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ABSOLUTE DATING OF CENTRAL EUROPEAN PREHISTORY

Abstract: The functioning of absolute dating in central European (mainly Polish) archaeology is discussed, and contrasted with western European approaches. Particular attention is paid here to the question of the dating of the Neolithic and Early Bronze Age and the question of the use of recent advances in absolute dating in regional syntheses.

Establishing Chronological Timetables

The establishment of a chronological framework is axiomatic before the student of artefact typologies can begin to write prehistory; without this, archaeology cannot function. In this paper I want to consider the effects of and especially the reception of absolute dating methods such as radiocarbon in the milieu of central European archaeology, using Poland as an example ¹.

The „traditional” (i.e., pre-radiocarbon) chronology for this region was established by several generations of scholars beginning in the nineteenth century. It was based on the comparative-typological scheme for objects and monuments. This enabled, by a series of cross-links across Europe, the establishment of a framework of relative dates. In order for these relative timescales to be transformed into an absolute one they had to be linked to chronological fixed points which could be reliably tied-in to a calendaric scale. In addition

¹ I would like to thank Professors J. Gąsowski and J.K. Kozłowski and also Ewa Marczak for discussion of individual points mentioned here. Responsibility for opinions expressed and any errors is of course entirely mine.

to actual imports from societies possessing a historical calendar, archaeological traces of other cross-cultural „influences“ were sought. It was assumed that the advanced civilisations of the east Mediterranean stimulated cultural change in peripheral areas; „advanced“ features of barbarian societies were thus apparently dated by the occurrence of similar features in areas of the „Classical“ civilisations. This diffusionist line of argument rests on a basic assumption that barbarian communities would not have themselves devised these cultural phenomena. This fundamental assumption was rarely questioned and led the dating of European prehistory up a blind alley for almost a century. An exception to this general rule was of course the school of Gustav Kossinna (1912) and his followers who reversed the direction of the arrows of the diffusionists, and attempted to demonstrate that the development of metallurgy and even writing had a beginning in Europe. Kossinna wrote some forty years before the advent of radiocarbon dates which were to support parts of his thesis, though this in itself is not justification of the uses to which his ideas were put under the Nazis. The true significance of Kossinna's writings (which is the ambiguity of the archaeological record and its possibility of simultaneous multiple interpretations) was overlooked after the end of the War.

In reaction to Kossinna's claims (but in part inheriting part of his methodology), Gordon Childe constructed in 1920s the framework of a new European prehistory, a framework that he and others were to build upon for several decades. In two books „The Dawn of European Civilisation“ (1925) and „The Danube in Prehistory“ (1929) he set out to create not only the timetable of European prehistory, but to attempt to explain cultural change. Nevertheless his reasoning was strictly diffusionist. Childe based his framework on a series of cross-links in the typologies of various objects from the Mediterranean to the edge of barbarian Europe (Lech 1992).

Before the advent of radiocarbon dating, there were no reliably fixed dates for northern Europe prior to 1600 BC, (and before about 3000 BC there were no calendrical dates anywhere). Childe recognised this and regarded the chronology that he established as one of several possible versions. He once likened the entire chronology of Europe to flexible bellows which could be expanded or contracted at will; one end was fixed at 1500 BC, the other (earlier) one was free to move, giving a longer or shorter chronology very much according to

the inclination of the individual archaeologist. Childe himself had a flexible approach to chronological schemes; he once wrote that the central European Bronze Age „could have begun around 2800 BC” but probably should not begin „not earlier than 1700 BC”, thus opting for the shorter („lower”) chronology. In the last years of his life Childe however showed great readiness to accept the new radiocarbon dates. Many central European archaeologists refer to the „low” chronology as the „traditional chronology”, despite the fact that this tradition has a relatively short ancestry. By the 1930s therefore the chronology of European prehistory had been put on an apparently firm basis, (Burkitt and Childe 1932). Childe’s chronology was only slightly modified in subsequent editions of the „Dawn”, and the time was now apparently right to begin the rewriting of regional prehistories based on the new ideas.

Two Revolutions and Passive Counter-Revolution

The year 1949 however represents the beginning of a new stage in the development of European archaeology. In the eastern part of central Europe new paradigms (historical materialism) were being used to reconstruct the methodology and aims of archaeology. These new paradigms were a transfer of working methods developed in the Soviet Union in the previous two decades and an independent predecessor of the Anglo-American „New Archaeology” of the 1960s (Trigger 1989). In the west a different theoretical reformation was underway. The „First Radiocarbon Revolution” 1949–1960 (Renfrew 1973, 48–83) was to have a profound effect on the dating of western European prehistory, and by the same token, the way that this prehistory was viewed. For example the succession of Neolithic cultures which had previously been squeezed into 500 years was soon seen to have occupied more than 1500; this implied however more than the alteration of a few dates, it changed the entire pace and nature of the cultural developments that the changes in the material culture represent. The graph (figure 1) based on that originally published by Graham Clark in 1965 showing the difference between traditional and radiocarbon dates is very expressive, (especially when amended for calibration).

As soon as the radiocarbon method was announced, the Polish archaeologist Zdzisław Rajewski published, together with the Poznań

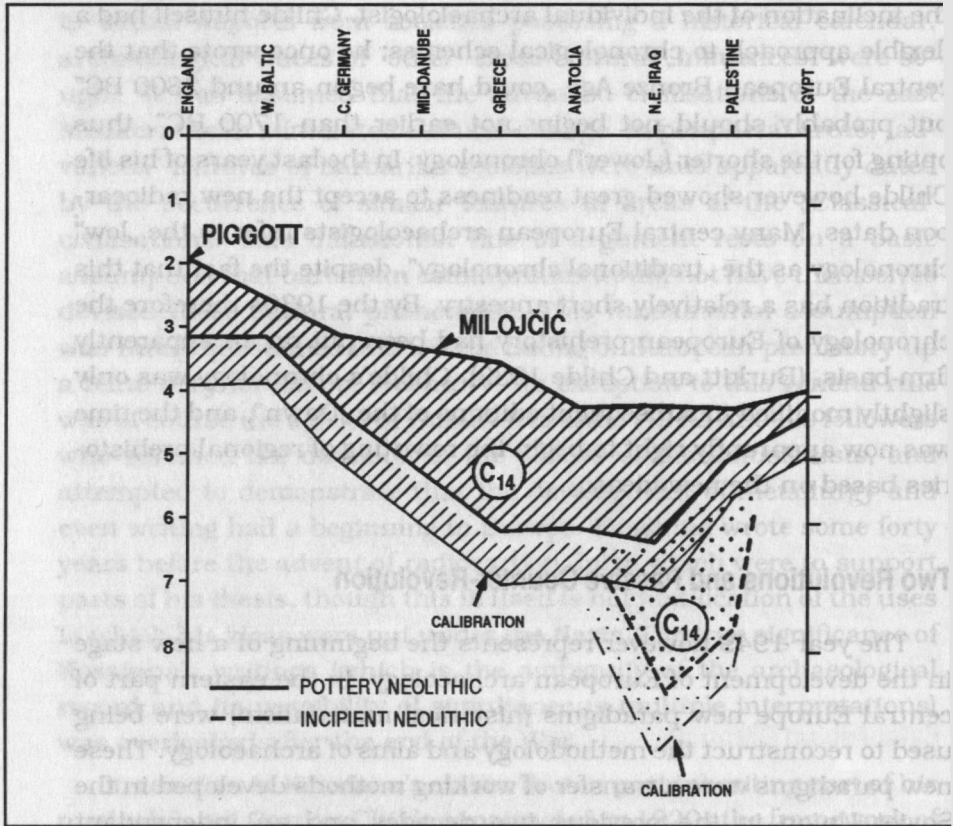


Fig. 1. The difference between the „traditional” dating of the beginning of the Neolithic and the uncalibrated and calibrated C₁₄ values (after Clark 1965)

physicist Włodzimierz Mościcki an article (Mościcki and Rajewski 1949) in the journal „Z Otchłani Wieków” for July/August 1949 which seems in fact to be the earliest record of the new technique in the European archaeological literature, before the famous editorial of „Antiquity” of December of the same year (see also Mościcki 1950). Attempts were made (apparently unsuccessful) to obtain radiocarbon dates for Biskupin.

Some of the earliest dates available from western European laboratories concerned the Linearbandkeramik material from the western extent of its distribution. Since the culture was thought to have had a southeastern origin, the Polish sites of this culture had to be, by implication, earlier. The early dating of the LBK relatively

rapidly found its way into central European textbooks (e.g., Chmielewski, Jażdżewski and Kostrzewski 1965, 55–61). In general, the earlier dates for the Neolithic produced by the First Radiocarbon Revolution were accepted by the majority of central European archaeologists, though the process was not a smooth transition to a new prehistory. There were some central European archaeologists who could not accept the conflict between the new dates and the „traditional” dating of the Neolithic and Bronze Age.

At about the same time as the method of radiocarbon dating was first announced, the Heidelberg professor Vladimir Miložević had published an important and detailed study of the chronology of Neolithic Europe. When it transpired that most of the new radiocarbon dates were older by a millennium than Miložević's chronology, he published a detailed critique of the method in „Germania” (Miložević 1956, 1957, 1959). He pointed out the weakness of some of the assumptions on which the method was based and highlighted discrepancies in the dating of samples from the same context. Many archaeologists who had welcomed the new dating were extremely disturbed by Miložević's attack, which began a series of discussions in the pages of such journals as „Antiquity” and „Germania”.

In the Soviet-Bloc countries of central Europe there were few laboratories able to carry-out these analyses, and western European laboratories cost too much. As a result there was a certain amount of difficulty in obtaining C₁₄ dates. In addition to these difficulties, there was the problem of the continuing debate on the validity of the method. Some central European archaeologists however managed to get single samples or series of samples examined (mainly by western laboratories) and by the late 1960s the broad outlines of a relative scheme were discernable (Quitta 1967, Neustupny 1968, 1969, Bakker et al. 1969).

What has been called in the West the „Second Radiocarbon Revolution” began in 1966 when the first dates from Bristlecone Pine were published and showed the need for a calibration of radiocarbon years to convert them to calendrical dates (Quitta 1967, 267; Neustupny 1969, 791–810; Waterbolk 1971; Renfrew 1973). The validity of the calibration was also now checkable against other methods of absolute dating, such as the thermoluminescent dating of LBK sherds (Zimmermann and Huxtable 1970). The Second Radiocarbon Revolution had a profound effect in European archaeology, and

threatened the whole framework of thought on earlier prehistory. It so happened that the dates available up to the mid 1960s had to some extent supported the older ideas of the „traditional” chronology. In the Bronze Age the first series of C₁₄ dates seemed to fit (more or less) the traditional chronology based on those of Montelius and his followers (Forenbaher 1993, 219). Calibration however made them appear far too early and disrupt previous views of cross-cultural links. The calibration of the radiocarbon dates for many other cultural phenomena now shifted them back in time far earlier than their supposed Mediterranean prototypes (Renfrew 1973). These alarming reversals in the chronology prompted a new series of attacks on the validity of the method and widespread dismay at the consequences. The archaeological world had only just become accustomed to the results of the First Radiocarbon Revolution, and now the revelation of calibration required a fundamental change in the interpretations of cultural change. The time was ripe for the abandonment of simplistic diffusionist or ethnocentric models and the introduction of processual archaeology in western Europe (Trigger 1989; Renfrew 1973; Renfrew and Bahn 1993).

In central Europe there were archaeologists who seized the refinement of the tool with eagerness. Neustupny (1968; 1969) gives a useful summary of the state of knowledge on the chronology of the Neolithic in central Europe and also the problems of calibration. He also (1969, 794–6) showed clearly and conclusively that variations in C₁₄ concentration were not geographically restricted, and that the Californian Bristlecone Pine calibration was applicable to central European dates. Not all central European archaeologists were able however to accept this at the time (nor for a long time afterwards). The new „high” chronology of the Neolithic and Bronze Ages met with some resistance from other quarters. Milošević renewed his attacks on C₁₄ (1967, 1970), it was dismissed as „*Vollständig indiskutabel*” and Neustupny’s work on the absolute chronology of the Neolithic as „*temperamentvolle Apologie*” and „*methodisch kaum möglich Verfahren*” (a procedure methodologically hardly tenable).

Coles and Harding (1979, 538) note that eastern and central Europe are among the less well-served areas by radiocarbon dating, while being one of the most important areas of Europe in the Bronze Age. They see the production of more accurate dates from this area as an urgent priority for the future. Forenbaher (1993, 219) describes

the central European archaeologist's recent attitude to dating the Bronze Age: „while uncalibrated determinations could still be reconciled (more or less) with the traditional chronology, the calibrated radiocarbon dates have appeared unacceptably early. Some determinations are never properly published: they are „embarrassingly wrong”. They are also costly: in eastern Europe, a tight-budgeted team of five could spend almost a week in the field (in 1991) for the price of a single ^{14}C analysis. Why waste scarce research resources on something which brings no intelligible result?”.

The Second Radiocarbon Revolution seems to mark the start of a specific variant of „intellectual Iron Curtain” (Barford 1993, 266–67) in the relationship between the methodologies of central and western European archaeology. In the West the tools for what was soon seen as the necessary task of calibration were continually improved, several calibration curves appearing in the two decades². The calibration curve has recently been extended even further back in time³. The western European archaeological literature of the period since 1966 has been marked by a general interest and awareness of the problems of radiocarbon dating, the sampling procedures and calibration problems (e.g., Waterbolk 1971; Pearson 1987; Ottaway 1987). Many practicing archaeologists in western milieux seem well aware of the problems and principles of good radiocarbon dating, with a good grasp of the physics and biology concerned.

Absolute Dating in Polish Archaeology

In central Europe however for a series of complex reasons, since Neustupny's brief discussion (1969), there has been relatively little interest in these problems and in western literature on this subject. In Poland for example there has until recent years (with the exception

2 In 1986 however a special calibration issue of the journal „Radiocarbon” was produced (Stuiver and Kra (eds.) 1986, republished with slight additions Long 1993) which seems to have established a version of calibration which at the moment may be regarded as relatively definitive, especially for the period after 2500 BC (see Pearson 1987 fig. 1 for a simplified version of this curve).

3 We should note that the position of the „plateaux” in the calibration curve discussed by Mellars 1990 coincides with some of the cultural divisions of the Mesolithic defined by Kozłowski 1989. Clearly these plateaux may affect our reconstruction of the pace of cultural change on sites dated solely using C_{14} .

of several articles in archaeological journals by M. Pazdur) been little published discussion of these issues. If one scans the pages of Polish archaeological journals (or „Polish Archaeological Abstracts”) one finds that discussions of these topics are rare. Furthermore radiocarbon dating is given scant attention in recent archaeological textbooks, often no more than a few sentences are devoted to the method itself, its principles and drawbacks. The student will not find in a single Polish archaeological textbook a detailed up-to-date discussion of radiocarbon dating; fortunately geology students do not have the same problem (Lindner (ed.) 1992, 405-14).

Another division within Polish archaeology is also apparent. Specialists working on the Stone Age (including the Neolithic) seem to have been aware of recent advances in western Europe in this field. In the case of scholars working with Palaeolithic and Mesolithic material, this is due to co-operation with geologists who have long been reliant on radiocarbon dating for their chronologies. In other cases this is due to personal and professional contacts with western archaeological institutions. Archaeologists working on later periods (and in the Mediterranean and Near Eastern post-Neolithic Classical civilisations) seem in general indifferent to latest developments in this field. The facts of this state of affairs are undeniable, explaining it is more difficult. A contributing factor may be a feeling of helplessness in the face of confusion over calibration and the two rival half-lives of the isotope, and an important part in the establishment of these thought processes in the central European archaeological milieu must have been played by the arguments of those central European scholars, like Milojević, who found it so hard to abandon traditional chronological schemes even in the face of the logic of the new framework created on the basis of the calibrated radiocarbon dates.

This cannot be the full explanation however. We find a similar strange indifference to the possibilities of creating an absolute chronology independent of the traditional methods of cross-dating in another field too. The principles of dendrochronology have long been known, and Poland is rich in sites containing wet wood (Biskupin-type strongholds, the palafittes of the northeastern lake districts, medieval towns etc.), thus it is a considerable surprise to discover that until recent years dendrochronology has seldom been used in Poland for establishing archaeological chronologies. The costs involved in setting-up such laboratories are less than C₁₄ laboratories,

and the technique is in principle simple and reliable. Why then, apart from a few half-hearted attempts in the 1960s (e.g., Gorczyński et al. 1965) were the possibilities of this technique virtually ignored in Poland? The contrast is greater when we consider the situation in West Germany where the technique was well-developed and producing useful results. In northern Italy (Barfield 1991, 103–4) and Switzerland dendrochronology on the Swiss lakeside settlements has been yielding important evidence for the dating of the Neolithic and Bronze Age. To the east, dendrochronology was well-developed in the investigations at Novgorod three decades ago. There seems an urgent need for development of this technique in Poland and as the recent results from Biskupin show, may hold many surprises (see Ważny in this volume).

We often find in central European publications that C₁₄ dates are quoted relatively casually, with a lack of common standards. They are often quoted without laboratory number or standard deviation, misquotes of various sorts are also to be found in the literature. Little detail is offered about the type of sample and its context, a general assignment to a particular „culture” is often the rule. Sites are usually represented by a single determination, and even when there are several from a site, their contexts are rarely given. These reports do not allow one to notice possible doubts about context, stratigraphic consistency, possible „old wood” or sampling errors. These factors conspire to make it impossible to maintain a high standard of „chronometric hygiene”. Applying strict criteria to the published dates would leave us with almost no dates at all!

When we turn to synthetic works we see a similar situation. A brief survey of some of the available textbooks will suffice to demonstrate some general trends. In the majority of Polish textbooks, archaeological cultures are „dated” using C₁₄, quite often by citing only one or two dates; often the same dates appear in different textbooks (in some cases slightly distorted in the process!). Seldom however is it stated whether dates are cited in calibrated or uncalibrated form. Only very rarely are the principles, problems, sample type and integrity discussed in any detail. While the dating of the Palaeolithic and Mesolithic is reliant on radiocarbon and similar techniques, Polish archaeological textbooks as we shall see below have a relatively reserved approach to the question of absolute dating of the Neolithic and Bronze Ages. The later Iron Age and Roman periods have their

own chronological systems based on artefact typology and links with Mediterranean calendrical systems by way of Greek and Roman imports. Where such artefacts occur on an investigated site, these chronologies seem quite satisfactory (and at present they are relatively stable), thus the non-use of C₁₄ or dendrochronological dating is perhaps understandable. The chronology of the Migration period of central Europe has its own problems, but archaeologists in this area are generally loathe to resolve these by recourse to absolute dating methods.

One of the first features that is noticeable to the first-year student of archaeology is the variety of chronological schemes used in the various current textbooks. This is particularly the case for the Neolithic and Bronze Age, which are both dated by different modern authors according to several schemes. In many cases it is not stated whether traditional dates are used, uncalibrated C₁₄ dates, or calibrated ones. The general effect is one of confusion. This reflects the general lack of discussion of the C₁₄ method noted above.

The Neolithic is discussed below, once the initial resistance had been overcome, we find that by the end of the 1970s many scholars discussing this period were willing to use the longer chronology afforded by calibration. It soon became apparent that C₁₄ gave a dating method infinitely more useful and sensitive than the former „traditional” (typological and cultural cross-links) methodology. It seems that after twenty years the vicissitudes of calibrated C₁₄ dating in the Neolithic are over (Breunig 1987).

This is still far from being the case for studies of the Bronze Age. The chronology of the Bronze Age in central Europe is still largely based on collation of old data from a variety of sources and ultimately rests on a series of cross-cultural connections with the Mediterranean. Until recently the basis of these cross-cultural links has rarely been questioned. Now it seems that these views need to be revised. A second problem is with the chronology of the Mediterranean zone itself (Forenbaier 1993, 220–235; Harding and Tait 1989). Accepting the calibrated C₁₄ dates completely upsets the traditional scheme. It is noticeable that much of the recent discussion of the chronology of Aegean (e.g., Mycenaean) links with barbarian Europe has been carried-out by western European archaeologists, central European archaeologists tend not to dwell on the chronological problems.

We may take here as an example one of the cultural groups of the Early Bronze Age, the Únětice Culture to illustrate the point. One of the main links in the chain of inference has been that between the early phases of the central European Bronze Age and the Mycenaean world of the Aegean. These concern the faience beads (whether or not these are Egyptian imports or local manufactures; Henderson 1988 and refs) and the spiral decoration on a number of objects and the amber spacer-plates and beads of south Germany and Bohemia and Mycenae (Piggott 1965, 134–7; Coles and Harding 1979, 66; Barfield 1991; Forenbaher 1993, 220). Calibration placed the central European Br A and Br B several centuries earlier than these supposed cultural links with the Aegean and Mediterranean worlds. Many authors working on Early Bronze Age material have been wary of applying calibration, because the uncalibrated dates fitted best the notions of dating based on the traditional schemes (Coles and Harding 1979, 66–7; Forenbaher 1993, 219).

The „traditional” dating of the Únětice Culture places it in Br A1–2 of Reinecke’s scheme („1800–1500 BC”), making it contemporary with the Shaft Graves at Mycenae. We may now examine a sample of opinions of investigators about its dating. Sarnowska (1969, 119–125) treats the whole problem as an exercise in juggling various local „traditional” chronological schemes. She concludes that the culture lasted from 1900 to 1550 BC. The synthesis „Prahistoria ziem polskich” volume III (A. Gardawski and J. Kowalczyk eds. 1978, 28–9) place the beginning of Únětice to be contemporary with C₁₄ dates of c. 1800 uncalibrated (when calibrated it is dated to 2200 BC). The same work dates the end of Únětice to 1500 BC (1978, 29). Gedl (1985, 52–6) discusses the relative chronology of Únětice, and (ibid, 337) dates it to 1800 BC to 1500/1450 BC. It seems from the section on chronology (Ibid 17–19) that the author does not consider C₁₄ as worth mentioning at all! Milisauskas (1978) places Únětice at 2050–1800 BC, but as noted below, one suspects that he has taken the „traditional” dates and calibrated them as if they were radiocarbon dates! Coles and Harding (1979, 67–8 tab. 3) cite a range of uncalibrated C₁₄ dates for Únětice, which calibrate to 2400–1700 BC. Renfrew (1973, 98–103) and Forenbaher (1993, 248–9 fig. 9) give somewhat similar values (figure 2).

The consensus of the results of absolute dating in fact suggest that Únětice may be regarded as functioning between 2400 and 2000 BC, i.e., that it ended 400 years before the Shaft graves at Mycenae,

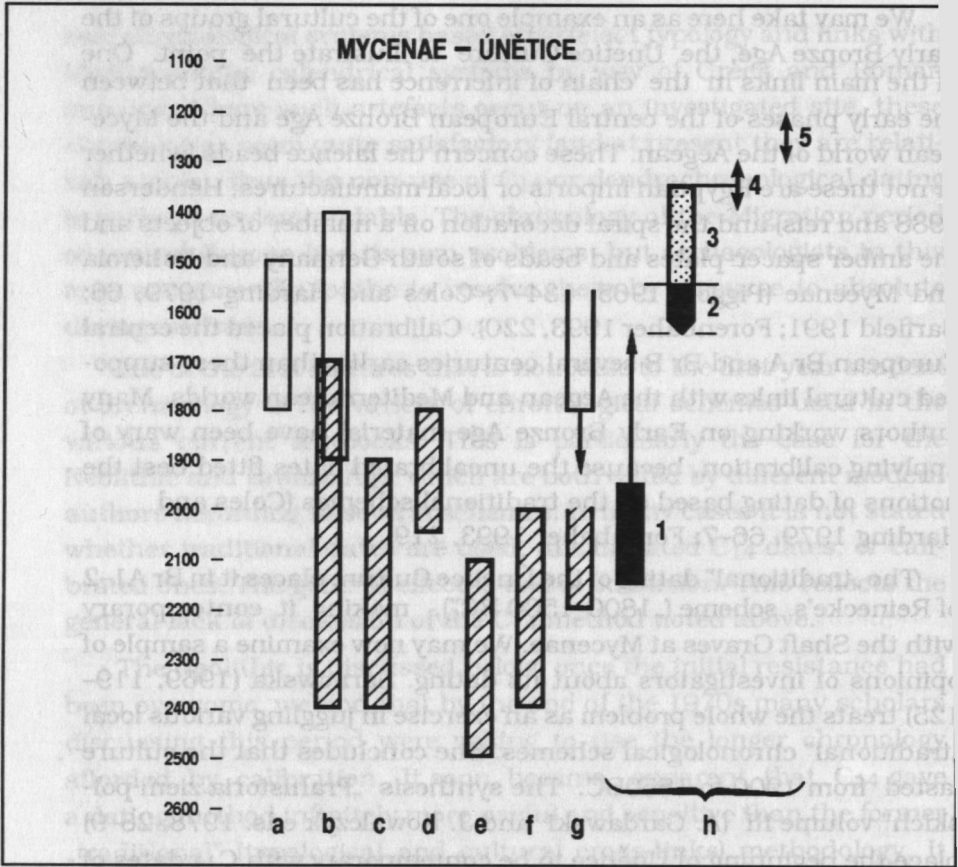


Fig. 2. Dating of the Únětice Culture according to various authors: (a) „Traditional scheme”, (b) Coles and Harding 1979–with calibration, (c) Forenbaher 1993, (d) Milisauskas 1978, (e) Harding 1980, (f) Renfrew 1973, (g) PZP III, (h) Aegean chronology; (1) Minoan palaces, (2) Mycenae begins, (3) Mycenae, (4) Collapse of Mycenae, (5) „Sack of Troy”

and in fact contemporary with the Minoan palaces rather than Mycenae. Once again though, we are reliant on a relatively small number of dates, which leave much uncertain.

The calibrated absolute dating of the Bronze Age in Europe has been considered by Neustupny (1976) and more recently by Becker et al. (1989) and Forenbaher (1993). One feature becomes clear from these papers, the earlier phases of the Bronze Age lasted much longer than the traditional chronologies allowed; the difference between the two schemes is too large to be ignored. The latest central European

Copper Age dates are about 2500 BC, the transition to a bronze metallurgy in central Europe between about 2500–2300 is still rather unclearly defined (Forenbaher 1993, 253). Br A began about 2300, certainly no later than 2200 BC (Becker et al. 1984, 433, 440) and the transition between Br A1 and Br A2 falls about 2000 BC–1900 BC. In northern Italy (Barfield 1991, 103–4) and Switzerland dendrochronology has been yielding important evidence for the chronology of the beginning of the EBA there, dating to about 2250 BC.

The absolute dating of the middle phases of the Bronze Age also requires some revision of previous views. Forenbaher points out (1993, 252) that the absolute dating evidence from southern central Europe suggests that the EBA-MBA transition should rather date here to around 1700 BC rather than the traditional 1500 BC, though in northern Italy and Switzerland dendrochronological dates for the end of the EBA and beginning of the MBA dates do indeed fall around 1500 BC (Barfield 1991, 103–4) and so far confirm the traditional chronology for this period in this region (the traditional chronology of Reinecke, it will be recalled, was originally devised for southern German material and extended to other regions for want of any other dating method).

Absolute Dating and Synthesis

We may now turn our attention to more general matters. It is interesting to examine the use of C_{14} in synthetic works produced in Poland on central European prehistory in order to determine the way that absolute dating functions in the general archaeological milieu. Figure 3 shows in schematic form the dating of the Neolithic and Bronze Age in Poland according to various textbooks. The result is quite thought-provoking.

The classic textbook of the late 1960s (Chmielewski, Jażdżewski and Kostrzewski 1965) uses uncalibrated C_{14} dates for the Neolithic, thus dating the Early Neolithic 4200–3500 BC, a full 1400 years earlier than the previously accepted value of 2800–2500 BC or thereabouts. The beginning of the Bronze Age is dated conventionally at about 1700 BC. Jażdżewski (1965) gives a similar dating, except he extends the beginning of the Early Neolithic three centuries further back in time to 4500 BC in line with newer C_{14} dates.

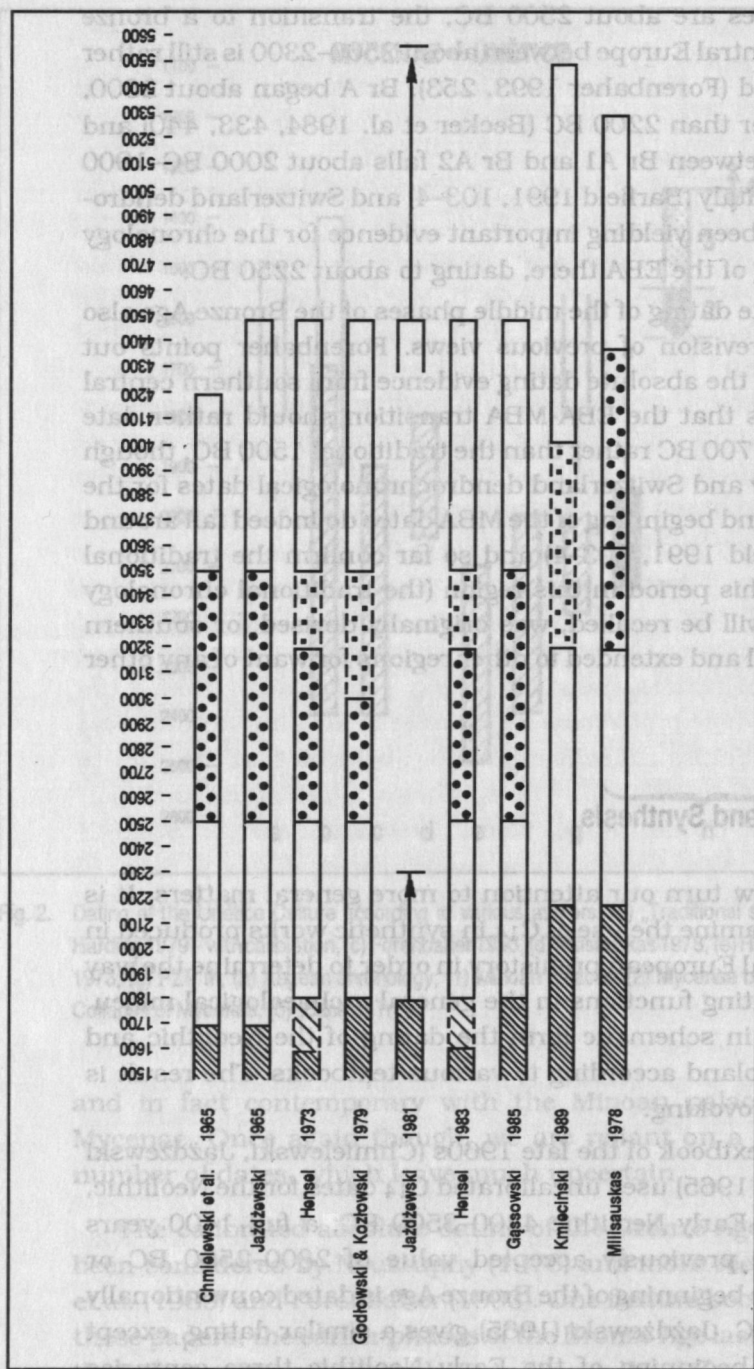


Fig. 3. Dating of the Neolithic and Bronze Age according to various authors, Early and Late Neolithic (central-European) blank, Middle Neolithic dotted. Beginning of Bronze Age hatched.

Hensel (1973) in the first edition of „Polska Starożytna” follows the same dating as Jażdżewski, but alters the beginning of the Bronze Age to 1900–1800 BC. In the preface of the second edition written in 1977, he states (without any further justification) that „nie wprowadzono dat kalibrowanych przy stanowiskach o chronologii uzyskanej metodą C_{14} ”, a characteristic shared by the third edition (1988). A similar conservatism is seen in the textbook of Godłowski and Kozłowski (e.g., 1985), who retain a similar chronology for the Neolithic as Jażdżewski’s (there is, however, a concise description of the C_{14} method 1985, 12–13).

The first major impact of calibration on the chronology of the Neolithic may be observed in Kruk’s (1973) seminal work on settlement in southern Poland. In „Prahistoria ziem polskich” volume II (Hensel and Wiślański (eds.) 1979) radiocarbon dating and calibration are discussed by T. Wiślański, who (1979, 9–15) is dismissive of Milošević’s scepticism. The authors even give (1979, fig. 1) an over-reduced figure of the early Suess, Clark and Switsur calibration curves. They specifically note that after the Second Radiocarbon Revolution that different authors began using different chronological scales, both uncalibrated C_{14} dates („błędnie zresztą utożsamianych przez większość badaczy z czasem historycznym operującym datami kalendarzowymi”) and calibrated ones. In „Prahistoria ziem polskich” volume II all dates supplied by the different authors as uncalibrated C_{14} dates have the calibrated (according to the Suess curve) version given in brackets alongside. These were added by the editors; one author however demanded the removal of the calibrated dates in the proof-stage of production (1979, 10 fn), even though the same author had used calibrated dates elsewhere. The editors deftly work the calibration of these early dates into their introduction instead, „Prahistoria ziem polskich” II (1979, 11) gives calibrated dates for the beginning of the Early Neolithic about 5450 BC in south Poland, while in the central Polish lowlands it begins about 5170–5085 BC. The Early Neolithic finishes according to calibrated dates about 4095 BC, and the transition between Middle and Late Neolithic was dated to 3245 BC. Pages 12–13 contain a useful table of the dating of the Neolithic cultures of Denmark and NW Germany, Czech, Moravia, Slovakia, Poland and Hungary which includes scales in C_{14} years (bc and BP) and one of the calibrations (though interestingly, not the one used in the text!). The end of the Neolithic and beginning of the Bronze

Age is dated (Hensel and Wiślański (eds) 1979, 11) „w przybliżeniu pomiędzy 1800 a 1700 (około 2230–2095) p.n.e.”.

In the previous year however the third volume in the same series had been published (Gardawski and Kowalski eds 1978), in which a short section (1978, 28–9) summarises the chronology of the Early Bronze Age. Here the dating scheme accepted „zgodnie w oparciu o chronologię południowo-bałkańską i dane C_{14} (bez tzw. kalibracji)” gives the beginning of the Bronze Age there as „na lata między 1900–1800 BC”, but accepts several centuries delay in the new technology reaching areas further north, suggesting that Montelius' dating of about 1700 BC for the north as being about right, while in central and western Europe prefers a date of about 1600 BC. From the following text, it is clear that the authors consequently avoid the implications of calibration of C_{14} and did not differentiate C_{14} dates from calendar years in their discussion.

The fourth volume of „Prahistoria ziem polskich” (Dąbrowski and Rajewski eds. 1979, 30) note that C_{14} dating had been only very rarely used for the Lusatian Culture, and it is noted that despite recent criticism was now becoming more acceptable, and that absolute dating methods may produce results differing from those of the typological method.

In 1978 Saraunas Milisauskas published his „European Pre-history” (although an unbalanced account-being mostly on Poland and especially its Neolithic), makes full use of calibration of radiocarbon dates. His (1978) figure 4.3 of the chronology of European Neolithic cultures against a C_{14} and calibrated C_{14} scale is very similar to that of Hensel and Wiślański's and is a clear and useful summary of the sequence of Neolithic cultural development in Europe. We have already noted however that Milisauskas however seems to make one methodological error, when discussing the beginning of the Bronze Age (1978, 205–6) he takes the „traditional” dates from the Montelius scheme, and treats them as radiocarbon dates and calibrates them!

Konrad Jażdżewski's monumental work „Pradzieje Europy Środkowej” is one of the few general works to touch on the methodology of C_{14} dating (1981, 64). His (1981 fig. 50) is a relatively clear diagram of the Neolithic cultural succession giving both calibrated and uncalibrated dates; the beginning of the Neolithic is clearly pushed

back well beyond the dates quoted in many previous syntheses. Jażdżewski (1981, 157) was also among the first Polish scholars to note that the calibration of the C₁₄ dates for the beginning of the Bronze Age should fall about 2300 BC and not 1800, but inconsistently fails to make use of this observation in his own discussion of the Bronze Age itself (1981, 289–92)!

Kozłowski [(ed.) 1981, 13–14] notes the need for calibration of C₁₄ dates, but states that „w tekście chronologi do II tys. p.n.e. włącznie podano w tzw. konwencjonalnych latach C₁₄, daty późniejszych (od 1700 p.n.e.) – w latach astronomicznych. Porównanie chronologii ułatwi tabela pt. Próba kalibracji dat radiowęglowych (s. 13)”. Nothing is eased by this table, the date 1700 bc (uncal.) is equal to 2300 BCcal, so this system of quoting dates „loses” three centuries. Also maps 25–28 within the same book need alteration, as they show cultures dated by uncalibrated radiocarbon dates alongside historically dated cultures in the Aegean region, creating anachronies. The use of the term „conventional” radiocarbon dates is unfortunate, incorrect and is in itself anachronistic (in a book written between 1975 and 1981). The otherwise splendid essay by Gąssowski (1985) has no discussion of the fact that throughout the book radiocarbon dates are given only in uncalibrated form. In effect the chronology given in this book differs little in detail from those published twenty years earlier, which is a serious drawback in the light of the new framework which was then emerging. In the same year the third edition of the university script by Gedl on the Bronze Age appeared, it dates (1985, 27 and 337) the beginning of the Bronze Age in southern central Europe to 1900BC, and tends to avoid the question of the absolute chronology of the different cultural groups discussed, simply giving their place on the „traditional” relative chronological scheme based on that of Montelius and Reinecke without discussing in any detail the regional chronologies of these stages.

The latest Polish synthesis to appear is that edited by Kmieciński (1989). This has a discussion of C₁₄ (1989, 29–31), and the introduction to the Neolithic (Jan Gurba) discusses in some detail the results of calibration of the dates for the consecutive periods of the Neolithic, though this is somewhat confusingly set-out. The confusion is deepened by the fact that only one of the authors (Gurba) discussing the Neolithic quotes calibrated dates, but the rest of the authors in the volume quote uncalibrated dates! Gedl’s discussion of the chro-

nology of the Bronze Age (1989, 398–400) mentions radiocarbon only in passing, but fails to correct the „traditional” chronology, which is maintained throughout the rest of the discussion of the Bronze Age in this volume.

This brief survey has demonstrated a disturbing and disappointing conservativeness in the broad dating of cultures and periods among the general syntheses presently available in Poland. While in the outside world calibration had been making its mark, the majority of the writers responsible for synthetic writing have been oblivious to the changes calibration requires in the way we see prehistory.

Many central European authors dealing with the Neolithic have come around to the longer chronology implicated by calibration. The majority of authors dealing with the Bronze Age of the same area however have great difficulty adjusting to the problems calibration seemingly cause. Accepting the calibrated C_{14} dates completely upsets the traditional scheme, and many scholars (who have spent a working lifetime mastering the complex typologies) are unwilling to reject the tools of their craft. This is despite the fact that this means there is now a „blank area” between where investigators of the Neolithic see the beginning of the Bronze Age, and the place where the majority of chronological schemes constructed by scholars involved in the detailed study of the Bronze Age wish to begin it! We have seen that the „traditional” scheme produces a distorted picture of the synchronisms between the Bronze Age cultures of the „barbarian” world and that of the area later dominated by the „classical” civilisations. This distorted picture is still current in many textbooks and academic syntheses and we must now examine again very closely the real factual basis of the long-established „traditional” scheme (especially it seems of the context and status of „imports” or „influences” from the classical world in barbarian Europe and a closer dialogue between scholars working in both areas).

We also should expect in future a new awareness of the possibilities and fallibilities of C_{14} dating. During the Second Radiocarbon Revolution, archaeologists began to realise that single dates were not important, what mattered was the way that dates started to form coherent patterns. A useful beginning towards the collection of such data was made by Wiślański (ed. 1989–90), but this was discontinued after his death. Sometimes these patterns of dates can tell us much more about the site than its chronology, for example the series of calibrated dates from a Neolithic tomb in western England shed new

light on the social organisation of the area and produce new insights into the British Neolithic (Saville et al 1987). The series from Iwanowice (Kadrow 1991, 53–61) gave not only information on the absolute chronology of the Mierzanowice Culture on this site, but also led to data on the changes of spatial organisation of the settlement over time. It is the accumulation of more series of dates from sites and microregions as well as a consideration of the taphonomy of the sample assemblages which should be the aim in the near future (Ottaway 1987; Kadrow 1991).

It has taken a long time for archaeologists to appreciate that there has in future to be more care in just what samples are taken and why. How old was the carbon before it got incorporated into the deposit, and was the context sufficiently stratigraphically secure? Is the sample securely associated with the archaeological event or episode to be dated? What stochastic and laboratory errors are involved in the radiocarbon measurement? Which of them were allowed-for in the quoted standard deviation? Which half-life was used in the calculation? A further difficulty is the frequency with which C_{14} dates are misquoted by the archaeologists who commissioned them, common mistakes are confusion of BC with BP, or miscalculation of dates counting back from the BP value quoted by the laboratory. The series of dates from the Andes collected by Mariusz Ziółkowski shows that such errors are considerably more common than may be expected (M. Ziółkowski pers. comm.), and there is no reason to regard archaeologists of this region as any more prone to these mistakes than any other. All these factors suggest that a ragbag of measurements (taken singly by different laboratories at different times on different materials from different contexts of different stratigraphic security) which has for decades been the norm in arguments about the dating of episodes such as the Wessex Culture are an insufficient basis for such discussions. It is now clear that arguments founded on such material are pretty meaningless (Chippendale, *Antiquity* 61, 97).

It has also taken a long time for many archaeologists to realise that radiocarbon dates are expressions of probability, the correct evaluation of which requires exacting mathematical treatment to extract the information the date conveys. Too often the central value of single radiocarbon dates have been used as „gospel truth” (because independantly – „scientifically” – derived) if it fits the preconceived

notion of what the result should be. This is as unproductive as a derisive attitude towards radiocarbon dating.

Conclusion

In Poland now it seems that we have well over 1000 dates for various archaeological phenomena (F. Pazdur pers. comm.). Many come from the Gliwice laboratory, others come from scattered western laboratories. Among them are some 270 dates for the Neolithic, but (characteristically) only 82 for the Bronze Age (11 of which are from Iwanowice). It may be suggested that:

1) We urgently need a collection of all the radiocarbon dates carried out on Polish material. These should be published in a uniform manner and their provenance, cultural affinities, laboratory numbers, sample type and sample integrity detailed. This should be a first step necessary for the selection of priorities for sampling and also increased awareness of chronological hygiene among Polish archaeologists. It would be highly important for similar projects to be carried out in other central European states too.

2) Polish archaeology urgently needs more discussion of the principles and problems of radiocarbon and dendrochronological dating, their limitations and reliability. The field archaeologist needs to be better prepared than he is at present for the selection and taking of samples, and the correct interpretation of the results. Possibly this is a recommendation which has wider application also in central and eastern Europe.

3) We need more sequences from central European sites with stratigraphical sequences, such as the series from Iwanowice, Biskupin and Podedłocie. These samples are best taken from good contexts, especially where results can be checked by other techniques (such as cross-checking C_{14} with TL and especially dendrochronological dates). We need more series from cultural groups from limited areas to compare with similar series from other areas to build up a picture of regional chronological variation of different cultural phenomena across whole macroregions.

4) We have seen that the Bronze Age of central Europe is still largely studied within the framework of the „traditional” schemes. This produces a distorted picture of the synchronisms between the Bronze Age cultures of different regions of Europe, and the time is now well overdue for a radical reappraisal of the regional absolute

chronology of this period across central, eastern and southeastern Europe. It is time to put away well-thumbed copies of Reinecke and Müller-Karpe, and bring out the calibration curves. The accumulation of new absolute dates will be a costly process, but one which could be a good candidate for a long-term prestigious international research project in the interests of „European unity”.

5) Finally, but no less importantly, we still need new editions of textbooks which use calibrated C₁₄ dates, and dendrochronological dates to construct a firm framework for a new prehistory of the area.

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