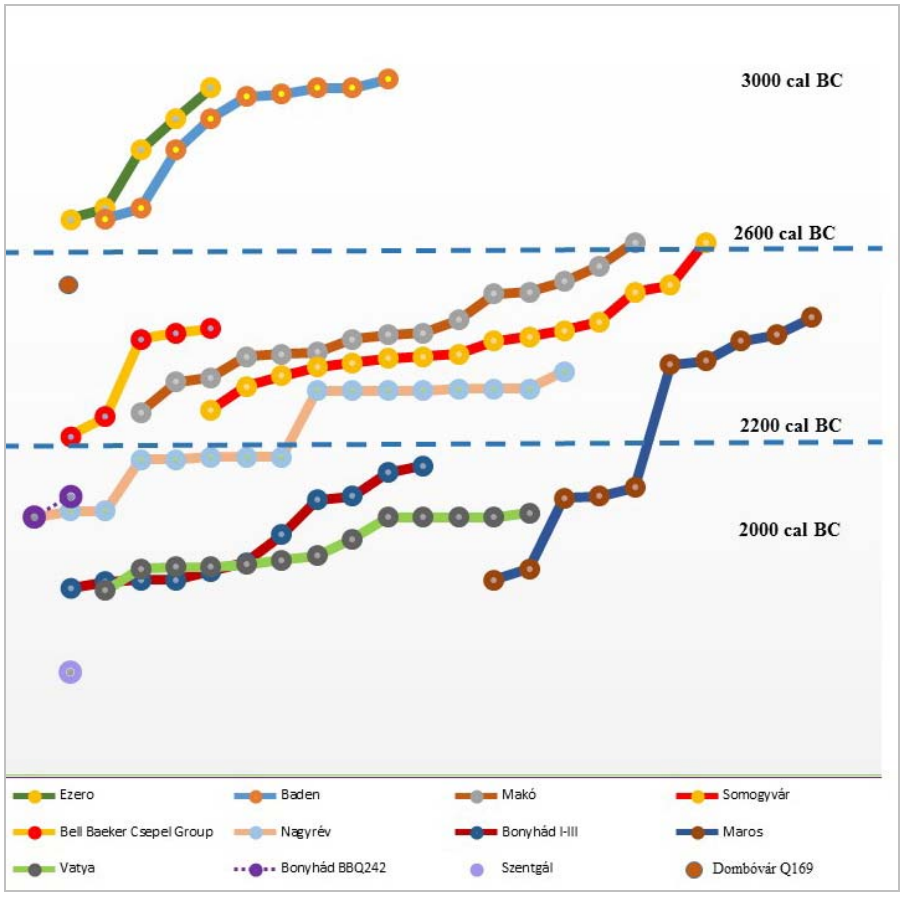

Fig. 3.: Trend lines of Early Bronze Age chronology in the Carpathian Basin based on the traditional and the latest AMS radiocarbon data (based on the data of **Table 1.**)

3. ábra: Kora bronzkori időrendi trendvonalak a Kárpát-medencében a hagyományos és újabb AMS radiokarbon adatok alapján (**1. táblázat** adatai alapján)

So I have decided that instead of using the curves usually applied for statistical analysis, this time I would leave out the extreme values and worked with the mean value of the received values, rounded to the nearest ten, so that I can get a more expressive, graphic illustration of the tendencies. However for answering certain partial questions, I have specifically taken into account the AMS results of the last decade (**Fig. 3.**)

Looking at the radiocarbon data and research results published from a wider or narrower area, it seems more and more apparent regarding the entire Carpathian Basin that what Hungarian research now calls the 1st period of the Early Bronze Age based on István Bóna's age division, might have started around 2600 cal BC beside the Makó-Kosihy-Čaka, the Somogyvár-Vinkovci and the proto-Nagyrév cultures, living in parallel. However, there are extremely high, mostly earlier, data at the excavation sites of both the Somogyvár-Vinkovci and the Makó-Kosihy-Čaka cultures (Črešnar & Teržan 2014 663; Raczky et al. 1992). Because of these it was not clear whether the deviation is caused only by the anomalies of radiocarbon dating, or the first waves of the Jamnaja culture really arrived in the southern half of the Carpathian Basin already in the Late Copper Age (Dani & Horváth 2012, 110-111). If it is the case, then the transition period presumed by others (Dani & Horváth 2012, 100; Kulcsár & Szeverényi 2013, 75., 82) would connect more tightly with the Late Copper Age than with the beginning of the Early Bronze Age, even according to those radiocarbon data which indicate the Baden culture as predominant in the entire area of the Carpathian Basin and the Balkans. However, the data from the sites of both the Late Copper Age Baden culture and the Early Bronze Age Somogyvár-Vinkovci and Makó-Kosihy-Čaka cultures indicate a value close to 2600 cal BC with relative consistency, meaning that the turn of the age happened in an enormous area swiftly and at the same time. There is a significant quantity of mixed archaeological findings missing from a large area to be able to confirm the longer transition period, presumed by many based on the elongated radiocarbon results. Moreover, the Baden elements found in the remains of the Somogyvár-Vinkovci culture are not necessarily a proof of their further stay in the Carpathian Basin, since during their migration they could have met these influences already on their way along the Lower Danube.

Looking at chronological dating supplemented with the examination of the area and the process of the expansion of certain Early Bronze Age archaeological cultures shows an especially interesting picture. Today researchers are relatively unified in that the Makó-Kosihy-Čaka culture occupying the eastern and north-western parts of the Carpathian Basin from 2600/2500 BC is almost of the same age as the people of the Somogyvár-Vinkovci culture, taking the area of the late Vučedol culture in the southern and western half of Transdanubia and as the proto-Nagyrév people settling along the Danube and Tisza rivers (P. Fischl et al. 2015, Fig. 3). These three cultures of Carpathian Basin-significance are perfectly completed by the row of sites of the Bell Beaker culture of determining importance with regards to the entire European Prehistory, coming up along the Danube until the area of Budapest and projecting into the territories of the other cultures and - based on radiocarbon data - settling down from around 2500-2200/2100 BC (Endrődi 2013; Patay 2013; P. Fischl et al. 2015, 505-506). The current research is also relatively unified in that this period closes with the ending of the Hungarian Early Bronze Age period 2/A – along with the life of the mentioned archaeological cultures, with the exception to the proto-Nagyrév people occupying the central parts of the Carpathian Basin alongside the two rivers. Life in the settlements of the latter culture becomes much more active than previously, and starts the thriving tell-development of the Nagyrév- and the significantly overlapping - Vatya culture until the end of the Middle Bronze Age.

Looking at the question from a different angle, all of this shows that regarding historical processes, in Bóna's Hungarian Early Bronze Age chronology the turning point is not between the 1st and 2nd period, but afterwards, and even then the change was only of a small degree which would not have an effect on the entire Carpathian Basin like during the turning period between the Copper Age and the Early Bronze Age. At the same time, it is evident that changes like at the end of the lives of the abovementioned four big cultures occurred later with some delay only affecting certain, much smaller regions, typically along the routes leading inside the Carpathian Basin. It is also apparent that from the beginning of the Copper Age these regions, lying in a half circle, starting from the south-eastern green corridor of the Danube through the Verecke- and Dukla Pass to the north-western region leading to the Vienna Basin, were under the direct or indirect influence of the movements of the different Steppe people living outside the Carpathians. First, the early Maros culture appeared in the area of the Tisza and Maros rivers, then the Nyírség culture in the eastern parts and the Hatvan culture in the Northern Great Plain region (P. Fischl et al. 2015, 506-508., Fig. 1b). Research traditionally places the development of these cultures stretching during the Hungarian Early Bronze Age period 2/B (Bóna 1992; Koós 1999, 105; Kiss et al. 2015, 27).

The Transdanubian occurrence of rolled stick-ornamented pottery at the end of the life of the Somogyvár-Vinkovci culture indicates the

influence of the Corded Ware culture coming from a north-western direction (Bándi 1967, 27; Szabó 2010). The related skeletal graves are at the same time marking the earliest period in the cemetery of the Encrusted Pottery culture at Bonyhád. The pottery of the Somogyvár culture appearing along the Danube at the Nagyrév sites from the second half of the Hungarian Early Bronze Age period 2 might also indicate that most of the population moved close to the river from the Steppe peoples arriving from Northwest, but originated from the East (Szabó 2010, 112).

The processing of the material found at the cemetery of the Encrusted Pottery culture at Bonyhád has brought results that give us the opportunity to have a unique, wider look at this complex problem, connecting the two approaches of different views, the ^{14}C values of the Szentgál Kőlik Cave of the Mecsek Hill and the latest radiocarbon data. The typo-chronological classification of grave furniture, especially of some of the metal objects is comparable with the re-measured finds of the cemetery at Singen. On the other hand, most of the radiocarbon examinations of finds were performed in the laboratory of Debrecen, though now using the AMS method. Furthermore, as I have already mentioned, one of the samples of grave BBQ 242 was also examined in the same Mannheim laboratory where many of the finds of Stockhammer were evaluated (**Fig. 2.**). The remains of the peculiar pottery of the people named by part of the research as the Kisapostag culture and their dead lying on the back with legs turned on the side, were found during the construction of the Bonyhád-Biogas plant and according to the five radiocarbon data of the two graves (BBQ242-243) measured in two laboratories (Debrecen, Mannheim) their ages are 1σ 2125–1891 cal BC, and 2σ 2136–1834 cal BC (Hajdu et al. 2016; Kiss at al. 2015, Fig. 11). These graves are already the first representatives of the process that leads to the Middle Bronze Age development. The southern Trandanubian inner hill-country and the areas along the Danube continue to develop in another direction. The spreading of Encrusted Pottery over the former areas of the Somogyvár culture and the Vatya culture living along the Danube and in the Mezőföld region, on the former tells of the Nagyrév culture without larger breaks was observed until the end of the Middle Bronze Age.

Besides the appearance of new elements, the strong influence and mixing of earlier archaeological cultures is apparent for example in the cemetery at Bonyhád (Bonyhád, BBQ103J5: Szabó 2010, 108., 5. Table 7). The overlapping and mixing seen in the findings and in the anthropological material might have led to the "tessellation" already described by Mária Károlyi in the 1970's (Károlyi 1972). In connection with the previously sharply divided RBz A1 and A2 periods of the Central European Bronze Age, Stockhammer and his colleagues have basically came to the same conclusion, picking out the mixing and regionally different dating of the typical artefact types of these two periods (Stockhammer et al. 2015, 29).

The rich material of finds from the graves at the Bonyhád site well reflects that the cemetery was continuously used until the end of the Middle Bronze Age. Similarly continuous and seamless development appears in most parts of the Carpathian Basin, which started at the latest at the beginning of István Bóna's Early Bronze Age Hungary period 3 and lasted until the end of the Middle Bronze Age (Bóna 1992, 16-17). All these indicate that the historical processes outlined by the radiocarbon data cannot be closely connected with István Bóna's three-part division chronology system of Early Bronze Age Hungary developed in the 1950's based on the stages of general social development theory (beginning, flourishing and decline).

As Hungarian research early recognised, the Carpathian Basin occupies a unique, independent place between the Central European cultures of basically German approach or the Balkan-Aegean cultures, not only in a territorial aspect but also regarding the historical processes (Mozsolics 1937; 1943; Patay 1938; Bóna 1958). In the Early Bronze Age the Carpathian Basin was in close contact with the abovementioned geographic regions, but it had a range of independent archaeological cultures developing in their own, regional pace. For this reason it still seems necessary to keep the Early Bronze Age chronological system of the Carpathian Basin reflecting its own peculiarities, aligned with the latest results of research, while to synchronise it also with the results of European research.

There is a wide consensus among researchers about the beginning of the Carpathian Early Bronze Age around 2600/2500 BC and ending around 1900 BC (Kiss et al. 2015, 32; P. Fischl et al. 2015). In light of the latest data, this, serving as a good basis, shows synchronising it with Reinecke's chronological system, generally used in European research, expedient and also possible through the clarification of the turning points of the internal periods. Findings from the Bell Beaker culture around Budapest give us a direct chance for synchronising, since they were present in a large part of Europe in the RBz A0 period (Endrődi 2013) (**Fig. 4.**).

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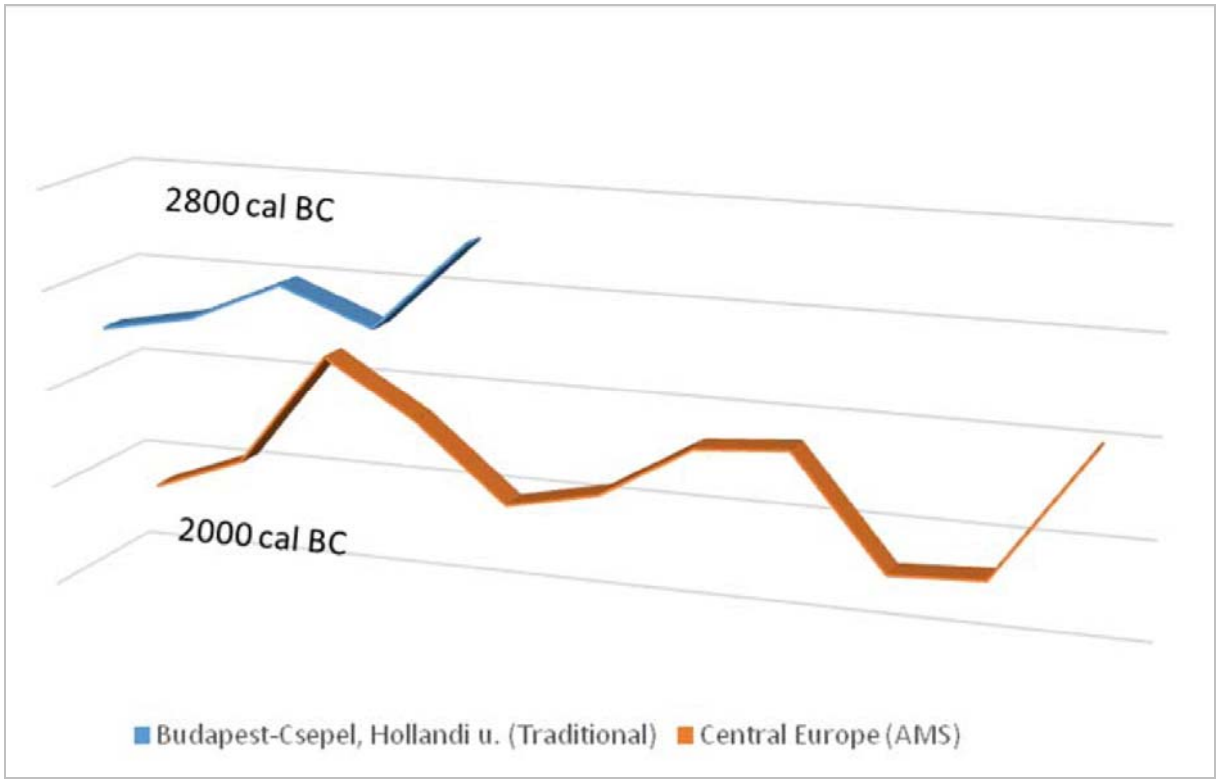

Fig. 4.: Comparison between the data measured by traditional methods of the Bell Beaker Culture cemetery found at Hollandi Road, Budapest-Csepel (Raczky et al. 1992) and the recent AMS results of Augsburg, Hugo-Eckener-Straße, Universitäts-gelände and Königsbrunn, Ampacksites (Stockhammer et al. 2015, based on the data of **Table 1.**)

4. ábra: A Harangedényes kultúra Budapest-Csepel Hollandi úti temetőjében hagyományos eszközökkel (Raczky et al. 1992) és az Augsburg, Hugo-Eckener-Straße illetve Universitätsgelände, valamint Königsbrunn, Ampack lelőhelyeken újabban mért AMS eredmények összehasonlítása (Stockhammer et al. 2015, Table 2. adatai alapján)

Stockhammer and his colleagues received data about the ages of three Bell Beaker culture graves from Engen-Welschingen to be around 2σ 2490–2110 cal BC, based on the results of the laboratory of Mannheim. Complementing these data by the re-measured data of the Early Bronze Age cemetery of Singen starting from 2150 cal BC, they have determined the end point of the RBz A0 period to be around 2150 BC (Stockhammer et al. 2015, 24). The value of BBQ242 grave of Bonyhád measured also in Mannheim to 2σ 2140–1950 cal BC fits well this picture, suggesting that the 1st period of the Carpathian Early Bronze Age could be partially parallel to the RBz A0 period, corresponding with its 2150 BC ending as well (**Fig. 2., 5.**).

The measurement of grave BBQ242 in the laboratory of Debrecen gave results – a bit younger than the data received in Mannheim, but still in agreement within the 2 sigma errors – between 2σ 2030–1830 cal BC (Kiss et al. 2015, Fig. 11). On the other hand, recently in the case of the skeletal grave BBQ226 they have measured the same 2σ 2140–1950 cal BC data (Kiss et al. in print Fig. 6) as the German laboratory, indicating that the 2nd period of the Carpathian Early Bronze Age could be considered parallel with the RBz A1 period, starting from the development of the Early Encrusted Pottery – and with some deviations – the early Maros, Nyírség and Hatvan cultures, spanning from around 2150 BC until 1900 BC.

In spite of the contradictions between typo-chronological and radiocarbon data, based on the observations made at the Bonyhád excavation site, it seems that in the middle of the second half of our Early Bronze Age – of the period lasting until approximately the 19th century BC –the use of pottery with encrusted ornamentation in a wide band, as seen in the graves of Bonyhád phase III, became popular together with the custom of cremation. (We should only mention in parentheses that the use of variously produced incrustations without a white inlay clearly shows that the incrustation had its own meaning by itself. Especially in case of grave potteries, their encrusted inlays provided further information to the observer (Szabó & Hajdu 2011).

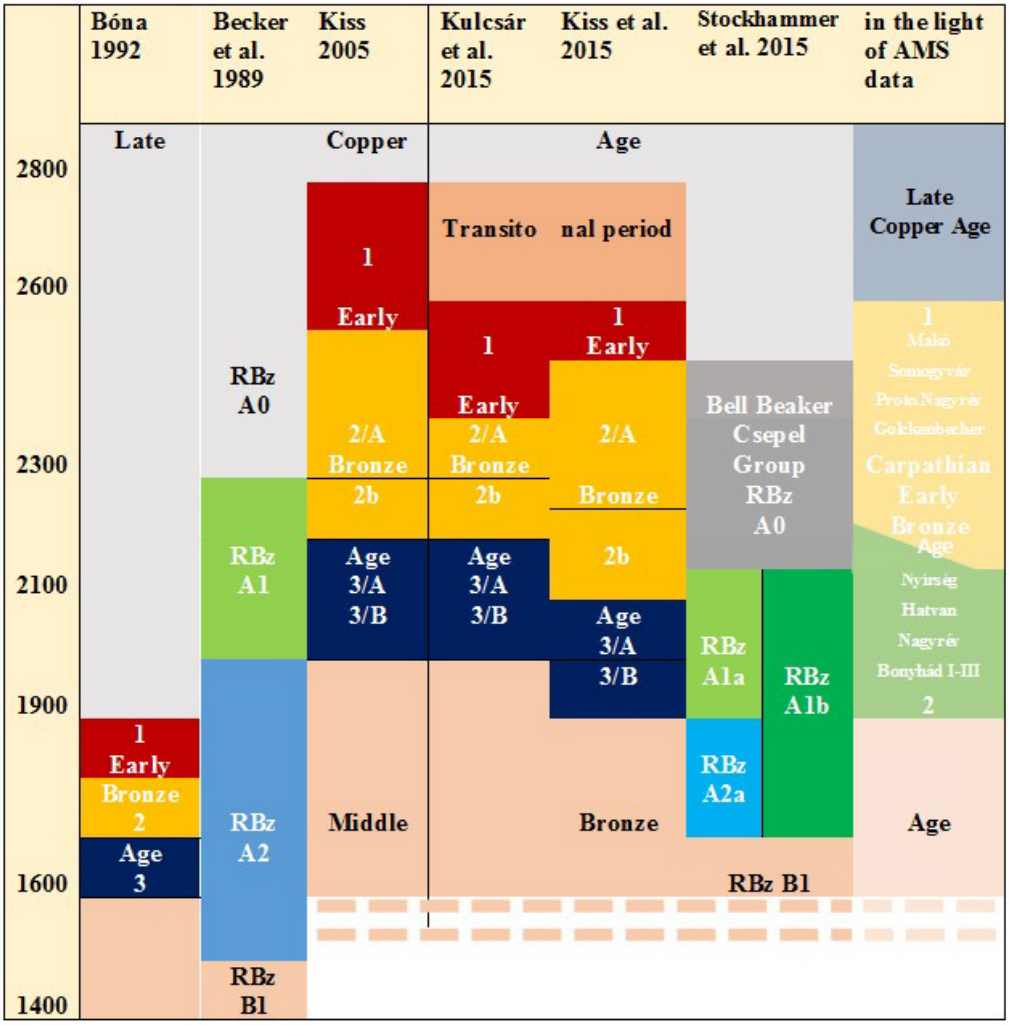

Fig. 5.: The chronological changes and the chronological order based on the recent ^{14}C data of the Early Bronze Age in the Carpathian Basin and their synchronisation with the archaeological findings in Central Europe

5. ábra: A Kárpát-medence kora bronzkori kronológiájának változásai és az újabb ^{14}C adatok alapján kirajzolódó időrendje, szinkronizációja Közép-Európa régészeti leleteivel

Periodization of the Carpathian Early Bronze Age in light of the recent radiocarbon data

New research results and the increasing number of AMS radiocarbon data both show that the Carpathian Early Bronze Age could be rather divided into two distinct periods, between which the turning point is not so sharp, since on a regional level the new and the older cultures seemed to live in parallel for a shorter or longer period of time. For this reason the new research results justify using a two-part division of the Early Bronze Age in Hungary, which better aligns with the historical processes than the previous, artificial division into three parts. Also, instead of using artificial national boundaries it seems more reasonable to categorically use the geographic territorial integrity, extending research to the actual boundaries of the Carpathian Basin (**Fig. 5**.).

Carpathian Early Bronze Age 1 (CEBA 1: 2600/2500 cal BC – ~2150 cal BC) spanning over the lifetimes of the Makó-Kosihy-Čaka, Somogyvár-Vinkovci, proto-Nagyrév cultures and Bell Beaker Csepel Group occupying the region according to radiocarbon data after 2600/2500 cal BC, corresponding with István Bóna's Early Bronze Age period 1-2/A.

Carpathian Early Bronze Age 2 (CEBA 2: ~2150 cal BC – ~1900 cal BC) involving the early period of expansion (Bonyhád phases I-III) of the Nagyrév, early Maros, Nyírség, Hatvan cultures, as well as the Encrusted Pottery culture in Transdanubia, reflecting the influences of the Late Corded Ware culture, corresponding with István Bóna's Early Bronze Age period 2/A-3.

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Table 1.: List of the used radiocarbon data
1. táblázat: A felhasznált radiokarbon adatok

Site	Sample	BP	References
Late Copper Age, Balkan			
Gomolova (RS)	GrN 13168	4380±70	Forenbaher 1993; Stadler et al. 2001, 551. Table 7.
Ószentiván (HU)	Bin 476	4515±80	Stadler et al. 2001, 551. Table 7.
Podolic (SK)	Bin 556	4455±80	Forenbaher 1993; Stadler et al. 2001, 551. Table 7.
Niederhollabrunn (AT)	ETH 15241	4710±95	Stadler et al. 2001, 551. Table 7.
Ezero (BG)	Bin 421	4335±80	Stadler et al. 2001, 551. Table 7.
Ezero (BG)	Bin 422	4310±80	Stadler et al. 2001, 551. Table 7.
Ezero (BG)	Bin 427	4365±80	Stadler et al. 2001, 551. Table 7.
Ezero (BG)	Bin 428	4260±80	Stadler et al. 2001, 551. Table 7.
Ezero (BG)	Bin 429	4130±100	Stadler et al. 2001, 551. Table 7.
Ezero (BG)	Bin 1822	4275±65	Stadler et al. 2001, 551. Table 7.
Ezero (BG)	Bin 1824	4135±65	Stadler et al. 2001, 551. Table 7.
Sitagroi (GR)	Bin 773	4390±100	Stadler et al. 2001, 551. Table 7.
Sitagroi (GR)	Bin 782	4310±100	Stadler et al. 2001, 551. Table 7.
Sitagroi (GR)	Bin 878	4395±100	Stadler et al. 2001, 551. Table 7.
Sitagroi (GR)	Bin 879	4550±100	Stadler et al. 2001, 551. Table 7.
Sitagroi (GR)	Bin 880	4510±100	Stadler et al. 2001, 551. Table 7.
Sitagroi (GR)	BM 650a	4363±56	Stadler et al. 2001, 551. Table 7.
Sitagroi (GR)	BM 651	4332±79	Stadler et al. 2001, 551. Table 7.
Arbon Bleiche (CH)	B 6360	4710±30	Stadler et al. 2001, 551. Table 7.
Foeni Gaz (RO)	MAM11203	4214±27	Krauß & Ciobotaru 2013, 61.
Foeni Gaz (RO)	MAMS10893a	4133±25	Krauß & Ciobotaru 2013, 61.
Foeni Gaz (RO)	MAMS-10893b	4126±26	Krauß & Ciobotaru 2013, 61.
Foeni Gaz (RO)	Hd-29516	4017±48	Krauß & Ciobotaru 2013, 61.
Late Copper Age, Hungary			
Sárrétudvar Őrhalom Tumulus 10 grave	Deb-6639	4350±40	Dani & Horváth 2012, 29; Frînculeasa et al. 2015, Tab. 1.
Sárrétudvar ŐrhalomTumulus 12 grave	Deb-6870	4520±40	Dani & Horváth 2012, 29.
Sárrétudvar Őrhalom Tumulus 9 grave	Deb-6871	4060±50	Dani & Horváth 2012, 28; Frînculeasa et al. 2015, Tab. 1
Sárrétudvar Őrhalom Tumulus 4 grave	Deb-7182	4135±60	Dani & Horváth 2012, 26; Frînculeasa et al. 2015, Tab. 1
Sárrétudvar Őrhalom Tumulus 8 grave	Poz-39563	4530±60	Dani & Horváth 2012, 28.; Frînculeasa et al. 2015, Tab. 1
Balatonőszöd-Temetői dűlő	Deb-13379	4480 ± 70	Horváth et al. 2006, 22.
Balatonőszöd-Temetői dűlő	Deb-13245	4220 ± 50	Horváth et al. 2006; Molnár 2008.

Table 1., cont.

Site	Sample	BP	References
Makó-Kosihy-Čaka Culture			
Berettyóújfalu-Nagy-Bócs-dűlő	Poz-31798	3990±30	Dani – Kisjuhász 2013, 689.
Berettyóújfalu-Nagy-Bócs-dűlő	Poz-31800	3955±35	Dani – Kisjuhász 2013, 689.
Berettyóújfalu-Nagy-Bócs-dűlő	Poz-31803	3970±40	Dani – Kisjuhász 2013, 689.
Domony	Hd-1330	3785±70	Dani – Kisjuhász 2013, 689.
Nyíregyháza-Császárszállás	Deb-9383	4020±70	Dani – Kisjuhász 2013, 689.
Nyíregyháza-Császárszállás 5	Deb-10260	3900±50	Dani – Kisjuhász 2013, 689.
Kismarja-Nagymarjai-dűlő	Deb-10092	3930±60	Dani – Kisjuhász 2013, 689.
Kismarja-Nagymarjai-dűlő	Deb-10093	3830±50	Dani – Kisjuhász 2013, 689.
Foeni Gaz (Ro)	MAMS-10894	3936±25	Krauß & Ciobotaru 2013, 61.
Foeni Gaz (RO)	Poz-38231	3915±35	Krauß & Ciobotaru 2013, 61.
Foeni Gaz (RO)	MAMS-10891	3902±25	Krauß & Ciobotaru 2013, 61.
Somogyvár-Vinkovci Culture			
Josipovac (HR)	Beta-261089	3840±40	Črešnar & Teržan2014, 664, 665.
Čepinski Martinci (HR)	Beta-278756	3850±40	Črešnar & Teržan2014, 664, 665.
Nagyárpád	Bln-1634	3885±40	Raczky et.al. 1992.
Szava	Bln-1640	4000±50	Črešnar & Teržan2014, 664, 665.
Nagyárpád	Bln-1945	3900±60	Raczky et.al. 1992.; Črešnar & Teržan2014, 664, 665.
Pod-Kotom sever I (SL)	KIA21397/2	3355±30	Črešnar & Teržan2014, 664, 665.
Jakopovec-Blizna (HR)	KIA22471	2960±25	Črešnar & Teržan2014, 664, 665.
Jakopovec-Blizna (HR)	KIA22473	2880±30	Črešnar & Teržan2014, 664, 665.
Grofovsko (SL)	KIA22956	3450±30	Črešnar & Teržan2014, 664, 665.
Grofovsko (SL)	KIA22957/2	3335±35	Črešnar & Teržan2014, 664, 665.
Vinkovci (HR)	KIA29563	3881±25	Črešnar & Teržan2014, 664, 665.
Pince (SL)	KIA30276	3940±30	Črešnar & Teržan2014; 663, 665.
Pince (SL)	KIA30279	3860±25	Črešnar & Teržan2014; 663, 665.
Pod-Kotom sever I (SL)	KIA32898	3365±45	Črešnar & Teržan2014; 677.
Josipovac (HR)	KIA35439	3926±24	Črešnar & Teržan2014, 664, 665.
Za Raščico (SL)	KIA36663	4096±30	Črešnar & Teržan2014; 662, 663,665.
Za Raščico (SL)	KIA36664	3900±35	Črešnar & Teržan2014; 662, 663,665.
Za Raščico (SL)	KIA36665	3865±30	Črešnar & Teržan2014; 662, 663,665.
Za Raščico (SL)	KIA37370	4020±25	Črešnar & Teržan2014; 662, 663, 665.
Vinkovci (HR)	Z-1817	3810±78	Črešnar & Teržan2014, 664, 665.
Vinkovci (HR)	Z-1818	3835±78	Črešnar & Teržan2014, 664, 665.
Balatonőszöd–Temetői dűlő, B-2104.	Ki-16688	3460±60	Horváth 2014, 576, Table 19.
Dombóvár-Tesco DTQ169. pit		2570-2470 cal BC	Gál 2017, 96.
Bell Beaker Csepel Group			
Budapest, Csepel-Háros	Bln-1221	4235±100	Raczky et.al. 1992.

Table 1., cont.

Site	Sample	BP	References
Budapest, Csepel-Hollandi u.	Bln-1333	3960±80	Raczky et.al. 1992.
Budapest, Csepel-Hollandi u.	Bln-1334	4030±60	Raczky et.al. 1992.
Budapest, Csepel-Hollandi u.	Bln-1335	4160±60	Raczky et.al. 1992.
Budapest, Csepel-Hollandi u.	Bln-1404	4165±60	Raczky et.al. 1992.
Budapest, Csepel-Hollandi u.	Bln-1406	3945±60	Raczky et.al. 1992.
Szigetcsép	Bln-1638	3970±45	Raczky et.al. 1992.
Szigetcsép	Bln-1639	4030±60	Raczky et.al. 1992.
Budapest, Csepel-Hollandi u.	GrN-6900	3945±40	Raczky et.al. 1992.
Budapest, Csepel-Hollandi u.	GrN-6901	3770±50	Raczky et.al. 1992.
Szigetszent-miklós-Felső-Ürge-hegyi dűlő 10. sír	VERA-4748	3920 ± 40	Patay 2013, Fig. 19; P. Fischl et al. 2015, Appendix 1.
Szigetszent-miklós-Felső-Ürge-hegyi dűlő 49. sír	VERA-4749	3830 ± 40	Patay 2013, Fig. 19; P. Fischl et al. 2015, Appendix 1.
Szigetszent-miklós-Felső-Ürge-hegyi dűlő 50. sír	VERA-4750	3775 ± 35	Patay 2013, Fig. 19; P. Fischl et al. 2015, Appendix 1.
Szigetszent-miklós-Felső-Ürge-hegyi dűlő 367.. sír	VERA-4755	3875 ± 40	Patay 2013, Fig. 19; P. Fischl et al. 2015, Appendix 1.
Szigetszent-miklós-Felső-Ürge-hegyi dűlő 626. sír	VERA-4757	3845 ± 35	Patay 2013, Fig. 19; P. Fischl et al. 2015, Appendix 1.
Békásmegyer 193. sír	DeA-2875	3845 ± 36	P. Fischl et al. 2015, Appendix 1.
Békásmegyer 432a. Sír	DeA-2876	3831 ± 35	P. Fischl et al. 2015, Appendix 1.
Békásmegyer 445. sír	DeA-2877	3874 ± 33	P. Fischl et al. 2015, Appendix 1.

Site	Sample	BP	References
Nagyrév Culture			
Bölcske-Vörösgyír	Bln-1647	3820±40	Raczky et.al. 1992.
Bölcske-Vörösgyír	Bln-1648	3855±50	Raczky et.al. 1992.
Bölcske-Vörösgyír	Bln-1649	3950±70	Raczky et.al. 1992.
Tószeg-Laposhalom	Bln-1987	3765±60	Raczky et.al. 1992.
Baracs	Bln-340	3735±79	Raczky et.al. 1992.
Foeni Gaz (RO)	MAMS-10892	3712±25	Krauß & Ciobotaru 2013, 61.
Foeni Gaz (RO)	MAMS-10895	3696±31	Krauß & Ciobotaru 2013, 61.
Nyírség Culture			
Bakonszeg-Kádárdomb	Bln-1645	3625±40	Raczky et.al. 1992.
Hatvan Culture			
Törökszentmiklós-Terehalom	Bln-?	3620±50	Raczky et.al. 1992.
Jászdózsa-Kápolnahalom	Bln-1020	3790±60	Raczky et.al. 1992.
Jászdózsa-Kápolnahalom	Bln-1844	3525±50	Raczky et.al. 1992.
Jászdózsa-Kápolnahalom	Bln-1845	3480±50	Raczky et.al. 1992.
Jászdózsa-Kápolnahalom	Bln-1849	3550±60	Raczky et.al. 1992.
Jászdózsa-Kápolnahalom	Bln-1851	3480±58	Raczky et.al. 1992.
Jászdózsa-Kápolnahalom	Bln-1852	3570±85	Raczky et.al. 1992.
Jászdózsa-Kápolnahalom	Bln-1853	3636±65	Raczky et.al. 1992.
Tószeg-Laposhalom	Bln-1898	3595±65	Raczky et.al. 1992.
Törökszentmiklós-Terehalom	Bln-1930	3620±51	Raczky et.al. 1992.
Törökszentmiklós-Terehalom	Bln-1931	3510±50	Raczky et.al. 1992.
Jászdózsa-Kápolnahalom	Bln-2020	3790±100	Raczky et.al. 1992.
Polgár-Kenderföld	Deb-1487	3360±60	Raczky et.al. 1992.
Polgár-Kenderföld	Deb-1488	3410±60	Raczky et.al. 1992.

Table 1., cont.

Site	Sample	BP	References
Polgár-Kenderföld	Deb-1489	3580±60	Raczky et.al. 1992.
Polgár-Kenderföld	Deb-1490	3490±60	Raczky et.al. 1992.
Polgár-Kenderföld	Deb-1491	3490±60	Raczky et.al. 1992.
Polgár-Kenderföld	Deb-1492	3440±60	Raczky et.al. 1992.
Tószeg-Laposhalom	GrN-6653	3685±35	Raczky et.al. 1992.
Maros Culture			
Klárafalva-Hajdova	Beta-23098	3660±110	Raczky et.al. 1992.
Klárafalva-Hajdova	Beta-23099	3820±90	Raczky et.al. 1992.
Klárafalva-Hajdova	Beta-23100/Beta-23101	3532±81	Raczky et.al. 1992.
Klárafalva-Hajdova	Beta-23103	3590±140	Raczky et.al. 1992.
Klárafalva-Hajdova	Beta-23105	3380±60	Raczky et.al. 1992.
Kiszombor-Új Élet	Beta-30493	3960±190	Raczky et.al. 1992.
Klárafalva-Hajdova	Beta-30494	3400±120	Raczky et.al. 1992.
Klárafalva-Hajdova	Beta-30495	3670±110	Raczky et.al. 1992.
Klárafalva-Hajdova	Beta-30497	3400±180	Raczky et.al. 1992.
Klárafalva-Hajdova	Beta-30500	3370±100	Raczky et.al. 1992.
Klárafalva-Hajdova	Beta-30501	3340±240	Raczky et.al. 1992.
Kiszombor-Új Élet	Beta-34442	3980±160	Raczky et.al. 1992.
Kiszombor-Új Élet	Beta-34443	3920±100	Raczky et.al. 1992.
Kiszombor-Új Élet	Beta-34444	3640±140	Raczky et.al. 1992.
Kiszombor-Új Élet	Beta-34445	3880±100	Raczky et.al. 1992.
Kiszombor-Új Élet	Beta-34449	3990±90	Raczky et.al. 1992.
Kiszombor-Új Élet	Beta-34450	4110±110	Raczky et.al. 1992.
Klárafalva-Hajdova	Bln-1225	3270±100	Raczky et.al. 1992.
Kiskundorozsma-Hosszúhát halom 56. sír	Deb-8073	3755 ± 32	Bende & Lőrinczy 2002, 87, Tab. 1.
Kiskundorozsma-Hosszúhát halom 55. sír	Deb-8055	3678 ± 47	Bende & Lőrinczy 2002, 87, Tab. 1.
Kiskundorozsma-Hosszúhát halom 66. sír	Deb-8095	3623 ± 44	Bende & Lőrinczy 2002, 87, Tab. 1.
Kiskundorozsma-Hosszúhát halom 15. sír	Deb-8071	3574 ± 51	Bende & Lőrinczy 2002, 87, Tab. 1.
Mokrin 208. sír (RS)	GrN-14179	3690 ± 30	Forenbaher 1994; P. Fischl et al. 2015, Appendix 1.
Mokrin 110. sír (RS)	GrN-14178	3655 ± 30	Forenbaher 1994; P. Fischl et al. 2015, Appendix 1.
Mokrin 52. sír (RS)	GrN-7977	3650 ± 50	Forenbaher 1994; P. Fischl et al. 2015, Appendix 1.
Mokrin 227. sír (RS)	GrN-14180	3650 ± 35	Forenbaher 1994; P. Fischl et al. 2015, Appendix 1.
Mokrin 237. sír (RS)	GrN-14181	3595 ± 35	Forenbaher 1994; P. Fischl et al. 2015, Appendix 1.
Mokrin 259. sír (RS)	GrN-8809	3500 ± 35	Forenbaher 1994; P. Fischl et al. 2015, Appendix 1.
Western Hungary, Encrusted pottery /Bonyhád I-V./			
Vörs–Máriaasszony-sziget 76.	Deb-11965	3570±50	Kiss et al. 2015, Fig. 7.
Vörs–Máriaasszony-sziget 75.	Deb-12542	3520±50	Kiss et al. 2015, Fig. 7.
Vörs–Máriaasszony-sziget 52.	Deb-1238	3490±50	Kiss et al. 2015, Fig. 7.
Vörs–Máriaasszony-sziget 75.	Deb-1239	3500±60	Kiss et al. 2015, Fig. 7.

Table 1., cont.

Site	Sample	BP	References
Vörs–Máriaasszony-sziget 80.	Deb-12547	3390±50	Kiss et al. 2015, Fig. 7.
Győr-Ménfőcsanak-Széles-földek 8464. sír	DeA-1742	3562±32	Kiss et al. 2015, Fig. 7.
Szentgál–Mecsekhegy, Kőlik-barlang	Deb-1693	3360±60	Ilon 1991, 93; Kiss et al. 2015, Fig. 7.
Balatonkeresztúr –Réti-dűlő B-938	VERA 4230	3455 ± 35	Kiss et al. 2015, Fig. 11.
Bonyhád–Biogáz BBQ242 grave	MAMS 19119	3657±28	Hajdu et al. 2016, 356; Kiss et al. 2015, Fig. 11.
Bonyhád–Biogáz BBQ242 grave	DeA–5488	3584± 24	Kiss et al. 2015, Fig. 11.
Bonyhád–Biogáz BBQ242 grave	DeA–6224	3583± 30	Kiss et al. 2015, Fig. 11.
Bonyhád–Biogáz BBQ243 grave	DeA–5489	3580± 23	Kiss et al. 2015, Fig. 11.
Bonyhád–Biogáz BBQ243 grave	DeA–6225	3584± 29	Kiss et al. 2015, Fig. 11.
Vatya Culture			
Bölcske-Vörösgyír	Bln-1646	3620±40	Raczky et.al. 1992.
Bölcske-Vörösgyír	Bln-1681	3410±60	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	Bln-1941	3265±60	Raczky et.al. 1992.; Forenbaher 1993.
Mende-Leányvár	Bln-1942	3280±45	Raczky et.al. 1992.; Forenbaher 1993.
Dunaújváros-Kosziderpadlás	Bln-341	3505±80	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6042	3325±50	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6043	3345±50	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6044	3245±50	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6045	3205±50	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6046	3420±50	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6047	3265±50	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6048	3370±50	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6049	3335±50	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6050	3475±80	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6051	3365±50	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6052	3285±50	Raczky et.al. 1992.; Forenbaher 1993.
Százhalombatta-Földvár	LuS6053	3520±50	Raczky et.al. 1992.; Forenbaher 1993.
Érd	LuS-6054	3585±50	Jaeger & Kulcsár 2013, 313, 318.
Érd	LuS-6055	3535±50	Jaeger & Kulcsár 2013, 313, 318.
Érd	LuS-6056	3320±45	Jaeger & Kulcsár 2013, 313, 318.
Érd	LuS-6057	3280±50	Jaeger & Kulcsár 2013, 313, 318.
Érd	LuS-6058	3255±45	Jaeger & Kulcsár 2013, 313, 318.
Érd	LuS-6060	3310±45	Jaeger & Kulcsár 2013, 313, 318.
Érd	LuS-6061	3460±50	Jaeger & Kulcsár 2013, 313, 318.
Érd	LuS-6062		Jaeger & Kulcsár 2013, 313, 318.

Table 1., cont.

Site	Sample	BP	References
Érd	LuS-6063	3550±50	Jaeger & Kulcsár 2013, 313, 318.
Kakucs-Balla-domb	Poz & 36175	3230±35	Jaeger & Kulcsár 2013; 296, 298, 308, 309.
Kakucs-Balla-domb	Poz-36176	3510±35	Jaeger & Kulcsár 2013; 296, 298, 308, 309.
Kakucs-Balla-domb	Poz-36177	3315±30	Jaeger & Kulcsár 2013; 296, 298, 308, 309.
Kakucs-Balla-domb	Poz-36178	3550±35	Jaeger & Kulcsár 2013; 296, 299, 308, 309.
Kakucs-Balla-domb	Poz-36202	3590±35	Jaeger & Kulcsár 2013; 296, 298 & 299, 308, 309.
Kakucs-Balla-domb	Poz-36203	3605±35	Jaeger & Kulcsár 2013; 296, 299, 308, 309.
Kakucs-Balla-domb	Poz-36204	3605±35	Jaeger & Kulcsár 2013; 296, 299, 308, 309.
Kakucs-Balla-domb	Poz-36205	3565±30	Jaeger & Kulcsár 2013; 296, 300, 308, 309.
Kakucs-Balla-domb	Poz-36206	3470±30	Jaeger & Kulcsár 2013; 296, 300, 308, 309.
Kakucs-Balla-domb	Poz-36207	3530±30	Jaeger & Kulcsár 2013; 296, 299, 308, 309.

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